

Analysis and Ecological Improvement of the Use-Time of PCs and Laptops in Small Organisations

An Action Research Approach towards Sustainable Consumption

DIPLOMARBEIT

zur Erlangung des akademischen Grades

Diplom-Ingenieur/in

im Rahmen des Studiums

Wirtschaftsinformatik

eingereicht von

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an der

Fakultät für Informatik der Technischen Universität Wien

Betreuung

Betreuer: Ao.Univ.Prof. Dr.phil. Gerald Steinhardt

Wien, 01.03.2016

(Unterschrift Verfasserin)

(Unterschrift Betreuer)

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MASTER'S THESIS

submitted in partial fulfillment of the requirements for the degree of

Diplom-Ingenieur/in

in

Business Informatics

by

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to the Faculty of Informatics
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Acknowledgements

Many people contributed to the accomplishment of this thesis directly or indirectly. First of all, I want to deeply thank my parents for their continuous and unconditional support throughout my life, as well as my boyfriend, Ewald Niederstätter, for his motivation, affectionate words and his talent of making me laugh in the most stressful situations. Next, I am grateful for my supportive advisor Dr. Gerald Steinhardt, for encouraging and helping me throughout the work of my master thesis. In addition, I received valuable and constructive feedback from Gerfried Mikusch, of which I am very thankful. Without attending the Smart Public Procurement Lab, organised by ÖkoKauf Wien in October 2014, I wouldn't have met Harald Wieser, with whom I developed the idea for the present thesis, had numerous discussions and who was very supportive in the first phase of my work. Moreover, Dr. Bernd Kopacek's lectures 'End-of-life management' and 'Resource efficiency' essentially contributed to my raised awareness and interest in the thesis's topic.

I want to highlight, that this research became possible only by the cooperation and close elaboration with Omega Ltd, its CEO and all employees involved. Their engagement and trust in my work as well as their effort and resources were never taken for granted and I am deeply thankful for our collaboration. Likewise, I would like to thank all my external interview partners for their expertise and contribution (in alphabetical order): Sepp Eisenriegler (R.U.S.Z.), Dieter Hundstorfer (AfB), Thomas Mosor (MA 22), Egmont Perthel (EPC Computerservice GmbH), Walter Schuster (MA 14) and Heinz Tschürtz (energie & reparatur café).

Special thanks go to Lena Hallwirth and Rebekka Kimla for reviewing parts of the thesis and increasing its expressiveness.

Abstract

Electronic waste has become a challenging global problem facing severe environmental as well as moral implications. It is the result of our today's unsustainable consumption patterns, which are of complex structure and have been influenced by various aspects like 'planned obsolescence', the belief in a 'throw-away mentality' or scaled down expectations of a device's life span and/or use-time. Cooper introduced the concept of 'relative obsolescence' addressing the phenomenon, that individuals tend to use their electronic goods for ever shorter periods of time and replace them long before they actually reach their end of usability. In addition, his study revealed that nearly 60% of discarded computers were still functional, contributing to the relevance of this topic (Cooper 2004). Thus, one step towards sustainable consumption is the decrease of turnover rates, or in other words, the prolonging of a device's use-time. Studies so far have extensively investigated causes for quick replacement strategies and possibilities to improve the use-time of electronic goods on the level of private households. However, the corporate sector, which faces additional constraints, has been largely neglected. As the application of those findings in an organisational setting is limited, the present thesis focuses on analysing and improving the use-time of PCs as well as laptops, and its related practices in a small organisation. These devices generally experience a relatively short use-time, are subject to quick innovation cycles and are rather expensive making repair reasonably worthwhile. To achieve valuable insights that go beyond conventional approaches, action research was conducted to develop improvement possibilities on site and simultaneously increase the scientific knowledge base. Action research typically comprises the creation of *"spaces in which participants engage together in cycles of action and critical reflection"* (McArdle / Reason 2008, p.125). Data was gathered as well as analysed by applying qualitative research methods. The process was documented in form of an action process log and action research reflection tool and knowledge claims were grounded on various sources not only to establish validity, but also to provide accurate evidence. The main outcome as regards content was an evidence-based guideline towards an improved use-time, based on the elaborated, discussed, reflected and evaluated actions performed. Moreover, the reflection upon the process itself revealed relevant findings for future work in this field and the appropriateness of action research to promote pro-environmental changes in (small) organisations. On a third level, the researcher herself evaluated the entire process with regard to communication, effort, emerged resistances and her role as a researcher in the conducted participatory approach.

Keywords: use-time, action research, pro-environmental change, sustainable consumption, practices, life span, e-waste, relative obsolescence, circular economy, waste management hierarchy

Kurzfassung

Durch den dramatischen Anstieg des globalen Elektronikschrotts stehen wir heute vor ökologischen, aber auch sozialen Herausforderungen. Diese sind das Resultat unseres nicht nachhaltigen Konsumverhaltens, welches von verschiedenen Aspekten wie beispielsweise der ‚Geplanten Obsoleszenz‘, einer ‚Wegwerfmentalität‘ oder den kontinuierlich nach unten geschraubten Erwartungen hinsichtlich der Lebens- und Nutzungsdauer von Geräten, beeinflusst wurde. Heute beobachten wir das Phänomen, das KonsumentInnen dazu tendieren, Geräte immer kürzer zu verwenden und bereits vor dem Ende ihrer Lebensdauer zu ersetzen. Dies wurde von Cooper als ‚Relative Obsoleszenz‘ bezeichnet und galt in seiner Studie als Hauptursache für den frühzeitigen Austausch. Dieser führte dazu, dass 60% aller weggeworfenen Computer noch funktionsfähig waren (Cooper 2004). Somit wäre ein wesentlicher erster Schritt in Richtung nachhaltigen Konsums, die Minderung von Ersatzkaufraten beziehungsweise die Verlängerung der Nutzungsdauer eines Geräts. Bisherige Studien konzentrierten sich größtenteils auf die Untersuchung der Gründe für den vorzeitigen Austausch und mögliche Verbesserungen hinsichtlich der Nutzungsdauer von elektronischen Gütern im Privatsektor, allerdings wurden Unternehmen und deren Bedingungen weitgehend vernachlässigt. Da diese Ergebnisse nur teilweise auf Organisationen übertragbar sind, konzentriert sich die vorliegende Masterarbeit auf die Analyse und Verbesserung der Nutzungsdauer von PCs und Laptops, und die damit verbundenen Praktiken in einem Kleinunternehmen. Diese Geräte haben eine relativ kurze Nutzungsdauer, unterliegen schnellen Innovationszyklen, sind jedoch relativ teuer, wodurch eine Reparatur grundsätzlich wirtschaftlich sinnvoll ist. Zur Erzielung substantieller Ergebnisse, die über konventionelle Ansätze hinausgehen, kam Aktionsforschung zum Einsatz. Diese Methode dient einerseits dazu Verbesserungen in der Organisation vor Ort zu etablieren und andererseits die Wissensbasis zu erweitern. Aktionsforschung umfasst typischerweise die Schaffung von „*spaces in which participants engage together in cycles of action and critical reflection*“ (McArdle / Reason 2008, p.125). Alle Daten wurden durch qualitative Forschungsmethoden gesammelt und analysiert, der Prozess wurde sowohl mittels wöchentlichem Tagebuch, als auch Reflexionstool dokumentiert. Zur Absicherung der wissenschaftlichen Erkenntnisse wird systematisch auf mehrere Datenquellen zurückgegriffen. Das inhaltliche Hauptergebnis ist ein evidenz-basierter Leitfaden zur Verbesserung der Nutzungsdauer, der auf den dokumentierten Diskussions-, Evaluations- und Reflexionsprozessen des Forschungsvorhabens basiert. Des Weiteren wurde der Prozess selbst reflektiert, um relevante Erkenntnisse für zukünftige Arbeiten zu generieren und um die Angemessenheit von Aktionsforschung im Zusammenhang mit der Förderung von umweltschonenden Veränderungsprozessen in (Klein-) Unternehmen zu untersuchen. Abschließend, widmete sich die Autorin der Reflexion des gesamten Prozesses in Hinblick auf Kommunikation, Aufwand, entstandenen Widerständen und ihrer eigenen Rolle als Forscherin, um wichtige Erkenntnisse aus einer Metaperspektive zu gewinnen.

Schlagwörter: Nutzungsdauer, Aktionsforschung, umweltschonende Veränderungsprozesse, nachhaltiger Konsum, Praktiken, Lebensdauer, Elektronikschrott, Relative Obsoleszenz, Kreislaufwirtschaft, Abfallhierarchie

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1 Introduction

“Excessive consumption in affluent nations is at the expense of people in less industrialized nations and of future generations.” (Cooper 2005, p.53)

1.1 Problem statement and motivation

The world produced nearly 42 million metric tonnes of electronic waste in 2014, resulting in an average of about 6kg for each of the seven billion inhabitants on earth. Austria put about 183,000 metric tons of electrical and electronic equipment (EEE) on the market in 2012, but generated 188,000 metric tons of e-waste in 2014. The data resulted from the first online map, established by the Solving the E-Waste Problem (StEP) initiative, which graphically portrays the accelerating global e-waste problem with country-level data (StEP initiative 2015). Estimations by the StEP initiative in cooperation with the United Nations predicted an increase by about 33 percent by 2017, which can be roughly typified by imagining the weight of 200 Empire State Buildings or seven Great Pyramids of Giza (StEP initiative 2013). However, the quantification of e-waste is still challenging, as the estimated number of unreported cases, including illegal shipment to locations where processing or recycling occurs at a very rudimentary level, seems to be much higher (StEP initiative 2013; StEP initiative 2015). A research project conducted by the Countering WEEE Illegal Trade (CWIT) revealed that only 35% of all e-waste disposed in Europe in 2012 ended up in an official collection and recycling system – the rest *“was either exported (1.5 million tons), recycled under non-compliant conditions in Europe (3.15 million tons), scavenged for valuable parts (750,000 tons) or simply thrown in waste bins (750,000 tons)”* (Huisman et al. 2015, p.6).

These dramatic figures are the result of our today's society, whose driving factors are not easy to grasp. The widespread belief in a throw-away mentality and the existence of planned obsolescence were often found guilty of the increase of replacement rates. More recent studies have challenged this view (Cooper 2005; Wieser / Tröger 2015; Prakash et al. 2016). Thus, the necessity of changing our prevalent consumption patterns towards more sustainable practices has emerged as recent debates considered severe environmental and moral implications, if the amount of e-waste will not drastically decrease. EEE like laptops or PCs contain a considerable amount of hazardous substances, heavy metals and rare earth metals like indium in LCD flat screens, which need to be recycled or disposed in a risk minimizing manner (Lundgren 2012). Although, the Basel Convention prohibits the export of e-waste into developing countries, containers with old electronic devices are officially declared as 'second-hand', even if in truth only ten devices, packed in the front rows, are still functional (Reuß / Dannoritzer 2013). Due to these cheap and hardly controllable illegal practices, dismantling processes take place under very rudimentary techniques leading to serious pollution and greenhouse gas (GHG) emissions. Besides, inappropriate landfill contaminates the soil and surface water. Apart from that, workers suffer from severe health problems including birth defects, tuberculosis, blood diseases, lung cancer and malfunctioning of the kidneys and respiratory system due to the hazardous chemicals, gases and vapours. Child labour at e-waste recycling sites is still present and additional health impairment like the underdevelopment of the brain and other organs may be the result (Lundgren 2012; Reuß / Dannoritzer 2013). At the same time, a considerably high amount is illegally traded within Europe. Here valuable components and precious metals become subject to scavenging or theft, leading to a serious economic loss of resources and materials for compliant e-waste treatment operators (Huisman et al. 2015). Regarding all these circumstances, sustainable consumption was defined by the Organisation for Economic Cooperation and Development

(OECD) in parallel to the Brundtland definition as *“the use of goods and services that respond to basic needs and bring a better quality of life, while minimising the use of natural resources, toxic materials and emissions of waste and pollutants over the life-cycle, so as not to jeopardise the needs of future generations”* (Norwegian Ministry of the Environment 1994; as cited in Oecd 2002, p.16).

One step towards sustainable consumption is the decrease of turnover rates (e.g. replacement) and thus, the extension of the use-time of durable goods. Cooper introduced a model suggesting that eco-efficiency, the more productive use of materials and energy, and slow consumption, the reduced throughput of products and services, increase the product life span (Cooper 2005). He argues, that innovation *“may not lead to sustainable development as long as consumption continues to increase”* (Cooper 2005, p.54). However, individuals tend to use their electronic goods for ever shorter periods of time and replace them long before they actually reach their end of usability (‘relative obsolescence’, see chapter 1.2). Reasons lying behind these behavioural patterns range from compatibility issues, technological innovations, changed individual preferences to cheaper replacement than repair possibilities, subtle marketing strategies, actual trends and fashion, to name just a few (Cox et al. 2013; Hübner 2013). To complement these findings, a different study from Cooper revealed that nearly 60% of discarded computers were still functional (Cooper 2004).

So far, however, the causes of quick replacement strategies and the possibilities of improving the use-time of electronic goods have mostly been investigated on the level of private households, while the corporate sector was largely ignored. The Austrian Economic Chamber confirmed the essential relevance of small to medium-sized enterprises (SME) for the economic structure in the European Union and especially in Austria. In 2014, 99.7% or 425,000 of all companies in Austria were SMEs, employing around 1,355,000 employees. Small organisations with a staff member size between 10 and 49, represented 6% of all enterprises (WKO 2016). Unfortunately, research results and conclusions of past studies are only applicable to a limited extent, as organisations face more constraints such as different actors, requirements, division of labour, regulative frameworks, market competition and economic parameters.

1.2 Definition of the concept use-time

In order to create an uniform understanding of a product’s use-time in contrast to its life span, this chapter aims at defining both concepts as used in the present thesis. From a product’s perspective, the use-time comprises all use phases, from the first till the very last, including the possibility of being passed on and belonging to more than one person. From a user’s (e.g. individual, household, organisation) perspective, the use-time starts with the first use and ends with the last use by this specific user. Wieser and Tröger illustrated the relation between the use phase and the entire consumption process in Figure 1 (Wieser / Tröger 2015, p.16ff.).

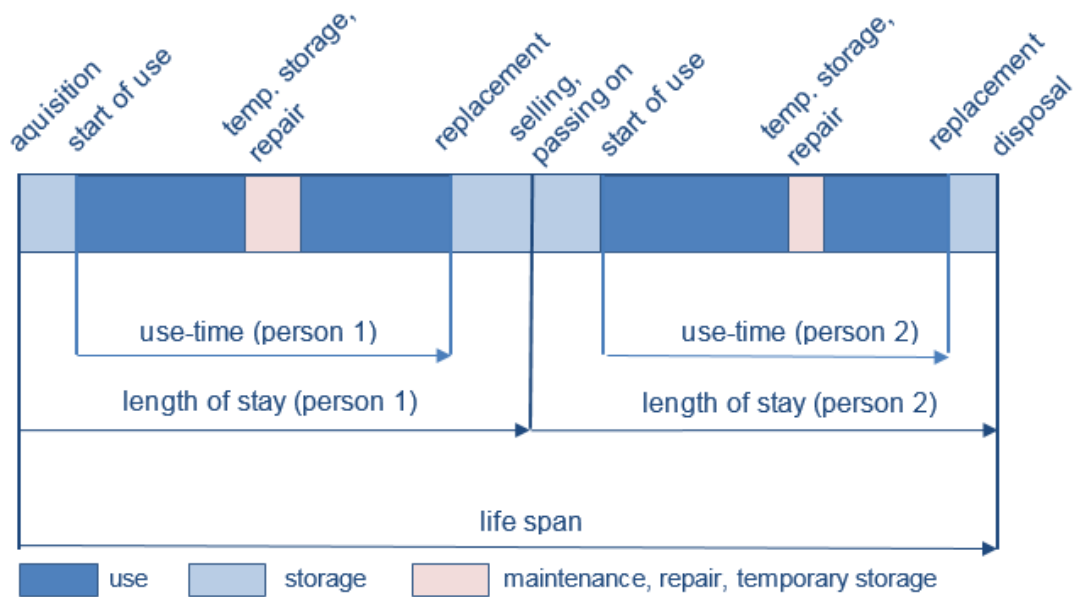


Figure 1 - Definition of the concept use-time (Wieser / Tröger 2015, p.17)

The use-time consists of the actual use, idle periods and time frames of non-use, if the product is for instance stored, repaired or maintained. In most cases a product stays longer with the same person, including use-time and storage before and after, which the literature defined as the length of stay. In contrast, a product's life span represents the period of usability. Given the situation, that many durable goods are disposed before their end of life span (e.g. still functional), the use-time is of higher relevance from an ecological point of view than the life span. According to Cooper (2004), the concept use-time comprises both, the 'relative obsolescence' (e.g. replacement before the end of life span) and the 'absolute obsolescence' (e.g. replacement due to the end of life span), which depicts an essential benefit (see chapter 2.1). By focusing on the investigation of the use-time, its reasons and possible improvements, insights, which would be hidden for life span studies, may be gained (Wieser / Tröger 2015).

Cox et al. defined a more detailed concept of a product lifetime (i.e. life span), which "comprised a mix of how long consumers expected something would last before it broke; and how long they wanted it to last before they updated it" (Cox et al. 2013, p.24). The two dimensions were identified as product "nature", which is controlled by a product's functionality and durability, and product "nurture" (e.g. "willingness to keep"), which is characterised by interrelated influences on attitudes and behaviours affecting a product's lifetime (Cox et al. 2013, p.24). Thus, the present study focuses on the latter dimension, but remains with the above terminology and definition.

1.3 Aim of the work

Given the problem statement and the concept of use-time, which has not been investigated in an organisational context yet, this study aims at answering the following central research question: *How can the use-time of PCs and laptops in small organisations be analysed and ecologically improved towards sustainable consumption?* In order to focus on relevant aspects, the following sub-questions guided the conducted research in cooperation with a small organisation:

1. Current practices

- Which practices regarding the use-time of PCs and laptops can be identified within the organisation?

- *Which reasons for premature replacement can be identified on the part of the management and the employees?*
 - *What is the average, expected and desired use-time of PCs and laptops on the part of the management and the employees?*
2. Outcome and process of improvements
 - *Through which internal actions may an extension and improvement of the use-time of PCs and laptops be possible?*
 - *How can employees become motivated to care about the use-time of PCs and laptops?*
 3. Relevance and changes
 - *How important is the use-time to the management and the employees before and after the cooperation?*
 - *Which advantages and disadvantages of an extended use-time can be derived?*
 - *What changed after the intensive collaboration with regard to use-time?*
 4. Reflection on a meta-level
 - *Which resistances emerged on an individual level and how were these addressed?*
 - *How was the role of the researcher perceived throughout the process?*

The aim of the study was to gain new qualitative insights into use-time related practices and behavioural patterns in an organisational environment by first, analysing the status-quo and second, commonly developing and evaluating improvements in order to gain knowledge that extends theory. In contrast to private use, different influencing factors and overarching conditions may affect the management's and the employees' decisions, reactions and behaviours. Employees, who only use and not possess the organisation's property, and the management, who needs to take financial aspects like depreciation into consideration, are just two differences regarding individuals, which may influence results considerably.

In order to be able to conduct an action research approach within a master thesis, the cooperation partner had to fulfil certain requirements, which enabled the possibility to induce change: small organisation with at most twenty employees, motivated management, resources for approximately three months of cooperation, and use of PCs and laptops in daily business. Thereby, the researcher was given the chance to establish a participatory collaboration with the employees and the management in order to improve the status-quo. It was taken into consideration that in small organisations, the employees' practices may be more influential on the management's decision making process. Throughout the study, the focus was on the prevalent practices to achieve a holistic image and not primarily on individuals' attitudes or desires, which may reflect a biased self-perception.

PCs and laptops were chosen, because both are experiencing a relatively short use-time nowadays, are subject to technological innovations and are rather expensive making repair considerably worthwhile. Moreover, these electronic devices are used as both: supportive tools at work and entertainment electronics at home. Consequently, employees take on a twofold role, as they may also be considered as private consumers and thus, they have typically gathered several experiences over time.

Due to the iterative action research cycles and the approach's focus on reflection, the expected outcome comprises three levels. As regards content, an evidence-based guideline developed from the actions performed towards an improved use-time, represents the main result of the cooperation. On a second level, a common evaluation of the development process of ecologically

worthwhile improvements was conducted. Third, the researcher herself reflected upon the entire process with regard to communication, effort, resistances, difficulties and her role as a researcher in a participatory approach.

1.4 Methodological approach

The methodological approach to investigate the use-time of PCs and laptops in a small organisation and to reach the expected evidence-based guideline of ecologically worthwhile improvements followed the principles of action research influenced by practice theory. Data was gathered and analysed primarily by conducting qualitative social research methods with the support of questionnaires. Throughout the process, all relevant steps were documented in an action process log and action research reflection tool in order to provide accurate evidence. Knowledge claims were based on various sources like surveys, interviews, common sessions and action meetings, within which the evidence-based guideline was continuously developed, reflected and evaluated with a purposefully selected core group (see chapter 4.1). Apart from the reflection upon the outcome as regards content, the action research process itself was evaluated among the core group members in a final reflection meeting. Finally, the researcher conducted a reflection on a meta-level with regard to effort, communication, emerged resistances, and the role of the researcher during the entire process (see chapter 6.4).

The entire cooperation lasted from 26th of May till the 30th of September 2015 (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). In the first part, an evaluation of the status-quo at the cooperating organisation took place. This phase included a detailed identification of the IT-equipment inventory captured in a central overview and monitoring sheet and an online survey regarding the employees' and management's current satisfaction, work requirements and awareness towards use-time (see chapter 4.3).

The second part focused on problem-centred interviews with a selected group of six employees and the management based on the results from the previously conducted online survey following the theoretical sampling approach. They were audio-recorded, literally transcribed and annotated in the postscript to provide accurate data for the thematic analysis and interpretation. Subject were practices regarding the use of PCs and laptops (see chapter 4.4). A first insight into findings and the introduction to the topic 'use-time' was made transparent by a common workshop offering all staff members the possibility to participate. Further data was gathered by a post-questionnaire evaluating the on-going progress and impacts of the workshop itself on the participants (see chapter 4.5).

In the third part, the iterative action meeting phase started, aiming to improve the status-quo. The involved core group discussed, implemented, reflected and evaluated the actions of different areas of improvement. As the output of the previous cycle became the input of the subsequent, the evidence-based guideline continuously evolved over time (see chapter 4.6). The final outcome was presented to all staff members in form of a presentation and common meeting again encouraging discussion and feedback. Two research questions, namely the advantages of an extended use-time and the motivation for employees to prolong the use-time, were interactively developed following a modified 6-3-5 brainwriting procedure. To conclude this phase, a post-questionnaire was answered by all participants providing interesting insights into the overall impact of action research and the developed improvements (see chapter 4.7).

Finally, the process itself was reflected upon the core group members addressing strengths, usefulness, difficulties in feasibility and next steps. The impulse towards a sustainable consumption of PCs and laptops was prevalent (see chapter 4.8).

In addition, six expert problem-centred interviews were conducted to gain profound insights into the process regarding smart public procurement, refurbishment of IT and the repair scene in Vienna. Recommendations regarding the prolonging of use-time influenced the development of improvements within the organisation (see chapter 5).

2 State of the art

The use-time of PCs and laptops is determined by many actors and influencing factors with different practices and aims. According to the literature, the following state of the art studies, significant findings, overarching conditions and legal frameworks were the key starting point for the present research. It also built on studies from other disciplines, such as the research on pro-environmental changes in organisations, which provided essential insights on change processes and practice theory approaches. There is no study known, which explicitly investigated the use-time of IT equipment in organisations and its improvement possibilities driven by ecological impacts. In order to stay within scope and to solely focus on relevant findings for the present thesis, the researcher refers to Wieser and Tröger, who rehearsed the entire literature overview and methodological approaches regarding 'use-time' in their paper (Wieser / Tröger 2015, p.26ff.).

2.1 Use-time studies in private households

Cox et al. conducted a study in private households involving 115 consumers in twelve qualitative discussion groups, which revealed that desktop computers and laptops are considered as 'up-to-date' products and are generally discarded not because they had broken down, but because users perceived them to be 'out of date' and don't want to be seen as 'old fashioned'. Social pressure and the increasing speed of new technologies keep them updating their still functioning products and make them want to have the latest available technology as a result of their personal success. Moreover, 'up-to-date' products are often treated with less care as simple actions like the use of protective sleeves or cleaning were rarely performed. *"Participants recounted many incidents of damage caused by pets, children and their own carelessness"* (Cox et al. 2013, p.25). Hence, one of the main findings showed that the consented expected product lifetime of computers, strongly dependent on past experiences including break-downs, only amounted to three to four years. Cox et al. suggested that *"consumers' expectations and experience of product lifetimes have reduced, at least for electronic and electrical items"* (Cox et al. 2013, p.24).

Besides, 'up-to-date' products, Cox et al. introduced two further classes: 'workhorse' and 'investment' products. The former comprises products valued for their service utility over a long lifespan, which are required to be reliable until they are disposed in a broken state, including large and partly small appliances and large items of furniture. The later represents a class of products being perceived as 'special' and valued more, which reasons the investment. Interestingly enough, 'quality' electronics were included into this section, implying that laptops or computers were not perceived as such by participants. The authors argued that a laptop may have the quality to become a 'workhorse' by increasing its reliability. However, *"in the current market context, it is unlikely that laptops will be anything other than up-to-date products for most people but there may be some types of consumer who would switch purchase decisions to more reliable workhorses, or pay for repairs, if these options were made more readily available"* (Cox et al. 2013, p.25).

Another reason for exchanging products before their maturity was based on the experience that either repair is too difficult or broken products are often cheaper replaced than repaired and thus, barriers to product repair arose. The price-performance ratio of repairing a 'workhorse' product is evaluated with regard to its expected lifetime afterwards, the actual repair costs and the involved inconvenience while repairing. As consumers lack of available information, these decisions are often dependent on luck rather than a rational judgement (Cox et al. 2013). Next, a

product's value and its expected product lifetime are typically determined by its brand and price. If a product is perceived as cheap or low priced, it becomes 'normal' after bad experiences that it may not work for a very long time. Hence, cheap price policies decrease the implied value and preclude an emotional attachment to belongings. Purchases involving either a financial stretch, value with regard to status or identity, long waiting times, or emotional attachment, were valued more (Cox et al. 2013; Hübner 2014).

The finding, that only few people have a sense of guilt or realise the tremendous environmental impact of frequent replacement rates, constitutes a problem. Environmental concerns were not the general drivers for use-time improving behaviours like maintenance and repair. Even the feeling and realisation that 'waste is bad' doesn't prevent users from replacement decisions. Their guilt was alleviated by taking old products to second hand markets assuming that other people should want their unfashionable products. However, participants admitted that they have little knowledge concerning reuse possibilities for electronics (Cox et al. 2013).

Due to an empirical lack of evidence concerning the users' preference of longer-lasting appliances, Cooper conducted a study in the UK, including 802 quantitative face-to-face householder interviews and five qualitative focus groups of ten householders each (Cooper 2004). His findings revealed several interesting aspects concerning the use-times of computers and peripherals. Participants considered nine years as a 'reasonable' life span for computers, but discarded them in disrepair after seven years on average. Overall, 50% *"considered that appliances generally last as long as they would like [...] when considering the period 'from purchase to being beyond repair'"* (Cooper 2004, p. 429) and in every category, the average age of products discarded in disrepair was below the mentioned 'reasonable' life span. Nonetheless, 29% of householders were dissatisfied with the actual product lifetime of computers and peripherals. Regarding the current stock of computers, 75% were aged under five years. When householders were asked about the disadvantages of longer-lasting products, they selected 'may become out of date after a few years' (30%), 'cost too much to buy' (23%) and 'repair and maintenance costs too expensive' (16%). At the end of use-time, 59% of discarded computers were still functioning and 12% in need of repair. *"The fact that a third of the discarded appliances that did not function were considered repairable suggests that much waste is unnecessary"* (Cooper 2004, pp.440–441). Positively mentioned, around two-thirds of computers were either donated or sold for reuse. Cooper's results suggested that 'relative obsolescence' has more influence upon life spans than 'absolute obsolescence' arising from technical failure. Thereby, he structured his main findings into three categories of relative obsolescence (Cooper 2004, p.440ff.):

1. Technological obsolescence: Innovations in technology attract the users to replace the current appliance. Products, which were mostly subject to technological advances like computers or mobile phones, implied less dissatisfied survey participants regarding the life span. The fear of *"being locked into the prevailing technology"* was apparent.
2. Economic obsolescence: If little or no value is attributed to an existing appliance, the user decides, possibly influenced by the cost of the new acquisition, expenses of maintenance and/or repair, or a more energy-efficient model, that future use doesn't pay off. As only a fifth of householders expressed to buy premium quality, Cooper suggested that consumers either don't focus on durability or are not convinced that they effectively last longer.
3. Psychological obsolescence: Influences mentioned like peer group pressure, fashion and marketing, led to users being no longer attracted to their belonging or satisfied by it. Some participants mentioned that a product's appearance is as important as its functionality.

Last, the study revealed that there was a highly significant relationship between those consumers desiring more information on product life spans in order to make conscious decisions and those considering environmental aspects to be important. However, their environmental awareness or perceived importance of waste reduction neither related with the extent of making use of repair services, nor with the likelihood of being dissatisfied with life spans (Cooper 2004).

A recent empirical investigation among 1,009 Austrian households and 25 in-depth interviews, conducted by The Vienna Chamber of Labour, focused on the use-time and obsolescence of durable goods (Wieser / Tröger 2015). One of its main findings contradicted the widespread assumption that planned obsolescence or a throw-away mentality are prevalent in our society. *“The decisive role of expectations among both consumers and producers”* were the real driving factors behind the increase of premature replacement rates (Wieser / Tröger 2015, p.4). Expectations are relatively low due to consumer’s experiences and the belief, that ‘planned obsolescence’ is a widespread strategy of producers nowadays. Simultaneously, this aspect influenced the decreased trust in a product’s lifespan and reliability, which resulted in preferred replacements over repair and a reduced willingness to invest more for long-lasting products or to purchase second-hand. A loss of trust in (former) premium brands may exist. Additionally, advertisement and quick product launch cycles give consumers the impression of being outdated. From a producer’s perspective, low demand in long-lasting products confirms their practices of producing appliances with shorter lifespans. Thus, expectations of a product’s lifetime or use-time are continuously scaled down to a lower level (Wieser / Tröger 2015).

Concerning the use of laptops, participants stated an **average use-time** of 4.1 years. One correlation revealed, that the older the users, the longer their product’s use-time. Consumer’s satisfaction regarding the lifespan of durable goods was divided: 45% were (rather) satisfied and nearly 30% were (rather) unsatisfied. In-depth interviews showed that this satisfaction is typically relevant for the purchase of a product of the same brand. Although, several participants desired an infinite lifespan or durable goods, some interviewees were in doubt about this unrealistic possibility with regard to computers. Through technological developments, a computer’s value is rapidly decreased and the device itself under pressure to be replaced. On average, participants desired a computer’s lifespan of seven years (Wieser / Tröger 2015).

The **expected lifespan** is of essential relevance as once it is exceeded, consumers are satisfied and replacement is easier justifiable. Thus, low expectations in lifespan reduces the use-time as it would have been the case. By asking about the reasons, the participants disclosed the following influencing factors: past experiences, brand and price, ‘planned obsolescence’, guarantee and technological development (Wieser / Tröger 2015, p.40ff.). Interesting to mention, 47 participants spontaneously named a computer, which had worked longer than expected and made last place in the top ten list. In contrast, 67 thought of laptops and 55 of computers that had functioned shorter than expected. On top of the list were washing machines (200), which lasted longer, and mobile phones (208), which had to be replaced earlier than expected (Wieser / Tröger 2015).

A special focus of the study was on mobile phones in order to investigate an entire consumption process. Reasons for choosing this durable good were either pragmatic or content related. Mobile phones are experiencing a relatively short use-time at the moment, consequently, many consumers have already had several ones and gathered experiences. Furthermore, consumers are usually the owners and in charge of decisions regarding purchases and replacements. Above that, mobile phones are liable to technological innovations and trends, which makes it interesting to

have a closer look at producer's and vendor's strategies. Last, mobile phones are rather expensive electronic devices, where repair may be considered as worthwhile (Wieser / Tröger 2015, p.31ff.). These reasons are mostly applicable for PCs and laptops and thus, were influential for the researcher of the present thesis to choose those as the products of investigation. Besides, new insights in the field of PCs and laptops and their related consumption practices may be gained.

2.2 Planned obsolescence

"Planned Obsolescence means instilling in the buyer the desire to own something a little newer, a little better, a little sooner than is necessary." (Stevens 1954)

The word obsolescence comes from the Latin word 'obsolescere', which means 'to wear out, to get old, to get out of date, to lose value' and comprises both the natural and the artificially designed product ageing. Natural obsolescence is dependent on the product's robustness, the user's usage and the implied wear and tear. In contrast, artificially designed obsolescence is a prematurely induced product ageing on purpose (Hübner 2013). Several studies, which investigated on users' perception, confirmed that they have recognised a tremendous decline of product lifetimes over the last decades (Cox et al. 2013).

To better understand the reasons for planned obsolescence, it is necessary to give a short historical introduction. The original lightbulb, also called centennial bulb, celebrated its hundredth birthday in June 2001. Before Shelby Electric Company, which produced these light bulbs invented by Chaillet, was taken over, their advertisement proudly stated 'longest life'. The later on discovered cartel and purposely limited lifetime of 1,000 hours constituted the first prominent example of planned obsolescence and introduced a radical paradigm shift, away from using the best and most durable materials and technology available. Likewise, Henry Ford's model T, which was the first mass produced car affordable to the vast majority, was easy to use and to repair. Nonetheless, it was substituted by General Motors' strategy of innovation, addressing the consumers' increased desires for comfort, style and prestige. Through the industrialisation and mass production, product supply was much higher than the markets demand, leading to an industry searching for solutions and starting to produce one-way products due to cheap material prices (Reuß / Dannoritzer 2013; Hübner 2013). With the big recession induced by the stock market crash in 1929, Bernard London published proposals for 'ending the depression through planned obsolescence', introducing the idea of a date of expiry for all products (London 1932). Although, his suggestions have never been set into practice, his idea of replacing still functional goods within ever shorter periods of time remained and propagated the belief that demand must be created not satisfied. Over time, several users have learned to accept shorter lifetimes and often interpret error messages as a practiced signal for new purchases. Additionally, the people's fear of job losses seemed preventable by an ever increasing growth and consumption of mass products, rejecting the compatibility with a sustainable use and treatment of goods (Reuß / Dannoritzer 2013).

Packard defined three different categories of planned obsolescence with regard to technical aspects (Packard 1960; Hübner 2013):

1. Obsolescence of function (technically caused): The old good becomes outdated as the newly introduced product performs the functions better. Products like laptops, which are subject to high innovation dynamics and technology leaps are structured within this category.

2. Obsolescence of quality (technically caused): The existing product prematurely breaks down or wears out at a certain point in time before the expected lifetime with regard to the current state of the art. Producers argue that due to cost pressure and the missing consumer's willingness to pay more for qualitative products, goods are rather cheaply produced. Moreover, quick innovation cycles limit the available time to work properly. Schridde contested that expenses for better materials with longer durability are within cent or even sub-cent ranges (Schridde 2012).
3. Obsolescence of desirability (non-technically caused): The possessed product, which is still functional with regard to quality and performance, is perceived less desirable by its user, due to styling or other changes. One of the category's most prominent example is fashion.

Based on his findings introduced in chapter 2.1, Cooper distinguished between absolute obsolescence, representing the end of lifetime, and relative obsolescence, representing the end of use-time. The latter is further divided into technological (e.g. new models, technology leaps), economic (e.g. financial factors) and psychological (e.g. subjective factors) obsolescence categories (Cooper 2004). Thus, Hübner concludes that Cooper's 'absolute obsolescence' may be put on the same level with Packard's 'obsolescence of quality', whereas 'relative obsolescence' may equate with 'obsolescence of function' and 'of desirability' (Hübner 2013).

Through these categorisations, it became apparent that obsolescence is dependent on its design, producers, but also from the usage of its user. Therefore, Hübner introduced a user's decision grid distinguishing two dimensions: the product-related (e.g. product lifetime dependent on usability) and the user-related (e.g. product use-time dependent on use) dimension. By combining these dimensions, Hübner defines four possible cases (see Figure 2).

Good ► ▼ Consumer		End of Usability	
		No	Yes
End of Use	No	(Case 1) The good is usable and its user/owner wants to sustain its use.	(Case 3) The good does not achieve the expectations anymore, but user/owner wants to sustain its use.
	Yes	(Case 2) The good is usable but its user/owner has no more use for it.	(Case 4) The good does not achieve the expectations anymore und user wants to abandon it.

Figure 2 - User's decision grid between use and usability (Hübner 2012, p.31)

Case 1 (e.g. no obsolescence) represents the continuation of use without interruption, in contrast, case 2 (e.g. relative obsolescence) and case 3 (obsolescence of technology) with interruption as a new use-phase is started. Case 4 (e.g. obsolescence of technology, absolute obsolescence) leads to the end of use, however, the distinction between a still repairable and a non-repairable good is possible. Both dimensions are interrelated and may not be strictly separated (Hübner 2013; Hübner 2012).

Critics regarding the existence of planned obsolescence have emerged as it is difficult to proof the producer's intention of making products that prematurely age. Both soft criteria are difficult to measure. Non-reparability often arises due to design decisions (e.g. glue instead of screws), which may be rated reasonable by producers or vendors for other reasons (e.g. stability, exclusion of use failures). It gets even more difficult to proof, if a product is still functional, but not able to satisfy the user's changed requirements anymore. Consumer preferences may be formed by external

influences, however, manipulation (e.g. through advertisement) is nearly unverifiable (Hübner 2013; Reuß / Dannoritzer 2013).

Hübner identified strategies and circumstances of our today's society, that foster planned obsolescence. First, due to supply excesses and abundance, consumers have to choose from an unmanageable variety of (similar) alternatives, which aim at differentiating the society along brands, communities or styles and the individuals' perceived needs. The following consumption patterns are rather typical for our economy and technology dominant culture: new is better than good, buying instead of repairing and possessing beats using. In return, these patterns get reflected in the producers' and designers' practices (Hübner 2013, p.20). Besides, there is no duty to supply information concerning the expected product lifetime or reparability on the part of the producer or vendor, making it very difficult for consumers to estimate a product's real value. Moreover, producers are not breaking any law, because there is no minimum requirement in relation to product lifetime (Verbraucherportal Baden - Württemberg 2015).

In contrast, several strategies, projects and initiatives against planned obsolescence have emerged. Schridde started a platform named 'Murks? Nein danke!' in order to gather and analyse cases of damage to make the system transparent to its users. Typical examples for laptops reported are dusty ventilation slots being difficult to clean, screws that are not resilient, power supplies with unsteady contactors and batteries with weak fitness (Schridde 2014, pp.55–56). Together with his community he demands sustainable product quality, optimal usability, easy reparability, accessible spare parts, regional services, better guarantee and material cycles. Positive examples like open workshops, repair cafés, borrowing shops and car-sharing do already exist in several cities (Schridde 2012, p.60). Further literature offering interesting insights is recommendable (Kreiß 2014; Reuß / Dannoritzer 2013).

2.3 Implications of a prolonged use-time

Although, the motivation to extend a product's use-time was made apparent, the following chapter focuses on scientific findings regarding the ecological, social and economic implications.

2.3.1 Ecological implications - life cycle assessment and embodied energy

"The embodied energy of the memory chip alone already exceeds the energy consumption of a laptop during its life expectancy of 3 years." (Decker 2009)

Although, laptops become more energy-efficient in their use phase, unfortunately, ecological impacts like resource exploitation and embodied energy during the production phase are typically ignored. *"The embodied energy of a material or object is the energy required to extract, refine, and manufacture the component substances and transform them into the material or object"* (Cookson 2012, p.114), which is lost upon disposal. Therefore, Prakash et al. focused on gaining a full picture of environmental impacts as they included the aspects of material and energy consumption in the entire product lifecycle. By providing an accurate lifecycle assessment, consumers may be supported in their decision between prolonging a product's lifetime and replacing it, resulting in a timely and ecologically optimised replacement. The researchers created four different scenarios based on different configurations and data sources (Prakash et al. 2012, p.6ff.). Energy consumption in the use phase was provided by the database of Energy Star 5.0 for computers considering three operational states: T-Off, T-Sleep and T-Idle. The calculation of the average electricity consumption of a laptop with a lifetime of five years, based on data for the German electricity mix, resulted in 231kWh per year and 0.599 kg CO₂ equivalents/kWh. Except the first

scenario, the production phase was dominant (54 - 56.4%) contributing with the greatest extent to the overall global warming potential (GWP). The use phase was responsible for emissions between 36.3 and 38.2% considering a lifetime of five years and the overall greenhouse gas emissions amounted between 230 and 382 kg CO₂ equivalents. One of the sensitivity analysis revealed that a reduced lifetime of 2.9 years, which is rather realistic under current market and consumption patterns, led to only 25% of greenhouse gas emissions, but to more frequent production and disposal phases to replace existing devices (Prakash et al. 2012).

In the second part of the study, amortisation periods in years were calculated, assuming that the new laptop under consideration is more energy-efficient in use compared to the old one. The results, again differentiated between four scenarios, were rather shocking and revealed that, if a new laptop is 10% more energy-efficient during the use phase, which may be a realistic improvement between two generations, the amortisation period is between 33 and 89 years (!). In other words, the old laptop *"would have had to be used between 33 and 89 years in order to compensate the greenhouse gas emissions attributable to the production, distribution and disposal"* (Prakash et al. 2012, p.33). Only by an increased energy efficiency of 70%, which was explained as unrealistic to appear, the amortisation periods of time are shortened between six and thirteen years. Concluding these findings, created greenhouse gas emissions before and after the use phase may only be compensated to a limited extent by energy efficiency improvements. Thus, *"it is not environmentally purposeful (with regard to global warming potential) to purchase a new notebook after a period of only a few years, even if the assumed energy efficiency of the new device exploits the full scope of cutting-edge technology"* (Prakash et al. 2012, p.48). Latest developments, office use, increased data quantities and data traffic in the web were discussed as limitations and consequently, were not considered in this study (Prakash et al. 2012, p.46).

Siddarth Prakash from the Oeko-Institut presented the results from the study summarised above at the conference 'Wider die Verschwendung' in Berlin, and focused on the impact of environmental relief through long-lasting laptops. Some findings were complemented with a study conducted by Defra. A long-lasting laptop of five years lifetime produces about 18% less greenhouse gas emissions than a short-lived one of only three years lifetime, thus, an annual reduction of about 15.2 kg CO₂ equivalents per notebook could be achieved. By upgrading the long-lasting laptop with an increased memory and a replaced hard disk drive, further five years of lifetime were assumed. If only 10% of stock changed in the UK, annual GWP savings would amount to about 25,800 tons of CO₂ equivalents (Prakash 2014; Defra 2011). Defra revealed with regard to the described scenario, that the majority of environmental benefits may be achieved in Southeast Asia and annual water use savings would amount to 160m³ per device (Defra 2011, p.13).

Bakker et al. went a step further and developed a model combining life cycle assessment and dynamic programming to determine the break-even point for replacing an old, inefficient laptop with a new one. First, the electricity consumption over time, including rather flat periods and jumps, was analysed revealing that laptops have become approximately 50% more energy-efficient from 1990 to 2020. The subsequent life cycle analysis calculated the environmental impact per unit of laptop between 1990 and 2020 by making use of the ReCiPe indicator, which takes human health, ecosystem diversity and resource availability into consideration. The higher the points, the higher the overall environmental impact. Its results demonstrated the decline of the use phase's impact from 3.1 (31%) in 1990 to 1.9 (21%) in 2010 and thus, an improved energy efficiency. However, percentages for production increased. Last, for the dynamic modelling a

baseline scenario of seven years, based on a laptop's median lifespan in 1990, was investigated. *"The optimal product lifespan is the point in time where the environmental impacts that arise from using a product equal the embedded impacts of a (more energy efficient) replacement product"* (Bakker et al. 2014, p.12). As apparent in Figure 3, the approach revealed that in all cases the baseline scenario is the optimal replacement scenario (Bakker et al. 2014).

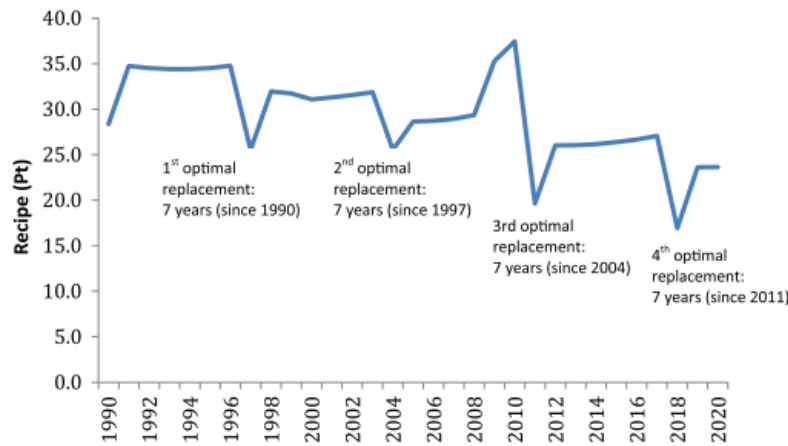


Figure 3 - Optimal replacement scenario (Bakker et al. 2014, p.14)

According to Bakker et al., the preferred strategy to decrease overall environmental impacts is the extension of a laptop's product life. The study aimed at being a starting point for a full lifecycle assessment considering the end-of-life, energy deterioration over time and different future scenarios of possible developments with regard to energy efficiency. As laptops are driven by technological and design innovations leading to rapid replacement cycles, it was regarded challenging to make a (modular) laptop last for seven or even more years. Thus, Bakker et al. suggested that *"recycling and remanufacturing are more likely strategies than longer product life"* (Bakker et al. 2014, p.14).

Apart from the presented studies, Gonzalez et al. introduced one further laptop LCA model named the 'Product Attribute to Impact Algorithm' focusing on a *"level of specificity that allows impact comparisons among laptops of different size, hardware configurations, and performance specifications"* (Gonzalez et al. 2012, p.144). However, it became apparent that various LCA models have been developed, but leading to different results and partly neglecting the intensive resource and water consumption during production. Andrae and Anderson concluded their study about life cycle assessments of consumer electronics that benchmarking is reasonable difficult due to lack of transparency. Especially models regarding desktops and laptop computers seemed less consistent (Andrae / Andersen 2010). Simultaneously, Gonzalez et al. recommended a higher devotion to evaluation and collection methods throughout the supply chain as its complexity and limited availability are restricting (Gonzalez et al. 2012). Two further studies concentrating on the LCA of an ecolabeled notebook (Ciroth / Franze 2011) and on the comparison of embodied greenhouse gases in modern computing (Teehan / Kandlikar 2013) may be found appealing for interested readers.

2.3.2 Social and economic implications

In 2010, Scholl performed an extensive literature review on the implications of use-time extension and intensification, which aim to accomplish a given demand, but simultaneously to reduce the amount of products. In order to better analyse all possibilities, strategies were divided into three

categories. First, product-supporting services are of type 'use-time extension' and are offered from the producer complementing the product - like user support, guarantee extensions, maintenance and repair, upgrades, take-back and disposal services. Second, usage-oriented services are of type 'use-time intensification' and include short-term and long-term leasing, sharing and pooling concepts, driving a shift from ownership to usage rights. Third, result-oriented services like least-cost-planning and facility-management were not relevant for the present thesis (Scholl 2000).

Due to its complex contexts and lack of empirical investigations, social implications on employment were structured into three levels of analysis (Scholl 2000, p.13ff.):

1. Macroeconomic analysis: The author assumed that job losses in production may be (over-) compensated by an increased service intensity in the tertiary sector, which would lead to tertiarisation and dematerialisation in the theoretical best case scenario. However, data of the German and Danish economics rejected the assumption as the production of qualitative products requires an increased amount of service intensity. Besides, services may not be regarded as substitutes for products but rather as complements.
2. Microeconomic analysis
 - a. *Direct implications on employment*: Implications were analysed and demonstrated according to a product lifecycle's various phases from preproduction to disposal. Product supporting strategies lead to a shift from preproduction and production to downstream stages like maintenance and upgrades. Disposal service providers may be replaced by new services like gathering, cleaning, refurbishing and distributing of used products. Under certain circumstances, the author assumed an overall positive implication. In contrast, usage-oriented and result-oriented strategies may lead to increased employment in management, processing of service orders and customer support, however, to an overall negative implication.
 - b. *Indirect implications on employment*: By offering product supporting services, customer loyalty may be strengthened, leading to an improvement of the company's competitive position. Additionally, leasing concepts may open up new markets. Besides, use-time extension and intensification must become economically attractive to succeed in the market in the long run. By buying second-hand or leasing products, customers save financial resources, which can be invested or consumed elsewhere. The concerned sectors may benefit from a positive employment impulse in return, however, rebound effects are not desirable from an ecological point of view.
3. Task-oriented analysis
 - a. *Secondary job market*: In case of durable goods, which are subject to technical, economic and/or psychological obsolescence, repair and refurbishment possibilities are only attractive to low-income consumers. Thus, public subsidies are suggested as irreplaceable by the author as labour expenses are difficult to cover with selling services. Nonetheless, a secondary job market, which additionally reintegrates long-term or hard-to-place unemployed and offers services to prolong or intensify the use-time has already been established.
 - b. *Informal sector*: Mutual support and technical active work have partly substituted the formal sector, which negatively affects mechanical services like car repair. The increased significance of the informal sector may be attributed to the exorbitant service prices and the steadily decreasing tool prices.

- c. *Qualification profile*: With the increased importance of services, qualification requirements simultaneously grow. The author summarised strategies identified by the OECD in 1997 making demands on product designers to create modular and durable constructions and consider the use of refurbished parts. Repair and maintenance engineers and qualified personnel for refurbishing taken-back products will be required. Thus, a ‘renaissance’ of manual qualifications and tasks of middle to high qualification levels will most probably take place.

Regarding economic implications for producers, costumers are willing to financially value long-lasting goods of high quality. Simultaneously, manufacturers may reduce costs by using refurbished spare parts and developing modular and easy to dismantle products. Moreover, producers can extend their offers by use-time prolonging services like guarantee, repair and maintenance and voluntary take-back to gain market shares or open up new markets. As long-lasting, qualitative goods are rather unaffordable for low-income customers, leasing concepts may become more attractive and intensify customer loyalty on the part of producers (Scholl 2000).

Until now, implications are mostly positive for the environment and rather ambiguous for producers and the overall economy. Concluding these heterogeneous and multifaceted findings, Scholl argued that *“current prognoses rely on abolition of the present discrimination of labour at the expense of increasing costs of natural resources”* (Scholl 2000, chap.abstract). If price ratios changed fundamentally, one would assume a positive implication on employment, especially by services of use-time extension (Scholl 2000). In contrast, Stahel addressed the clearly vital importance of a transition towards a sustainable society through longer use. *“Compared to fast-replacement, product-life extension is a substitution of service activities for extractive and manufacturing industries, and a replacement of large-scale capital-intensive companies by smaller, labour-intensive, locally integrated work units”* (Stahel 1984, p.72). In fact, our society has to realise that positive implications on the environment may not be strictly separated from benefits for our economy, producers and lifestyle. *“Indeed, while increasing the number of skilled jobs available and reducing our dependence on strategic materials, such activities will provide the private sector with fresh impetus to make cheaper goods available as part of a self-replenishing economy built on a spiral-loop pattern which allows a substitution of manpower for energy. In this way, unemployment and poverty which certainly aggravate the fundamental instability of the world economy might be substantially reduced”* (Stahel 1984, pp.72–73).

2.3.3 The waste management hierarchy and its legal framework

The EU Waste Framework Directive (2008/98/EC) has introduced a waste management hierarchy, which *“shall apply as a priority order in waste prevention and management legislation and policy”* (European Parliament 2008, p.10). Approaches are ranked according to their environmental impact (see Figure 4). The preferred strategies, prevention and re-use, are marked green and have been recognised in the EU’s **Waste Electrical and Electronic Equipment (WEEE) Directive**, which aims at tackling the fast growing e-waste stream, reducing the amount of e-waste going to landfill and contributing to an enhancement of resource efficiency by improving the collection, treatment and recycling of EEE at the end-of-life (European Commission 2015b; European Parliament 2012). Moreover, the **RoHS Directive** restricts the use of hazardous substances in EEE and requires certain heavy metals to be substituted by safer alternatives (European Parliament 2011).

Since 2014, the EU is working on a new Directive and developed an ambitious action plan to establish the concept of a **circular economy**. By *“closing the loop’ of product lifecycles through*

greater recycling and re-use”, the circular economy will “*boost global competitiveness, foster sustainable economic growth and generate new jobs*” (European Commission 2016). At the same time, saving energy and helping to avoid “*irreversible damages caused by using up resources at a rate that exceeds the Earth's capacity to renew them in terms of climate and biodiversity, air, soil and water pollution*” is of essential importance for the creation of a sustainable society. (European Commission 2015a, p.2). Products, which have reached their end-of-life are no longer considered as waste, but as a new input resource. Common EU targets were set to achieve certain waste reductions by 2030 (European Commission 2016).

One of its instruments is the **Ecodesign Directive**, which expressed the extension of lifetime through “*minimum guaranteed lifetime, minimum time for availability of spare parts, modularity, upgradeability and reparability*” (European Parliament 2009, p.24). However, these aspects have not yet been considered or implemented in any regulation. The focus has clearly been on energy efficient measures so far. As some criteria are conflicting, the Ecodesign Directive is limited in its appropriate application (Wieser / Tröger 2015; Hübner 2012). Hübner investigated its limits and challenges after twenty years of existence and discovered several blind spots (Hübner 2012).



Figure 4 - The waste management hierarchy (European Parliament 2008)

Bakker et al. translated the waste management hierarchy into corresponding design strategies for product designers. As recovery and disposal do not contribute to a circular economy, both approaches were left out (Bakker et al. 2014, p.11):

1. Prevention: material efficiency, longer product life
2. Re-use: product repair / refurbishment / remanufacturing
3. Recycling: product / material recycling

The authors further argued that these generic waste management strategies need to be adjusted to the specific product under consideration. For instance, laptops, which are subject to highly dynamic markets and innovation cycles, may require feasible remanufacturing and recycling strategies instead of a longer product life. In this particular case, the hierarchy is turned upside-down (Bakker et al. 2014).

Partly complementing and partly contradicting, Computer Aid International published a special report in 2010 focusing on the reasons why the reuse of ICT equipment is better than its recycling. One of their key findings, based on the waste management hierarchy, was that “*reusing working computers is up to 20 times more energy efficient than recycling them*” (Computer Aid International 2010, p.1). Recycling is always related with a high amount of energy to dismantle and recover desired product parts, moreover, a full recovery of all raw materials is not yet possible.

Additionally, residual waste generated during the recycling process requires disposal (Computer Aid International 2010).

2.4 Pro-environmental changes in organisations

As far as the researcher is aware, studies investigating the use-time from an ecological perspective in organisations haven't been conducted. However, interesting papers regarding pro-environmental changes in organisations were taken into account, as the improvement of use-time may be considered as such a change. Both selected studies applied a practice-based approach, which provides *"a more holistic and grounded perspective on behaviour change processes as they occur in situ"* (Hargreaves 2011, p.79). The influences of practice theory on the present thesis are further described in chapter 3.3.

Instead of considering employees' attitudes and values as predetermining for behaviour, the focus of Hargreaves's study laid upon the performance of social practices in their natural environment including their interactions, social and power relations and elements that were challenged, interrupted and re-established by more sustainable elements. *"Bringing about pro-environmental patterns of consumption, therefore, does not depend upon educating or persuading individuals to make different decisions, but instead on transforming practices to make them more sustainable"* (Hargreaves 2011, p.83). By conducting participant observations and 38 semi-structured interviews throughout a pro-environmental behaviour change initiative in an UK organisation, which aimed at reducing waste going to landfill and CO₂ emissions, he revealed several main findings. The audit of the status-quo motivated the selected team to change something as the results related to their practices and environmental impacts were localised in their organisation. After several planning meetings and the roll-out of a 'no bin day' to make use of the improved recycling facilities, they were confronted with conflicts concerning the Facility Management, employees and team members themselves. Thus, Hargreaves argues that these *"surprising connections between practices, would be missed in more conventional and functionalist analyses of pro-environmental behaviour change processes that focus exclusively on individuals' explicitly 'environmental' attitudes and values"* (Hargreaves 2011, p.92). However, the second audit revealed a reduction in waste sent to landfill and CO₂ emissions as subtle changes in the manner of understanding and experiencing practices, not apparent to superficial investigation of everyday business, have been achieved. 'Conspicuous environmentalism', the change from former inconspicuous actions like photocopying to conspicuous performances of double-siding according to environmental credentials, became more prevalent. Colleagues started to remind each other of turning off the light and began to redefine their identity of working at an environmentally conscious organisation. By changing from the inside out, new rules were incorporated in daily working practices. *"Whilst the practices themselves had not been fundamentally transformed, these observations suggest that the way practices were approached, understood and experienced by practitioners had changed, and so too had the sorts of interactions and identities that these practices sustained."* (Hargreaves 2011, p.95).

Viola Muster investigated which role organisations play in promoting sustainable consumption behaviour in their employees' daily living as the workplace is a key setting. As institutions like schools and universities foster formal and informal learning, establish routines and impose peer groups, so do companies in an adult's everyday life. Especially, organisational structures, formal and informal rules, relationship constellations and prevalent interpretations influence employees' behaviour in order to be seen as a full member of the company. By encouraging certain activities at work, people that are typically not interested in sustainability, may be reached. *"Workplace*

conditions have the power to broaden or constrain the opportunities people have to behave in certain ways, including their sustainable consumption behaviour” (Muster 2011, p. 161). Employees represent a twofold role as consumers in their private life and as producers at work. Muster suggests that by creating interventions that tackle both behavioural patterns, a consistent sustainable lifestyle may be established, however, companies rarely support their employees’ outside of work to consume sustainably. According to the study, it is of vital importance not only to integrate employees’ thoughts, ideas and concerns, but to reflect commonly on consumption practices and offer different participation possibilities, eventually strengthened by incentives. By that, the risk of meeting with employees’ refusal or reluctance, as certain interventions may be perceived as a threat to individual freedom. Managers and other superiors shall be encouraged to work as role models and moreover, to actively take part in the change process. Increased employees’ motivation through engagement in their concerns, improved image as a ‘first-mover’ in promoting sustainable consumption, competitive advantages for staff recruitment and above that, staff members, who spread the word in their social environment are among the companies’ benefits discussed by Muster. “Assisting them in the small challenges of their daily lives fulfils CSR as corporate social responsibility” (Muster 2011, p. 168). Moreover, success requires practicability and certain motivation as a precondition, fostering of positive feelings, an analysis of the status-quo as a kick-off event and avoidance of sending conflicting messages. The study highlighted that the overarching aim shall be to develop interventions, which “establish an organisational culture in which employees learn sustainable consumption patterns” (Muster 2011, p.169). As each company differs due to its specific characteristics and employees, activities are preferably tailored to it and different forms of information, support and participation possibilities shall be offered. Last, Muster discusses the implications of public policies in this field and underpins the chances, if public institutions lead by example (Muster 2011).

3 Methodology

As most past investigations focused on private households only, a research approach addressing the organisation's specific characteristics had to be chosen. In this context, the researcher decided to choose action research because of two crucial differences to other forms of inquiries. First, action research is characterised by the active participation and commitment of the researcher to induce change processes and improvements in the field as part of the research process. Second, action research is an iterative process, which means that all findings get evaluated, reflected, and become the input for the next cycle. Thus, they enhance the research process and generate practical change in the organisation. Brydon-Miller et al. argues that taking part and trying to change the social environment is of vital importance in order to be able to understand practises (Brydon-Miller et al. 2003). Thus, the following paragraphs discuss the advantages and possibilities of action research in order to induce positive change within a given setting. Additionally, the reasons for choosing this specific approach are being explained. Last, arguments for the application of qualitative social research methods and the influences of practice theory are adduced.

3.1 Action research

"The research needed for social practice can best be characterized as research for social management or social engineering. It is a type of action research, a comparative research of the conditions and effects of various forms of social action, and research leading to social action. Research that produces nothing but books will not suffice." (Lewin 1946, p.35)

According to Reason and Bradbury, action research is *"a participatory process concerned with developing practical knowing in the pursuit of worthwhile human purposes"* (Bradbury / Reason 2007, p.4). Involved people cooperate in order to address problems, develop a consciousness and create positive change in their communities or organisations (Bradbury / Reason 2007). Looking at the two containing words 'action', referring to what you do, and 'research', referring to how you find out what you do, the main focus can be revealed: learning in and/or through action and reflection to contribute to improved human, non-human and environmental wellbeing (McNiff 2013).

Similar to design science research according to Hevner (Hevner 2004) and Zelewski (Zelewski 2007), action research pursues two main goals: first, to contribute to increasing the scientific knowledge base and second, to contribute to solving important problems in the real world. However, the latter is addressed differently. While design science research achieves the solution of the real world problems by building and evaluating *"purposeful artefacts"* (Hevner 2004, p.78), action research reaches its second goal by inducing and evaluating change in social practices.

The inductive action research process mainly consists of three cyclic phases and is an iterative approach (see Figure 5). First, the status-quo is evaluated, the current practice is reviewed and past inquiries under similar circumstances are investigated. Next, an aspect, which the researcher wants to investigate, is identified and action possibilities are planned. In the action phase, interventions towards the desired goal are conducted and evidence is gathered. In order to measure and compare the outcome to the baseline, the gathering of data in all four steps is of considerable importance. This can be achieved by mainly qualitative, but also quantitative or mixed methods. Moreover, reasons for and purposes of the taken action have to be documented.

Within the next step, the taken action, its measurement and outcome are evaluated and reflected. Thereby, meaning is added to the internal process and the development of the project by the researcher and all those involved. Thus, claims to knowledge, based on inferred conclusions, are made. All these three phases are not strictly separated and may merge into one another (Bradbury / Reason 2007; James et al. 2011; McNiff 2013).

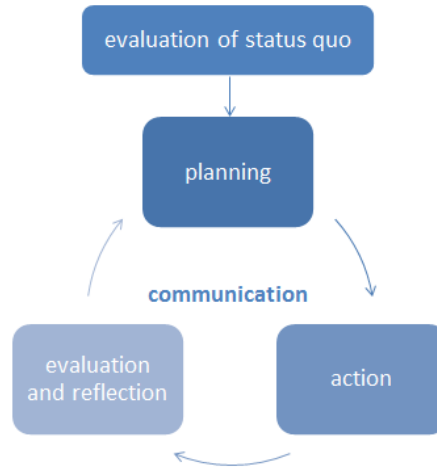


Figure 5 - Action research process

3.1.1 Role of the researcher

“Any scientific inquiry, which is made on the level of human encounter, involves the inquirer in an interpersonal exchange. The inquirer has to gain the confidence of the community with which she works. The centres of human existence can be reached only if there is common trust that the encounter takes place for the benefit of people involved. This means that there is in last resort no mere observer position in such an encounter; there is common search for common good.” (Swantz 1970, p.359-60)

Swantz defined her position as a researcher by rejecting the conventional participant observer (Swantz 2007). The idea of an active participation of the researcher – going native – instead of an observing outsider originated from Lewin’s research around World War II, which has then been adapted from a short-term intervention to a continuous, cyclic and long-term process (Bradbury / Reason, 2007). By identifying with the interests of the people involved, they may gain confidence in the researcher and forget about the fact of working with an external person (Swantz 2007). James et al. clarified the role of the researcher in action research as a project manager, who is learning and implementing new ideas or solutions, compared to a researcher in charge of collecting and analysing data as in pure knowledge research (James et al. 2011, p.22). Hence, action research does not follow the mainstream concept of a seemingly objective and value-free investigation to knowledge generation, but favours the involvement of the system’s members in the inquiry to better understand and change the given situation (Brydon-Miller et al. 2003).

3.1.2 Gathering data and generating evidence

In order to ground and support a claim to knowledge, the monitoring of practices, the gathering, analysis and interpretation of data, and the generation of evidence is necessary. On the one hand, data is gathered by monitoring practices of as well as interactions between the researcher and all involved. By keeping continuous records like a research diary during the entire action research process, the real-life situation and how it evolves over time may be demonstrated. On the other

hand, quantitative and qualitative data-gathering methods support the researcher's understanding of the on-going transformation (McNiff 2013).

McNiff suggests the identification of criteria (e.g. participation in meetings, improved learning) and their standards (e.g. extent of participation in meetings, way the learning had improved) when analysing the data. Therefore, the evidence of the criterion in the data must be analysed and interpreted according to the achievement of its standard. Instances, that show the criterion in action, will be the evidence for a new knowledge claim (McNiff 2013). In contrast, James et al. recommends inexperienced researchers and students to measure the distance from the baseline towards the last implemented action's outcome by employing mainly qualitative, but also quantitative or mixed methods. The data gathered and the notes taken represent an accurately and defensible measurement according to research standards. Thus, conclusions may be drawn (James et al. 2011).

With regard to the above suggestions, the researcher decided on the following documentation during the entire action research process to prove evidence for knowledge claims. Thereby, the researcher systematically explored how to improve the situation, produced evidence by keeping records of each action, its measurement and outcome in order to judge the enhancement of the respective baseline. Certain criteria like the perceived importance of the topic 'use-time' or the participation during common meetings and their standards influenced the analysis phase of the data.

1. Action process log

The action process log represents the researcher's diary, which was extended weekly by precisely documenting in a three-column form the date, the action and what the result was. It supported the researcher to gain more insights in the taken actions, to reflect upon on-going process and plan further steps based on past activities (see Appendix).

When re-reading the entire log, an additional personal development became apparent. The way of reporting became more detailed and profound from the fourth week onwards as advantages of keeping a diary were realised. In retrospect, it was considerably essential to track every week and schedule enough time for reflecting on the weekly activities, as it not only supported the researcher during the inquiry as such, but also while writing the present thesis.

2. Action research reflection tool

E. Alana James et al. recommends her students to use this simple form in order to gather the data needed for documenting all discoveries, steps taken and the outcomes linked to the reflections made. Given an example that the inquiry starts at point X where the participants have little or no understanding of the research topic. All start working together and reach a point Y where enough understanding to fill out a survey concerning the topic has been gained. By passing out the survey to the group and getting back the data takes the researcher to a point Z. Afterwards the distance from X to Z can be measured and evaluated accurately as data was gathered at every point X, Y and Z (James et al. 2011).

Thus, for each action taken the researcher documented its date, baseline, description, measurement and outcome. It made the iterative process effectively visible, where past actions and their results became the baseline for the next intervention. Furthermore, the tool helped to plan the measurement and evaluation of each upcoming action (see Appendix).

3. Transcription and post-notes

Every interview, workshop, meeting or presentation was audio recorded and afterwards transcribed. The researcher distinguished between a literal transcription for interviews (see Appendix) including the extension of the postscript and the documentation of the course and discussions in meetings including the literal transcription of important quotes (see post-notes in Appendix). Due to the time intensive action research process, a literal transcription of the entire common meetings like the workshop would have been out of scope and concurrently would not have revealed more insights.

After every interview, the postscript was extended by documenting the quality of the interview and how the interview partner interacted with the researcher and the environment.

3.1.3 Establishing validity

In order to create knowledge, the researcher's knowledge claims have to be tested for validity, making them justifiable. Within traditional social science research methodologies, tests are conducted using statistical data analysis and results have to be seemingly objective and replicable. In action research, knowledge claims are best grounded in some form of corroborating evidence. In 1975, Heinz Moser suggested three criteria for validity in action research. First, transparency regarding the entire process, aims and methods to all participants involved. Secondly, the compatibility of the aims with the methods and means used to reach them. Third, the gained expertise of the researcher, who should then be able to understand the situation better than any external observer does (Swantz 2007). Through the concept of triangulation, which uses at least three independent sources of data (e.g. diary, interviews and reflection meetings), claims are established and their accuracy increases. Additionally, McNiff suggests a range of peers (e.g. a group of 3-4 experts, which support the investigation process), who may criticise or support these evidences and perform validity tests to ground their judgements: internal (personal validity), external (social validity), shared (peer validity). All validity measures act as intersubjectively comprehensible tests in order to judge quality of the research process (McNiff 2013; Sagor 2000).

Due to the time and resource intensive effort that comes with validity tests, the knowledge claims of the present thesis were based on gathered data and pieces of evidence coming from various sources like surveys, interviews, a common workshop, action meetings with a small core group, the final presentation, post-questionnaires and a last reflection meeting. Whenever possible, actions were discussed, evaluated and reflected by all participants. In order to trace claims to knowledge, all actions were documented and monitored as described in the previous section (see chapter 3.1.2). Moreover, the three criteria defined by Moser have influenced the researcher's concept and were taken into consideration. All steps of the action research process were made transparent to the cooperation partner. Methods and means were chosen on purpose to match the aims and research questions of the present thesis. Last, due to the small organisation size, the researcher was able to closely cooperate with all employees and the management. All conditions and aspects, she has become aware of, were honestly set forth within this master thesis.

3.1.4 Why action research?

Regarding all these characteristics, action research leads to notable options. First, it is also applicable within small groups, because *"through such micro-practices people increase their ability to make sense of their world and act effectively"* (Bradbury / Reason 2007, p.2). The focus shifts

from observations and descriptions of actions to revealing the reasons and intentions of the person acting (McNiff 2013). Furthermore, as action research is a participative research method, all involved people are equally treated and hence, get involved in the on-going, transparent change. The researcher is not doing research on them, but is researching with them, resulting in a practice-based research. People are considered as individuals and not as a pure source of information (McNiff 2013). The attitude, that we are not isolated, but interconnected individuals and part-of a whole, addresses *“the ecological devastations wrought by humans”* (Bradbury / Reason 2007, p.9). Next, knowledge is seen as dynamic and incomplete and thus, a living process shaped by experience, learning and interaction (McNiff 2013). Besides, established routines and habits can be improved by the encouragement of forced changes within each reflective cycle. Hence, complex situations or apparent impossible tasks, which normally cause people to shut down as they are afraid of the implied difficulties, can be tackled in a secure holding environment of action research. People get encouraged to induce positive change within their system as the outcome of the previous cycle becomes the input of the new one. Moreover, participants and the researcher become more open to new ideas as reflecting can serve as a chance to eventually take a closer look at the actual work setting. Last, the benefit of positive change and developed solutions to all those involved is always the main focus of the desired final result, making it an innovative approach for businesses on their way towards sustainability (James et al. 2011). Through action research’s contribution to practical knowledge, a more *“equitable and sustainable relationship with the wider ecology of the planet of which we are an intrinsic part”* may be established (Bradbury / Reason 2007, p.4).

3.1.5 Selection of the cooperation partner

The cooperation partner had to fulfil certain requirements to meet the aim of the work. As the researcher was still in her master’s degree and had no prior experience in action research, a small organisation offered the possibility to work intensively with the management and the individual employees together. Before the cooperation, Omega Ltd¹ was not known or familiar to the researcher in any way. Although, the majority was between 18 and 30 years old and male, the staff members seemed balanced with a strong team spirit. Due to its familiar and dynamic structure, change was more welcomed and could be induced more easily than in larger, stricter organisations. The aspect of employee’s practices and behaviour having more influence on the organisation’s decision making was interesting to be taken into consideration.

Besides, the organisation’s field of expertise was likewise in the area of informatics with an additional small administration team and external customer contact. Thus, the employees’ requirements and practices regarding IT equipment differed and were interesting to investigate.

Moreover, for the last two years the organisation has been growing and expanding its staff members. Consequently, the need for defined procurement processes of PCs as well as laptops, structure and documentation in general became more important and relevant to the management.

3.1.6 Practical application in the present thesis

Figure 6 demonstrates the timeline of the applied action research process within this master thesis. Empty circles represent the central and commonly performed sections at the organisation, filled circles symbolise digital evaluation methods conducted. In addition, six expert interviews were conducted to gain profound insights into the public procurement processes in the City of

¹ Omega Ltd, all names and all participants are pseudonyms, which are used throughout this thesis to protect the anonymity of the organisation and all research participants being studied.

Vienna and the repair scene itself (see chapter 5). Recommendations were considered as valuable input for the action meetings. The main result as regards content was a structured and condensed evidence-based guideline for improving the use-time of PCs and laptops in small organisations, similar to the cooperation partner (see chapter 4.9).

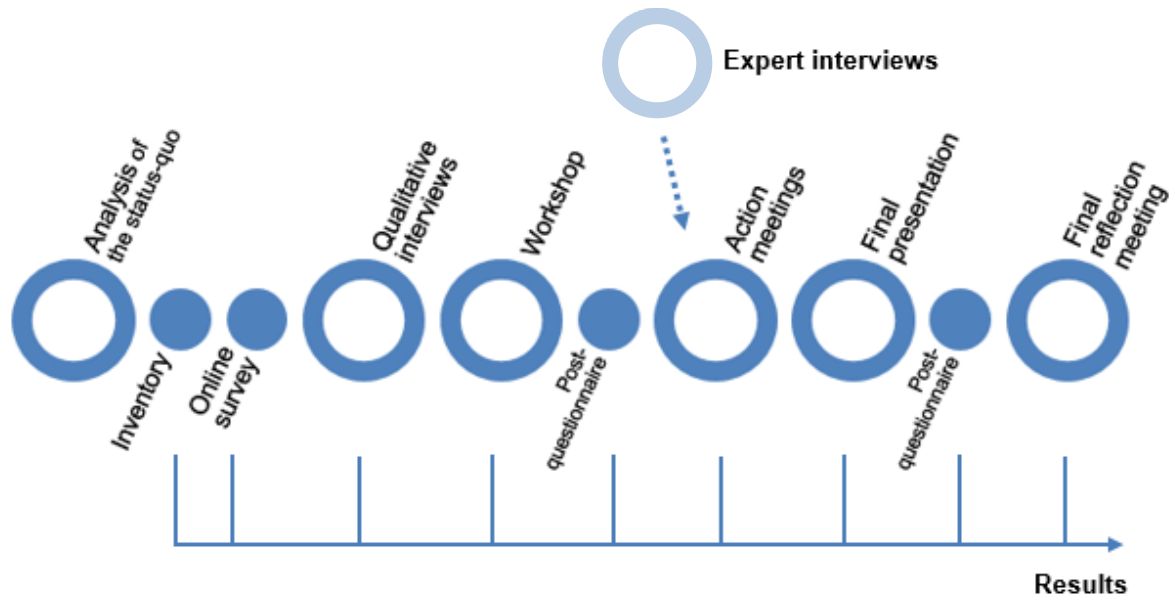


Figure 6 - Timeline of the action research process

The following paragraph gives an overview of the process's single parts, which were analysed and evaluated in detail in chapter 4. Qualitative social research methods like the problem-centred interview are extensively described in the upcoming chapter 3.2.

1. Analysis of the status-quo

After the kick-off and first preparation meeting, the status-quo regarding the current PCs and laptops in use was split into two steps. First, the inventory was developed in form of a Microsoft Excel sheet including specific equipment properties, the allocation to actual employees and the history of users per device. The continuous development throughout the process resulted in a central overview and monitoring sheet. Second, all employees were asked to participate in the first online survey addressing their demographic data, individual work requirements, PC or laptop in use, satisfaction, current knowledge about the topic 'use-time' and the organisation's vision and goals. At the beginning of the survey, employees were informed that all information was treated confidentially and anonymised for further use. Although, the researcher was aware of the challenges regarding socially desirable responding (Bortz / Döring 2007), the participant's names were important in order to make a selection of interview partners in the next step (see chapter 4.3).

In general, the analysis of the status-quo represented the baseline for measuring improvements, actions taken and the overall achievement.

2. Qualitative interviews

Similar to theoretical sampling (see chapter 3.2.1), interview partners were purposefully selected based on their answers given in the online survey in order to cover extreme and diverse cases.

For instance, employees with an early hiring date with more profound knowledge about the organisation's processes, who shared their laptop or whose satisfaction was low due to slow devices, held useful information for increasing the knowledge gain. The exact criteria for choosing an interview partner are listed in chapter 4.4.

All qualitative interviews were conducted according to Witzel's problem-centred interview following semi-structured guidelines as a supportive instrument (see chapter 4.4.1). They were audio-recorded, literally transcribed and annotated in the postscript. Next, their thematic coding and analysis led to deeper insights in the employee's practices at work and personal behaviour (see chapter 4.4.2). The underlying methodology is described in chapter 3.2.

3. Workshop

The qualitative interviews were followed by a common workshop, which aimed at concluding the status-quo analysis and representing a kick-off event for the subsequent development of improvements. By presenting facts concerning e-waste and its implications, the importance of the topic 'use-time' became apparent. Second, all anonymised results from the online survey and the conducted interviews created a common and transparent baseline in order to evaluate actions taken at the end of the cooperation. Last, as the organisation lacked of a specified vision and derived goals, all participants including the management were encouraged to commonly develop and actively brainstorm. The researcher's aim was to discover whether ideas or desires of including sustainable intentions were existent.

In order to get an impression of the workshop's influence on the participants, to continuously gather data and to measure the on-going development since the first online survey, a post-questionnaire was sent via e-mail (see chapter 4.5).

4. Action meetings

After the intensive analysis phase and based on its results, the action meeting phase started. The aim was to improve the status-quo by each meeting of the core group, which consisted of two technically skilled employees, additionally responsible for internal organisational tasks, the management and the researcher herself. By planning, discussing, implementing reflecting and deriving actions of various areas of improvement, ranging from procurement to end-of-life, an iterative and continuously developing process, which aimed at prolonging a PC's or laptop's use-time, was established. The output of the previous cycle became the input for the upcoming. All discussions, comments and results were documented in written form in order to provide evidence and validity for knowledge gains (see chapter 4.6).

5. Final presentation

Based on all discussion, actions taken, reflections and evaluations during the action meeting phase, the results were structured in form of a notebook in Microsoft OneNote and presented by the core group at the common final presentation.

After several discussions, feedback, reflections and newly derived actions, participants were encouraged to interactively develop advantages and their motivation to prolong a device's use-time in two groups. The creativity technique used was a modified version of the brainwriting 6-3-5 method, ensuring an easy to participate and exchange ideas approach, whose analysis led to a multifaceted, structured result.

Based on the previous surveys, the action meeting phase and the final presentation, the last post-questionnaire was sent out to all participants. It aimed at evaluating the overall development and change in practices since the beginning of the cooperation.

6. Final reflection meeting

Within the final reflection meeting, the outcome as regards the cooperation process was evaluated among the core group members. By reflecting upon the usefulness, feasibility, difficulties and effort of the applied action research process, future necessary steps and adjustments became apparent to the management. Thus, the cooperation represented an essential impulse to continue developing sustainable practices. The long-term evaluation after the final presentation was out of scope of the present master thesis.

3.2 Qualitative social research

As described in the previous chapter, action research complements well with qualitative, quantitative or mixed methods. Due to its inductive approach in the field (see Przyborski/Wohlrab-Sahr 2014, p.39ff.), the researcher decided on an increased deployment of qualitative social research methods, partly strengthened by small surveys or questionnaires. Therefore, this chapter aims at shortly describing its characteristics and the approach applied within the present thesis.

According to the SAGE dictionary of social research methods, qualitative research is *“research that investigates aspects of social life which are not amenable to quantitative measurement. Associated with a variety of theoretical perspectives, qualitative research uses a range of methods to focus on the meanings and interpretation of social phenomena and social processes in the particular contexts in which they occur”* (Jupp 2006, pp.248–49). As it emphasises a detailed understanding and interpretation in depth, it is mostly conducted at a *“small-scale or micro-level”* (Jupp 2006, p.249).

Lichtman reviewed some common elements of the various definitions available. In contrast to quantitative research, which is associated with hypothesis testing and generalisation, qualitative research aims at understanding the ‘what’ and ‘why’ of human interactions and social phenomena in natural settings. It is essential to understand, why people act as they act and how these practices emerged. As the method is dynamic and inductive, it purposes the evolvement of collecting and analysing data during the research progress. There is no objective reality or single interpretation, but a reality constructed and critically reflected by the researcher (Lichtman 2013, pp.12–13). According to Mayring, qualitative thinking is based on five postulates namely the strengthened subject orientation, the description and interpretation of the subject under research, the need for investigating subjects in their natural environment and the individual, stepwise justified generalisation of results. These abstract requirements are then broken down into thirteen pillars (Mayring 2002, p.19ff.).

To ensure qualitative results and a traceable process of gaining knowledge with regard to scientific standards, the fulfilment of quality criteria is being controlled. The classical quality criteria of quantitative research – validity, reliability and objectivity – were criticised for their limited application to qualitative research methods. Thus, Mayring suggests six quality criteria for qualitative research, considering the approach’s openness, flexibility and position in the field, which were used for this thesis (Mayring 2002, pp.140–48):

1. Documentation of procedure: As methods and techniques are not standardised like in quantitative research, a detailed description of the applied research process is mandatory to guarantee traceability to others. Within the present thesis, all steps and decision were documented, explained and made transparent in the respective chapters.
2. Argumentative validation of interpretation: Interpretations cannot be proven, nonetheless, argumentation must be coherent and comprehensible. Alternative and negative explanations have to be taken into consideration. This quality criteria was carefully taken into consideration while performing the thematic analysis and interpretation of data available.
3. Rule-based procedure: Although, qualitative research is flexible, open towards the subject and its on-going process may be modified, a systematic and rule-based approach, which is well-defined, is required. Therefore, the data collection and analysis methods were first, theoretically and second, as applied and modified described.
4. Proximity to the subject: Qualitative research relates to subjects within their natural, real-life environment and to their concrete social problems, as previously described as field research. By the subject's and researcher's interests approximation, proximity and an equal relationship is ensured. As the applied action research process is already a participatory approach (see chapter 3.1), the proximity to the cooperation partner was given.
5. Communicative validation: Results may be presented to and discussed with the people under investigation to increase validity and back up findings, if participants recognise themselves within the interpretations. Important to mention, qualitative research allows investigated people competences and classifies them as thinking subjects, not pure data suppliers. The researcher of the present thesis applied communicative validation in two ways. First, common meetings for all employees were organised in order to make all results transparent and encourage participants to discuss them. Second, during the action meetings, the core group reflected upon and evaluated prior actions taken.
6. Triangulation: Results from different sources of data, methods, interprets and theories may be compared. Triangulation aims at complementing and highlighting strengths and weaknesses of different perspectives, resulting in a kaleidoscopic picture. As described in chapter 3.1.6, various sources of data and methods have been used to investigate the phenomenon from different positions and perspectives.

3.2.1 Data collection

Within qualitative research, a verbal approach plays a prominent role. Subjects are the experts of their own meanings, behaviour and practices (Mayring 2002). The following paragraph constitutes the reasons for choosing the interview partners in the organisation and performing the problem-centred interview as a data collection method during the status-quo analysis and for interviewing external experts.

Theoretical sampling

Representatives of grounded theory defined the inductive procedure as *"sampling on the basis of the emerging concepts, with the aim being to explore the dimensional range or varied conditions along which the properties of concepts vary"* (Strauss / Corbin 1998, p.73, as cited in Patton 2014). Relevant cases or participants are selected against the background of theoretical considerations in order to accurately describe the phenomena. Thus, they are not chosen because of abstract methodological criteria, but according to criteria regarding their content (Strauss / Corbin 1996).

By adding additional cases, the continuous comparison provides a theory-sharpening analysis process (Patton 2014). The selection of cases or participants stops as soon as the inclusion of a new case doesn't imply any further modification of the theory, which then counts as saturated (Schreier 2010).

Within the present thesis, the researcher applied a modified form of theoretical sampling due to the organisation's size and the limited time resources. During the status-quo analysis concerning the employees, the following criteria from the online survey proved to be relevant to select an accurate and typical representation of the staff members: early hiring date (e.g. before 2014, profound knowledge about the organisation), internal responsibility (e.g. contact person, management, procurement), IT-equipment in use (e.g. PC or laptop), current or past problems (e.g. system freezes/ crashes, hardware difficulties), current satisfaction (e.g. high or low) and requirements (e.g. CPU-intensive work) while working, perceived importance of use-time. As important criteria evolved over time, interviewees were successively chosen in order to include diverse cases, but also similar employees for comparing practices. In contrast to the group of staff members, the management was additionally interviewed. The values of criteria chosen are summarised in chapter 4.4. Moreover, the postscript partly influenced the selection of additional cases as suggested by Witzel (Witzel 2000). Important to mention, the saturation of the theory is no strict criterion, but dependent on the specific inquiry context and practical considerations (Schreier 2010).

Questionnaires

In total, three online questionnaires were designed following different aims. The first was a short online survey, which included questions to constitute the basis for applying a reduced form of theoretical sampling as described above. The two further questionnaires after the workshop and final presentation respectively, were geared to a formative evaluation and aimed at receiving feedback of in how far goals were achieved. *"When the cook tastes the soup, it is formative evaluation; when the dinner guest tastes the soup, it is summative evaluation"* (Robert Stake, as cited in Cowan / George 1999, p.1). The formative's focus is on gathering data to identify scope and potential for improvements, evaluate the process, monitor learning and guide decisions in the next step (Cowan / George 1999; Nieveen / Folmer 2013; Pratzner 2001). Furthermore, it is characterised by its exploratory, flexible design and its interest in the broader experiences of the participants (Aggarwal 2009).

The researcher was aware of the challenges regarding socially desirable responding, which may be regarded as a special form of self-manifestation. Participants fear social insults and thus, are motivated to adapt their answers according to wide-spread norms and expectations of their behavioural patterns (Bortz / Döring 2007, p.232ff.). Nonetheless, the inclusion of the participants' names in the questionnaire was vitally important to evaluate individual developments over time and to select relevant interviewees after the first online survey. Thus, employees were informed at the beginning of each questionnaire, that all information was treated confidentially and anonymised for further use, in order to diminish the potential bias.

Problem-centred interview (PCI)

Although, the name may suggest dealing with a problematic issue, the meaning refers, according to Witzel, more to a specific research question under investigation (Witzel / Reiter 2012). However, *"the research question has to correspond to an everyday problem in the perspective of*

practical knowledge that the respondent can articulate and has also an interest in dealing with. This is an important step towards realising the PCI's endeavour of learning about the real motivations behind actions" (Witzel / Reiter 2012, p.5).

According to the adapted definition and classification by Mayring (Mayring 2002, p.66), the problem-centred interview is an open, semi-structured data collection method. Openness refers to the interviewee's possibility to answer freely and without pre-defined response options. In general, this approach is more honest, reflected and accurate. By focusing on a preferably equal and open relation, where the interviewee is taken seriously, trust may be established leading to more profound insights. Based on the prior analysis of the discussed problem, an interview guideline structured in topics develops. As the naming reveals, it represents a supportive instrument during the interview, but not a strict course (Mayring 2002). Witzel described the guideline as a *"framework for orientation to ensure comparability of interviews"* (Witzel 2000, para.7). Thus, spontaneous ad-hoc questions may arise when conducting the interview and are welcomed, if relevant to the research topic or for preserving the conversation. Besides, the guideline is tested in a pilot interview and, if necessary, adapted following the inductive approach (Mayring 2002). Audio-recording, transcriptions and postscripts are additional instruments to provide authentic and accurate data for the later interpretation and analysis phase (Witzel 2000).

Moreover, Witzel describes the interactive, interpretive process of data collection as a *"discursive dialogue"* between the respondents and the interviewer in order to *"co-construct and reconstruct problems together"*. When the researcher's prior knowledge and the interviewee's practical knowledge meet, the former needs to be sensitised not to *"jeopardise the requirement of openness in qualitative research"* (Witzel / Reiter 2012, p.18-19).

According to all these characteristics, the problem-centred interview complements the prior described action research process to gather data of employee's practices regarding the use-time of PCs and laptops and to better understand the status-quo at the organisation. Establishing trust for revealing more profound insights was essential to the present thesis. Therefore, the researcher developed three different interview guidelines, which evolved over time, performed one pilot interview and last, audio-recorded, literally transcribed and extended the postscripts of all interviews conducted within the organisation (see chapter 4.4). The literal transcription was performed according to Kuckartz et al., who suggested the use of deliberately simple and easy to learn transcription rules focusing on the content. For increased readability, dialect and unnecessary fillers like 'uhm' were not transcribed, nonetheless, laughs and long pauses were explicitly marked as they were perceived as potentially interesting for the interpretation (Kuckartz et al. 2008, p.27ff.). With regard to the expert interviews, all steps except the pilot interview and the postscript were similarly conducted (see chapter 5).

Workshop, meetings and final presentation

According to Sork, a workshop is *"a relatively short-term, intensive, problem-focused learning experience that actively involves participants in the identification and analysis of problems and in the development and evaluation of solutions"* (Sork 1984, as cited in Brooks-Harris / Stock-Ward 1999, p.3). Following this definition and the possible emphases introduced by Brooks-Harris and Stock-Ward, the workshop of the present thesis focused on increasing knowledge without being solely a didactic lecture, systemic change and personal awareness, as emphases are intended to overlap (Brooks-Harris / Stock-Ward 1999, p.3ff.). The precise arrangement and course of the

respective sessions were commonly elaborated with the management, in order to achieve an accurate setting suitable for this specific organisation's nature.

3.2.2 Data analysis

Regarding the interpretation and analysis of data, Mayring suggested several approaches differing in the degree of structuring and the type of underlying material. The qualitative content analysis aims at systematically analysing texts and developing a theory-driven category system as near as possible to the original material. In contrast to the quantitative content analysis, it considers the context of text passages, the understanding of latent structures of meaning, striking individual cases and aspects not mentioned in the text (Mayring 2002).

The researcher decided on a similar, sometimes interchangeably used approach called thematic analysis, because, according to Braun and Clarke, *"thematic analysis should be seen as a foundational method for qualitative analysis. It is the first qualitative method of analysis that researchers should learn, as it provides core skills that will be useful for conducting many other forms of qualitative analysis"* (Braun / Clarke 2006, p.78). As the researcher had no prior experience in qualitative analysis, thematic analysis as described by Braun and Clarke was chosen (Braun / Clarke 2006). Moreover, the method is described as useful when working within a participatory research paradigm as in the case of action research.

Thematic analysis

"Thematic analysis is a method for identifying, analysing and reporting patterns (themes) within data" (Braun / Clarke 2006, p.79). The researcher's judgement is necessary to determine, which data extracts within the data set capture something important with regard to the research question in order to count as a theme. Although, the method provides high flexibility, which may reveal unanticipated insights in the data set, the researcher has to explicitly state the procedure and decisions made during the analysis phase in order to make evaluations traceable and comparable with other studies.

With regard to the different possibilities explained by Braun and Clarke, the researcher decided on a rich description of the data set and therefore, conducted an inductive, data-driven thematic analysis, which means that themes were identified based on the data themselves. Important to mention, identified themes may bear little relation to the original question asked in the interview (Braun / Clarke 2006). Although, researchers shall sensitise their theoretical and epistemological commitments, they cannot completely free themselves and code in *"an epistemological vacuum"* (Braun / Clarke 2006, p.84). Prevalence was counted in terms of the number of different employees, who addressed the theme within the interviews.

The step-by-step guide by Braun and Clarke suggested the following phases (Braun / Clarke 2006):

1. Familiarising with the data: the researcher explores the depth and breadth of the content by reading and re-reading the data available (e.g. transcriptions of interviews) and creates an initial list of ideas.
2. Generating initial codes: the researcher systematically works through the entire set of data, draws equal attention to all aspects and codes as many potential themes as possible.
3. Searching for themes: the researcher starts sorting and structuring different codes in overarching themes or sub-themes by considering relationships between codes and themes.

4. Reviewing themes: the researcher may refine themes until data within meaningfully coheres together and themes are clearly and identifiably distinctive.
5. Defining and naming themes: the researcher identifies the essence of each theme and names, not paraphrases, them according to the aspect it captures.
6. Producing the report: the researcher writes a detailed analysis for each theme, by providing sufficient evidence in the data and a *“concise, coherent, logical, non-repetitive and interesting account of the story the data tell”* (Braun / Clarke 2006, p.93).

Considering *“the validity of individual themes in relation to the data set, but also whether your candidate thematic map ‘accurately reflects the meanings evident in the data set as a whole’* (Braun / Clarke 2006, p.91) is of essential importance while reviewing themes.

Following the step-by-step guideline of thematic coding, the researcher performed the approach with support of the Atlas/ti software. In total, three iterations of refining codes and themes were necessary. After the first round, codes with grounding ‘1’ were additionally considered and the researcher decided, whether they are worth being kept or may be subsumed by a similar code. Second, codes were categorised into code families, representing the sub-themes, which partly represent answers to the present thesis’s research questions. Next, by re-reading all transcriptions and identified quotes, duplicates or wrongly linked codes were eliminated. As a last step, all sub-themes were restructured and rearranged, which finally led to the following five themes:

- Omega Ltd practices
- Differences in practices
- Influences on use-time
- Advantages and disadvantages of a prolonged use-time
- Potential for change

These themes consisting of sub-themes and codes are presented, analysed and interpreted within chapter 4.4.2. Apart from that, research questions evolved through the coding process and became more precise with relation to the prevalent setting of a small organisation.

3.3 Practice theory

Practice theory has its roots in Marxian theory, where work becomes the centre of investigation and understanding. A concrete practice including material action and the presence of instrumentality produces an outcome, which may become the raw material for another activity and thus, the fundamental grounding of sociality. Moreover, the workers’ identity is shaped by their work and cannot be examined in isolation, but only in relation to each other. Additionally, work is not just physical behaviour, but depends on a background of beliefs and intentions and the surrounding environment. Without these conditions, work loses its meaning. Hence, Marx argues that work can only be examined by taking its configuration into account and that human behaviour can only be understood by studying the activity a person is engaged in (Nicolini 2012). Marx theory has been then further developed and evolved through the traditions of Friedrich Nietzsche, Martin Heidegger and Ludwig Wittgenstein (Nicolini 2012, p.29ff.).

The present thesis was influenced by practice theory in order to better understand and focus on prevalent practices at the organisation. Orlikowski proposed a practice theory for studying technology in organisations by developing *“a practice lens to examine how people, as they interact with a technology in their ongoing practices, enact structures which shape their emergent and*

situated use of that technology” (Orlikowski 2000, p.404). Through regular, recurrent interaction with technology and its properties, structures of use are recursively established. Orlikowski argues that “*users shape the technology structure that shapes their use*”, which may be observed through the practice lens (Orlikowski 2000, p.407). As users decide to use a technological artefact, they simultaneously choose how to interact with it. Adapted from Giddens’s notion of structure, 1984, Orlikowski proposed technology-in-practice as a kind of structure with a similar recursive establishment (see Figure 7). Following this constitution, “*people’s use of technology becomes structured by these experiences, knowledge, meanings, habits, power relations, norms, and the technological artifacts at hand. Such structuring enacts a specific set of rules and resources in practice that then serves to structure future use as people continue to interact with the technology in their recurrent practices*” (Orlikowski 2000, p.410). Thus, the structure of technology use is established and re-established leading to the execution of a distinctive technology-in-use.

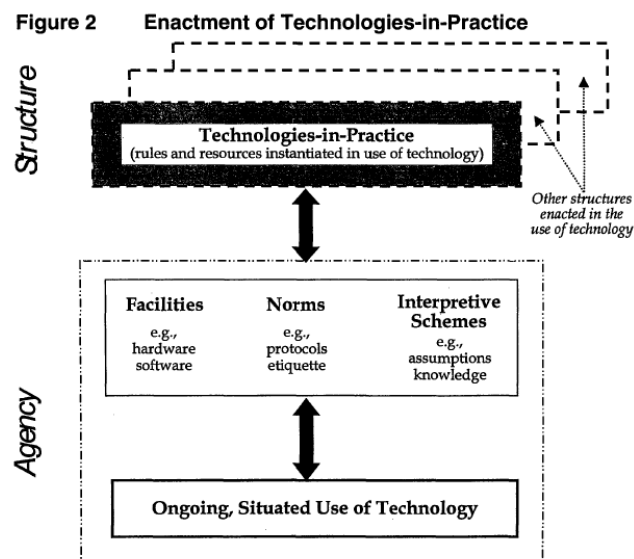


Figure 7 - Technologies-in-Practice (Orlikowski 2000, p.410)

However, enacted structure may be changed by the possibility to change user’s habits of use, emerging from experienced “*awareness, knowledge, power, motivations, time circumstances and the technology*” (Orlikowski 2000, p.411). This approach influenced the present thesis’s aim to induce change in the employee’s and management’s practices regarding the use-time of PCs and laptops.

4 Action research process

The following section is written from the first-person perspective as the researcher is actively participating and going native in an action research process. Thus, the individual involvement in the inquiry to better understand and change the given situation is of vital importance (McNiff 2013, p.151). Moreover, as action research is a continuously evolving and iterative approach, the analysis of 'lessons learned' after every milestone is essentially relevant to improve the next step based on the previous one.

The action research process started with a kick-off meeting on the 26th of May and ended with a final reflection meeting on the 30th of September 2015. From July till September were the most time and work intensive months for the employees as well as for me.

4.1 Participants characteristics

The information is partly taken from the organisation's website, e-mails, the online survey or performed interviews. Omega Ltd, all names and all participants are pseudonyms, which are used throughout this thesis to protect the anonymity of the organisation and all research participants being studied.

4.1.1 *Omega Ltd*

The Omega Ltd was the cooperation partner during my action research process, is located in Vienna and operates in the field of IT solutions, data warehousing and consulting. The small organisation employed fifteen employees and the CEO, is a successor of the company Psi Ltd, was founded in 2008 and has successfully expanded over the last years. It achieved total sales revenues of 770,000 € in 2014. Thus, the need for more structure, monitoring and guidelines arose.

4.1.2 *Core group*

The core group was formed for developing internal actions and improvements. Members were selected based on their responsibilities and experience in the organisation.

Ms C1 is between 51 and 60 years old, the CEO of the organisation and uses one laptop and one surface due to mobility issues. She uses her laptop since 2008.

Mr C2 is between 25 and 30 years old, works as a data warehouse engineer since 2010 and uses two laptops. Moreover, he is responsible for the procurement process and contact person in case of software problems. He already had four or more laptops in use.

Mr C3 is between 25 and 30 years old, works as a data warehouse engineer since 2010 and uses one laptop. Moreover, he is co-responsible for the procurement process and contact in person in case of hardware problems. It is his third laptop in use.

4.1.3 *Employees*

Ms E1 is between 25 and 30 years old, works as an administrative assistant since 2014 and uses one laptop. It is her first laptop in use.

Ms E2 is between 18 and 24 years old, works as an administrative assistant since 2014 and uses one laptop. It is her first laptop in use.

Ms E3 is between 18 and 24 years old, works as a project officer since 2014 and used two shared laptops. On the day of our interview she received her first own laptop.

Ms E4 is between 18 and 24 years old, was an internship in July and August 2015 and only participated in the workshop. During her internship she used one laptop.

Mr E5 is between 18 and 24 years old, works as a data warehouse engineer since 2013 and uses one laptop. He already had two laptops and one PC in use. He was my first contact person to establish the cooperation with Omega Ltd.

Mr E6 is between 18 and 24 years old, works as a data warehouse engineer since 2014 and still uses one PC. It is his first PC in use.

Mr E7 is between 31 and 40 years old, works as a business intelligence consultant since 2014 and uses one laptop. It is his first laptop in use.

Mr E8 is between 31 and 40 years old, works as a business intelligence consultant since 2015 and uses one laptop. It is his first laptop in use.

Mr E9 is between 18 and 24 years old, works as a business intelligence consultant since 2015 and uses one laptop. It is his first laptop in use.

Mr E10 is between 18 and 24 years old, works as a data warehouse engineer since 2013 and uses one laptop. It is his first laptop in use.

Mr E11 is between 25 and 30, works as a business intelligence consultant since 2015 and uses one laptop. It is his first laptop in use.

Mr E12 is between 51 and 60 years old, works in the field of data centre operation since 2008 and uses one laptop. He already had four or more laptops in use.

Ms E13 is between 25 and 30 years old and worked as an administrative assistant since 2012 until September 2015. It was her third laptop in use.

4.2 Kick-off and preparation

The first meeting with Ms C1, CEO of Omega Ltd, took place on the 26th of May 2015 in order to present her my concept of a cooperation to analyse and improve the use-time of PCs and laptops within her organisation. The iterative process of action research was entirely new to her. Although she seemed sceptical about possible improvements, she agreed on working together and we planned a rough timeline.

4.3 Analysis of the status-quo

The first important step was to analyse and identify the status-quo, which constituted the baseline for my action research process. All improvements were measured iteratively starting from the baseline and demonstrated the overall achievement.

Within this phase we had a closer look at the inventory of PCs and laptops, the allocation to employees, the user's satisfaction and requirements and finally the employee's practices in their daily business.

4.3.1 Inventory

On the 1st of June 2015 a preparation meeting with the two administrative assistants, Ms E1 and Ms E2, took place aiming at clarifying five main parts: organisation's history and goals, organisation's structure and decision paths, presence of documentation regarding PCs / laptops and their use-time, used systems and partners. During the meeting we realised that the organisation neither defined any vision and goals nor monitors their IT-infrastructure in a structured way. Concerning the missing vision or goal statement, I extended the online survey by adding three questions at the end. Regarding the overview, I asked them to first create a Microsoft Excel sheet including all employees, existing PCs and laptops and their allocation to each other. Second, I requested an additional Microsoft Excel sheet stating the different users per device as far as traceable. These two documents were the baseline for the future central overview and monitoring sheet, which we further developed, evaluated and reflected in every action meeting.

4.3.2 Online survey

Both, the online survey and the two post-questionnaires, were implemented with Google Forms and sent via e-mail by Ms E1 to all employees. As the workforce changed due to holidays, educational leave and other reasons not all three forms were filled out by all employees. For instance Mr E12 only participated in the first online survey, but demonstrated through his answers that he is either not motivated to cooperate or work on this topic together. Additionally, I talked with Ms C1 about his reactions and she confirmed, that he doesn't want to participate in our process. Therefore, I accepted his decision believing that action research is only reasonable when all involved are motivated to interact. Furthermore, Ms E4 undertook an internship in July 2015 when the workshop took place and filled out the post-questionnaire. Her answers were very interesting, but I could not conclude any development as for the other employees.

The online survey aimed at clarifying employee's demographic data, used PC or laptop properties, user's satisfaction with current equipment, use-time and presence of vision or goals from Omega Ltd. In total 14 employees participated in the online survey. As some employees use more than one device or share devices, the form was filled out twice leading to 16 answers.

In the following paragraph I will discuss the **main results**.

Q1: "How CPU-intensive do you estimate your current activities or your software currently in use?"

- Very CPU-intensive (4)
- More or less CPU-intensive (4)
- Less CPU-intensive (7)
- Not CPU-intensive at all (1)

As Omega Ltd works with extremely high amounts of data, which need to be copied, extracted or moved, and partly with virtual machines, some laptops have high technical requirements. However, as I discovered later on during the interviews, most tasks are performed remotely on a very powerful and modular server. Thus, laptops are mostly used similar to thin clients and only a few developers need more computing power. Due to this fact, laptops can be exchanged between employees with different requirements. This was then a topic in one of our action meetings.

Q2: "How satisfied are you in general with your PC / laptop?"

- Extremely satisfied (7)
- Very satisfied (6)

- More or less satisfied (2)
- Less satisfied (1)

The majority of employees was extremely or very satisfied with their equipment. This may be due to the fact that most laptops in use were purchased in 2014 and are still as good as new. However, one employee with a laptop from 2014 was only more or less satisfied and thus, I selected him for an interview.

Q3: "Which problems did you have with your current PC / laptop?"

- None (8)
- Speed (4)
- Hardware (3)
- Functionality (1)
- Keyboard due to liquids (1) – open answer 'others'
- Operating system (0)
- Software (0)

The selection possibilities of Q3 and Q4 were created according to frequent problems subsumed into groups. By the open answer 'others', participants had the opportunity to report specific problems. Although some problems existed with PCs or laptops, the interviews revealed that none of them were documented in a structured manner like server problems are handled. Furthermore, solutions can only be difficultly reproduced or supportive for future problem handling. This was part of our discussion in the action meetings.

Q4: "Which problems do you have with your current PC / laptop?"

- None (11)
- Hardware (2)
- Speed (2)
- Functionality (1)
- Power connection (1) – open answer 'others'
- Operating system (0)
- Software (0)

Most of the problems seemed to have been fixed. Besides, at that moment it was unclear, if current problems have already been reported before filling out the online survey. Moreover, some employee's satisfaction didn't seem to be influenced by their reported problems like speed or hardware. I assumed that employees differ in their requirements, practices and individual patience towards their device. Hence, this topic was closely enquired during the interviews. Moreover, we focused in the action meetings on how problems should be treated in the future as they may become a chance to react quicker and improve the work performance for the involved employee.

Q5: "How often does your current system of your PC / laptop crashes?"

- Occasionally (2)
- Rarely (1)
- Very rarely to never (13)

Q6: "How often does your current system of your PC / laptop freezes?"

- Occasionally (4)
- Rarely (1)
- Very rarely to never (11)

I subsumed these two questions as they didn't seem to have any direct influence on the employee's satisfaction. Although, some reported system crashes or freezes occasionally, they were very or extremely satisfied with their device. The only exception constituted the employee, who was less satisfied and who wanted to exchange her laptop within this year. I assumed that system crashes or freezes haven't had severe consequences like data loss and thus, were not perceived as interruptive.

Q7: "Within which period of time do you plan to replace your current PC / laptop?"

- Within the next 1-2 weeks (2)
- Within this year (1)
- Within the next year or later (13)

These results coincided exactly with the satisfaction answered before. One employee shared two laptops and got her first own laptop shortly after filling out the online survey. For this reason I chose her as an interview partner. Another employee was less satisfied with her current laptop and hoped to replace it within this year. Unfortunately, she was not available during the period when I conducted the interviews. All other employees were enough satisfied to use their devices at least until the next year or longer, which was very positive.

Q8: "Have you ever dealt with the topic 'use-time' before?"

- Very intensively (1)
- More or less intensively (4)
- Less intensively (5)
- Not intensively at all (4)

This result showed clearly that the topic 'use-time' hasn't been discussed before within the organisation. No policies or guidelines have been introduced. Except the CEO, all employees have never explicitly dealt with their practices of using PCs or laptops.

Q9: "How important do you perceive the topic 'use-time' in general?"

- Very important (3)
- More or less important (10)
- Not important at all (1)

Only the CEO and two employees perceived the topic 'use-time' as very important. As I haven't introduced and defined the term 'use-time' before passing out the online survey, I assumed that many employees were not confident with the issue and chose a neutral answer. Moreover, I supposed that the social or ecological consequences like 'e-waste' were not immediately linked to the topic. Mr E12, who I already mentioned before, perceived the topic as not important at all and never participated in any workshop or presentation.

At the end of the survey I asked three questions regarding the vision and goals of Omega Ltd and whether they were present or not. The intension behind asking these questions was on the one hand to estimate, if common goals and motivation to work in the same direction existed, although none were explicitly stated. On the other hand, I was wondering whether environmentally conscious aspects were present and more important, if they were somehow lived or transparent to the employees. The importance of having a vision statement comes with its definition of specifying *“the mid-to long-term (three- to ten-year) goals of the organisation. It should be market oriented and should express – often in visionary terms – how the enterprise wants to be perceived by the world”* (Kaplan / Norton 2008, p.40). Moreover, it must be communicated to all people involved in order to be fully aware of it, appreciate it and actually live it mentally as in daily business (Winkel / Dijkstra 2007).

Q10: “Which three main goals pursues Omega Ltd?”

Q11: “Which vision pursues Omega Ltd in your eyes?”

Both were open questions and one of the most mentioned main goals with nine votes was customer satisfaction. Working atmosphere, company growth, quality, automation, product and solution variety, flexibility, efficiency and data security were further reported main goals associated with *Q10*.

Results from *Q11* revealed very divergent views ranging from *“easy usage and processing of large amounts of data through automated processes”* to *“achieving maximal revenue through customer-friendly service and motivating employees additionally by a pleasant working atmosphere”*.

However, I immediately received the feedback from the administrative assistant per e-mail and later on during the interviews, that answering *Q10* and *Q11* was very difficult and challenging. The main goals and vision have never been explicitly discussed or formulated, making it complicated for employees to answer. Moreover, it was perceived like an exam with unknown learning matter.

Q12: “To which aspects does Omega Ltd attach particular importance?”

- Customer satisfaction (8)
- Employee satisfaction (8)
- Accuracy (3)
- Quality (2)
- Integrity (1)
- Resources and environment (1)
- Good situation concerning orders (1)
- Flexibility (1)
- Affability (1)
- Interest in activities (1)
- Simplicity with the highest possible functionality (1)

Similarly, *Q12* was also an open question and related answers were summarised and sorted according to their votes. For instance customer and employee satisfaction were reported in various ways, but could be subsumed to one term respectively. Other terms were listed explicitly to demonstrate the variety of perceived important aspects mentioned.

4.3.3 Lessons learned

According to the data of the online survey, none of the current laptops or PCs, except Mr E12's laptop, has been repaired. Unfortunately, the question was misleading, as I didn't distinguish between the terms 'repair' and 'upgrade'. As I found out later, nearly all laptops have been upgraded by exchanging the integrated hard disks by much faster solid state disks (SSD) in order to use the devices longer. Furthermore, some random access memories (RAM) have been substituted for performance reasons. All these practices haven't been reported as they were not perceived as a repair activity.

When analysing the results of the further use-time, I was on the one hand satisfied with the majority answering 'within the next year or later'. On the other side, it should have been more detailed as it makes an essential difference if an employee is willing to use his or her device one or four years longer. Moreover, questioning the 'desired and expected use-time' was missing. Based on these discoveries, I added these questions to my interview guideline. However, the answers from not interviewed employees are missing at this early stage of investigation.

4.4 Qualitative interviews

Based on the results from the online survey, I applied a modified form of theoretical sampling (see chapter 3.2.1) and selected six employees and the CEO as interview partners over time. The following criteria from the online survey proved to be relevant for choosing my interviewees: early hiring date (e.g. before 2014, profound knowledge about the organisation), internal responsibility (e.g. contact person, management, procurement), IT-equipment in use (e.g. PC or laptop), current or past problems (e.g. system freezes / crashes, hardware difficulties), current satisfaction (e.g. high or low) and requirements (e.g. CPU-intensive work) while working, perceived importance of use-time. I summarised my decision and the values in Table 1.

Employee	Reason for selection	Date of interview
E1	<i>Pilot interview</i>	30/06/2015
E5	<ul style="list-style-type: none">• Early hiring date: 10/10/2013• Used two laptops• Keyboard problems due to unintentionally poured out liquids	01/07/2015
C3	<i>Co-responsible for internal processes (procurement, problems, installation, etc.)</i> <ul style="list-style-type: none">• Early hiring date: 07/04/2010• Hardware problems• More or less satisfied with laptop	08/07/2015
C2	<i>Responsible for internal processes (procurement, problems)</i> <ul style="list-style-type: none">• Early hiring date: 02/08/2010• Used four or more laptops• Does CPU-intensive work	08/07/2015
E3	<ul style="list-style-type: none">• Works on two shared laptops• Gets a new laptop within the next one to two weeks• Speed and functionality problems with one laptop• System occasionally freezes	10/07/2015
E6	<ul style="list-style-type: none">• The only employee using a PC• Speed and hardware problems• System occasionally freezes and rarely crashes	10/07/2015
C1	<i>CEO</i> <ul style="list-style-type: none">• Uses laptop since 2008	14/07/2015

	<ul style="list-style-type: none"> • System occasionally crashes • Perceives use-time as very important 	
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Table 1 - Qualitative interviews

All interviews lasted between 28 and 53 minutes, on average about 38 minutes. Due to the fact that none of the two meeting rooms had doors, the conversations were theoretically audible to every employee. However, this was no limitation as the room structure was part of the informal and open atmosphere within Omega Ltd, to which every employee was used to.

4.4.1 Interview guideline

I developed three different interview guidelines: one for five employees, one for Mr C2 as an overall expert regarding procurement and internal processes, and one for Ms C1 as CEO and head of management.

The employee interview contained the following structure:

- Demographic data: age, highest educational attainment, position within the organisation, used device (PC or laptop), shared device (yes or no)
- Career as an user and practices
- Motivation and reasons for replacement
- Currently used device
- Relevance and PC/laptops as material
- Consumer competences
- Final questions concerning Omega Ltd and environmentally conscious behaviour

After the pilot employee interview and the first transcription, I adapted the guideline accordingly. Some questions had led to very simple answers and were replaced by more narrative impulses. Moreover, I reflected on my interview style and how to better treat pauses.

Based on my first experiences and results, I developed the expert interview guideline by adding questions, which couldn't be answered during the employee interviews before. From my point of view, it was very important to get a profound overview about the internal processes regarding procurement, IT problem management, maintenance, allocation of IT equipment for new and existing employees, use-time practices, existence of documentation and end-of-life possibilities.

However, to complete and expand my knowledge about internal processes, I arranged an interview with Ms C1, the CEO of the organisation. The questions followed the structure below:

- Procurement (selection criteria, supplier)
- IT problem management (contact person, replacement, repair, upgrade)
- Use-time (monitoring, minimum, importance, expected and desired use-time)
- End-of-life (possibilities)
- Final questions concerning Omega Ltd and environmentally conscious behaviour

Before I conducted the interview with Ms C1, I presented the first insights of the online survey to her. Although, I completely anonymised the data, she knows her employees very well and some open answers were still obviously identifiable. After the interview we planned a workshop for all employees summarising the findings and further steps.

4.4.2 Analysis and results

Some codes were coded into more than one sub-theme as they influence various factors and may be present in existing practices, but are also potential for change in the future.

4.4.2.1 Omega Ltd practices

During my interviews it was of great importance to focus on the practices lived by the employees and the management of the organisation. As the organisation has expanded and grown over the last years, they neither had any explicit guidelines or processes defined nor a standardised work environment. Thus, employees behaved differently and some questions were perceived as very difficult to answer.

Omega Ltd general IT practices

Quotation(s): 51

Questions like ‘How and why did you get this specific laptop?’, ‘How do you react in case of problems and who will you inform?’ and ‘May you take part in the decision-making process when you require a new device?’ are summarised within this sub-theme.

“Procurement process”

Ms C1 described the procurement process in the following way: Mr C2 and Mr C3 are asked to search for a new laptop and to give their technical recommendations. Both make one to three suggestions, which also take the price-performance ratio into account (cp. Ms C1, par. 4). Mr C2 added that they had very good experience with procuring online via Amazon (cp. Mr C2, par. 10). Up to now, Mr C2 and C3 have not been briefed to search for green or sustainable devices.

Besides, the fact that laptops are procured online from an international wholesaler, which was lately criticised for poor working conditions, was an interesting topic within the action meetings and discussions.

“IT chosen because of good price-performance ratio” and “no OS pre-installed because of Microsoft partnership”

Most employees argued that the current laptop from Lenovo was mainly chosen because of a good price-performance ratio: *“Lenovo ist meiner Meinung nach gerade das Beste, was Preis / Leistung hat. Weil solche guten Geräte gibt’s normalerweise nirgends”* (cp. Mr E5, par. 73). Either the procurement selection criterion was communicated or Lenovo has achieved this image over the last years. Mr C3 added that Omega Ltd is a Microsoft Partner and therefore, they chose a version of the model without an included operating system, which made it even more low-cost.

“Same criteria for everybody” and “Same laptop based on chosen former model”

Mr C2 explained that they don’t differentiate between developers and administrative assistants, but all employees receive the same powerful and low-cost laptop (cp. Mr C2, par. 28). Thus, devices can be easily exchanged and procured without defining specific criteria. As most of the tasks are performed remotely, all employees have similar low requirements, but may work on a very powerful laptop (cp. Mr E5, par. 56). Due to all these facts, Omega Ltd procures always the newest generation based on the chosen former model. Mr C2 argued that his laptop, bought at the beginning of the year 2014, wasn’t available anymore in 2015 (cp. Mr C2, par. 28). Two employees, except those responsible for procurement, were aware of this practice and knew why they received this specific laptop (cp. Ms E3, par. 28 and Mr E5, par. 54).

“Employee may take part in decision-making”

Although, employees agreed that they probably may take part in the decision-making process, they have never used this possibility: *“Theoretisch könnte ich sicher mitbestimmen, aber ich hab’s nicht gemacht”* (Mr E5, par. 58). Mr C3 argued that in small organisations like Omega Ltd, one may say that he or she needs a new laptop and have the right to choose or express a preference (cp. Mr C3, par. 114). Moreover, employees always have the possibility to install the newest operating system version, if they wish to use it.

“IT was just available”, “IT was at fixed position” and “New user gets new Windows OS”

There exists one practice that was reoccurring through nearly all interviews: When employees started working at Omega Ltd, they received their device because it *“was just available”*. The device was just not in use back then and was not newly procured (cp. Mr E6, par. 70 and Mr C3, par. 16). During the months of my action research process I recognised that this practice has changed, as new employees received a newly procured laptop from Amazon. The old stored devices were apparently not up-to-date to fulfil the current requirements. Another practice that has changed was reported by Mr C3: In the past, devices were at a fixed position and employees changed their places due to tasks and availability (cp. Mr C3, par. 16). Now, everyone has a proper desk and seat.

Last but not least, every time devices are exchanged or allocated to a different user, they are completely formatted and the new Windows version gets installed (cp. Mr E5, par. 79).

“Management and internal contact person in case of problems”

In case of problems or decision-making procedures, employees responded to ask either Ms C1, the CEO, directly or Mr C2 for his support. As there haven’t been many reported problems so far, this scenario and eventual contact persons are not clearly defined (cp. Mr C2, par. 62). Moreover, as a small organisation everyone is working closely together and process definitions haven’t been necessary up to now. This was an important topic within our action meetings and a point for improvement in order to prepare for a growing organisation.

“Test performance after some time” and “Performance for employees counts”

When asking Mr C2 about what will happen after his stated average use-time of two years, he answered that they will test the performance and decide whether it works properly or needs to be upgraded or substituted (cp. Mr C2, par. 108). The performance is especially important to Ms C1, who wants her employees to be satisfied with their work tools. It already starts with the procurement, where performance is a more relevant factor than the price, as labour costs are much higher than a little more expensive device (cp. Ms C1, par. 6). Every other property is ranked behind this aspect (cp. Ms C1, par. 81).

“Old IT stored because of sensitive data on hard drive”

Ms C1 pointed out that most of Omega Ltd’s old IT has been stored in-house, because of their customer’s sensitive data on the hard drive. This fact has mainly prevented them from donating their old equipment, although they used this option once, but retaining the hard drives (cp. Ms C1, par. 102). As the amount of old devices grows, end-of-life possibilities were an important issue within our action meetings.

Omega Ltd use-time practices

Quotation(s): 86

Within the organisation many directly associated (e.g. average use-time), but also non-obvious (e.g. intensity of use) practices concerning the use-time of PCs and laptops exist. It was very appealing, what employees reported and where use-time practices are hidden. Besides, some contradictions occurred.

"Current laptop generation"

At the moment, most employees use a new laptop generation procured in 2014 (cp. Mr C3, par. 48). Purchasing laptops is the new standard, as many employees have customer contact and go on meetings, thus, mobility is very essential (cp. Ms C1, par. 4). As the devices are still as good as new, Ms C1 has not yet developed a feeling for *"the point of replacement"* and the use-time of the current laptop generation. However, she is still willing to try upgrading and repairing in-house, if possible (cp. Ms C1, par. 60).

"Average use-time (Omega Ltd)" and "Pause in use-time"

On average, the employees estimated an average use-time of PCs and laptops of nearly four years. *"Ich würde so fast an die 4, 5 Jahre hin tippen. Aber das ist jetzt wirklich nur ,rein aus dem Bauch heraus",* responded the management (Ms C1, par. 75). In order to give a good estimation, some respondents thought about their hiring date, their past device(s) and by doing so, tried to assess an acceptable value.

However, the data revealed that most interview partners didn't differentiate between the actual time of a device being in the organisation and the effective time of being used. Only one employee reflected upon the difference: *"Ich glaube schon relativ lang, da ich auch alte Geräte verwendet habe. Ich glaub zwar, dass es teilweise eine Pause gibt bei der Nutzung. Das der einmal eine Zeit lang ,umeinander liegt' und wenn wieder wer Neuer kommt, dann bekommt der den. Aber ich schätze, 3-4 Jahre werden die Geräte schon benutzt und ich glaube auch, dass das relativ lang ist"* (Mr E5, par. 151). Unfortunately, I missed to ask into more detail as I haven't noticed the relevance earlier.

"Desired use-time (management)" and "Expected use-time (management)"

The difference between desired and expected use-time was even more interesting, when asking employees, because they are influenced by their private practices. Thus, these results are reported in the section of *'employee's influence'*. Ms C1, the CEO, stated to expect in any case three years and desires five years, which *"would be lovely, if possible"*. However, she was sceptical about the current laptop generation and their durability compared to past models (cp. Ms C1, par. 96-100).

"Use-time important to management" and "single device counts"

All employees (remark: Ms E3 and Mr C3 weren't asked this question) agreed that the use-time is quite important to the management of Omega Ltd. Mr E5 stated, *"Ich glaube schon, dass es wichtig ist. Irgendwann habe ich mit der Ms C1 einmal geredet und sie hat gesagt 'Unsere Geräte werden eh benutzt, bis man sie wirklich kübeln kann' und darum glaube ich schon, dass das wichtig ist für Omega Ltd"* (Mr E5, par. 160). As he was my first contact person of the organisation, he reproduced Ms C1's response when introducing my master thesis topic. It also represented her earlier mentioned scepticism towards my intended improvement possibilities. Within her interview she

underpinned Mr E5's statement by saying, *"Wir sind eigentlich... wir nutzen sehr lange. Das kann man wirklich sagen, ja"* (Ms C1, par. 10).

According to Mr E6, use-time is generally important to any management or organisation, because money and costs always matter. Besides, he cannot think of any other advantages except less cost (cp. Mr E6, par. 136). Ms E1 added ecological reasons like less discarded devices prioritised behind financial ones.

Furthermore, Mr C2 concluded the importance by reporting the following practices: *"Grundsätzlich neue Laptops werden nur gekauft, wenn tatsächlich ein alter kaputt ist oder wenn wir einen neuen Mitarbeiter bekommen. Wirklich Geräte ersetzen, haben wir bis jetzt relativ selten gehabt. Also von wegen weil sie jetzt z.B. 2 Jahre alt sind oder so, das gibt's eigentlich nicht bei uns"* (Mr C2, par. 10). Thus, the depreciation timespan has little influence on the use-time and no device is replaced automatically. Moreover, he told me that the current laptops in use have already been in the organisation for a long time and instead of replacing them, they exchanged for instance the hard drive (cp. Mr C2, par. 124). Although it emphasises the importance to the management, it is rather contradicting to relate a not yet two year old laptop as an organisation's long-time equipment. In practice, the way of treating devices, using them, passing them on and the fact, that not everybody receives a new device on a regular basis, are activities that persuaded Mr E5 of the lived importance to Omega Ltd (cp. Mr E5, par. 219).

Last but not least, Ms C1 confirmed that every single device counts and not any other influences (cp. Ms C1, par. 79).

"Reuse over dispose"

Old devices are often reused by different employees rather than disposed and replaced by a new device. *"Dann wird der ausgegraben und wieder verwendet. Also solche Sachen... so wird der schon immer weiterverwendet [lacht]. Also so richtig entsorgen ... passiert sehr, sehr selten, muss ich sagen"* stated Ms C1 and underpinned the rather rare case of disposal in the past. Moreover, Mr C2 supported the importance of end-of-life possibilities for the future by adding the organisation's growth as a reason (cp. Mr C2, par. 180).

"Try to fix it in-house" and "Try to fix it yourself"

In case of problems or errors, two strategies exist. Mr E5 reported, that most employees firstly try to fix it themselves by searching on the Internet. As most users have high informatics competences, the majority of the problems can be fixed easily (cp. Mr E5, par. 68-70). Secondly, if the self-experiment fails, other employees, probably Mr C2, are being asked for their support (cp. Mr C3, par. 70). Last, if the attempt terminates without success, the laptop will be sent back to the vendor (cp. Mr C2, par. 73). However, Ms C1 particularly emphasised the preference of an in-house repair compared to an external service or shipping (cp. Ms C1, par. 60).

"Willingness to upgrade"

Four employees and the CEO reported some practices regarding past upgrades. Omega Ltd definitely prefers to upgrade (cp. Ms C1, par. 60), especially easy adaptations like the exchange of a hard drive, RAM or the possibilities given by a modular PC to replace the graphic card (cp. Mr C3, par. 24 and par. 104; Mr C2, par. 64). Mr C2 reflected that these actions also improve the performance and prolong the lifespan of a device (cp. Mr C2, par. 190). Next, if the new version of

the operating systems required better technical performance, hardware upgrades would be performed (cp. Mr C2, par. 82-83).

In the past, when Omega Ltd still procured PCs and mobility wasn't that important, they configured some devices manually, which were afterwards easier to upgrade as parts can be better accessed. One or two have been completely renewed over time (cp. Ms C1, par. 47).

On the contrary, Ms C1 reported that they have sometimes reached their limitations in upgrade possibilities, because devices were too old (cp. Ms C1, par. 24-26).

"Device was passed on to another employee", "Oldest device to new employee" and "Pass on to people with less performance requirements"

Practices like *"devices are passed on and exchanged between employees"* were reported by employees working since 2014 or earlier (cp. Mr E5, par. 16 and 44; Mr C2, par. 58-60). Ms E3 has often heard that PCs or laptops are either passed on or stored as a backup (cp. Ms E3, par. 181).

Apart from that, the data revealed a contradiction when it comes to new employees. Mr C2 reported that newer, more powerful laptops are being passed on to new employees (cp. Mr C2, par. 91). However, Mr E5 stated that he once received a better PC and his new colleague was equipped with his old laptop (cp. Mr E5, par. 36). This is probably due to the fact, that the organisation was rather small and had no fixed exchange process (cp. Mr C2, par. 91).

Employees working in the administrative area have less performance requirements and it is distinctly useful to pass older devices from the development to the administration on. This is not only in the interest of the organisation but also regarding the improvement of the use-time. However, Ms C1 admitted that employees from the administration are *"a little worse off"* (cp. Ms C1, par. 62-64).

Beyond, Mr E5 related the importance of passing old devices on and his practices in the private use of PCs and laptops: *"Aber sonst... ist es schade, weil man's natürlich auch für etwas anderes verwenden könnte, wenn's länger halten würde. Es ist ja nicht so, wenn er für mich nicht mehr passt, dann könnte ihn ja wer anders verwenden. Theoretisch könnte man ihn weiterverkaufen und dann würde man die ganzen Ressourcen nicht verschwenden. Das wäre natürlich ein Vorteil, wenn's länger halten, weil es gibt sicher genug Leute, die mit meinem 5 Jahre alten Laptop alles machen können. Ohne irgendwelche Probleme"* (Mr E5, par. 193; further comments: par. 231 and 235).

"Shared IT"

The only employee, who made real shared IT experiences, was Ms E3. She reported that due to different working hours, she has already worked on nearly every PC or laptop. Recently she used only two different laptops shared with Ms E2 and E13. On the day of our interview she received her new installed, proper laptop, because she started working fulltime in October (cp. Ms E3, par. 14-16). Mr E6 stated that, he normally doesn't share his PC, however, he is not working fulltime and if technical problems occurred, he would definitely offer his equipment (cp. Mr E6, par. 20).

"Intensity of use"

As the majority of the employees at Omega Ltd are between 18 and 30, different working models exist. Some are still students and work less hours per week during the semester, but fulltime during the summer holidays (cp. Mr C3, par. 28 and Mr E6, par. 26). Others use their device eight

hours per day, five days a week (cp. Ms E1, par. 16). The intensity of use makes a considerable difference according to the use-time and the state of the device (for further results see section *'differences in practices'*). Thus, this issue was part of our discussions when working on the central monitoring sheet.

"Old IT is stored as backup"

Nearly all employees stated that old PCs and laptops are stored as a backup, if a currently used device brakes, has problems or a colleague doesn't require a powerful one (cp. Ms E3, par. 181; Mr C2, par. 79 and 155; Mr E6, par. 95). Especially all old and sorted out PCs are still stored and, in principle, fully functional (cp. Mr C2, par. 12 and Mr C3, par. 48). Moreover, Ms C1 reported, that even devices with too little technical performance are still stored. These are partly kept because of specific interfaces not available nowadays (cp. Ms C1, par. 28 and 34).

"IT may still be in use"

Although, employees reported the fact, that old IT is mostly stored in-house, they are not sure what exactly happened to their former device after exchanging it. One stated, that it *"may still be in use"* (cp. Mr E5, par. 18, 101, 103). For further results see section *'potential for change'*.

Omega Ltd environmentally conscious practices

Quotation(s): 28

While analysing the status-quo I was wondering, whether employees would rate Omega Ltd as an environmentally conscious organisation and which practices they have observed so far.

"Checklist on door"

All employees, except Ms E1 and Mr E6, mentioned the checklist of *"things to do before you leave the office"*, which is positioned at eye-level on the front door. It is perceived as a sign of environmentally conscious behaviour: *"So schauen wir schon hier und da, dass wir ... umweltbewusst sind. Es hängt auch da draußen auf der Tür auch ein Zettel, was man alles ausschalten muss, bevor man geht. So dass nur das Notwendigste rennt. Drucker ausschalten, Klimaanlage ausschalten und so... Verteiler ausschalten"* (Mr E5, par. 145).

"Turn off and save energy"

This practice is part of the checklist on the door, however, some employees mentioned it without bringing both in relation: *"Mir fällt jetzt eigentlich nur ein, dass wir immer schauen, dass der Strom abgedreht ist und solche Sachen. Also nicht irgendwie Strom verschwenden oder so"* (Mr C2, par. 182).

"Waste recycling"

The second explicitly stated environmentally conscious practice is the possibility to recycle not only waste, but also Tetra-Paks separately. Although, the infrastructure is put in place, some employees don't seem to be used to using it: *"Ich glaube, wir trennen zumindest Müll, was mir so aufgefallen ist. Ich weiß nicht, ob ich das so gut mache [lacht]. Ich glaube, da werde ich demnächst eh eine Rüge bekommen [lacht]"* (Mr C3, par. 145). Another employee observed a similar negative behaviour upon her colleagues.

“Environment important to management”

All employees stated that Omega Ltd is an environmental-friendly organisation and that Ms C1, the CEO, attaches great importance to it. It is because of her, that these practices are in place and carried out: *“Ja, grundsätzlich schon. Das ist der Ms C1 sicher sehr wichtig”* (Mr C2, par. 178). Two employees perceived that Omega Ltd, being a small organisation, is taking more care of the environment than others (cp. Ms E3, par. 209 and Mr E6, par. 200). However, Mr C2 admitted that this green behaviour like energy efficiency and environmental protection hasn't been an important criterion during the procurement process, but this practice will definitely change in the future (cp. Mr C2, par. 36).

When asking the management about her future plans concerning environmentally conscious practices, she added the importance of end-of-life possibilities as the number of devices will rise by further expansion: *“Gerade eben diese Bereiche: kann man sie weitergeben, gibt es Firmen, die sie noch weiterverwenden können und irgendwo weiterverkaufen oder was auch immer. Das sind Dinge, über die ich mir bis jetzt eben noch keine Gedanken gemacht habe. Ist aber allerdings jetzt eigentlich... ist eigentlich der nächste Schritt und sehe ich auch als sehr wichtig an. Und eigentlich... über diesen Weg, kann man ja eigentlich auch wieder sehr viel für die Nachhaltigkeit machen, finde ich, oder?”* (Ms C1, par. 131). Moreover, she has nominated Ms E13 as an environmental officer, who should research about energy efficiency, cost reduction and resource protection possibilities. Due to lack of time she hasn't been able to implement any new concepts or actions so far (cp. Ms C1, par. 124). Besides, she left the organisation with the beginning of September 2015 and in our final reflection meeting Ms C1 mentioned, that she will nominate another interested employee.

Employee's motivation to work at Omega Ltd

Quotation(s): 15

In order to understand the positive and familiar work atmosphere, I was interested in the employee's motivation to work at Omega Ltd and why they applied for this job. Moreover, I wanted to analyse, whether environmentally conscious aspects are motivating.

“Motivated because of colleagues”, “Motivated because of management” and “Motivated because of small organisation”

In general, employees agreed on the fact that the work environment is being positively influenced by the colleagues, who became friends, the management, who is concerned about their satisfaction and infrastructure and the aspect of working in a small organisation, which makes all processes easy and informal (cp. Mr C2, par. 167 and Ms E1, par. 196). One employee told me about his positive job interview with Ms C1, which impressed him very much (cp. Mr E6, par. 188). During my cooperation I discovered exactly the same atmosphere and may confirm the narrations.

“Motivated because of flexibility”

Two employees stated that they appreciate the offered flexibility of working at home and not only during office hours. Both are still students and are more or less dependent on this flexibility, as their time tables may change (cp. Mr E5, par. 202 and Mr E6, par. 190). As a student I can comprehend the necessity of flexible working conditions and the motivation provoked by them.

“Motivated because of varied work” and “Motivated because of work itself”

Mr C2 enjoyed the variety of work, the challenges to learn something new and the continuous professional development involved (cp. Mr C2, par. 167). According to Mr C3 this is due to the small organisation size, that employees are responsible for and may participate in more than one activity. Generally he and Ms E3 liked the treated issues and the work itself as it is very interesting and corresponds to their strengths (cp. Mr C3, par. 125 and Ms E3, par. 195).

Work environment

Quotation(s): 54

During my analysis of the lived practices, it was certainly important to have a closer look at the present work environment and answer how important PCs and laptops are to employees as well as the management.

“IT important as tool” and “IT important to work”

PCs and laptops are the main production tools and therefore considerably important to Omega Ltd. As developers’ and business intelligence consultants’ requirements are higher than in the administration area, Ms C1 cares about their devices’ condition and performance. In order to fulfil the demand she is also willing to equip her employees with new equipment (cp. Ms C1, par. 26 and 133). Mr E5 underpinned the importance by ranking his laptop directly behind his mobile phone and reported that the latter has substituted some functions like writing e-mails. However, he mixed up private and work practices (cp. Mr E5, par. 133).

Throughout the interviews all employees agreed on the importance of IT to perform their daily work properly: *“In der Arbeit ist es unverzichtbar, weil ohne Laptop oder ohne Computer hätte ich keine Arbeit. Von dem her ... natürlich sehr wichtig”* (Mr E6, par. 115).

“Practices supported by IT”

Most of the daily business practices are supported by IT. They reach for most of the employees from writing e-mails, searching the Internet, coordinating dates in Microsoft Outlook and timekeeping in the time-recording system to conference calls with Skype, activities with Microsoft Word / Excel / Project and connecting to the server via remote control (cp. Ms E1, par. 20-26; Mr C3, par. 32-34; Ms E3, par. 20-22). More technical employees mentioned some additional practices like developing data-cubes, databases or internal software solutions, using import-/export tools and coding in development environments (cp. Mr E6, par. 28-30; Mr E5, par. 30). Furthermore, many internal tools to support for instance invoicing and quality management have been developed in-house to optimise processes (cp. Mr C2, par. 136).

“Work remotely” and “No data loss due to auto-save”

The effective computing power and work is performed on the server and employees connect remotely (cp. Ms E3, par. 22; Mr C3, par. 32). Mr E5 reported, that due to the remote work, their requirements are relatively low, nevertheless, they possess very powerful devices (cp. Mr E5, par. 56). He added that the expandability of the server regarding RAM is the most important property, which is apparently given (cp. Mr E5, par. 143).

At the end of our interview, Ms C1 reflected upon the sustainable characteristic of their performed work remotely: *“Wobei eigentlich eine Sache, die, finde ich... die eigentlich auch in diese Richtung geht, ist unsere Arbeit per Remote. Dass wir eigentlich sehr viel auf den Servern arbeiten und dadurch eigentlich auch die Last von den Rechnern nehmen. Und damit haben wir, schon auch wieder einen Schritt eigentlich in diese Richtung indirekt gemacht”* (Ms C1, par. 133).

Moreover, due to the established auto-save function and the fact, that all data should be stored centrally, no information may be lost. Thus, unplanned restarts or system crashes don't face any severe consequences (cp. Mr E6, par. 78).

“Position it aside”, “Use of keyboard”, “Use of monitor” and “Use of mouse”

Within this section, mentioned possibilities to carefully treat PCs or laptops were summarised. Mr E5 related that he had recently poured out a sweet liquid over his laptop, which led to a sticky keyboard. Consequently, he suggested positioning the laptop aside in order to prevent similar occurrences in the future (cp. Mr E5, par. 151).

When asking about used external peripheral devices, the majority answered to use a keyboard, a mouse (cp. Mr E6, par. 44) and a monitor, which is used as a second, bigger display (cp. Ms E3, par. 48). *“Also, es ist auf jeden Fall, er hält auf jeden Fall länger, zumindest von außen, von der Abnutzung her, wenn man immer externe Maus und Tastatur und so hat”*, reflected Mr C3 during our interview upon the importance and positive implications of using external peripheral devices (Mr C3, par. 151).

“Only used at work” and “Use of battery while connected to a power source”

Regarding wear and tear, it makes a considerable difference, if the device is only used at work or is also taken home. Mr C3 summarised this aspect by saying, *“Ein Laptop, der nur da steht im Büro und den ich verwende, wenn ich nur da bin. Und mit angeschlossener Tastatur und Maus... Der schaut dann nach 3 Jahren immer noch neu aus”* (Mr C3, par. 147). As he needs to carry his laptop to customers and partly works from at home, he recognised traces of usage after some time.

A further work environment practice, which became apparent in the data, is the permanently connected laptop to a power source, although, the battery is inserted (cp. Ms E1, par. 114). Mr C3 was uncertain, whether the withdrawal of the modern batteries while plugged in makes any difference (cp. Mr C3, par. 147). One could reason, that it would be more reasonable to use a PC instead of a laptop, however, most employees, regardless their position, need to take their devices to meetings.

“Use of docking station at home” and “Cooling device at home”

Because of past and current problems with his private laptop, Mr C3 uses a cooling device at home. His laptop's graphic chip easily overheats, however, he reported that even the cooling device couldn't help. Moreover, he uses a docking station at home, which connects all external peripheral devices with one plug to his laptop.

All in all, the protection and careful treatment of PCs and laptops were an important topic during our action meetings and based on all these given suggestions, we developed an optimal usage guideline.

4.4.2.2 Differences in practices

I often asked my interview partners to reflect on differences and their perceived reasons for the existence. Although many comments were contradicting, they brought new insights after investigating the variety of arguments.

Differences between individuals and organisations

Quotation(s): 9

Individuals and organisations differ in a variety of aspects. Throughout the interviews, all employees confirmed that these are prevalent and influence the use-time of PCs and laptops.

“Different intensity of use”

One employee argued that business and private devices are used with a different intensity: *“Ich glaube, dass die von einer Privatperson länger ist, weil wenn ich in der Arbeit, unter der Prämisse, dass ich Vollzeit hier arbeite, dann rennt der ja jeden 8 Stunden, 9 Stunden, 10 Stunden oder so etwas. Und zuhause ... komme ich ja auf die Zeit pro Tag definitiv nicht. Also selbst wenn ich ihn exzessiv nütze, denke ich, verwendet keine Privatperson einen Laptop öfter als 3-4 Stunden pro Tag ... Also im Schnitt gerechnet. Das kann ich mir nicht vorstellen. Und von dem her, glaube ich, dass die Lebensdauer zuhause durchaus länger ist, als hier. Oder allgemein in Unternehmen”* (Mr E6, par. 154). As most individuals are also employed at an organisation, they have less time available to use their private device.

“Individuals attach importance to personal requirements” and “Individuals attach importance to up-to-date devices”

In contrast to an organisation, private people attach importance to their individual requirements like appearance, reported two employees (cp. Mr C3, par. 114; Ms E3, par. 151).

Moreover, up-to-date devices may play a more important role to some individuals: *“Ja, weil’s immer irgendeinen neuen Blödsinn gibt, den man haben will [lacht]. Also, ich meine, wenn ich es jetzt mit meiner Freundin vergleiche: Die hat ihren Laptop seit 6 Jahren oder so etwas. Und ich hab in den 6 Jahren schon 3 Laptops gekauft”* (Mr E6, par. 148). This personal importance is overruled by an organisation’s general managerial decisions and strategy. However, the practice that the smaller an organisation, the more influence employees have, has to be investigated into more detail. Mr C3 stated, that people, who buy every second year a new laptop, surely exist, but in his belief, these are just a few (cp. Mr C3, par. 112).

“Individuals buy easier” and “Individuals only need to replace one device”

One employee tried to express the reasons, why individuals buy easier: as soon as they can afford it, they have the opportunity to buy a new device. Thereby, they are not facing any immediate consequences. However, she was uncertain how to articulate the exact differences (cp. Ms E3, par. 151-153). Mr E6 underpinned Ms E3’s comment by explaining the financial implications: As laptops are rather inexpensive nowadays, an individual only needs to buy one new device and thus, is capable of affording the cost more easily. On the contrary, an organisation may have to replace ten devices to treat every employee fairly (cp. Mr E6, par. 152). Furthermore, Mr E5 expressed similar considerations (cp. Mr E5, par. 170).

Differences between organisations

Quotation(s): 16

Most differences were mentioned between big and small organisations. Others were expressing differences based on requirements and industries.

“Big organisations don't ask employees”, “Big organisations procure higher amounts” and “Big organisations exchange higher amounts”

Within big organisations, employees are more limited in their ability to take part in decision-making processes and are not asked to choose a desired device. One reason may be the higher procurement amounts and the entailed cost saving and discount advantages: *“Und bei Firmen wird, glaube ich, eher geschaut, was ist jetzt ein gutes Angebot im Sinne von Masse oder es wird einfach irgendein Modell genommen und davon werden, in größeren Firmen wahrscheinlich, 100/200 gekauft und die werden dann an die Mitarbeiter ausgegeben. Da wird jetzt vielleicht auf den Tätigkeitsbereich vielleicht ein bisschen geschaut, was sind die Anforderungen, aber wahrscheinlich nicht auf den einzelnen Mitarbeiter. Zumindest in großen Firmen”* (Mr C3, par. 114). Another employee argued that he knows big organisations that procure a very high amount of *“odd devices”*, which in his opinion are *“complete nonsense”* (cp. Mr E5, par. 162).

Higher exchange rates were mentioned as a third characteristic of big organisations. These tend to ignore whether a device is still functional and fulfils the user's requirements (cp. Mr E5, par. 170). Next, this practice goes hand in hand with less administrative effort (cp. Mr C3, par. 110).

“Big organisations use devices for a shorter time period” and “Big organisations use devices for a longer time period”

These contradicting statements were mentioned during the interviews. Only one employee argued that big organisations use devices for a shorter time period, reasoning that after the full depreciation, devices become worthless (cp. Mr C3, par. 110). Quite the contrary was observed by Mr E5, who related two examples of big organisations using their devices by far too long. Their employees were comprehensively unsatisfied and unable to perform their work properly. He ranked this behaviour very poorly (cp. Mr E5, par. 162 and 170). Moreover, this even contradicted the previous section of high exchange and procurement rates.

“Small organisations use devices for a longer time period”

Once again, Mr C3 explicitly stated that small organisations use PCs and laptops for a longer time period. By using an extra code, I wanted to draw attention to the fact, that no other employee highlighted this property of small organisations (cp. Mr E3, par. 110).

“Shorter use-time in organisations with production”

According to Mr E5, organisations exchange their PCs and laptops more often, if they interfere in their production area. This equipment is certainly essential to the organisation and responsible for the outcome (cp. Mr E5, par. 170).

“Organisations that need less IT performance, use devices for a longer time period”

Moreover, Mr E5 related that organisations in general have less IT performance requirements and thus, use their devices for a longer time period. Interestingly to note, he added the following: *“Da*

kann man auch einen 5 Jahre alten Laptop arbeiten müssen, wenn es ‚ganz blöd hergeht‘. Und deswegen glaub ich, dass die die so lange haben, bis er kaputt wird... wirklich kaputt wird” (Mr E5, par. 162). His comment may be interpreted as a five-year old laptop is already unacceptable.

“Other organisations use devices for a similar time period” and “Other organisations use devices for a longer time period”

Three employees argued that other organisations use their PCs as well as laptops for a longer time period, without explicitly defining the size or industry of the other organisation (cp. Mr E5, par. 170). Mr E6 related his previous employer, where devices were used *“seven to eight years or even longer”* (cp. Mr E6, par. 142). Another employee explained his experience when having customer contact: *“[...] dann bekomme ich öfter einmal mit, dass das schon ältere Geräte sind, die nicht ganz so leistungsstark sind. Aber das kann natürlich auch Zufall sein. Weil ich da auch nicht mit den Entwicklern Kontakt habe, die wahrscheinlich bessere Geräte haben. Aber grundsätzlich würde ich vermuten, dass es länger ist”* (Mr C2, par. 112).

In contrast, only one employee indicated that other organisations use devices for a similar time period compared to Omega Ltd. However, she was highly uncertain (cp. Ms E3, par. 143).

Differences between PCs and laptops

Quotation(s): 19

Considerable differences between PCs and laptops were made obvious. However, concluding this section, all employees share the opinion, that they now prefer working with a laptop due to its mobility, although it comes with reasonable downsides.

“Laptop gets hot, because components assembled in close proximity” and “Usual wear and tear of laptop is higher”

Mr C3 has made bad experiences with his private laptop concerning heat and its consequences. He reported that components are too closely assembled and the graphic chip is poorly cooled, even though he tried to compensate it by using an external cooling device. Thus, the HDMI interface melted and was broken. By blaming the producers for the close proximity, he admitted, that consumers at the same time demand thinner and lighter devices leading to a field of tension (cp. Mr C3, par. 153). All in all, from his point of view, this leads to a higher wear and tear of laptops (cp. Mr C3, par. 102).

“Prefer laptop over PC due to higher mobility”

Throughout the interviews, employees agreed that they prefer laptops over PCs. Reasons like higher mobility, availability of documents in meetings, possibility to work at home and meanwhile same computing power were mentioned (cp. Mr C2, par. 194-196; Mr E5, par. 196; Ms E3, par. 110; Mr C3, par. 100). According to Ms E3, laptops are the compromise between a PC, which is not portable and a tablet, which is not powerful enough (cp. Ms E3, par. 187). Moreover, she added, that mobility is especially essential to her as she has no proper desk (cp. Ms E3, par. 36).

Although a PC is more modular, Mr E6 doubted that single parts are being exchanged nowadays – a fact that eliminates the only advantage of a PC (cp. Mr E6, par. 182). Mr E5 underpinned this statement by claiming, *“Ich würde mir keinen Stand-PC mehr kaufen, weil ein Laptop muss man wahrscheinlich sowieso schon fast alle 2 Jahre austauschen, sonst ist er alt. Beim Stand-PC genauso.*

Und dann muss man halt alles austauschen und dann kann man gleich einen neuen Laptop auch kaufen” (Mr E5, par. 141).

“Missing upgrade possibilities for laptops”, “PC upgrade easier and cheaper” and “PCs have higher life span than laptops”

As stated above, upgrade possibilities for laptops, except exchanging the hard drive or the memory, are time-intense and complicated. Mr C3 added, that PCs are definitely easier and less expensive to upgrade (cp. Mr C3, par. 80 and 102). Above that, Ms E3 admitted the advantages of modularity, but claimed that *“at the same time, much is lost”* like for instance mobility (Ms E3, par. 112). *“Wir haben teilweise auch Rechner anfänglich zusammengebaut selber... das ist aber schon länger her. Und wir haben auch ... ein oder zwei wirklich runderneuert im Laufe der Zeit. Und das ist schon ein großer Vorteil, ja... das sicher”*, related Ms C1 about past practices (Ms C1, par. 47).

Besides, Mr C3 compared the previous generation of PCs with the current laptops at Omega Ltd. He assumed that the new generation will probably not last for five years like the former PCs did, because laptops are, generally speaking, not as robust (cp. Mr C3, par. 102). Later in the interview, he smilingly added, that PCs are also not as vulnerable as laptops when it comes to poured out sweet liquids. By that he referred to Mr E5’s ‘accident’ (cp. Mr C3, par. 151).

4.4.2.3 Influences on use-time

Within this section, very diverse influences on the use-time are described and grounded with striking comments. The main focus lied upon the employee’s influence and premature replacement reasons.

Changes

Quotation(s): 13

Changes like in working hours or activities may influence the use-time positively or negatively. I asked all employees about their career development within Omega Ltd, their tasks and the associated requirements. These properties were also targeted in our action meetings.

“Change in activities” and “Change in requirements”

Four employees related their development within the organisation and how their tasks have changed over time. Ms E3 started as a data warehouse engineer and is now responsible for project management and administrative activities (cp. Ms E3, par. 8 and 120). Therefore, she uses other tools, which are not that CPU-intensive leading to a lower load of the laptop. In contrast, Mr C3 and Mr E5 changed from solely software development to more customer contact, which requires not least mobility (cp. Mr C3, par. 42; Mr E5, par. 149). By using a laptop outside of the office and on the way, tear and wear are higher and thus, have a negative influence on the use-time. Besides, problems like slowness of a PC may also be perceived less important with different activities. Like Mr E6, who changed from only working remotely to programming, which also sometimes requires him to open more than ten tabs in the browser (cp. Mr E6, par. 123). Through this change he is more bothered by the absent speed and might demand to exchange his PC earlier.

“Change in intensity of use”

If working hours change, the intensity of use adjusts simultaneously. Regarding the use-time it apparently makes a vital difference how many hours per day a device is used. Two employees reported a considerable change in their intensity of use. Ms E3 has increased her working hours

from ten to forty hours per week and becoming full-time employed (cp. Ms E3, par. 124). Moreover, Mr E5 started with twenty hours weekly and expanded by more hours in the office, but also working from at home. He admitted, using his laptop also partly for private issues. These different intensities over the years should be registered and monitored, in order to compare use-times better with each other. A laptop, which has always been used by full-time employees over three years will be in a different condition than a laptop only used between ten and twenty hours weekly over the same period of time. Thus, this was an extension for the central overview and monitoring sheet within our action meetings.

“Change in organisation size”

Both, Ms C1 and Mr C2, reported about the expansion of the organisation and the involved change. Many new colleagues have been employed, new laptops have been procured, but so far processes haven’t been adapted accordingly (cp. Mr C2, par. 14). Ms C1 mentioned, that activities like passing old devices on to other organisations, donating them and assessing which different possibilities exist, haven’t been considered until now. *“Das sind Dinge, über die ich mir bis jetzt eben noch keine Gedanken gemacht habe. Ist aber allerdings jetzt eigentlich... ist eigentlich der nächste Schritt und sehe ich auch als sehr wichtig an. Und eigentlich... über diesen Weg, kann man ja eigentlich auch wieder sehr viel für die Nachhaltigkeit machen, finde ich, oder?”* reflected Ms C1 about the next possible steps, which may also lead to more sustainable practices (Ms C1, par. 131).

Employee's influence

Quotation(s): 102

Employees, especially in small organisations, may directly and indirectly influence a laptop’s or PC’s use-time. Their practices, reactions, estimations, motivation and last, but not least satisfaction is essential to understand and to take into consideration in order to improve a given situation. Mostly, they are affected by their experiences made in the past.

“Average use-time (employee)”

Compared to the business sector, employees reported different average use-times regarding private persons. Answers reached from *“up to two years”* to *“four to five years”* throughout the interviews and various reasons were mentioned. Mr C2 differentiated between people, who only use the Internet and an e-mail programme and those, who use their laptop for programming and gaming. According to him, latter use for a shorter period of time, but concluded with an average use-time of two years like in organisations (cp. Mr C2, par. 114-116). Later on, during our action meetings, he developed a different opinion and admitted that a longer use-time is definitely possible. Mr E6 agreed that in IT interested people replace more often, as there is always a new attractive gadget available (cp. Mr E6, par. 146 - 148).

Furthermore, Mr E5 stated, that private persons use their devices shorter than organisations due to lack of competences how to repair or upgrade by themselves (cp. Mr E5, par. 168). Ms E1 reported a much longer average use-time of four to five years as she thought of her boyfriend already having his PC for about ten years (cp. Ms E1, par. 167).

The data revealed an interesting aspect, namely that nearly all employees rated the average use-time practices of private people shorter than or as long as in organisations. This may be due to their personal or friend’s habits like gaming, which requires a higher computing performance or

related to their experiences with organisations that use too long in their perception. Thus, it was of considerable importance to show and elaborate possibilities to prolong the use-time and simultaneously improve and/or maintain the device's performance.

"Desired use-time (employee)" and "Expected use-time (employee)"

When asking about the use-time, I was very interested in the difference between desired and expected use-time. Furthermore, I was wondering whether the expected use-time is always lower than the desired one on the part of employees.

The expected use-time coincided more or less with the stated average use-time per employee and thus, reached from two to five years. Ms E3 related her changed requirements and expectations over the last years: *"3 Jahre schätze ich einmal, auf jeden Fall. [Pause] Mindestens 2 ohne das etwas sein sollte, etwas Gröberes... 3-4 Jahre sollte er schon laufen, zumindest. War aber auch einmal anders, die Ansprüche".* When asking in what direction her behaviour changed, she responded: *"Eher auf längere Zeit. Früher war es mir nicht so wichtig, dass er lange funktioniert. Da wollte man immer etwas Neues haben, aber jetzt will man ...eher länger etwas haben und eine Ruhe damit haben"* (Ms E3, par. 161-165). In her opinion, using a device longer includes less change and less effort needed.

Moreover, from Mr E5's point of view, a laptop demands maintenance after two years: Either you let it repair or you substitute it: *"Und bei mir wird's dann so sein, dass ich ihn austausche und den alten meinen Eltern gebe oder so etwas"* (Mr E5, par. 235).

Not like initially expected, some answers regarding the desired use-time sometimes coincided with the expected one. *"Also ich muss sagen, mit den 2 Jahren bin ich relativ zufrieden. [Pause] Aber ja, ich meine, 3 Jahre wären natürlich gut. Ja, ist immer schwer zu sagen"*, stated Mr E6 and thereby admitted, that he is relatively satisfied with two years of use-time (Mr E6, par. 160). Additionally, Mr C2 responded, *"Das ist schwer zu sagen, weil's meistens so ist, dass man dann sowieso ein besseres, stärkeres Gerät verwenden möchte. Aber grundsätzlich wären natürlich 3 Jahre oder noch länger schon wünschenswert"* (Mr C2, par. 151). Both agreed that the current system of exchanging devices after a certainly short period of time is acceptable and leads to having more powerful PCs or laptops in use. Thus, the main focus of the common workshop was on the impacts and consequences of the resulting electronic waste.

Besides, Mr E5 reflected more differentiated about the desired use-time: *"So lange es geht, im Endeffekt. Aber... Ich glaub schon, dass man Laptops machen kann, die nicht kaputt werden. Aber die kosten dann wahrscheinlich auch enorm viel. Von daher ist es schwierig zu sagen. [Pause] Vor allem bei Laptops, die werden halt langsam, die Programme entwickeln sich weiter, deshalb.... Am besten wär's, wenn er 4 Jahre... naja wenn er 4 Jahre geht, passt's eh schon, dass er nicht kaputt wird. Das ist wahrscheinlich eh der seltenste Fall, da muss man schon irgendwann einmal etwas reparieren. [Pause] Im Endeffekt passt's eh"* (Mr E5, par. 177). Interestingly enough, he believed in the possibility to produce IT that doesn't break or may be repaired properly. The related higher costs raised would evidently pay off, if price policies were differently designed. However, while answering my question he qualified his initial desire by adding that four years are somehow acceptable in the end.

“Further use-time”

Unfortunately, I only asked two employees about their further use-time of the current device in use. Both agreed, that at least one more year and if it continues to work properly even longer (cp. Mr E5, par. 110; Mr C3, par. 74). Mr E5 possesses his laptop since December 2014 and Mr C3 since January 2014.

As Mr C3 was part of the core group performing the iterative action meetings, we had intensive discussions about further use-times and how to motivate colleagues to improve them.

“Experience”

While talking about use-time / life span and the employee’s estimations, I additionally asked about their reasons and experiences made. The collected answers varied considerably and gave interesting insights. Mr C3 argued that due to his experience, private persons either buy any offer or ask their competent friends (cp. Mr C3, par. 114). They are lacking of competences and if they don’t have the opportunity to ask a skilled person, they often let prices decide and buy poorly produced devices, which consequently have a lower life span.

Moreover, Mr E6 mentioned that he has only made good experiences with the durability of his past laptops (cp. Mr E6, par. 117). However, as I have quoted before, Mr E6 only expects two years as an acceptable use-time and exchanged his private laptop three times in six years. These facts qualify his statement concerning experiences made.

On the contrary, Mr C2 has experienced that his private laptops broke partly very quickly (cp. Mr C2, par. 144). To explain this perception, he related the following story: *“Es war so, dass ich meinen Laptop schon zweimal eingeschickt habe, dann habe ich ihn wieder zurückbekommen, dann ist er innerhalb von ... kürzester Zeit, also weniger als einem Monat, wieder kaputt geworden und dann habe ich ihn wieder eingeschickt. Und dann hat irgendwann der Verkäufer, das war in diesem Fall der Amarkt, gesagt, Wir geben euch eine Gutschrift und kauft euch ein neues Gerät, das macht keinen Sinn mehr’. Da einfach die Reparatur so lange dauert, dass der Mediamarkt im Endeffekt entschieden hat, dass das jetzt nicht mehr repariert wird. Das ist eben aber jetzt meine private Erfahrung. In der Arbeit habe ich das eigentlich noch nicht gehabt, irgendwie ... eine Reparatur oder so”* (Mr C2, par. 147). In his case, the vendor decided to not continue repairing his broken laptop anymore, which is definitely a step in the wrong direction. He argued that even in normal use, the devices break after a certain time span (cp. Mr C2, par. 188).

“General interest in use-time”

I was interested, whether a general interest and motivation regarding the topic ‘use-time’ existed or not. Two employees, Ms E1 and Mr E5, responded that they don’t attach a high importance to the issue, but rate it as generally interesting (cp. Ms E1, par. 147; Mr E5, par. 158). One of the core group members, Mr C3, stated, *“Ja, grundsätzlich bin ich schon interessiert. [lange Pause] Keine Ahnung [schmunzelt]. Es ist schon ein interessantes Thema, aber man beschäftigt sich halt jetzt nicht so jeden Tag damit. Aber so ein bisschen am Rande, so dass man sich einmal damit beschäftigt, ist glaube ich, nicht so schlecht”* (Mr C3, par. 108). He indirectly addressed the problem of the topic ‘use-time’, namely of being treated marginally with little importance in an organisation, but also in general. The present consumption system promotes quick replacements by offering attractive and low-cost options. Keeping a laptop for a longer period of time is mostly perceived as time- and

cost-intensive, but also as a waiver of up-to-date technology. Consequently, these topics were important parts of our discussions in the action meetings.

"If it works, it works" and "Already use as long as possible"

Three employees stated that they don't intend to replace a device as long as it is working properly (cp. Mr C3, par. 120). Ms C1 explained that after her last upgrade, she is actually very satisfied and asked, why she should change that (cp. Ms C1, par. 41). Next, Mr E5 justified his motivation to keep using a device by stating the following: *"Naja ich glaube das ist meine Grundeinstellung eben. Ich schmeiße nichts weg, was noch funktioniert, weil das kann man noch verwenden. Wenn ich ihn austauschen muss aus irgendeinem Grund, dann schau ich auch, dass ich ihn irgendjemand anderen weitergebe oder so etwas. Das ist irgendwie meine Grundeinstellung, etwas Funktionierendes nicht wegschmeißt und dass man das so lange benutzt, wie lang es noch geht"* (Mr E5, par. 231). Even if he cannot use it anymore, he tries to avoid disposal by passing his old, but functional device on. Thereby, the still working device receives a new owner and the use-time is prolonged.

Interestingly enough, the same employee responded that he already uses his device as long as possible and therefore, doesn't need any motivation to use it longer (cp. Mr E5, par. 229). Ms E1 added that she couldn't change any practice, which would prolong her laptop's use-time. Through our workshop and final presentation we were able to demonstrate colleagues which improvements are nevertheless possible.

"Consumer's responsibility", "Important how you use it", "Take care" and "General motivation, because organisation's property"

Throughout the interviews, employees agreed that it is within the consumer's responsibility to carefully use their devices. Many argued that consumers are moreover responsible for the short use-time through their practices, usage and decisions: *"Ich denke, dass es immer beim Kunden irgendwo liegt, weil... Wenn man halt das Billigste vom Billigsten kauft, kann man es halt auch wiederum nicht unbedingt dem Hersteller zuschieben, wenn's dann halt natürlich eine kürzere Nutzungsdauer hat, als irgendwelche anderen Laptops. [Pause] Und ja ... Wie man dann den Computer an sich nutzt und was man installiert oder wie man ihn behandelt, ist dann in meinen Augen die Letztverantwortung beim Kunden"* (Mr E6, par. 208). Furthermore, in Mr E5's opinion consumers don't take enough care of their devices, cause them to break after two years and thus, it makes no sense to produce laptops that last for four years. It is the consumer's fault that the system has developed in this direction (cp. Mr E5, par. 225). Additionally, Ms C1 confirmed that, *"Letztendlich das 'Klick' müsste beim Nutzer kommen, weil dann muss sich der Hersteller ja auch wieder entsprechend ausrichten"* (Ms C1, par. 129). Through a different demand, the supply will have to react.

A general motivation to take care comes with the fact of using an organisation's property, which you don't own (cp. Mr C3, par. 151). Mr E6 argued differently, by stating to treat the organisation's laptop as if it was your own and your private belonging (cp. Mr E6, par. 180).

Within Omega Ltd Ms C1 has trusted her employees that they treat their devices correctly (cp. Ms C1, par. 84). However, we discussed in the action meetings that it may be of vital importance to define explicitly some guidelines, especially for new employees. The difference comes with the format of being written down and communicated.

“Negative motivation”

Another possible motivation would be the inverse: Employees receive a ‘punishment’, when they constantly destroy an organisation’s property like a mouse or keyboard. However, Mr C3 immediately reflected that this practice is likely not to occur (cp. Mr C3, par. 151).

“Environmentally conscious person”

Only one employee, Mr E5, definitely considered himself as an environmentally conscious person and argued that as a scout he cares especially about waste and correct disposal: *“Das ist mir eigentlich am Wichtigsten: So dass die Natur die Natur bleibt und da nicht zu viel verschwendet wird. Und ja, sonst ... bisschen darauf achten, was man kauft. Wenn etwas dreimal eingepackt ist, dann kauf ich’s vielleicht nicht. Oder eine Banane muss auch nicht in Alufolie eingepackt sein. Solche Sache. Da schau ich dann schon auch eher, dass... aber auch nicht immer. Ich bin ja auch nur ein Mensch [lacht]”* (Mr E5, par. 210). Being lazy as a human being is hereby rated as an excuse, which one could laugh about.

The next two employees ranked themselves as more or less environmentally conscious. Ms E1 mentioned separating waste, collecting old mobile phones in the red bag and using things as long as possible (cp. Ms E1, par. 202-204). Additionally, Mr C3 admitted to use his car daily on his way to work, which he knows to be not environmental friendly, but apart from that tries to choose the sustainable option when having a choice. Even if the environmental friendly printer paper costs more, he makes a green decision, although, he described his practices as not excessively strictly matching. In his opinion, the small activities like turning unused equipment off and saving energy are those that count (cp. Mr C3, par. 139-143).

Last, the remaining three employees have rated them as “not really” environmentally conscious persons. When asking them about their practices or important topics, Ms E4 stated, *“Beispielsweise möchte ich nicht lauter Plastikflaschen kaufen und wegwerfen, die ich jedes Mal... Ich möchte lieber Sachen haben, die ich wiederverwenden kann. Einfach weil es auch vom Müll für zuhause weniger ist, das ist auch eigentlich sehr praktisch. [Pause] Und ja, vielleicht nicht so viel Strom verschwenden. Also ... diese typischen Sachen, auf die jeder irgendwie achtet, aber nichts Besonderes”* (Ms E4, par. 205). From her point of view, these practices are not enough to reach the status of an environmentally conscious person. Mr C2 argued that these activities are targeted by the common sense and should be relatively standard for everybody (cp. Mr C2, par. 176). Above all, Mr E6 mentioned, that he purchases organic food, if that counts within this section.

When having a look at people’s practices in the supermarket, in public areas or in the woods, these mentioned practices don’t seem to be common sense. Thus, I assume that my interview partners either underrated their efforts or thought that only use-time associated activities count. Most of them smiled when answering the question, giving me the impression that they feel by some means embarrassed.

“IT important as computer scientist” and “No specific relation to device”

Two contradicting comments were mentioned during three interviews. Two computer scientists explained why they attach high importance to an IT device. Ms E3 argued, *“Als Techniker ist man eben... Oft hat man eine sehr nahe Beziehung zum Computer”* (Ms E3, par. 108). Moreover, Mr E5 related his private practices like gaming, watching movies or series and added, *“Eigentlich, wenn*

ich wohin komme, wenn ich nachhause komme, rennt immer mein Laptop, wenn ich in der Arbeit bin, rennt immer mein Laptop. [Pause] Ich bin halt ein Informatiker [lacht]" (Mr E5, par. 131).

On the contrary, Mr C2 mentioned to have no specific relation to his laptop. Although, I emphasised that this is a general question and not associated with his current laptop, I am uncertain how to interpret his answer as it was unclearly expressed: *"Also wie gesagt, ich hab jetzt keinen speziellen Bezug auf das eine Gerät. Wenn's ein anderer wäre, wär's mir genauso recht. [...] Aber sonst, habe ich eigentlich keinen speziellen Bezug zu dem Gerät" (Mr C2, par. 100).*

"Satisfaction, "No desire to replace" and "Repeat decision of choosing the same device"

All interview partners seem to be satisfied with their equipment to a greater or lesser extent and have no desire to replace their current device. Already mentioned problems or weaknesses like a poor WLAN reception influence the employee's satisfaction, however, not (yet) to a considerable degree. Mr C3 stated, *"Es gibt sicher Laptops, die ich lieber hätte, als den, aber ich bin jetzt zufrieden. Ich sage jetzt nicht unbedingt 'Ich mag den nicht mehr haben und will jetzt einen anderen haben' oder so. [Pause] Im Prinzip macht man eh mit allen das Gleiche. Höchstens er schaut ein bisschen anders aus oder so. Ich glaube nicht, dass es da irgendwelche speziellen Sachen gibt, die ein anderer kann, die der nicht kann" (Mr C3, par. 92).* In contrast, Mr E5 reported, that his current laptop is the best he has ever had (cp. Mr E5, par. 56).

The general satisfaction may also be influenced by the fact, that we were talking about a laptop used at work and thus, individual requirements move to the background. Mr E6, who related to replace his private laptop more or less every two years, explained, *"Ich kann mich nicht beklagen [lacht]. Für einen Arbeitsrechner, dafür was ich brauche, völlig ausreichend. [Pause] Allerhöchstens... nicht einmal das, nein also. Ich hab absolut keine Probleme. Wie gesagt, in der Früh muss man ihm ein bisschen warten bis er hochgefahren ist ...Muss man ihm ein bisschen seine Zeit geben" (Mr E6, par. 72).* As we later found out during our action meetings, he has never reported his current PC's slowness to the management.

When asking whether they would repeat their decision of choosing their current device, all agreed. As Mr E6 didn't have the possibility to choose his current PC, he had to laugh at my question (cp. Mr E6, par. 119). Apart from that, Mr C3 argued that although it has some weaknesses, he would repeat his decision due to the excellent price-performance ratio (cp. Mr C3, par. 94).

Without a doubt, the price-performance ratio is an important criterion, but was enhanced by technical and sustainable criteria during our action meetings.

End-of-life possibilities

Quotation(s): 11

During the interviews, I wanted not only to analyse the beginning of a product lifecycle, but also the withdrawal of old devices from the organisation and of which practices employees think about. It should be noted, that laptops or PCs leaving the organisation may follow two directions: either being passed on to a new user, which prolongs the overall use-time or being considered as waste, which at best can be transformed into a resource by recycling.

“Donate old IT”, “Pass old IT on” and “Sell old IT”

Mr E6 preferred donating old devices, if they are in an acceptable condition (cp. Mr E6, par. 166 and 210). Additionally, Ms C1 added that she is also in favour of donating, however, the organisation faces the problem of having sensitive data on the hard drives. Once they donated some old devices to a Hungarian organisation, but kept the hard drives, which are now still stored in the office (cp. Ms C1, par. 102 and 106).

Two other employees related their practices of passing old devices on to somebody in order to prevent the disposal of a still functional laptop or PC. Mr E5 explained, *“Wenn ich ihn austauschen muss aus irgendeinem Grund, dann schau ich auch, dass ich ihn irgendjemand anderen weitergebe oder so etwas. Das ist irgendwie meine Grundeinstellung, etwas Funktionierendes nicht wegschmeißt und dass man das so lange benutzt, wie lang es noch geht”* (Mr E5, par. 231). Furthermore, Mr C2 first stated, *“Ja, man kann’s wahrscheinlich weiter verkaufen, wenn man es dementsprechend ... formatiert hat. [Pause] Sonst ... fällt mir jetzt eigentlich grad gar nichts ein”*. After asking which possibility Omega Ltd should favour, he adapted his opinion and added, *“Ich würde mir natürlich wünschen, dass es weitergegeben wird. Es muss nicht unbedingt verkauft werden, wenn’s noch funktionstüchtig ist. Es wäre auf jeden Fall der Entsorgung vorzuziehen, dass man das Gerät weitergibt”* (Mr C2, par. 157 - 159).

Lastly, Ms C1 once enquired whether the possibility of selling an old device pays off, but discovered that particularly old laptops or PCs are only worth twenty euros or even less (cp. Ms C1, par. 102).

In general, the data indicated, that all respondents would desire a sustainable practice within the organisation and thus, ‘end-of-life’ was an important topic within our action meetings.

“Correct disposal” and “Recycling of resources after end-of-life”

If an old device is either not functional anymore or doesn’t fulfil the minimal requirements, it has to be disposed. In this case, Ms E3 desired, *“Dass sie korrekt entsorgt werden, was auch immer das sein mag”* (Ms E3, par. 185). In contrast, Mr E5 seemed to care more about the exact process and explained, why recycling is very important from his point of view: *“Und deswegen ist es extrem wichtig, dass man zumindest recycelt. Irgendwann muss man einen Laptop wegschmeißen, das ist klar, aber man kann die ganzen Ressourcen recyceln und wiederverwenden. Das ist das Wichtigste, glaub ich, und deswegen ist es wichtig, dass man schon ein bisschen schaut”* (Mr E5, par. 239).

During the workshop, I presented some problems regarding dismantling and recycling in developing countries in order to underpin the preference of prolonging the use-time instead of only trusting in recycling.

Repair / upgrade

Quotation(s): 17

Within our current system and price policy, many new devices are as expensive as or even cheaper than repair or upgrade services. This is mainly due to exploitation of work force, resources and the assembly of poor materials. Thus, I was interested, under which circumstances employees or managers prefer to repair or upgrade.

“Expected life span after repair” and “If repair / upgrade pays off”

Ms E3 made a very interesting comment: *“Weil Reparaturen teilweise auch sehr teuer sind und dann eben die Lebensdauer bis das Nächste kaputt ist, nicht mehr so hoch ist, wie bei einem Neuen, wo man ein bisschen mehr investiert”* (Ms E3, par. 173). She addressed the expected life span after repair, which cannot be guaranteed by anyone. Moreover, Mr C3 compared this situation with the repair of a car: *“Stimmt, das kommt eigentlich auch noch... Weil wenn man repariert und repariert und nach einem Jahr ist er wieder kaputt... Das ist wie mit dem Auto”* (Mr C3, par. 118). Additionally, Ms C1 underpinned the previous comments by pointing out the fragile parts of a laptop nowadays and the problem of availability during or after repair. As laptops and PCs are the main working tools for Omega Ltd, they must continuously work properly and be available when needed (cp. Ms C1, par. 26).

Even more importantly ranked, was the aspect of a repair’s or upgrade’s profitability. However, employees and managers mentioned different facets. Whereas, Mr E5 stated, *“Wenn es sich auszahlt, wenn es billiger ist, als einen neuen zu kaufen, würden wir ihn wahrscheinlich sicher reparieren lassen”* (Mr E5, par. 116), Mr C2 made it also dependent from how time-critical the situation is (cp. Mr C2, par. 79). Next, Mr E6 argued that the exchange of low-cost parts pays off compared to a mainboard for instance, which is more difficult to access and thus, requires a more time-intensive repair (cp. Mr E6, par. 101).

In contrast, Ms C1 as the CEO and manager had a more precise idea of the profitability: *“Ich würde sagen... also wenn es mehr ist, als ein Viertel vom Einkaufspreis, dann ... dann zahlt es sich auf gar keinen Fall mehr aus. Du darfst ja nicht vergessen, jetzt musst du es dann... Verschicken musst du es meistens, weil du musst es direkt zum Hersteller bringen. Geschäfte nehmen es ja überhaupt fast nicht mehr, außer eben in der Gewährleistungszeit gerade noch mit ‚Hängen und Würgen‘, nicht einmal immer. [...] Gut, das heißt du hast den Versand, du musst das alles verpacken, musst das in Evidenz halten, kommt das Ding auch wieder zurück, nachhaken, weil es ist nicht immer... von selber kommt da auch oft einmal nichts und so weiter. Also da ist ein immenser administrativer Aufwand, den du noch zusätzlich hast ... zu den Kosten. Und darum... ist da nicht viel Spielraum”* (Ms C1, par. 37). Repair and upgrades produce a considerable amount of overhead costs, which are often not taken into consideration, even if a device is still under guarantee.

Due to all these comments, we devoted many research and discussion time to ‘repair possibilities in Vienna’ during our action meetings.

“Battery exchangeable”, “Exchange fan” and “SSD against slowness”

When asking about concrete practices regarding repair or upgrade, three possibilities were mentioned throughout the interviews. First, having the chance to substitute a laptop’s battery and thus, increase its mobility (cp. Mr C3, par. 84-86; Mr E5, par. 85-87).

Mr E5 argued, that if his laptop would become noisier, he would request to exchange the fan, if still possible nowadays (Mr E5, par. 112).

Third, two employees reported about past upgrades within Omega Ltd to act against slowness: the substitution of the conventional hard drive by a faster and more powerful SSD (cp. Mr C3, par. 46; Mr C2, par. 24 and 64). Mr C3 added that mainly all programmers’ laptops or PCs, who require a good computing performance, were upgraded (cp. Mr C3, par. 26).

External influencing factors

Quotation(s): 23

Especially when asking for the reasons of a shorter use-time, additional external factors were mentioned. All interview partners had the impression to be unable to change or influence them properly.

“Depreciation” and “Government's responsibility”

The financial depreciation has a considerable influence on the use-time. Ms C1 reported that most laptops and PCs in Omega Ltd are generally depreciated over three years. From the tax consultant's point of view it would be recommendable to invest in a new device after the depreciation period. However, Ms C1 cares more about the environmental and sustainable side of the coin (cp. Ms C1, par. 45 and 79). Last, the depreciation influences the decision whether a necessary repair or upgrade still pays off (cp. Ms C1, par. 37). During the final reflection meeting we discussed the impacts more in detail and the government's possibilities to promote and financially support a longer depreciation period.

According to Mr E5, the government is likewise responsible for the current system and should ensure that producers are not allowed to manufacture poorly assembled devices with low life expectancies. He was the only employee to mention the government's impact and responsibility concerning short use-times. However, he mentioned to have completely lost faith in the politicians of today (cp. Mr E5, par. 227).

“ISO certification”

Omega Ltd planned to certify their processes according to ISO 27001, which requires them to secure their laptops' and PCs' hard drives. Microsoft Windows offers for instance the BitLocker tool. Ms C1 stated that she has already talked to Mr C2 and the certification's requirements may be a reason to replace some selective, older devices earlier, if they don't support this functionality (cp. Ms C1, par. 79-81).

“Life span”

Throughout the interviews, all agreed that the life span of a laptop or PC is definitely higher than the actual use-time. Mr C3 estimated at least five years and afterwards added the following: *“Und Lebensdauer wahrscheinlich mit reparieren und so, 5 Jahre. Also so circa. [Pause] Ohne jetzt eine spezielle Erfahrung darin zu haben. Ich glaube, das kommt relativ gut hin. Oder vielleicht 6 Jahre Lebensdauer, ich weiß es nicht”* (Mr C3, par. 116-118).

Furthermore, Ms E3's answer is comparable, but more reflected in the sense of influencing requirements and conditions: *“Das kommt auf die Situation darauf an. Ich glaube, wenn jemand einen gewissen Leistungsstandard hat, der erfüllt werden muss, kann der sicher für 3... ja 4 Jahre so etwas erfüllt werden. Generell funktionieren kann er wahrscheinlich länger”* (Ms E3, par. 157). Her comment transpires that the life span is in truth very dependent on user's decisions. Similarly, but slightly more negative, Mr E5 stated, *“Wenn's einem egal ist, wie schnell er ist, dann 4 Jahre. Wenn man halt immer am Stand der Technik sein will, wenigstens ungefähr, dann eher nur 2 Jahre”* (Mr E5, par. 172). When asking, if a laptop or a PC is broken after four years, he confirmed, *“Da geht er gar nicht mehr”* (Mr E5, par. 174).

Apart from that, Ms C1 has recognised that past devices lasted longer than the new ones and were about ten years operative (cp. Ms C1, par. 87). By contrast, Mr C2 has observed a different development: *“[...] und meiner Erfahrung nach, halten z.B. Laptops jetzt auch wieder länger, als noch vor ein paar Jahren. Da habe ich einfach privat die Erfahrung gemacht, dass doch mehrere Geräte früher kaputt gegangen sind”* (Mr C2, par. 209).

Regarding all these comments, life span may be to a high degree a subjective issue (e.g. people with less requirements would consider the same device as still functional), which is perceived and treated differently in practice.

“Producer’s responsibility”

All interview partners, except one employee, mentioned the producer to be equally responsible for the bad life expectancies and consequently, the short use-times. The general argument that if the user takes care of his device and nevertheless it brakes, must be intended by the producer: *“Wenn man vorsichtig damit umgeht und nur ... für Office Anwendungen benutzt, dann wird es wahrscheinlich nicht am Benutzer liegen ... wenn etwas kaputt wird. Und da ist es nicht dessen Verantwortung, sondern... Ich glaube eher Richtung Hersteller”* (Ms E3, par. 175).

Moreover, the producer is in charge of the close assembly of components, their poor cooling and the related heat problems. According to Mr C3, the producer may be able to change these conditions (cp. Mr C3, par. 153).

Although, Mr E5 admitted earlier that the user is to blame for the current system, he underpinned that the producer is able to change the system. Greater pressure should be exerted on the producers on the part of the organisations using their devices. In his opinion, the poor life span is intended (cp. Mr E5, par. 223-225).

As later on discovered, many employees feel powerless to influence the producers. Thus, this was an important topic within our final presentation.

Influencing problems

Quotation(s): 17

Past or current problems influence on the one hand the user’s satisfaction, but on the other hand also a device’s performance in the long run. Therefore, I asked all employees about occurrences and their reactive practices.

“Slow, but still ok” and “Slower due to large data amount”

Two interview partners perceived their laptop as slow, but still functional and useable (cp. Ms E1, par. 92). However, Ms E3 admitted that her daily work was negatively influenced by slowness, when she was working with Ms E2’s shared laptop and demonstrated the following procedure: *“Der ist nämlich schon ein bisschen älter und auch dementsprechend langsamer. Das heißt, wenn man sich in der Früh hinsetzt, dauert es schon einmal 10 Minuten fast, bis der PC wieder hochgefahren ist. Wenn man etwas öffnen möchte, dann wartet man auch ein bisschen... Also man hat einfach diese Wartezeiten ... und teilweise eben Abstürze oder er hängt sich einmal auf... passiert halt ab und zu”* (Ms E3, par. 52). Thus, Ms E2 responded in the online survey with the wish to replace her laptop within this year. Ms E3 has now a proper laptop and is not facing these

problems anymore. After all, this is a significant example of a problem influencing the use-time of a certain device.

Moreover, E6 reflected upon a laptop's or PC's performance development over the years. He argued that you may recognise how the system becomes slower due to large amount of data on the hard drive, even if you delete and sort out data regularly. Above that, many unnecessary software tools weaken the device's system (cp. Mr E6, par. 176).

To address these problems we discussed maintenance processes within the iterative action meetings.

"Problem with battery / earphone interface / peripheral interface / software / system / WLAN"

All five employees, except the expert Mr C2, related past or currently prevailing problems. Mr C3 recognised that his laptop's battery has become worse recently, but was uncertain, if it was his fault and he hadn't taken enough care of it (cp. Mr C3, par. 82). Next, Mr E5 mentioned a Lenovo specific earphone interface, which makes it impossible for him to use his normal earphones. The website states that a converter is necessary, but it was not delivered with the laptop. Additional, it was him, who accidentally poured out a sweet liquid over his laptop and thus, he needs to deal with a sticky keyboard: *"Und nach 1000 Schlägen ist es anscheinend wieder normal. Das werde ich abwarten"* (Mr E5, par. 69). Although, Mr C3 is generally satisfied with his laptop, he is bothered by the touchpad having no proper mouse buttons.

Concerning software problems, Mr C3 related the following: *"Irgendwann ist einmal irgendetwas nicht mehr gegangen. Ich glaube, Skype, ist einfach so für ein Monat lang nicht gegangen und dann ist es auf einmal wieder gegangen. Aber ich glaube, das war eher eine Software-Schwierigkeit"* (Mr C3, par. 64). Throughout the interviews, it became apparent that all employees tend to wait, if a certain problem disappears on its own. Some are even accepted and rated as *"okay"*. More severe problems are reported to Mr C2 or Ms C1.

As I have already mentioned in earlier chapters, Ms E3 and Mr E6 reported problems with their system, which occasionally freezes or crashes (cp. Ms E3, par. 52; Mr E6, par. 76).

In general, a reoccurring problem seemed to be either the WLAN reception, the installed software or the driver. When using the built-in WLAN and afterwards inserting the Ethernet cable, the network connection fails: *"Man könnte das wahrscheinlich selber lösen, aber ich bin zu faul und hab keine Zeit, dass ich das jetzt das Problem behebe"* (Mr E5, par. 91).

Maintenance

Quotation(s): 2

Maintenance processes and activities are definitely underestimated and underrepresented within Omega Ltd. Ms C1 and Mr C2 admitted that no procedure has been defined yet and only two employees reflected upon maintenance possibilities.

"Clean fan" and "Set up as maintenance"

According to Mr C3, the fan should be cleaned and removed from dust in order to increase the performance and motivate employees (cp. Mr C3, par. 151). Mr E6 suggested to regularly set up

the laptop or PC to prevent unstructured data and unnecessarily installed software, which slow down the system (cp. Mr E6, par. 178).

Both recommendations and further possibilities were extensively discussed during our action meetings.

Mobility

Quotation(s): 22

Within Omega Ltd, mobility has become a very important property and criterion. As I have already discussed earlier in the section '*differences in practices*', employees prefer laptops over PCs due to their higher mobility.

"Replace PC because of mobility"

Two employees, Mr C3 and Mr E5, have replaced their last PC, because they started to require a device providing more mobility. Mr E5 added that his old PC has been passed on to another colleague (cp. Mr C3, par. 16; Mr E5, par. 16). Apart from that, I talked with Mr E6 about being the only employee using a PC and whether his requirements may change in the near future: *"Nein. Weil ich eigentlich von zuhause wenig machen könnte ... und von dem her. Sobald ich etwas habe, was ich auch von zuhause aus machen könnte, wär's natürlich schon eine Überlegung wert"* (Mr E6, par. 60).

"From development to customer contact" and "Customer contact"

The two employees mentioned in the previous paragraph have changed and/or expanded their tasks from solely development to customer contact (cp. Mr C3, par. 42; Mr E5, par. 149). Mr C3 argued that having a mobile device is very practical to work from at home or take it to the customer and that he doesn't want to change back to a PC anymore (cp. Mr C3, par. 100). Furthermore, as Mr E5 is still programming and developing software, his initial requirements haven't changed except the demand for mobility (cp. Mr E5, par. 149).

When talking with Ms C1 about her employees' requirements, she concluded, *"Es hat sich allerdings jetzt dadurch ergeben, dass ... die Mitarbeiter sehr viel zu Kundenkontakten müssen und ihre Unterlagen dabei haben müssen, dass es einfach vorteilhaft ist, wenn man es mit einem Laptop macht. Damit ist es eigentlich jetzt sehr stark in diese Richtung gegangen"* (Ms C1, par. 47). Thus, currently only laptops are procured to enable also future requirements.

"Meetings", "No own desk" and "Work from at home"

Four employees reported to prefer their laptop's mobility in order to take their device to meetings (cp. Mr C2, par. 38; Ms E1, par 110-112; Mr E5, par. 149). Hereby, they have all documents available and can create meeting minutes: *"Weil eigentlich nur mehr Laptops verwendet werden. Was praktisch ist, weil wenn wir Besprechungen haben, schreibe ich immer mit. Und da ist es schon praktisch, wenn man es einfach mitnehmen kann zum Besprechungstisch"* (Ms E3, par. 32).

Another reason for demanded mobility, is the fact, that Ms E3 didn't have an own desk for a certain time period. While sharing two laptops, she always had to move to an empty desk and therefore, was dependent on using a laptop (cp. Ms E3, par. 36).

The last mentioned argument was the advantage of working from at home. Again Mr C3 and Mr E5 make use of this possibility and thereby, they gain reasonable working flexibility, which simultaneously supports their career as a student (cp. Mr C3, par. 29 and 100; Mr E5, par. 32 and 50).

"Thin and light weight"

For the current laptop generation, the criterion of weight and thickness was not considered. Although, Mr C2 mentioned the property to be useful, Mr C3 didn't care that much back then and they decided on a normal weight device with a good price-performance ratio (cp. Mr C3, par. 54). However, through the experiences they and other colleagues have made (cp. Mr E5, par. 135) over the last one and a half years, we again discussed the criterion within our action meetings and whether a differentiation between employees with higher and lower mobility requirements makes sense.

Replacement reasons

Quotation(s): 76

One of my sub-research questions is addressing the reasons for premature replacement on the part of the employees and the management. Therefore, I firstly asked all interview partners for their individual reasons as the initial status-quo. Secondly, I added a question in the last post-questionnaire in order to be able to analyse the employee's development and practice change.

"Broken", "Technical defect" and "HW component of old device broken"

The primary and most often mentioned reasons may be summarised within these codes. According to Ms C1, Omega Ltd's motto is: *"Wenn er ganz kaputt ist, okay, dann gibt es eigentlich nur eine Alternative: Austauschen"* (Ms C1, par. 26). "Broken" was often the first argument, which has then been more differentiated with practices and explained by narrating examples (cp. Ms E1, par. 59; Mr E5, par. 112; Mr C2, par. 186). Moreover, it represents a state where a laptop or PC cannot be repaired or upgraded anymore. A different way of expressing the same condition is *"having a technical defect"*, which is a central characteristic. (cp. Mr E5, par. 112).

However, sometimes only the defect of a single hardware component is sufficient to replace an old device. Mr E5 reported of his previous PC, which often had system crashes or freezes due to a defect graphic chip: *"Die wollten wir Ewigkeiten immer wieder austauschen, haben wir aber nie getan und dann haben wir gleich den ganzen Computer ausgetauscht. Ich weiß jetzt nicht, wer den noch in Verwendung hat, aber da ist dann sicher die Grafikkarte ausgetauscht worden"* (Mr E5, par. 101). A similar practice was reported by Mr E6: *"Ich denke einmal, wenn entweder was wirklich kaputt ist, wird man ihn wahrscheinlich ganz austauschen, wenn er schon älter ist"* (Mr E6, par. 99).

"HW component, which cannot be replaced easily"

Two employees argued that specific hardware components are highly difficult to access and replace (cp. Mr C3, par. 82). Especially, laptops cannot be repaired easily: *"Ich denke einmal, wenn entweder was wirklich kaputt ist, wird man ihn wahrscheinlich ganz austauschen, wenn er schon älter ist"* (Ms E3, par. 83). Unfortunately, I haven't asked about the age limit to be classified as an old device.

“Doesn't work properly” and “Set up doesn't help anymore”

In the Austrian dialect we have a special phrase called *“nicht mehr g'scheit arbeiten”*, which may be translated with ‘doesn't work properly’ and has been used by two employees to describe a possible replacement reason. Mr C3 related the possibility to ask for a new device in such a situation: *“Oder wenn man nicht mehr ‘g'scheit’ arbeiten kann damit, dann, glaube ich schon, auf jeden Fall sagen, dass ich einen neuen haben will”* (Mr C3, par. 96).

Moreover, Mr E5 explained into more detail, what he means by this specific expression: *“[...] dass er halt so alt ist, dass er nicht mehr ‘gescheit’ geht... Wenn er zu langsam wird und wenn das Neu Aufsetzen auch nichts mehr hilft, dann muss man ihn ersetzen”* (Mr E5, par. 112). If the lack of speed cannot be improved by a system set up, the device is apparently ready to be replaced.

“Upgrade or repair more expensive than new device” and “Price-performance ratio doesn't pay off”

Both sides, management and employees, reported about their past experiences with upgrade and repair. Ms C1 stated the following: *“Ich habe die Erfahrung gemacht, dass die Differenz zwischen Reparatur und Neuanschaffung, dann schon so gering ist, dass es sich... selten auszahlt”* (Ms C1, par. 24). Similarly, Mr C3 argued, *“Man könnt's theoretisch noch tauschen, aber... Irgendwann kommt halt auch einmal der Punkt, wo das Aufrüsten oder das Reparieren teurer ist als ein neues Gerät, wo es einfach keinen Sinn mehr macht, wenn man um vielleicht, keine Ahnung, 50% mehr gleich ein viel besseres Gerät bekommt”* (Mr C3, par. 116). Comparable to the previous two comments, Mr E5 stated the subsequent: *“Wenn sie nicht repariert werden, dann weil es billiger ist einen neuen zu kaufen. Ich glaube Reparatur für Laptops ist auch relativ teuer, weil es auch sicher nicht so einfach ist”* (Mr E5, par. 187). Due to the current price politics, service providers are more expensive than the price of a new device. Resources are thereby evidently exploited and wasted.

Two employees pointed out the importance of the price-performance ratio when it comes to repair or upgrade: *“Also quasi immer dann, wenn ein Austausch schon sich wirtschaftlich nicht auszahlt”* (Ms E3, par. 83). This argument partly overlapped with the *“HW component, which cannot be replaced easily”* mentioned earlier: *“Für mich aus Kosten-/ Nutzen-Rechnung. Wenn ich eben irgendetwas habe, wo ... ich weiß, dass die Teile jetzt eh schon 3 Jahre, 4 Jahre alt sind. Der Computer jetzt nicht mehr unbedingt das ist, was ich mir erwarte. Und ich dann noch eine, weiß ich nicht, neue Grafikkarte für 200€ kaufen müsste ... dann zahlt sich's für mich einfach nicht aus”* (Mr E6, par. 168).

Repair or upgrade related costs seemed to play an important role and therefore, we had a very critical and reflective look on repair possibilities during our action meetings. For me it may have been the most important part to convince the organisation and its employees of the advantages and environmental impacts, by simultaneously taking their criticism seriously.

“New, better device”, “Not up-to-date” and “Too slow to work with”

A further very prominent argument to prematurely replace the current device was the possibility to have a better and up-to-date one. Mr E5 reported that his first laptop within the organisation was replaced by a better PC (cp. Mr E5, par. 16 and 36). Above that, Mr C2 stated to generally prefer a new, better device (cp. Mr C2, par. 151) and Mr E6 added, *“Nein, für mich ist es einfach nicht so wichtig, weil ich einfach nicht glaube, dass noch wirklich viele Teile getauscht werden. Höchstens die Festplatte oder so etwas. Aber ich glaube, dass heutzutage recht viele lieber neu*

kaufen, als das dann auszutauschen" (Mr E6, par. 184). He addressed the nowadays problem of demanding new and fancy gadgets, although already having a well working device.

Not being up-to-date comes with a prolonged life span or use-time, which was often mentioned as a disadvantage: *"Klar, kann's auch sein, dass er länger hält, aber dann ist er halt nicht mehr auf dem neuesten Stand"* (Mr C3, par. 80). Mr E5 related the downsides of quickly developing technology: *"Nachteile: Dass eben die Leistung nachlässt, weil einfach die Technik so schnell weiterentwickelt, dass ein 4 Jahre alter Laptop 'ur alt' ist und ein 2 Jahre alter Laptop schon schlecht ist. Deswegen bringt's eigentlich nicht viel, wenn der jetzt 10 Jahre hält, weil in 10 Jahren haben wir wahrscheinlich schon gar keine Laptops mehr [lacht]"* (Mr E5, par. 193). Although, he laughed at the end of his comment, he summed up a relevant message in a nutshell.

Especially in the private sector, new technology developments are demanded: *"Hauptsächlich, weil die Leute das neueste Gerät haben wollen"* (Mr E5, par. 191). When asking about future trends, a crucial comment was the following: *"Andererseits, glaube ich auch, dass der Trend eher zur kürzeren Nutzungsdauer geht, weil man sieht's z.B. auch bei den Smartphones, dass sich manche jedes Jahr ein neues Handy kaufen, obwohl man das locker noch ein Jahr verwenden könnte. Aber das ist halt, ich glaube im Beruflichen geht's eher eben dazu, dass man's länger verwendet"* (Mr C2, par. 209). At the end of his statement, Mr C2 reflected that the trend in the business sector may go in a different direction and tries to prolong the use-times again. This was an interesting and essential aspect for my further inquiry, unfortunately, I forgot to ask about the reasons for his belief.

To conclude, new and up-to-date devices are additionally demanded because the current device became too slow to work with. As all interview partners mentioned this replacement reason, I wanted to ground it with interesting employees' comments: *"Oder die Gesamtleistung einfach schon so dramatisch niedrig ist, dass man einfach...ein tägliches Arbeiten nicht wirklich möglich ist"* (Ms E3, par. 83), *"Aber es hat natürlich auch den Nachteil, dass es von der Performance her schlechter wird, das Prozesse unter Umständen länger dauern und das es deswegen vielleicht sogar sinnvoller ist, in ein neues Gerät zu investieren"* (Mr C2, par. 153) and *"Beziehungsweise, wenn er halt wirklich dann irgendwann einmal so dermaßen langsam ist ... dass einfach nichts mehr geht"* (Mr E6, par. 99). The primary focus lies upon the lack of performance and support for daily work, which apparently demotivates employees. Thus, Ms C1 underpinned the importance of giving her employees the possibility to work properly. Otherwise she would have to replace the current device: *"Wie ich Eingangs schon gesagt haben, wenn dann der Zeitpunkt kommt, wo der Mitarbeiter in seiner Leistung gehemmt ist, dann ... muss man austauschen. Dann ist der Zeitpunkt da"* (Ms C1, par. 60).

"Problem with processes", "Program doesn't function anymore", "System always crashes" and "Problem with graphic board / display / peripheral interface"

Mentioned examples during the interviews addressed many problems, which may be interruptive and bothering. Mr C3 argued that if processes fail severely, it might make no sense to keep the device (cp. Mr C3, par. 104). Another reason may be a non-functioning program, which is, however, not very likely, as most employees are working remotely on the server (cp. Mr E5, par. 112). Ms E1 mentioned the problem of regular system crashes, but reflected immediately that they may be remedied by certain repair possibilities (cp. Ms E1, par. 61). For a non-technician, like Ms E1, system crashes can have drastic impacts. Further problems like the graphic board causing Blue Screens (cp. Mr E5, par. 101), the display causing eye pains by being too dark or too light and the

peripheral interfaces causing usage difficulties (cp. Ms E1, par. 63) were reported to be possible reasons.

"Less than one hour of battery"

The laptop's battery was considered as essential to ensure mobility. Interestingly enough, one employee argued in the first place to replace his laptop because of a poor battery, but in the second place added to just exchange the component itself: *"Wenn's weniger als 1 Stunde ist, dann hätte ich ein Problem. Weil dann kann ich keine Besprechungen mehr machen. Weil 1 Stunde muss man schon Akku haben, dass man bei einer Besprechung bisschen mitschreiben kann, ohne dass man ihn anstecken muss. Wenn's weniger als das ist, dann würde ich mir einen Laptop besorgen. Oder einen neuen Akku"* (Mr E5, par. 85). I mentioned the comment to point out some striking train of thoughts.

"IT quickly set up"

Mr E6 mentioned an interesting aspect: The fact, that laptops and PCs can be easily and quickly set up is, in principle, a positive characteristic. However, a new device doesn't involve a disproportionate effort to be set up and ready for use consequently. Thus, the replacement can more easily be managed than the substitution of a server for instance (cp. Mr E6, par. 138).

"Time-critical reasons"

As Omega Ltd has backup devices stored, they may overcome a certain period of time, if a current laptop or PC needs repair. However, if repair takes longer than initially estimated, the need to procure a new device may arise: *"Das würde wahrscheinlich auf den Preis darauf ankommen bzw. wie zeitkritisch es ist. Da wir ... eben Ersatzgeräte haben, könnten wir ja zumindest eine Zeit lang, einen anderen PC verwenden. Aber wenn's wirklich länger dauern sollte, dann müssten wir wahrscheinlich überlegen, ob wir nicht inzwischen ein neues Gerät anschaffen"* (Mr C2, par. 79).

"Exchanged after fixed period"

When reflecting solely about the business sector, Mr E5 argued that laptops and PCs may be replaced after a fixed period: *"Im Firmensektor, dass einfach ausgetauscht werden, weil sie alle 2 Jahre ausgetauscht werden oder so etwas. Da gibt's sicher in manchen Firmen irgend so etwas, das zu einem gewissen Zeitpunkt immer ausgetauscht wird"* (Mr E5, par. 191). The time period may be influenced by the selected depreciation as fully depreciated belongings become financially worthless (cp. Mr C3, par. 110).

It should be positively noted, that in small organisations more individual and personal influences can be taken into consideration. For instance, dedicated managers or employees may directly decide whether to keep their current device or not. However, this can also turn into the opposite, if environmental and sustainability reasons are ignored.

"I cannot stand it anymore, I need a new one"

Lastly, Mr C3 mentioned a problem of mainly private consumers, who replace their current device, because they cannot stand it anymore: *"Aber es gibt auch andere, die halt nach 2 Jahren sagen 'Ich kann ihn nicht mehr sehen, ich will einen neuen'. Das ist ganz unterschiedlich oft"* (Mr C3, par. 120). However, this argument has little or no influence in the business sector and was only mentioned for the sake of completeness.

4.4.2.4 Advantages and disadvantages of a prolonged use-time

In order to act sustainably, it is of vital importance to reflect upon the advantages and disadvantages. Only by that, one may realise that the positive aspects prevail and that some perceived down sides can be turned into acceptable compromises.

However, as I only interviewed a part of the employees and presented much new information during our cooperation, I included an interactive part in the final presentation to integrate every participant. All were requested to develop their ideas of advantages and motivation of prolonging the use-time.

Environmental advantages

Quotation(s): 23

Prolonging the use-time and discarding less devices leads to important environmental advantages. When conducting the interviews, I was wondering which aspects would come to their mind and are regarded as positive impacts. Mainly I asked which relation exists between a laptop's or PC's use-time and sustainability as well as the environment.

"Less CO₂ emissions", "Less environmental pollution" and "Pro environment"

One aspect was the positive impact on the environment. Mr C3 mentioned that less transports of new devices to the vendors are necessary and thus, CO₂ emissions may be reduced (cp. Mr C3, par. 155). Thinking in the same direction, Ms E1 argued that the longer a device is used, the less production is needed and consequently, resulting in less environmental pollution (cp. Ms E1, par. 221). Realising that acting pro environmental can be achieved by buying less and using longer is an important step in the self-reflection process: *"Naja, natürlich schon, dass ... es von Vorteil ist, wenn man die Geräte länger verwendet, damit man eben die Umwelt ein bisschen schützen kann"* (Mr C2, par. 211).

"Less procurement of new devices"

Interestingly enough, the data demonstrated that only one employee related *"less procurement of new devices"* with environmental advantages. In the end, our adapted practices may influence the environment in a positive way: *"Vorteile wären sicher: Es werden generell weniger Geräte neu gekauft. Was auch dann am Schluss einfach der Umwelt mehr bringt"* (Mr C3, par. 120). Three other employees connected it mainly with the positive aspect of reduced costs and profitability of buying less. This strongly represents our way of thinking, acting and where our preferences are positioned. Looking at a price label before studying the object's description or properties has become a well-known and lived practice. Thus, I sorted this code into both sub-themes.

"Longer use-time, less production"

Two employees emphasised the aspect of less production, if we use devices for a longer time period. Mr C3 reflected upon our current system by arguing the following: *"Ja, da besteht schon ein gewisser Zusammenhang. Weil wenn die Geräte eine längere Nutzungsdauer hätten, sagen wir doppelt so lange, dann würden wir uns die Hälfte an Ressourcen ersparen dafür. Und das hängt auch mehr oder weniger direkt mit der Umwelt zusammen. Weil ich glaube kaum, dass für einen Laptop oder für einen PC alle Teile umweltfreundlich produziert werden. Da gibt's sicher Sachen, die man eigentlich gar nicht wissen will. [Pause] Wenn z.B. jeder seinen Laptop statt 3 Jahren, 5 Jahre nutzen würde, wenn's irgendwie geht, dann kann man durch das... Ich mein, ob das jetzt direkt so*

zusammenhängt weiß ich nicht, aber wenn durch das weniger Geräte produziert werden... Irgendetwas bringt's sicher!" (Mr C3, par. 155). He addressed very important aspects namely first, the potential of saving resources by producing less. Second, poor production conditions and prevalent exploitation may be reduced or even eliminated in the long-run.

It is interesting to note, that he mentioned the people's preference of looking away instead of tackling unfair circumstances. The problem comes with not being directly affected. If I discard my laptop every two years, which is eventually shipped illegally to developing countries and dismantled at very rudimentary levels, I am not immediately negatively affected. The related pollution and worker's illnesses are not within my daily field of concern. By continuing this ignorant behaviour, our system will reach its limits and poverty, hunger and environmental catastrophes will even increase, then having immediate consequences also for the so called 'developed countries'.

"Longer use-time, less waste" and "Less discarded IT"

By using longer, we don't only decrease our production demand, but also the generated electronic waste: *"Zusammenhang... Also natürlich je länger etwas genutzt wird, umso weniger Müll haben wir oder umso weniger muss man eben wegwerfen. Von dem her denke ich schon, dass es einen Zusammenhang gibt, aber... Ich weiß ehrlich gesagt nicht, wie viel das ausmacht, wie viele Computer oder PCs weggeschmissen werden. Also von dem her, ist es echt schwer zu sagen"* (Mr E6, par. 210). As he mentioned to be uncertain about the amount of discarded laptops and PCs, I included some statistics and facts in my workshop presentation. In my opinion, this is important to understand the reach of one's actions.

Ms E3 only answered the following, when asking about the context between use-time and environment: *"Naja, wenn man ihn nicht mehr nutzt, ist mehr Müll da. Das ist der Zusammenhang, den ich sehe"* (Ms E3, par. 219).

Furthermore, Ms C1 underpinned the importance of discarding less IT by stating, *"Ja, letztendlich, dass man weniger entsorgen muss. Es ist eigentlich ... um das geht's ja"* (Ms C1, par. 131). She is convinced that having a closer look at end-of-life possibilities like passing old devices on or donating them to prolong the use-time are the important next steps within Omega Ltd in order to act more sustainably. Therefore, we developed strategies and I conducted an external interview with Mr Hundstorfer from AfB (see chapter 5.1.2).

"Save resources", "Less wear and tear" and "Recycling of resources after end-of-life"

According to Mr E5, saving resources is an essential aspect of extending the use-time: *"Ja, Ressourcen. Wenn man Sachen länger benutzt, dann kann man ressourcenschonend produzieren. Und ich glaube wir können nicht mit den Ressourcen so umgehen, wie wir es jetzt tun ... auf Dauer. Irgendwann wird das ein Problem werden"* (Mr E5, par. 239). Resources are limited and cannot be extracted in endless amounts. Thus, effective and efficient recycling needs to improve and waste must be considered as a valuable resource in the production cycle.

Besides, Mr C3 argued that due to an prolonged use-time, wear and tear may decrease (cp. Mr C3, par. 120). Unfortunately, the data was not precise whether he addressed the aspect of less wear of resources or the actual wear and tear of components. I assumed that the former is accurate and thus, sorted the code into the same sub-theme as "save resources".

The code *“recycling of resources after end-of-life”* has already been described in the section *‘influences on use-time’*, however, is important to additionally highlight it within this sub-theme. Recycling is positioned in the centre of the waste hierarchy (see chapter 2.3.3) and therefore, above energy recovery and disposal. The improvement of recycling’s effectiveness and efficiency will be an important field of activity in the next years. Moreover, products need to be differently designed and assembled to dismantle them more easily. Screws instead of glued interfaces are just one example.

Organisational advantages

Quotation(s): 16

When talking about the advantages of a prolonged use-time, employees recognised a variety of positive impacts on the organisation itself. By that, an improvement of practices may be induced.

“Less procurement of new devices” and “Reduce costs”

As I have already mentioned in the previous sub-theme, three employees directly linked *“less procurement of new devices”* to the positive consequence of reduced costs and financial advantages for the organisation. Ms E1 stated, *“Ja, Vorteile: Wir müssen keinen neuen kaufen ... Geld eben”* (Ms E1, par. 186). However, some consumption practice changes require financial benefits as a first impulse. Only later, people start realising which further constructive impacts they have additionally achieved.

“No disadvantages if longer use-time / life span”

Three employees concluded that a longer use-time or life span doesn’t involve any disadvantages, thus, can apparently be rated as advantages: *“Wenn das Gerät noch länger funktioniert, dann fallen mir jetzt keine Nachteile ein. Wenn jetzt die Geräte grundsätzlich länger leben würden...”* (Mr C3, par. 120). Consequently, if producers manufactured long-lasting devices the use-time may simultaneously be prolonged leading to more sustainable consumption practices. Even if one desires up-to-date devices, he can easily pass on devices to people with less requirements who enjoy using robust and durable laptops or PCs. Moreover, modular laptops could be an option to upgrade components more easily.

“Proper IT motivates” and “Keep own data and less change”

A longer use-time should go hand in hand with good maintenance and treatment. Otherwise, devices may easily be perceived as too slow or not properly working: *“Ja, also die Chefin ist eigentlich relativ bemüht, dass das Betriebsklima passt, dass sich alle wohlfühlen und dass jeder seine Sachen zum Arbeiten hat. Weil wenn man... Das ist jetzt auch speziell bezogen auf die Laptops und so. Weil wenn man auf einem Gerät arbeitet, das ‘mega’ langsam ist und wo man nicht wirklich ‘gescheit’ arbeiten kann, dann freut’s einem nach einer Zeit auch nicht mehr. Das spielt da auch mit dazu eigentlich”* (Mr C3, par. 137). An appropriate maintenance process has not been established before we started the cooperation, and thus, we focused on the development during our action-meetings.

Furthermore, by keeping your current laptop you may also keep your own data and thus, less change is required (cp. Mr E5, par. 193). Every user configures a device according to his or her preferences and by that, personalising it. This step is time-consuming and important data or settings might be lost. However, a regular system set up to maintain the device may lead to the

same difficulties. Consequently, we took this aspect into consideration when conceptualising the new maintenance process.

“Know when new devices or upgrades needed”

Regarding the documentation and monitoring of use-times and maintenance activities, Mr C2 mentioned the advantage of knowing the point in time when new devices or upgrades are needed: *“Es hätte natürlich schon Vorteile, wenn man sich darauf vorbereiten kann, dass wahrscheinlich demnächst neue Geräte angeschafft werden müssen bzw. Upgrades”* (Mr C2, par. 95). Therefore, we further developed the central overview and monitoring sheet within our action meetings.

Organisational disadvantages

Quotation(s): 34

Along with advantages come disadvantages. It was important to tackle these and consider them in all developed improvement actions. Otherwise the trust in the realisation and the willingness to change may be lost.

“Disadvantage if longer life span, because no new devices”

Contradicting to the previous comments coded with *“No disadvantages if longer use-time / life span”*, one employee considered the longer life span to be a disadvantage. He argued that by that no new or up-to-date devices are procured: *“Also eigentlich ist es Nachteil, wenn er lang hält, weil du dann auf deinem Gerät sitzen bleibst. Dann will man sich auch nicht unbedingt einen neuen kaufen. Da ist es gescheiter, er wird gleich ‘hin’, dann freut man sich, dass man sich einen neuen kaufen kann”* (Mr E5, par. 193). This statement includes the fear to miss the joy of unpacking and using a new device, which is (normally) better than the old or current one.

However, it is important to note, that his train of thoughts continued in a more sophisticated and reflective manner by suggesting to pass old devices on to people with less requirements and thus, a longer life span is positive.

“Upgrade or repair more expensive than new device”, “Not up-to-date” and “Too slow to work with”

These three codes have already been described and analysed in the sub-theme *‘replacement reasons’* in the section *‘influences on use-time’*. Nevertheless, they are listed at this point again as they were also considered to be disadvantages of a prolonged use-time. The data revealed that specific replacement reasons contradict an extended use-time otherwise they wouldn’t have been rated as such.

Consequently, we addressed these three reasons explicitly within our action meetings by focusing on repair possibilities in Vienna and their related costs, the establishment of a maintenance process to improve the device’s performance and end-of-life opportunities to prevent disposal but at the same time give somebody outside the office the chance to use the device.

4.4.2.5 Potential for change

Within the last theme I want to point out potential for change based on the interview partner’s responses. Changes are required in order to improve the status-quo of employee’s, organisation’s, producer’s and system’s practices. During our action meetings we focused on and attempted to

influence the first two subjects. Some codes addressed Omega Ltd and its employees, others were mentioned when talking about private customers or organisations in general.

Potential for change (employee)

Quotation(s): 53

Many practices on the part of the employees have high potential impacts on the use-time. Several codes are more relevant for the employee as a private person and consumer. Some comments have influenced me to include these topics in our action meetings, but also in the two common sessions, where most employees participated.

“Use-time is a logical consequence”

According to Ms E3, a laptop’s or PC’s use-time can be considered as a logical consequence: *“Ich weiß nicht. Ich glaube, das ergibt sich dann einfach aus dem... das ergibt sich irgendwie mit der Zeit. Ich finde, es ist eigentlich eine relative logische Schlussfolgerung, wann man ersetzt und wann man austauscht. Für mich ist das einfach ein Prozess, wo man das am Weg entscheidet. Das ist auch situationsabhängig”* (Ms E3, par. 141).

Although, she argued that the replacement of a device is situational, which I likewise consider to be correct, it may be controlled and managed by certain guidelines and processes. To substitute a laptop, which is working slowly, shall not be the logical consequence. Instead, proper maintenance and upgrades may be performed. Wherever this is not possible, the use-time doesn’t have to end with the organisation, but can be prolonged by external people.

“Consumer's lack of competences”

Mr C3 made the experience that most private customers buy any random, good-looking device due to their missing knowledge and competences: *“Vor allem, die meisten Leute kennen sich auch nicht so gut aus. Die nehmen einfach irgendein Gerät, das ihnen gut gefällt”* (Mr C3, par. 153). In addition, Mr E6 argued that nowadays people are less capable or repairing devices than in former times (cp. Mr E6, par. 186). Moreover, Mr E5 related his competences as an experienced user, who learned how to treat and repair his laptop properly: *“Weil viele nicht die Möglichkeit haben oder nicht wissen, wie man ihn repariert. Ich hab bei meinem Laptop den Lüfter ausgewechselt. Das macht nicht jeder. Die meisten machen ihn kaputt wahrscheinlich dabei. Und ich hab ihn auch ein bisschen kaputt gemacht [lacht], aber nur äußerlich. Und ich weiß wie man Computer neu aufsetzt. Wenn er langsam ist, dann weiß ich, was ich dagegen tun kann. Und ich hab jetzt auch auf dem alten ‚Rechner‘ Windows 8 drauf und er läuft eigentlich relativ gut. Das sind Sachen, die kann ich machen, weil ich’s kann und gelernt hab. Aber ich glaube, der Standarduser... geht da entweder schon irgendwo hin und lässt ihn reparieren. Das ist aber oft so teuer, dass man sich gleich einen neuen kaufen kann”* (Mr E5, par. 168).

The potential to change lies within educating pupils at school to learn the basics of how a laptop or PC is functioning and how to open them correctly. Secondly, awareness should be raised that repair services are not only affordable, but important to save resources, in the long-run the environment and our system. Last, current price policies of new devices must be adapted to reflect the real value and producers may offer additional, but affordable services, which in return fight unemployment.

“Life span unknown because stopped using it” and “Lower use-time than life span”

Most employees reported that they stopped using their private laptop before it reached its real end of life. Like Mr C3, who stated the following: *“Ja, das weiß man gar nicht so eigentlich, wenn man’s gar nicht mehr nutzt das Ding... Ich hab noch einen alten Laptop zuhause, der ist sicher schon 10 Jahre alt, der funktioniert theoretisch sicher noch immer. Nur, würde ich halt nicht mehr damit arbeiten, weil er schon relativ langsam ist”* and *“Ich habe auch keinen Laptop so lange benutzt, bis er wirklich schon so ... Keine Ahnung, wirklich am Ende war [lacht]”* (Mr C3, par. 116 and 118). Although, he smiled at the end, I perceived his way of responding as if he felt embarrassed about his past practices. Moreover, Mr E6 argued similarly by narrating that he has never exchanged a laptop because of being broken, but due to slowness, weight or size (cp. Mr E6, par. 117). Besides, Mr E5 critically reflected the current prevalent practices: *“Naja sie werden sicher kürzer genutzt, als sie funktionieren. Ich glaube viele Laptops stehen ‘umeinander’, die eigentlich noch gehen würden, einfach weil sie ausgetauscht worden sind durch ein neues Gerät. Da glaube ich schon, dass ganz viele Laptops unbenutzt herum stehen. Die werden sicher nicht so lange benutzt. Vor allem wegen der Leistung wahrscheinlich. Es gibt sicher viele funktionstüchtige Geräte, die eigentlich keiner benutzt”* (Mr E5, par. 183).

According to Cooper, nearly 60% of the discarded laptops were still functional (Cooper 2004). To address this problem, processes to pass devices on to people with less requirements or who cannot afford a new device must be simplified and communicated as important to the users. Successful examples are platforms like ‘willhaben.at’ or online exchange groups in social media like ‘Facebook’.

“Extend use-time through private use”

During the interviews, I asked all employees whether they would be interested to keep their business laptop as a private laptop and thereby, extend the use-time beyond the organisation’s direct influence. Two employees were in favour of this idea and justified it by the following two comments: *“Ja. So lange er funktioniert, ist es ja ... schade darum”* (Ms E3, par. 89) and *“Ja, das würde ich auf jeden Fall tun. Da ich privat keinen speziell guten Laptop brauche, sondern nur für Medien im Endeffekt, würde ich den auf jeden Fall verwenden. Und ich hab jetzt einen private, der jetzt schon 3/4 Jahre alt ist. Ich würde auf jeden Fall den ... privat noch nutzen”* (Mr E5, par. 118). Apparently the device still has to be functional and capable of processing media. Ms C1 was positively surprised about these two responses and could imagine offering this possibility. Two employees would reject the offer as they have different private requirements or are satisfied with their current private laptop. Mr E6 would definitely refuse to prolong the use-time of his business PC, but could imagine accepting a laptop instead.

Two experts explained to me the possibility for employees to reserve their former business laptop as a private device and later, purchase it for little money. Additionally, the laptop comes again with twelve months of guarantee (see chapter 5). Apparently, this option is more successful in bigger organisations, where laptops are more often exchanged and still in a very good condition. However, in Omega Ltd old devices are partly kept as backup and partly too old for private use. If the organisation continues growing, this option may become attractive again.

“Missing interest in use-time”, “Missing interest in repair over replacement” and “Too lazy to fix it”

Two employees responded honestly that they are not really interested in the topic ‘use-time’. Ms E3 argued that she perceives use-time as a logical consequence (see *“use-time is a logical*

consequence" within this chapter). In contrast, Mr E6 stated the following as an explanation: *"Nein, interessiert bin ich nicht wirklich daran, weil ich ... sowieso versuche... wie soll ich sagen... den PC gut zu behandeln [lacht]. Ich weiß nicht, wie ich es anders sagen soll. Also ich versuche eh sehr darauf zu achten, also von dem her"* (Mr E6, par. 212). Additionally, he supposed that nowadays not many components, except hard drives are exchanged, but people prefer to buy a new device instead of letting it repair or upgrade (cp. Mr E6, par. 184). Interestingly enough, it was also him, who reported to exchange his laptop every two years.

Besides, Mr E5 admitted that he doesn't care whether it will be repaired or newly bought (cp. Mr E5, par. 158) and Mr C3 explained, that he has too little time and is too lazy to fix his current software problems (cp. Mr C3, par. 91).

From my point of view, these practices are mainly influenced by the low prices of new devices. As a reaction, private consumers lose their interest in maintaining their belongings and don't take the time to establish a relationship with them. Repair cafés and networks try to fight this trend and improve people's involvement with their devices. After successfully repairing a broken device, its value increases. Thus, we discussed attending one repair café within the framework of our cooperation (see action meeting 1).

"Conflict between handy and life span"

Taking care of a device requires time and sometimes additional action, which often contradicts convenience. Mr C3 related his daily practices, when carrying his business laptop with him: *"Klar, man kann besser aufpassen, aber dann ist es halt nicht mehr praktisch. Weil wenn ich jetzt... keine Ahnung [Pause]... weiß ich nicht, fällt mir jetzt kein Beispiel ein ... z.B. der Dongle von der Maus wird wahrscheinlich irgendwann kaputt werden, weil ich immer den Laptop als Ganzer in die Tasche gebe und das spießt sich halt irgendwann einmal. Das z.B. . Und wenn ich ihn jedes Mal ausstecke und in die Maus hineingebe, bevor ich ihn hineingebe, ist zwar die Nutzungsdauer, zumindest von der Maus, besser, aber für mich ist es halt nicht so praktisch. Außerdem denke ich nicht immer daran. Das ist halt dann der Spielraum zwischen praktisch und ... und Lebensdauer"* (Mr C3, par. 147). Previously he admitted to be a partly lazy person, which became again present within this practice.

As he was describing an activity with his business laptop, which is not his own property, the organisation can influence it. By defining guidelines for correct usage, he is enforced to treat the laptop and mouse in a more careful way. This may have an additional advantage, namely when being used to the new practice, he might also adapt his private behaviour and take simultaneously more care about his personal laptop.

"Raise awareness"

To raise awareness is listed at three different levels, as I assumed it to be considerably important in order to change the status-quo. Awareness may be raised peer-to-peer, by the management / organisation or by the system.

Experienced users or computer scientists may grasp the opportunity to inform family members and friends about the importance of correct treatment and maintenance. They can either help them personally or instruct them and encourage them to perform these activities themselves. Moreover, Mr E5 suggested the following: *"Aber das würde auf jeden Fall etwas bringen, wenn man ein bisschen Bewusstsein schafft, dass das ein hochtechnisches Gerät ist und nicht ein unzerstörbares Ding"* (Mr E5, par. 223).

“Exert greater pressure on producers”

The importance of exerting greater pressure on producers is similarly listed at three different levels, as I supposed: the higher the pressure, the quicker the change. Ms C1 stated that in the end it is the customer's decision which products he or she buys and which he or she rejects (cp. Ms C1, par. 129). Moreover, Mr E5 suggested the following: *“Aber man könnte ja den Hersteller trotzdem dazu auffordern, dass er das nicht so macht”* (Mr E5, par. 225).

Many customers have the impression of not having influence on the producer's practices. This perception was also prevalent during our workshop. However, this is not correct as supply follows demand. Like the trend of organic food, the demand for greener electronics has to be communicated. Consumers may criticise behaviour by writing e-mails to the producers, expressing their desire in front of the vendor or signing petitions against certain production violations. Moreover, many initiatives, which want to make the electronics sector fairer, exist. At the workshop and final presentation we explained our colleagues how to take action as a customer.

“Important how you use it”, “Take care” and “Use of battery while connected to a power source”

All three codes have already been described and analysed within the sub-themes *“employee's influence”* and *“work environment”*. However, I wanted to highlight which potential of change lies within and thus, list them at this point again.

Employees must realise, that they are using an organisation's property, which they have to take care of. Ms C1 previously stated that she has never established any guidelines as she trusts her employees to correctly treat them. Nevertheless, people follow different practices and pursue their own ideas of correct accurate usage. Thus, I proposed to develop guidelines, even though some may sound trivial, in order to create a common understanding.

Moreover, all respondents were uncertain about the best way of protecting a laptop regarding its battery. Some stated that former batteries were vulnerable concerning charging cycles and memory effects. Consequently, we included this topic in our action meetings to define a practical and useful manner within Omega Ltd.

Potential for change (organisation)

Quotation(s): 51

Further potential for change may be realised on the part of organisations. A company is capable of playing an important role model to its employees, raise awareness, but additionally use its power as a big player to influence producer's practices.

“Difficult to motivate employees”

Mr C3 honestly admitted to be very difficult to motivate (cp. Mr C3, par. 151). In fact, employees, who don't act sustainably by themselves, need motivation communicated by the management.

It was one of my research questions to find out, which ways and arguments motivate employees to take care of their device and use it longer. We had some discussions within the action meetings and thus, I included an interactive part in the final presentation to let the employees themselves additionally develop useful ideas.

“Minimal use-time unknown”, “Missing maintenance process”, “End-of-life process unknown” and “Vision and goals unclear”

Throughout the interviews, the data uncovered many processes, where employees are not directly involved, are unclear or missing. In order to provide feedback to Ms C1, I gathered all mentioned comments.

First, no employee was certain, if a minimal use-time, in which the organisation repairs or upgrades instead of replaces, exists. Mr C3 estimated three years (cp. Mr C3, par. 104) and Mr C2 responded that they have never talked about a minimal or maximal use-time, because they have never had any severe problems (cp. Mr C2, par. 101). In addition, Mr E6 argued, *“Ich schätze, zwischen 1 und 2 Jahre. Ich glaube viel länger, zahlt es sich dann gar nicht mehr aus”* (Mr E6, par. 130). In contrast, Ms C1 stated that devices are used at least for three years (cp. Ms C1, par. 39 and 42-43). However, this has never been communicated to her employees.

Second, up to now no maintenance process has been defined: *“Nicht direkt. Wir haben noch nicht wirklich das Problem gehabt, dass jetzt irgendwie Hardware kaputt gegangen ist. Das Einzige, was wir teilweise gemacht haben, ist, dass wir einmal die Festplatte ausgetauscht haben, also eine schnellere Festplatte. Sonst gibt’s ... eigentlich keine Prozesse bis jetzt”* (Mr C2, par. 24). If there was a maintenance process in place, Mr C2 would know it, because it would probably be his responsibility. Ms C1 confirmed that there are no established guidelines, but is in favour of implementing them as a next step (cp. Ms C1, par. 84).

Next, employees were unable to answer what has happened to old and sorted out devices so far. Except Mr C2, who related the following: *“Konkret weiß ich eigentlich nur von einem einzigen PC und was wirklich mit dem dann passiert ist, weiß ich nicht. Ich glaube der ... ist noch irgendwo verstaubt, aber was genau, müsstest du dann die Ms C1 fragen. Und sonst, die anderen Geräte sind eigentlich alle jetzt auch noch im Büro, das man sie noch verwenden kann, weil sie noch funktionstüchtig sind bzw. werden sie dann eventuell übergeben, wenn jemand mit einem nicht so leistungsstarken Gerät auch noch arbeiten kann”* (Mr C2, par. 155). Although, Ms C1 confirmed that old devices are mainly stored as backup in-house, she has never communicated the availability of them to her employees. Moreover, she concluded with the necessity to have a closer look at end-of-life possibilities as the organisation is growing and some stored, but very old devices need to be sorted out.

Last, Omega Ltd’s vision and goals seem to be unclear. This was also a main result of the online survey, which was confirmed by the interview partners’ answers: *“Oh Gott. [lacht] Das habe ich geschrieben [lacht sehr]. Dazu möchte ich nichts mehr sagen. Das waren so schwierige Fragen. Darüber haben wir eigentlich noch nie hier geredet, was sind unsere Ziele oder so. Nein, da schaust du dann in meinem Fragebogen nach”* (Ms E1, par. 198). As an administrative assistant she should actually be able to answer the question easily, but was too embarrassed to respond.

“No communication about environmentally conscious behaviour” and “No communication about use-time”

Following the previous section, no communication about environmentally conscious behaviour like guidelines to save energy has taken place within Omega Ltd. At least according to Ms E1, who stated that she has been employed since December, but never heard about any rules (cp. Ms E1, par. 215). Although, some employees reported the contrary, the communication apparently wasn’t clear enough.

Moreover, the issue 'use-time' has never been communicated or treated as an important topic within a meeting. Mr E5 smiled while stating, *"Nein. [Pause] Also bevor du da warst, nicht [lacht]"* (Mr E5, par. 156). In contrast, Mr C3 reflected that the issue has not been directly addressed, but surely mentioned before: *"Direkt nicht, aber vielleicht, dass wir irgendwann einmal darüber geredet haben, aber das weiß ich jetzt nicht mehr auswendig. Irgendwann haben sicher einmal darüber geredet. Aber jetzt nicht so regelmäßig oder direkt irgendwie oder das wir jetzt gesagt hätten 'Wir setzen uns jetzt an einen Tisch und reden über Nutzungsdauer'. Das haben wir nicht gemacht"* (Mr C3, par. 106). Thus, it may have been the right time to start the cooperation and introduce the importance of use-time to the employees.

"No specific contact person" and "No specific employee's criteria identified"

In addition to the two previous sections, two further aspects bring potential for change. First, Mr C3 stated, that no specific contact person in case of problems has been defined (cp. Mr C3, par. 68). Unofficially, Mr C2 has become the general contact person due to his responsibility of setting up new devices. However, to improve the structure of the organisation, more than one contact person does make sense.

Last but not least, employees were not asked about their requirements and no criteria have been defined. Although, all employees perceived this circumstance as adequate, it may make sense to distinguish between employees with less / more requirements or additional mobility needs. Consequently, both issues were discussed within our action meetings to improve the status-quo.

"Raise awareness"

The second possible level to raise awareness is from the organisation's position. According to Mr E6, the management may communicate to treat devices like own belongings and underpin, that is not irrelevant, if they work or not: *"Versuchen zu kommunizieren, dass man da halt darauf aufpasst. Also den so behandelt, wie man seine privaten Sachen behandelt. Dass es eben nicht egal ist, wie lange der rennt oder wann der kaputt wird"* (Mr E6, par. 180).

The majority of employees probably doesn't intentionally treat devices in the wrong way, but just lacks of competences and knowledge. By compensating this absence, the organisation may profit equally.

"Exert greater pressure on producers"

As a big player, organisations may exert higher pressure on producers: the bigger the organisation, the more power it has. Large companies procure a higher amount of devices and consequently, their purchases affect the producer's profit to a larger extent: *"Auch sonst müsste man halt den Firmen ein bisschen einen Druck machen, dass die nicht so schnell zerstörende Geräte produzieren. Weil das ist wahrscheinlich schon Absicht, dass die in 2 Jahren kaputt sind"* (Mr E5, par. 223). Even more powerful are organisations that build a network and act as one. Within this section I see considerable opportunities to change the status-quo, however, not as a rather small organisation like Omega Ltd.

"Depreciation" and "Proper IT motivates"

Both codes have already been described in the sub-theme *"external influencing factors"* and *"organisation's advantage"*, but certain aspects may be a potential for change.

The depreciation is financially important and cannot be ignored. Although, the Austrian law suggests at least three years for laptops and PCs, most organisations only use this minimum depreciation. A short period of time brings financial and economic advantages. In contrast, a depreciated asset is financially worthless and doesn't positively influence the organisation's profit. Ms C1 is an environmentally conscious person and therefore, keeps even fully depreciated laptops and PCs in use. To support this pro-environmental behaviour, I added this code additionally to the sub-theme "*potential for change (system)*", as the law should actually promote and not block such practices.

Maintenance of laptops and PCs requires valuable employee's working time to perform it. However, if an organisation invests in improving the device's performance, employees are motivated and may work more efficiently. Consequently, Ms C1 was in favour of developing a proper process.

Potential for change (producer)

Quotation(s): 12

I consider transformation on the part of the producer as essentially important, however, I assume that it needs changed demand as a trigger. Despite, a closer analysis and improvement process is out of scope of this work.

"Older generation lasted longer" and "Possible to produce IT that doesn't break"

According the Ms C1's experience, older laptop or PC generations lasted longer and were more durable: "*Ja. Also die neueren halten einfach weniger lange, das ist richtig, ja. Ich weiß, wir haben zum Beispiel meinen Acer, der ist eben aus 2008... Da war danach ca. 2-3 Jahre danach ein richtiger Qualitätssprung ... nach unten eben eindeutig. Da sind dann ein paar Nachfolgermodelle gekommen, wo man schon gemerkt hat... Also einen hatten wir dann, das war, glaube ich, eh ein 'Montagsgerät', den mussten wir dann wirklich ein paar Mal einschicken, gleich kurz nach dem Kauf. Und ja... Da waren dann ein paar, wo ... es eigentlich eine Zeit lang ,gehapert' hat*" (Ms C1, par. 89) and "*Also, wie ich dir schon gesagt habe, ich habe das Gefühl, dass die Qualität schlechter wird. Das heißt, dass liegt eindeutig beim Hersteller*" (Ms C1, par. 129). She is convinced that it is the producer's fault to produce shorter lasting devices. According to several studies (see chapter 2.2), planned obsolescence has been discovered and may correspond to Ms C1's narrations.

To improve the current system, Mr E5 reflected that it must be possible to produce laptops and PCs that don't break (cp. Mr E5, par. 177). Apparently prices will increase, but in the long-run they will amortise and lead to a considerable reduction of demanded resources.

"Recycling not completely possible"

Ms E1 and Mr E5 critically reflected upon the difficulties of recycling: "*Und auch mit der Nutzungsdauer aufpasst. Weil wenn ich alle 2 Jahre einen neuen kaufe, dann wird... dann werden Ressourcen verschwendet und man kann auch nicht alle Ressourcen recyceln*" (Mr E5, par. 239).

Although, recycling is a certainly important achievement of the last decades, it is still not entirely possible. Processes fail due to poor infrastructure like in developing countries or product design, which makes it impossible to dismantle all resources from each other. Recycling still entails high potential of change and improvement.

“Repair / upgrade became more difficult”, “Better upgrade possibilities necessary” and “Upgrade impossible because of incompatibility”

In order to be able to prolong the use-time, repair and upgrade services are necessary across time. However, these must be possible to be performed within an acceptable time frame. Two employees and Ms C1 reported about their perception that repair and upgrade has become more difficult (cp. Ms C1, par. 26; Mr E5, par. 112, Mr E6, par. 186). In addition, Mr C3 reflected that to achieve a longer use-time, better upgrade possibilities are necessary: *“Naja klar, man könnte irgendwie die Geräte so machen, dass man Teile besser austauschen kann”* (Mr C3, par. 80).

Moreover, Ms C1 related her experiences made with incompatibility: *“Aus der Erfahrung ... aus der Historie heraus, besser gesagt, waren es eigentlich dann so Punkte, wenn ... man wirklich ... wie dieses BIOS-Update. Es funktioniert einfach nicht, du kannst dann die neuen RAMs nicht mehr reinstecken, die Platten sind nicht mehr kompatibel oder sonst etwas... das ist wirklich... das sind Zeiträume von Jahren”* (Ms C1, par. 60). This then leads to no other opportunity than replacement.

All three issues may be addressed and changed solely by the producer himself/herself. However, within the current system, producers profit more when consumers buy many new products. Business models need to change, in order to earn money from offering sophisticated services by skilled employees.

“Poor production conditions”

Mr C3 doubted that most components of a laptop or PC are produced under environmental friendly conditions (cp. Mr C3, par. 155). Moreover, I assumed that people are either not interested, ignore and trivialise the facts on pictures or have not been informed about it.

The user’s demand for greener electronics may be the trigger and the important first step, but subsequently producers have to change their production conditions regarding workers, resources and the environment. Producers might also recognise the potential that lies within this change, namely of being a first-mover in the area of fair and environmental friendly devices. There is a high likelihood that consumers are willing to pay more for a so called green laptop or PC.

Potential for change (system)

Quotation(s): 22

Although, the data convinced me that in the long-run the system has to change likewise, the detailed analysis and improvement process of its potential would go beyond the scope of this work.

“Learn IT basics at school” and “Raise awareness”

Mr E5 suggested a very interesting aspect of improvement from the part of the overarching system: *“Eigentlich müssten die Leute in der Schule lernen, wie man einen Computer neu aufsetzt. Weil dann habe ich erstens weniger zu machen [lacht]. Zweitens, dass die Leute das selber ein bisschen machen können, dass sie ein bisschen eine Ahnung haben. Weil wenn ich mich an meinen Informatikunterricht in der Schule zurückerinnere, das war irgendwas. Ich hab gelernt, wie man mit Word umgeht, das hab ich aber schon gekonnt. Und deshalb war das umsonst. Da hätte man lernen können, wie kann man einen Computer neu aufsetzen. Das hab ich dann in der HTL gelernt, was eigentlich ganz gut war. Wenn das jeder könnte, oder zumindest ein paar Leute, dann kann man*

schon einmal schauen 'Okay, der Laptop ist nicht kaputt, es reicht, wenn man den neu aufsetzt'" (Mr E5, par. 223).

The third level to raise awareness may be on the part of the system namely regulations, legislators and the government. For instance, changes within the school or study system could reach young generations and enlighten them to think about environmental impacts when purchasing, using or discarding devices. As a computer scientist student I have never had a mandatory subject in this direction. Thus, much potential of change is lost with every new generation that is not voluntarily interested and informed.

"Poor production conditions" and "Exert greater pressure on producers"

Governments and supranational institutions like the European Union may take a stand against importing components or goods manufactured under exploiting production conditions. As a third level they could react to customer's and organisation's demand for greener electronics and establish stricter, pro-environmental regulations in order to exert greater pressure on producers.

"Depreciation", "Exchanged after fixed period" and "Upgrade or repair more expensive than new device"

Again, I want to end this sub-theme by additionally listing three codes that have already been described and analysed within the previous sub-themes *"external influencing factors"* and *"replacement reasons"*.

I suggest that not only the actors, but the system itself has to change in order to improve the status-quo. Organisations shall be encouraged to use devices longer and not be financially benefitted when choosing a short depreciation period or even replacing laptops / PCs after a fixed period of time. Furthermore, the support of repair service centres is of vital importance. These offer jobs for long-time unemployed and are also willing to train them. Thus, they assume responsibility for the society, but also for the environment by saving resources. Through impulses such as tax incentives, pro-environmental practices like purchasing green products or letting devices be repaired may be promoted and made attractive.

4.4.3 Summary of the findings

Within this section, I aim at summarising and discussing the main findings from the conducted interviews. The data revealed that all work-related **practices** performed at Omega Ltd are **supported by IT**, making laptops and PCs essential to work (cp. Mr E6, par. 115). Although, employees related certain problems, occasional system freezes, performance and speed issues, the general satisfaction with the devices was (very) high. Several problems were not even reported to the management, but accepted by the user. These practices strongly diverge from the reported individual behaviour, where problems often lead to replacements (cp. Mr E6, par. 72). Moreover, personal desires for up-to-date technologies are overruled by managerial and financial decisions made by Omega Ltd. Since we are talking about a small organisation, the employee's individual influence is higher as he or she may take part in decision making processes or express desires, if they concern him or her. Nonetheless, the majority reported, that they don't make use of their 'right' as they are satisfied with their work environment, equipment and the decisions made (cp. Mr E5, par. 58).

Consequently, the data gave evidence that the **price-performance ratio** of a device is the **most important criterion** according to the employees (cp. Mr E5, par. 73). Both technical employees,

who were responsible for procurement, searched for the best performance for the smallest price available and decided on Amazon as a vendor at the beginning of 2014 (cp. Mr C3, par. 54-58). Subsequent purchases were based on this selected model, although, long-time evaluations concerning its life span and durability are still missing. This reported practice contradicted the management's willingness to invest more for a better performance, as inefficiently working employees are more costly (cp. Ms C1, par. 6), and to upgrade as well as repair in-house (cp. Ms C1, par. 60). Ms C1 admitted that the importance of use-time, repair possibilities or environmental aspects, which she takes into consideration when making the final decision, were not communicated to those employees being in charge of proposing adequate devices (cp. Ms C1, par. 7-8). With regard to **repair**, Ms C1 related her poor experiences made, as the difference between repair costs and new acquisition expenses are rather small. Due to the overhead effort and missing availability meanwhile, repair only pays off if related costs are less than one fourth of the replacement costs (cp. Ms C1, par. 37). In comparison with other responses, repair was generally perceived as a very expensive and difficult to achieve practice. Complicated to access parts like the mainboard will typically not be repaired or exchanged due to its time intensive repair work (cp. Mr E6, par. 101). Nonetheless, Ms C1 underpinned a minimal use-time of three years, in which repair is performed if necessary – a practice, which none of the employees was aware of (cp. Ms C1, par. 39 and 42-43). In this context, it is interesting to note, that the expected life span after repair was likewise perceived as very low due to a laptop's "*fragile parts*" (cp. Ms C1, par. 26). Mr C3 compared the situation with the repair of a car, where one repair is followed by the subsequent within short periods of time (cp. Mr C3, par. 118). Although the willingness of repair is still existent, Omega Ltd currently procures solely laptops, which are considerably more difficult to repair than PCs. The data revealed that **mobility** and its implied convenience was the main reason mentioned by employees, which outweighed the PC's advantages of modularity and higher life span (cp. Mr C2, par. 194-196; Mr E5, par. 196). Additionally, Mr E6 doubted that single parts are being exchanged nowadays, which, if true, eliminates the main benefit of a PC (cp. Mr E6, par. 182).

Furthermore, the results showed that many organisational **processes** like 'how did I get my laptop?', 'what shall I do in case of problems?' and 'what happens to the laptop after being replaced?' were **unclear** to the majority of employees. Likewise, documentation, maintenance processes and guidelines, how to treat IT devices, have not been defined (cp. Ms C1, par. 84). Mr C2 reasoned that circumstances by explaining that the organisation has expanded over the last years, but structures have not been developed accordingly (cp. Mr C2, par. 14). Several employees reported that their position and/or tasks have changed (e.g. from development to customer contact, from work remotely to programming, from part time to full time), leading to different requirements (e.g. mobility) and intensity of use regarding their devices (cp. Mr C3, par. 42; Mr E5, par. 149; Ms E3, par. 124). All these changed conditions, which shape the state of the device and its use-time, have not been monitored or taken into consideration. It is worth noting, that Ms C1 stored most of the old devices either as backup or due to their contained sensitive data in-house. By narrating about her practice, she highlighted the need for **end-of-life possibilities**, which have been unknown to her, as the organisation is growing (cp. Ms C1, par. 131). Additionally, employees confirmed that they want Omega Ltd to act sustainably with the old, sorted out devices and mentioned several possibilities ranging from donation to recycling.

None of the interview partners knew how long laptops and PCs are being used at Omega Ltd on average (cp. Ms C1, par. 75). Most employees grounded their estimations based on their hiring date and past device(s). On average, nearly four years were estimated. As mentioned above, employees were not informed about the procedure after their use (e.g. stored, passed on,

disposed), limiting their estimation capability. The data revealed, that only Mr E5 explicitly considered pauses in use-time, in other words, he thought about laptops being stored for a certain time period and reused by a colleague afterwards (cp. Mr E5, par. 151). Moreover, nearly all employees rated the **average use-time** in organisations longer than or as long as the average use-time practices of private people. Their perception may be influenced by their individual as well as friends' practices like gaming or high interest in IT, which typically requires more powerful and up-to-date devices. Similar to Mr E6, who admitted that he had replaced his laptop three times in six years (cp. Mr E6, par. 148). In contrast to the average use-time, the management **expected** at least three years **and desired** five years of **use-time** within Omega Ltd (cp. Ms C1, par. 96-100). Employees expected a similar use-time like the estimated average use-time (e.g. between two and five years), but were inconsistent about their desires. Some responses coincided with the expected use-time, with which they were already satisfied (cp. Mr E6, par. 160), some desired a longer use-time (cp. Ms E1, par. 180), and one explicitly highlighted the tension between prolonging the use of an old laptop and buying a new, more powerful one. *“Das ist schwer zu sagen, weil’s meistens so ist, dass man dann sowieso ein besseres, stärkeres Gerät verwenden möchte. Aber grundsätzlich wären natürlich 3 Jahre oder noch länger schon wünschenswert”* (Mr C2, par. 151). One employee even considered a longer life span to be a disadvantage, as no new or up-to-date devices, which are (typically) better than the old or existing one, are procured. *“Also eigentlich ist es Nachteil, wenn er lang hält, weil du dann auf deinem Gerät sitzen bleibst. Dann will man sich auch nicht unbedingt einen neuen kaufen. Da ist es gescheiter, er wird gleich ‘hin’, dann freut man sich, dass man sich einen neuen kaufen kann”* (Mr E5, par. 193). Although, he qualified his comment by suggesting to pass old devices on to people with less requirements and thus, a longer life span is after all beneficial, three employees strictly contradicted his initial thoughts. They concluded that a longer use-time or life span doesn't involve any disadvantages, thus, can apparently be rated as advantages: *“Wenn das Gerät noch länger funktioniert, dann fallen mir jetzt keine Nachteile ein. Wenn jetzt die Geräte grundsätzlich länger leben würden...”* (Mr C3, par. 120).

In general, **positive aspects of an extended use-time** prevailed. Although, several employees replaced their private laptop after a rather short period of time, they were always concerned about passing it on instead of simply disposing it. *“Weil ich glaube kaum, dass für einen Laptop oder für einen PC alle Teile umweltfreundlich produziert werden. Da gibt’s sicher Sachen, die man eigentlich gar nicht wissen will”* (Mr C3, par. 155). Interesting to note, one employee tackled the poor production conditions of a PC or laptop, but argued, that some things are better not to know. By that, he highlighted that our daily IT support is rated too important and useful to renounce its implied convenience and possibilities and thus, one may look away from and implicitly accept unfair circumstances. Besides, mentioned environmental advantages ranged from less CO₂ emissions, less production and waste to saving resources. In an organisational context, a prolonged use-time was related with less procurement, which implied, according to the employees, reduced costs (cp. Ms E1, par. 186). **Financial aspects** were apparently more relevant than environmental impacts. However, I assumed it to be a first impulse into the right direction, which eventually leads to further realised beneficial impacts. During the interviews, employees only had a few ideas how to prolong a PC's or laptop's use-time: cleaning the fan, setting up the system and making use of end-of-life possibilities described earlier. Two employees were in favour of my suggestion of extending a device's use-time, which apparently has to be still functional and capable of processing media, through private use (cp. Ms E3, par. 89; Mr E5, par. 118). The management was positively surprised about these two responses and could imagine offering this possibility in the future. Apart from that, one employee explicitly mentioned that he 'already uses his laptop as long as possible' and doesn't need any motivation to use it longer.

Nonetheless, based on his experiences, he is convinced that after two years, repair, upgrade or if not, replacement, is necessary (cp. Mr E5, par. 229). Although, no frequent maintenance process had been set into practice, employees confirmed that proper IT motivates them (cp. Mr C3, par. 137).

PCs and laptops get **replaced** if they are completely broken (e.g. have a technical defect) or too slow to work with (e.g. persistent speed / performance issues), if a broken hardware component is not easy accessible (e.g. mainboard) or part of an old device (e.g. new / better / up-to-date device desired) or if its upgrade / repair has a bad price-performance ratio in contrast to its replacement costs / new acquisition costs. Additionally, Ms C1 reported that Omega Ltd has occasionally reached the limitations of upgrade possibilities, because devices were too old to be successfully maintained (cp. Ms C1, par. 24-26). Moreover, changed activities may require basic mobility standards (e.g. replace PC with laptop) or even more mobile devices (e.g. thin and light-weight laptops as convenience). Non-technical employees mentioned software problems and system crashes as potential replacement reasons, but indicated that those issues may be handled by proper maintenance. In an organisational context, employees imagined that full depreciation (e.g. fixed turnover rates) is a replacement reason in other companies, but within Omega Ltd, Ms C1 additionally considers the environmental side of the coin (cp. Ms C1, par. 45 and 79). Moreover, IT may be quickly set up (e.g. through images, backups) in contrast to individuals facing problems (cp. Mr E6, par. 138), nonetheless, several employees preferred to keep their own data, settings and enjoy less change (cp. Mr E5, par. 193).

Employees agreed and perceived Omega Ltd as an **environmentally conscious organisation**, not because of their use-time practices or work remotely (cp. Ms C1, par. 133), but due to the checklist on the door addressing energy savings (cp. Mr E5, par. 145) and the available waste recycling possibilities. All confirmed that its pro-environmental aspects are extraordinarily important to the management (cp. Mr C2, par. 178), however, only one employee rated himself as an environmentally conscious person (cp. Mr E5, par. 210) and two colleagues perceived themselves as 'more or less' environmentally aware (cp. Ms E1, par. 202-204; Mr C3, par. 139-143). From my point of view, their perception was underrated, because they either reflected solely upon their use-time practices or suddenly had the impression of 'doing too little' for being a real environmentally conscious person (cp. Ms E3, par. 205-207). In general, none mentioned pro-environmental characteristics as relevant criteria to start working at Omega Ltd. These findings were evident by the employee's general interest in use-time, which was however not overwhelmingly prevalent (cp. Mr C3, par. 108).

Last, the results demonstrated that the interview partners were in two minds about **'Who is to blame for shorter use-times?'**. On the one hand, it is important how consumers use and treat their devices. If they cause them to break after a short period of time, the producers won't produce better (cp. Mr E5, par. 225). In contrast, if the users take care and it nevertheless breaks, the producer is to blame (cp. Ms E3, par. 175). In an organisational context, the data revealed that employees are motivated to take care of their devices as they are the organisation's property (cp. Mr C3, par. 151). Besides, if consumers buy the cheapest products or suspicious cheap offers, they must not be surprised about an implied short use-time (cp. Mr E6, par. 208; Ms C1, par. 129). However, several employees argued that this system may be changed by signalling a different demand. On the other hand, the close assembly, use of glue instead of screws and poor cooling of certain parts (e.g. graphic chip) in the laptop are the producer's fault and may be intended, as Ms C1 has perceived a decrease in the laptops' life span (cp. Ms C1, par. 87) and Mr E5 has observed

less possibilities of repairing or upgrading himself (cp. Mr E5, par. 235). Organisations shall exert greater pressure on producers to make devices more durable (again). Only one employee additionally blamed the government, who allows producers to poorly manufacture and assemble devices with low life span (cp. Mr E5, par. 227).

4.4.4 Lessons learned

When analysing the interview data, I first had problems of applying the thematic analysis approach. Due to my questions I had prefixed codes in mind and started coding with generalised phrases like 'replacement reason'. Therefore, I didn't distinguish between the several reasons mentioned, but grouped them automatically into one code. Not only that I biased the data, I lost important and new insights into the variety and nested information within the answers given, which are not initially obvious. Through this process it became apparent, that people tend to only partly answer the posed question, but provide information beyond the topic. By the help of an instructor and recommended literature by him, I started from scratch and coded every important comment. Afterwards I performed two iterations to rename, restructure and reorder my codes. After several iterative revisions, I was finally able to recognise the main statements and messages represented through my codes.

After rereading my transcriptions several times, I was confronted with my inexperienced interview style: many questions like 'Why?' and 'What do you mean by that?' were missing. During the interviews I often didn't realise the necessity to ask more into detail. Moreover, I rarely highlighted contradictions within the same interview, and thereby missed the chance to challenge my interview partner to explain them. Apart from that, I asked some suggestive questions heading towards my pre-defined direction, which I had not realised until listening to the audio-record.

4.5 Workshop

To conclude the analysis of the status-quo and to begin the section of improvement, we planned a common workshop for all employees. Aim of the workshop was to create a common baseline for Omega Ltd from which improvement may be evaluated afterwards. Therefore, the structure of the workshop was divided into the following four parts:

1. Electronic waste as a consequence of premature replacement of PCs and laptops
2. Insights into the results from the online survey and interviews
3. Developing and specifying the common vision and the derived main goals in written form
4. Further materials and take action possibilities

The first part was presented by myself and focused on the two main questions: 'How many PCs and laptops are disposed?' and 'What impacts does it have?'. At the beginning, I included a short video called '*Citizens at Risk*' from a collaboration between Silicon Valley Toxics Coalition, Chintan Environmental Research and Action Group, and IMAK News and Entertainment, which *"takes the viewer to relatively unknown and forgotten areas in and around Delhi, and shows how the poor, both children and adults are forced to recycle highly toxic waste materials under perilous conditions. It points out the need for manufactures to demonstrate responsibility and help adults to upgrade into viable businesses"* (Bhagat / Chaturvedi 2008). Furthermore, striking statistics about global e-waste as well as Austrian measured behaviour and UN estimations about the increase visualised in pictures were presented to the audience. By demonstrating facts with moving and non-moving images, people are being made sufficiently aware of and sensitised to a given issue. Afterwards, I showed negative ecological as well as moral implications like landfill, child labour or pollution and

pointed out the current problems concerning rudimentary recycling and conflict minerals. In order to conclude the first part of my presentation, I introduced the prolonging of use-time as a chance, which may reduce greenhouse gases polluted during production and influence the producer's supply. Lastly, I presented the waste management hierarchy as an illustration of priorities and my master thesis's approach in cooperation with Omega Ltd. After finishing the first part, no questions or feedback arose. However, I had the general impression that the majority was curious and interested while listening to my presentation.

Within the second part of the workshop, I gave some insights into the results from the online survey and the seven conducted interviews. The answers of the majority were highlighted to capture the status-quo more easily. From the interviews I compared responses given regarding 'average use-time at Omega Ltd', 'expected / desired use-time', 'replacement reasons', 'possibilities to prolong the use-time / life span' and 'Omega Ltd as an environmentally conscious organisation'. Ms C1's answers were not anonymised in order to have a standard value. Moreover, I gathered questions and processes concerning Omega Ltd, that were partly unclear or unknown to the interview partners and suggested the CEO to answer them in plenary. As she hadn't had time to prepare herself before the workshop, she confirmed to answer them at a later point in time. Besides, I gathered questions regarding use-time which arose during the interviews. These ranged from questions that I will (partly) tackle during my master thesis, questions that have already been answered by different studies to questions that were out of scope, but interesting for future work. Last, I opened the floor for a discussion and asked 'What could change for the positive?'. The presented slide included further sub-questions as causes for thought and I underpinned that any feedback, suggestions, critics and ideas are more than welcomed. Comments and discussion will be analysed and interpreted in the next chapter.

The third part was dedicated to develop and formulate a common vision and based on that, derive main goals as both haven't existed so far. When I suggested this part to Ms C1 before our interview, she was immediately in favour of my plan, but sceptical to what extent employees would actively participate. Therefore, I prepared two slides resulting from the online survey and the conducted interviews in order to support the process, whose analysis may be found in chapter 4.5.2.

I rounded off the workshop with a fourth part including further video material and links for those more interested in details. On the last slide I stated a quote from HP founder David Packard in 1947 with the aim to address everybody to take action: *"The betterment of society is not a job to be left to a few. It's a responsibility to be shared by all"*.

All in all, the workshop was entirely audio-recorded in order not to miss any ideas, comments or feedback. Post-notes representing the course of the workshop were taken and only important comments were literally transcribed. In total, the session lasted one and a half hours, took place on the 28th of July and nine employees plus the CEO attended. Due to summer holidays not all employees were able to participate. However, the slides were sent to all employees the day after the workshop in order to give everybody the possibility of reading it.

4.5.1 Comments and discussion

Within this section I aim to report only relevant topics and to leave out discussions taken out of the context or of little importance.

I started the second part by raising several questions like *"What would you want to change within Omega Ltd?"*, *"How could the use-time be prolonged / optimised?"* and *"What would motivate you?"*.

First, everybody kept silent until Mr E5 broke the ice and started the discussion by asking the others about the laptop's optimal battery usage. This was one of the unclear questions I gathered and presented during the result insights. During the discussion they differentiated between older and newer battery generations, stating that latter are supposed to be not negatively affected by the power supply or interrupted charging cycles. Thus, I noted as a first to-do to ask repair services and producers themselves for more information. Ms C1 remarked, that manufacturer's information must be accepted with caution as new sales are part of their business model.

As an impulse for further discussion, I asked if the problem of e-waste was already familiar and whether documentaries or images have reached them so far. Again Mr E5 answered, that resource scarcity should be known by now, however, we are facing severe problems. He argued that it is difficult to change the producer's behaviour and to influence, which resources are being used. Moreover, he reflected that most producers probably don't know about their resources' origins. Consequently, I suggested to research for a producer ranking regarding their social responsibility. Ms C1 confirmed that is important to discover which manufacturers care about their environmental footprint.

Mr E5 mentioned the former intention of having an environmental officer and Ms C1 admitted that the person in charge hasn't had time so far and may be replaced, if somebody is voluntarily interested in the task.

Moreover, Ms C1 expressed the wish for more information about repair networks as she hasn't made any positive experiences so far. Recommendations would be very helpful to prolong an old device's use-time. Additionally, Mr C2 reported to have a broken monitor and Mr E5 complained that repair has become more difficult, making him afraid of trying to fix it compared to former times, when he unscrewed everything himself. Thus, I added this topic including related costs and services to my to-do list.

Following recent incidents, namely the pouring out of liquids leading to sticky keyboards, Ms C1 suggested to analyse the workplace into more detail. Enough space for the usage of an external monitor, key and mouse is given and due to convenience already applied. Nevertheless, I added the topic to the overall to-do list in order to discuss it within a future action meeting.

To encourage further debate, I asked for their desires, wishes and circumstances that would motivate them to change the status-quo. For the first time, Mr E10 replied and asked, if manufacturer's initiatives to produce longer-lasting devices exist. He argued that most laptops break after three to five years and he was wondering whether a platform with information regarding more durable devices exists. Ms C1 agreed and Mr E5 added that a longer-lasting product may also cost more. He reflected that for their internal work remotely little computing power is necessary and laptops may be used as long as the connection can be established. Moreover, he mentioned the aspect of the recent Fairphone² offering repair possibilities and asked, if also a 'Fair-laptop' exists. Again Ms C1 agreed and expressed her desire for more repairable laptops. Moreover, she argued that in order to save repair costs, she would like to be capable of repairing laptops herself or at least in-house. As all confirmed that information is difficult to discover and access, I included this issue on my to-do list.

As Mr E5 has already mentioned before, Omega Ltd mainly performs its tasks remotely. Additionally, he reported of having supported a crowd funding project, which aimed to develop

² <http://www.fairphone.com>

the first Android PC³ for about 40\$. Although, reparability is probably poor, less resources are needed and the required performance would be given. Mr E7 compared it with the functionality of a thin client.

In general, mainly four employees and Ms C1 participated actively in the discussions. One employee, who was already very timid during the interview and didn't seem to be interested in the topic 'use-time', didn't say anything at all. My part in the discussion was to comment little, provide impulses for further discussion and make room for worries and feedback. Although, most of my raised questions have been left unanswered, it was a prosperous discussion with many new ideas for the upcoming action meetings phase.

All written down to-dos from the discussions, post-notes, audio recording and post questionnaire were answered during the action meetings process and presented at the end of the final presentation.

4.5.2 Developing a common vision

The third and interactive part of the workshop aimed at developing a common vision and main goals for Omega Ltd. However, in the end we ran out of time and therefore, focused solely on the vision as a common basis. During this part I switched roles and attempted to influence the situation as little as possible. Thus, Ms C1 was responsible of moderating this session. I only intervened with short comments or impulses when I had the impression of longer breaks or prevalent silence. In order to recognise group dynamics, practices, reactions and participation behaviour I additionally took observation notes.

First, we had a closer look at my two prepared slides resulting from the online survey and the conducted interviews. I assumed, that these essentially supported the beginning of the process in order not to start from scratch. Immediately, Mr E5 related that as a scout he has already often developed a vision and suggested to perform a brainstorming for 'Omega Ltd's vision 2020' on a flipchart. The leading question was *"How do I want it to be in 2020?"*. From this moment on, he moderated the process and Ms C1 stepped back into a co-moderating role.

The first written down idea was a 'Fair-laptop' suggested by Mr E5 himself, arguing that it would be a significant achievement by 2020. As the remaining employees kept silent, Ms C1 asked *"What else do we want to have until then?"*. Moreover, I intervened that the vision should reflect all involved and everyone may contribute or vote for an already existing aspect. In the meantime, Mr E5 added the terms 'Quality' and 'Consumer satisfaction', probably inspired by the slides in the background, to the flipchart. Next, Ms E1 raised her voice for the first time and suggested 'New customers' to be part of a future-oriented vision. Again, Mr E5 added 'Working atmosphere' while the others were thinking and observing the situation.

Interestingly enough, Mr E10 suddenly raised the question *"For what do we actually want a vision?"* and argued that it would be important to know. Perhaps the relevance and advantages were not made clear and obvious enough to every employee, leading to hesitant behaviour and statements. Immediately, Mr E5 responded that now everybody has the chance to express his or her desires for 2020 by stating *"I want, that..."*. Additionally, I motivated them to think about aspects they want to stay as they are and which they want to be improved.

³ <http://www.jide.com/en/mini>

After this intermediate discussion, employees participated more actively and voluntarily. Mr C2 suggested a better 'Documentation', even though *"no one wants to say it"* as it is related to additional work. Moreover, Mr E10 suggested 'Standardised' and an improved 'Customer communication', where customers are using the available ticket system. Again Mr E5 slipped into the moderator role and explicitly stated that *"during brainstorming, all ideas are allowed and won't be valued"*. This is an important aspect to mention, as some employees are too introverted to participate because of their fear being evaluated or graded.

Although, Mr E5 and Mr C1 expressed their perception of being already finished, I intervened in order to give all colleagues a final opportunity to add their ideas to the flipchart. All of a sudden, Mr E10 stated 'New technologies' and for the first time Mr E7 raised his voice to add 'New products' to the brainstorming list, followed by a discussion about 'Being state-of-the-art'. After, Mr E10 suggested to add 'Efficiency', Ms C1 intervened that up to now the presence of environmental topics has been disregarded. Consequently, Mr E5 included 'Environmental friendly' on the list. Thus, the environmental component was represented by two terms, which I critically reflected afterwards as not much, but more than before and hence, a little, but considerable improvement into the right direction. Last, Mr C2 added 'Structured working' to the list.

Afterwards, Mr E5 suggested to structure all listed terms into groups. First, all ideas were sorted into the following three sections: 1. 'Technology', 2. 'Organisation' and 3. 'Environment'. However, Ms C1 intervened that the first group is too general from her point of view and was therefore split into 1.1 'Technical innovation' suggested by Mr E10 and 1.2 'Working method' proposed by Mr E5. Resorting the terms was followed by a discussion were to put 'Quality' as it was perceived as an overarching criterion. Finally, it was grouped into the section 'Working method' together with 'Efficiency'.

Furthermore, Mr E5 started a second sheet of paper to evaluate the status-quo of these terms. Therefore, he first slightly renamed the three categories and added a fourth. Moreover I suggested to explicitly state the desired working method, leading to the following outcome:

1. Technical innovation / Product development
2. Working method (qualitative, standardised and efficient)
3. Environmental friendly
4. Customer-oriented

Although, I claimed that 'Technical innovation' is very abstract and Mr C2 argued that automation contradicts innovation, the categories were not further adapted. Besides, the adjective 'standardised' subsumed 'structured' as Mr E5 explained the latter to be a pre-condition. Next, Mr E5 drew a grid with a row for every category and a column for the status-quo. The first idea to rank the degree of improvement (improve, stay as it is, decrease) was dismissed due to ambiguities. Everybody had to become interactive, stand up and evaluate the current state of each section by making a stroke in the particular cell. It is important to note, that also Ms E4, the intern, and myself were invited to rate the situation based on our impressions so far.

Regarding the results (see Figure 8), 'Method of working' and 'Technical innovation / Product development' were prioritised to be improved. The third and fourth category were partly perceived as already very satisfying and positive. However, most votes were given in the middle column, a behaviour, which I assumed to happen because of timidity to rate '-', little self-reflection

and group dynamics. Some new employees might also have had too little insights into general practices.



Figure 8 - Developing a vision

Due to time reasons we decided, that one person is going to write down the vision and we will coordinate a second session for defining associated goals. To conclude this part of the workshop, I thanked everyone for their participation and congratulated them as well as us what we have accomplished within forty minutes.

Unfortunately, the completion of this step wasn't part of our cooperation in the end, again due to time constraints. Within the final reflection meeting we discussed further steps (see chapter 4.8). It will be interesting to see, how environmental aspects will be included in the written down vision and which goals will be derived. Although, I was somehow disappointed to not complete this step within our common cooperation, our work during the action meetings phase and our final concepts may had considerable positive influence on the definition, which would not have been the case beforehand.

4.5.3 Post questionnaire

The post questionnaire aimed to measure the on-going development since the first online survey, get written feedback and recognise changes driven by my interaction and participation so far. It was sent out two days later, in order to give the attendees time to have a look at the slides. Based on the first online survey, my post-notes and impressions from the workshop, I developed the questions and structured them within five sections. The selection of answers were taken from the presentation given within the workshop. Except Ms C1, all participants filled out the post questionnaire.

1. E-waste and use-time

The first section was the longest and most detailed one, as most people may concentrate better at the beginning of a questionnaire. In the following paragraphs I aimed to discuss only the main results.

Q1: *"Have you ever dealt with the topic 'e-waste' before?"*

- More or less intensively (4)
- Less intensively (4)
- Not intensively at all (1)

Q2: *"How important do you perceive the topic 'e-waste' after the workshop?"*

- Extremely important (2)
- Very important (4)
- More or less important (3)

Although, participants haven't dealt with the topic 'e-waste' in the past, the workshop seems to have influenced their perception of importance. Nobody has rated the topic's relevance as 'little important' or 'not important at all'. The development of this attitude will be measured with the final presentation post questionnaire.

Q3: *"Why has your attitude to the topic 'e-waste' (not) changed after the workshop?"*

More interesting to analyse are the reasons for their change in attitude. Five participants stated that they have changed their attitude because of the workshop and argued by writing the following:

- *"Ich habe nie an die schädlichen Stoffe gedacht und ich hatte wirklich keine Ahnung, wo man die Computer transportiert, um sie zu recyceln."*
- *"Vor allem der kurze Film hat eindrucksvoll bewiesen, welche Schäden und langfristig negative Einflüsse der ,E-Waste' auf die gesamte Erde haben kann."*
- *"Da ich zuvor nie mit dem Thema in Verbindung gekommen bin, und mir daher auch keine Gedanken darüber gemacht habe."*
- *"Aufgrund des Workshops habe ich mich mit dem Thema beschäftigt, wodurch sich meine Sichtweise geändert hat."*
- *"Weiß jetzt besser Bescheid"*

These comments made obvious, that consumers are not directly affected by their practices of prematurely replacing their laptop. I assumed that the video has explicitly demonstrated where e-waste may be transported and which impacts it has on the local people and environment. It is not a matter of available information on the Internet, but I suppose a lack in our educational system. Moreover, our economy is still based on increasing consumption, which rarely involves environmental or social impacts. These consequences are mainly addressed by NGOs, initiatives and volunteers. However, some start-ups focus on sustainability and may change the market profoundly not least because of crowd-funding projects.

Those employees, who reported that their attitude has not changed, were already more critically reflecting upon consumption behaviour, resource exploitation and illegal e-waste:

- *"Mittlerweile gibt es schon recht gut zugängliche Informationen zu Konsumgeneration, Ressourcenausbeute, Entsorgen in 3. Welt Länder,..."*
- *"Die meisten der im Workshop angesprochenen Themen habe ich bereits vorher als Problem gesehen, auch wenn mir einige der Fakten nicht bewusst waren. Der Workshop hat mir aber*

einige zusätzliche Probleme durch E-Waste aufgezeigt und mich darin bestätigt, in Zukunft noch mehr darauf zu achten."

- *"Durch die Informationen die ich vorher schon hatte wusste ich doch schon sehr viel, meine Einstellung war vorher schon eher kritisch."*

One comment stood out by narrating that she has already grown up with these practices of using devices as long as possible. Moreover, she stated that she is an explicitly pro-environmental person, who hopes that more organisations and in general private persons will act more consciously: *"Der Workshop hat meine Einstellung zu E-Waste bestätigt. Ich war schon dafür Sachen/Geräte bis ,zum Schluss' zu verwenden (bin so aufgewachsen) und wir haben auch zuhause nicht die neuesten Technologien. Da ich extrem FÜR den Umweltschutz bin, finde ich es sehr gut dass du dich mit diesem Thema befasst und hoffe, dass in Zukunft viele Unternehmen, aber auch generell jeder, bewusster mit elektrischen Geräten umgeht"*.

Q4: *"Which facts / impacts regarding 'e-waste' have you already known?"*

- Pollution of noxious substances and environmental pollution (7)
- Recycling only partly possible (7)
- Child labour (5)
- Illegal transport to developing countries (4)
- Landfill (4)
- Hazardous substances / Rare earths / EU Critical Minerals (3)
- Severe health problems and genetic malformations of the workers (3)
- Conflict minerals (Democratic Republic of Congo) (0)

Answers were ranked according to their votes. Although, participants have barely dealt with the topic 'e-waste', seven out of nine respondents knew about pollution and recycling problems. More than half of the participants have already been aware of prevalent child labour at dismantling and recycling areas in developing countries. Interesting enough, final disposal like landfill including critical resources and associated health problems were only familiar to a few attendees of the workshop. Respondents of the post questionnaire also had the possibility to add a different known fact or impact within a text field called 'Others', however, none made use of it.

Moreover, I asked an open question which information / facts regarding 'e-waste' have surprised or shocked them the most:

- *"Das trotz Trennung/Recycling der ,User' so viel Müll überbleibt"*
- *"Landfill war mir nicht bekannt, schockiert mich!"*
- *"Illegaler Transport; die ,E-Waste'-Stadt vom Video."*
- *"Kinderarbeit mit den gefährlichen Stoffen"*
- *"Umweltverschmutzung"*
- *"Die Zustände, unter denen der Müll in Entwicklungsländern recycelt wird."*
- *"Dass der Abfall dieser Produkte teilweise unter der Erdoberfläche gelagert wird und das für unsere Umwelt mit Sicherheit nicht gerade positiv ist ..."*
- *"Erkrankungen / Missbildung (schockiert)"*
- *"Die Erkrankungen der Arbeiter und wie sie ausgenützt werden"*

Thereby, participants had to reflect upon the workshop and the given presentation once again. Answers ranged from landfill, illegal transport, recycling conditions within the city of the video to

severe health diseases / malformations of the workers, child labour and environmental pollution by all these practices. Most respondents were obviously shocked not surprised by these circumstances.

Q5: "How important do you perceive the topic 'use-time' after the workshop?"

Results after the first online survey	Results after the workshop
Extremely important (0)	Extremely important (1)
Very important (3)	Very important (6)
More or less important (10)	More or less important (2)
Less important (0)	Less important (0)
Not important at all (1)	Not important at all (0)

Table 2 - Influence of workshop on use-time

- By asking this question, I aimed at measuring the progress and potentially direct influence of the workshop compared to the first online survey (see Table 2). First of all, I would like to note with satisfaction that a shift towards greater importance has taken place. As not all employees participated in the workshop, thus, the amount of answers differ. Moreover, Ms E4, the intern, who was only employed in July and August, had no chance to fill out the first online survey, but rated the topic 'use-time' as 'Extremely important' after the workshop. Besides, Mr E12, who was the only employee selecting 'Not important at all' in the first online survey, has never participated in any further meetings or questionnaires again. Consequently, the main development appeared from 'More or less important' to 'Very important' strengthened by the fact that Ms C1, who chose 'Very important' in the first online survey, didn't fill out the post questionnaire.

Q6: "Why has your attitude to the topic 'use-time' (not) changed after the workshop?"

Interesting to note, the stated change in attitude (yes/no) and the comparison between both importance ratings (online survey / post-questionnaire) didn't directly coincide. For instance, two employees still rated 'use-time' to be more or less important, but reported that their attitudes have changed after the workshop. I supposed, that some didn't remember their answer in the first online survey.

Nevertheless, I wanted to give insights into the reasons stated for changing attitudes. Four of nine respondents perceived a development and explained it in the following way:

- *"Da mir das Thema e-waste nun bekannt ist, und durch die heutzutage sinkende Nutzungsdauer viel mehr e-waste anfällt"*
- *"Besser bewusst was getan werden kann"*
- *"Um die oben genannten Problemfelder nach Möglichkeit zu verringern und eben weniger ‚E-Waste‘ zu produzieren."*
- *"Es gab interessante Informationen und Links (reparaturnetzwerk.at, etc). Dadurch Überblick über mögliche Informationskanäle in Bezug auf Nutzungsdauer."*

The main reason mentioned was the introduced topic 'e-waste', which one argued being the result of a shorter use-time. Two employees were influenced by the information presented and became aware of possibilities to improve the status-quo.

Besides, the remaining five respondents argued that their attitude has not changed after the workshop as they have already been conscious of using their devices as long as possible or passing

them on. Therefore, I only wanted to highlight two interesting parts of comments: *“Ich glaube, dass ich nicht mehr machen kann“*. Thus, it became one of my aims during the action meetings to change the employee’s perception of not being able to change their practices to the better. Moreover, one employee stated, *“[...] und es mir nicht wichtig ist die neuesten Technologien zu besitzen“*. By regularly maintaining older devices, they are longer efficiently useable and consequently, up-to-date technology is not necessary.

Q7: *“Which facts / impacts regarding ‘use-time’ have you already known?”*

- Prolonging by passing device on (9)
- Majority of e-waste (laptops) still functional (5)
- Decisions / demand influence producer (4)
- Savings of greenhouse gas emissions by long-lasting laptops (including repair) (3)
- More than 50% of greenhouse gases during production (1)
- Waste hierarchy (reduce, reuse, recycle, energy recovery, disposal) (1)

By asking this question, the awareness of use-time may be evaluated. All respondents have already known about the possibility to pass old devices on and thereby, extend the use-time. This corresponds to the answers given during the interviews as many employees related this lived practice. Interesting to note, one employee only selected this fact as already known. More than half of the participants have already been aware about the fact that many discarded laptops are still functional. The most striking result from my point of view was that only four employees are conscious about their influences on producers by changing their demand. Admittedly, it has no direct effect and market changes need time, but like in the food industry, adapted demand led to more organic food supply in the long-run. However, people are worst off when they have the perception of being helpless and thus, accept the status-quo. The remaining three facts were results of lack in environmental education and being sufficiently informed.

Q8: *“Has the workshop been able to arouse your interest in the topic ‘use-time’?”*

Seven out of nine participants responded with ‘yes’ and explained their awakened interest by the following statements:

- *“Gute Präsentation, Fakten”*
- *“Wusste nicht, dass es diese Fair Laptops gibt, die (hoffentlich) langlebiger sind. Ärgerlich dass Geräte nur 2 Jahre halten.”*
- *“Wegen schockierendem Video.”*
- *“Besser bewusst was getan werden kann”*
- *“Da es mich überrascht hat, dass gerade die Produktion schon sehr umweltschädlich ist. Weiters dachte ich nicht, dass so viele weggeworfene Laptops noch funktionieren würden.”*
- *“Interessante Links zu Videomaterial.”*
- *“Obwohl ich schon immer versuche elektronische Geräte nicht wegzuwerfen, ist es interessant mehr darüber zu erfahren.”*

Unfortunately, one employee misinterpreted a fact, apparent in the second comment, which included the surprised reaction about the existence of ‘Fair-Laptops’. However, it may be seen that the interest and demand for longer-lasting products was present. To conclude the answers given, one may say that the presented information, links and facts were interesting to the audience and an important impulse for their aroused interest.

The eighth employee only responded with 'no' as his interest has already existed before the workshop. Thus, only one employee is actually not interested in the topic, which was not surprising as she had already replied in a similar way during the interview. Nevertheless, she mentioned to take these facts into consideration for further decisions: *"Ich finde das Thema wichtig, und werde es persönlich bei zukünftigen Entscheidungen miteinbeziehen, aber ein richtiges Interesse hat es nicht geweckt".*

Q9: "Have you already brought the topics 'e-waste' and 'use-time' into relation before the workshop?"

Interestingly enough, only five out of nine participants associated these two topics with each other. This fact underpinned my assumption of a consumer not being directly affected by his or her practices. I considered it of vital importance to combat this missing link.

Q10: "What information / facts have been missing?"

In order to react and adapt the following process to the employees' demand and concern, I was interested what information or facts were missing. Five respondents had constructive ideas, which influenced our action meetings and research work:

- *"Vielleicht Produkte/Firmen die auf Langlebigkeit setzen"*
- *"Wie schaut es in Europa aus?"*
- *"Statistiken über die Lebensdauer von Elektronikprodukten nach Herstellern; was passiert mit E-Waste, der in Österreich (Wien) an Müllsammelplätzen entsorgt wird; Fair-Recycling-Initiativen?"*
- *"Evtl. wären noch mehr (konkrete) Informationen/Tipps zur Verlängerung der Nutzungsdauer interessant gewesen"*
- *"Betrifft wahrscheinlich jetzt nicht direkt Dein angepeiltes Gebiet, aber es wäre eventuell interessant zu wissen, wie es mit der Kinderarbeit aussehen würde, wenn es diese E-Waste nicht gebe. Also, ob es tatsächlich weniger Kinderarbeit geben würde oder da dann einfach ein anderes Gebiet stärker betroffen werden (keine Ahnung, ob man sowas überhaupt heraus finden kann)"*

The first three comments led to a summary of links introduced in the final presentation. Moreover, the fourth comment addressing the desire for concrete improvement actions was apparently our main focus of the action meeting phase and simultaneously the central outcome of our cooperation. Therefore, this information wasn't presented in detail during the workshop. Concerning the last comment, I was very positively surprised about the employee's reflection upon child labour and whether it would sustainably decrease by less e-waste or just shift to a different sector. Unfortunately, I couldn't find any relevant study or public information regarding this topic.

Q11: "What did you like / dislike about the first part of the workshop?"

In general, participants were extraordinarily satisfied with the first part of the workshop. None reported critics, only one referenced to Q10, where missing information was reported. Positive feedback included: a good overview was given, interesting new information and a demonstrative video. Apart from that, I wanted to list three comments explicitly:

- *"Die Fragen geben einen guten Überblick, mit welchen Themen wir uns mehr auseinandersetzen sollten"*

- *“Mir hat das Video sehr gut gefallen, dass die schlimmen Zustände sehr gut veranschaulicht hat.”*
- *“Ich habe viele neue Informationen und Fakten präsentiert bekommen, die mich in meiner bisherigen Vorgehensweise bzgl. E-Waste bestärken.”*

The first comment referenced to the unclear questions and processes regarding Omega Ltd itself as well as the use-time. Thereby, the employee is aware of which areas may be improved and changed to the better. Furthermore, the second comment illustrated the importance of moving images and their power to influence people. The last comment demonstrated how facts and new information may underpin and empower already existing practices.

2. Results from the online survey and interviews

The second section of the post questionnaire dealt with the participants' rating of the presented results from the online survey and interviews.

Q12: “How important did you perceive the presentation of the results?”

- Extremely important (2)
- Very important (4)
- More or less important (3)

Based on these answers, I assumed that the presentation of the results was interesting for the participants. I included the data, because the progress of our cooperation should be transparent to every employee, because I wasn't able to conduct an interview with every staff member. Moreover, I supposed that if people take their time to fill out a survey, they want to compare their answers with the others given.

Q13: “Which results did you find particularly interesting?”

- Possibilities to prolong the use-time / life span (9)
- Average use-time at Omega Ltd (7)
- Omega Ltd as environmental-friendly organisation (5)
- Expected / desired use-time (3)
- Inventory (online survey) (3)
- Replacement reasons (2)

Apparently we were able to arouse the participants' interest in the possibilities to prolong the use-time, which is our cooperation's main goal. Moreover, my interview partners were uncertain about the average use-time at Omega Ltd and therefore, found it particularly interesting to get insights in Ms C1's and their colleagues' answers. Apart from that, more than half of the participants were curious about environmentally conscious practices within Omega Ltd, which again underpinned their support of moving into the right direction. The remaining three categories have certainly been known to most of the attendees.

Q14: “Which results surprised you the most?”

Eight out of nine participants answered the current question, resulting in some interesting comments:

- *“Die erwartete Nutzungsdauer”*

- *“Die Nutzungsdauer kann verlängert werden”*
- *“Umweltbewusstsein der Firma (und die weitere Stärkung dessen)”*
- *“Überrascht trifftts wohl nicht wirklich, aber die möglichen Austauschgründe waren für mich sicher am Interessantesten.”*

From my point of view, I agree that the differences regarding the expected use-time were one of the most interesting outcomes as it ranged from two to five years. The second comment revealed that not all employees were aware of the fact, that the use-time may be prolonged. Thus, the workshop has clearly achieved one of its goals. Regarding the third comment, this made clear that the absence of communication regarding Omega Ltd aiming to be an environmental-friendly organisation exists. Last, one employee argued that the mentioned premature replacement reasons were most interesting. Two employees reported that the results either corresponded to their previous observations or were actually not surprising.

Q15: “How important are Ms C1’s answers to the unclear questions to you?”

- Extremely important (1)
- Very important (4)
- More or less important (3)
- Less important (1)

More than half of the participants rated the answering of the gathered questions at least as very important. However, I was surprised by these results as I would have assumed a more unambiguous result. One employee, who rated it to be ‘more or less important’ explained that Ms C1 has already little time, therefore a written reply would be sufficient. This may also be an applicable reason for his colleagues’ answers. Another employee, who perceived it as ‘very important’ agreed, *“Schriftlich würde mir reichen. Oder auch gerne bei einem Round Table. Da würde ich mich ganz nach der Ms C1 richten”*. In general, most employees expressed their desire for a common meeting in order to answer the questions. Unfortunately, Ms C1 couldn’t reply to the questions within our cooperation due to time constraints. However, we discussed it as one of the next steps within the final reflection meeting.

Q16: “What did you like / dislike about the second part of the workshop?”

Again, participants were very satisfied with the second part and only criticised the missing time to answer the gathered questions already within the workshop. I had to agree, that I was somehow disappointed that we were lacking of time as it would have been an exceptional opportunity to address prevalent uncertainties among the staff members.

Moreover, one employee stated as a positive feedback, *“Explizit aufzeigen, was bei uns bereits alles zum Thema Umweltschutz getan wird, und wo noch mehr getan werden kann”*. Besides, one colleague positively remarked that Ms C1’s answers, given during the interviews, were not anonymised. By reading this comment, I felt confirmed in my decision to create a benchmark by explicitly stating Ms C1’s replies.

3. Omega Ltd’s vision and goals

The third section of the workshop dealt with developing Omega Ltd’s vision and goals. It was the first time within our action research process to include all participants and offer them the time

and space to commonly develop a part of Omega Ltd. As I attempted to intervene as little as possible, I was wondering if my observations corresponded to the online feedback.

Q17: "How important did you perceive the development of Omega Ltd's vision and goals?"

- Extremely important (1)
- Very important (5)
- More or less important (3)

The majority of employees perceived the development as very important. My observations overlapped in so far as the employee, who was very introverted during the workshop, selected 'more or less important'. Moreover, the employee, who was very embarrassed during the interview to not being able to answer the question regarding Omega Ltd's vision and goals correctly, selected consequently 'extremely important'.

Q18: "How important was the possibility to actively participate in the process of developing Omega Ltd's vision and goals to you?"

- Extremely important (2)
- Very important (2)
- More or less important (3)
- Less important (2)

According to the results, my impression, that employees have not been used to this kind of interaction and additionally don't desire it, was confirmed. As I have already mentioned, mainly four employees actively participated in the workshop and those have rated the interactive process as very or extremely important. Nevertheless, I am convinced that it was worth attempting it and everybody may be satisfied with the outcome.

Q19: "In how far do you agree with the statement, that your suggestions / wishes / ideas were taken into consideration during the process?"

- Strongly agree (6)
- Somewhat agree (3)

All employees were being included and listened to. In order to achieve this atmosphere, I intervened three times by motivating all participants to raise their voice and express their thoughts. As it was a brainstorming process, all ideas and suggestions were taken into consideration without valuing them.

Q20: "What did you like / dislike about the third part of the workshop?"

Although, five employees rated the possibility to actively participate as (more or) less important, six positive feedbacks included the terms "interaction", "brainstorming" or "working together". For instance, one employee, who rated Q18 as less important stated, "Jeder wurde miteinbezogen, was ein Bild des IST-zustands geschaffen hat". Thus, I decided to take the answers of Q18 not too seriously.

One of the active participants criticised that more suggestions from the entire team would have been desirable. Another very interested employee argued, "Doch ein bisschen zu lang gedauert (obwohl es ja ein sehr wichtiges Thema für Omega Ltd ist, das noch besprochen werden muss)". As

employees have a tough time schedule, long creative processes seem not to be that common. The remaining attendees didn't express any critics.

4. Further material

The fourth part of the workshop included further links and videos to get more involved in the topic. Therefore, slides were sent to the employees two days before the questionnaire in order to give them time to have at least a short look at them. Moreover, it was a second impulse to go through the slides once again.

Q21: "How important do you rate further material concerning the topics 'e-waste' and 'use-time von PCs and laptops'?"

- Extremely important (1)
- Very important (6)
- More or less important (2)

More than half of the employees perceived it as a very important link summary for further details. Only two generally less interested participants rated the further material as more or less important.

Q22: "Have you already had a look at some links / videos from the section 'further material'?"

Only two employees had a look at some links or videos. Both watched a further documentary about e-waste in Ghana, one of them additionally skimmed over some websites. The remaining seven participants argued that due to lack of time they had not been able to access them. Additionally, one of them reported, *"Ich hatte keine Zeit, aber werde sie mir sicher mal anschauen und Freunden zeigen"*. Unfortunately, one employee stated that he didn't know where to find the information.

When asking, if they have planned to take a look at further materials, all employees answered with 'yes'.

5. Future

The last section of the post questionnaire didn't directly relate to the presentation, but concerned the introduced future action meeting procedure to develop improvement possibilities. As it would have gone beyond the scope to include everyone within the iterative process, I thereby asked for their suggestions, desires, but also fears.

Q23: "How important do you rate to try out improvement possibilities regarding the use-time at Omega Ltd?"

- Extremely important (1)
- Very important (7)
- More or less important (1)

Regarding this result, I was very satisfied to discover that more or less all employees are in favour of developing and implementing improvement possibilities. It is of vital importance to have the support of the staff members involved as in the end they will have to follow new guidelines and

change certain practices. Moreover, I felt confirmed, that people are more interested in changing the status-quo than only analysing the current situation from a theoretical point of view.

Q24: "From your point of view, in which areas should improvements regarding the use-time be applied?"

- Maintenance (5)
- Procurement (5)
- Repair (4)
- Communication (3)
- Documentation (3)
- Process definition (2)
- Use (2)
- End-of-Life (1)
- Storage (1)
- Certification (0)

In order to get a feeling where to start with our improvement actions, we let the employees decide. It is apparent that the majority aimed at procuring more durable laptops and maintain them regularly in order to use them longer, but without waiving good performance. Moreover, repair was considered an important area for improvement. A need for better communication and documentation was at least desired by three participants. Interesting enough, 'use' was downgraded. I assumed that firstly, employees have the perception of already treating their devices as carefully as possible. Secondly, if we discovered that their use could be improved, that would lead to changes in their practices and possibly less convenience. Although, end-of-life was only selected by one employee, we aimed to improve this area due to many old stored devices, which according to Ms C1 need to be sorted out.

Q25: "Which improvement possibilities should be tried out / applied first?"

Summarised, three improvement possibilities were stated, which should be applied first. First, competent and reliable repair services should be researched: *"Es sollte versucht werden einen geeigneten Partner hinsichtlich eventueller Reparaturen zu finden"*. Additionally, one employee stated that laptops and PCs should be repaired as long as possible. Next, maintenance was mentioned. Last but not least, two employees stated that procurement should be improved first: *"[...] und Support vom Hersteller bei neuen Bestellungen"*.

Q26: "Where do you see problems regarding the improvement of the use-time?"

Throughout the action research process, I aimed at addressing fears, perceived problems and critics in order to improve our developed actions and to convince as well as include everybody involved. Most often *"costs"* were mentioned, followed by *"organisational effort"* to develop and implement these actions. Some feared that the device's performance may suffer or restrict the use-time. One employee additionally mentioned the difficulty to influence producers. The last perceived problem aimed at the user's practices: *"Menschen sind oft faul und schlampig. Ich denke, dass hier auch oft viel Potential verloren geht bzw. verschenkt wird"*. Apparently, to change employees' daily behaviour is one of the most demanding challenges.

All statements were gathered and taken into consideration during our action meeting process. Our taken measures against all critics and fears were documented and explained within the final presentation in the end.

4.5.4 Lessons learned

As it was my first workshop with a moderating role, I am on the one hand very satisfied with the overall outcome, but on the other hand I want to reflect upon some downsides. Sometimes I was overstrained with the amount of people arguing. During our main discussion, little group conversations started increasing the noise level. Therefore, some comments were not comprehensible on the audio record due to higher distances between some participants and the microphone. For the final presentation, I better positioned the microphone and increased its sound sensitivity.

Moreover, some participants seemed to be too timid or introverted to speak up and introduce their ideas to the audience. As this part of the workshop was hardly prepared, because I initially thought that Ms C1 will moderate her employees, I didn't know how to intervene. For the final presentation I considered my lessons learned and planned the interaction more precisely.

In general, I learned how to effectively write my action research diary in order to support my action research process. I started feeling more comfortable with reflecting upon and evaluating my actions taken. When initialising the diary, it felt more like a burden, but after a while I realised the advantages implied by writing down my thoughts. Last but not least, it profoundly helped me to remember the procedure of my steps and why one was followed by the other.

4.6 Action meetings

Based on all my gained insights from the online survey, conducted interviews and workshop, we started the action meetings phase aiming to improve the status-quo. Without this intensive analysis of lived and prevalent practices on the part of the employees, but also on the part of the management, the further process would not have been possible or useful neither for the organisation nor for gaining new knowledge.

Figure 9 gives an overview of our four action meetings performed between the 5th of August and 8th of September. Each meeting was structured in the following way:

1. **Reflection and derived actions** (except in the first action meeting): Within each meeting, new actions were discussed and assigned to a person in charge. These were then reflected at the beginning of the subsequent meeting, leading to an evaluation result and further derived actions in form of a to-do list (see 3. *Results*). Thus, each action got iteratively developed.
2. **New actions and discussion**: Based on previous actions, new actions were being discussed and elaborated. Each action was referenced to an area of improvement like maintenance or procurement. In order to have sufficient time to perform the action, responsibilities were split upon the core group members or partly delegated internally.
3. **Results**: New actions were being summarised in form of a to-do list including three columns: person in charge, to-do itself and area of improvement. Thus, one may easily see the progress each action within a certain area of improvement has made.

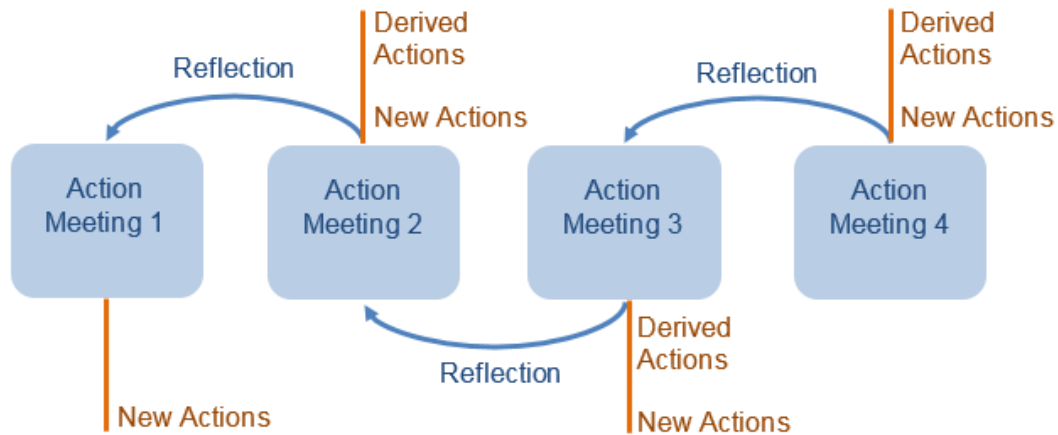


Figure 9 - Action meeting process

All actions aimed at prolonging the use-time of PCs and laptops internally as well as externally (e.g. pass them on), if devices no longer fulfilled the organisation's requirements. The results were gathered within a Microsoft OneNote notebook in a structured and written down way, similar to a guideline.

Furthermore, the following results from the analysis phase, which have already been described in the respective chapter, were taken into consideration during the action meeting process:

1. Open unclear questions regarding use-time from the interviews, which were presented on a slide during the workshop
2. Derived to-do list from the workshop's discussion
3. Results from the post questionnaire of the workshop
 - a. Missing or desired information / facts
 - b. Expressed critics and fears
 - c. Areas of improvement to start with

4.6.1 Action meeting 1

As a preparation for the first action meeting, I contacted many repair shops and initiatives in Vienna in order to meet them personally and perform short interviews. The main focus was on possibilities to prolong the use-time, maintenance and practical issues like battery use. Thus, I conducted three interviews before the first action meeting. Moreover, I organised three more external interviews: two in the public sector and one with a representative of a company employing disabled people to refurbish old IT hardware. A detailed description and analysis may be found in chapter 5.

On the 5th of August the first action meeting took place and lasted about 45 minutes. As Ms C1 was ill, I performed the meeting solely with Mr C2. Each session was audio-recorded to prevent missing important ideas and later on, to reflect on the core group's comments regarding specific actions. We decided to focus on two to three new areas of improvement per meeting, in order to have enough resources to research, conceptualise and implement the actions.

4.6.1.1 New actions and discussion

Based on the results from the post questionnaire of the workshop, where participants mentioned particular areas to address primarily, we discussed repair possibilities in Vienna and internal maintenance as the first two areas of improvement.

Repair possibilities in Vienna

As I had conducted three expert interviews in advance, I reported relevant facts and recommendations to Mr C2. Moreover, I handed over some information material regarding contact addresses within the Viennese Repair Network⁴ supported by 'die umweltberatung' since 1999. All member repair services offer a fixed price for making an estimate of the costs, which will then be deducted from the order. One of the experts, member of the Viennese Repair Network, argued that repair pays off in most cases as PCs and laptops have few critical points: If these get exchanged, the device is as good as new. However, according to one of the experts it is of vital importance where devices are being repaired as most commercial enterprises focus on sales not repair and thus, costs are not economical. Furthermore, I introduced the R.U.S.Z. (repair and service centre), one of the founder members, to Mr C2 and explained that besides their repair services they takeover old devices, refurbish them and sell them as 'second live' with twelve months of guaranty. Thereby, an alternative business model was implemented.

Considering all these information, Mr C2 was convinced that further research and a summary regarding repair possibilities in Vienna may be useful for Omega Ltd: *"Ist mitunter das Interessanteste, dass man bei der Reparatur einmal ein bisschen sich besser informiert"*. I suggested to take responsibility of this topic as I have already familiarised myself with it. Thus, I attempted to ensure that the core group may easily and freely express desired information of interest, which is apparently related to work and time effort.

Additionally, I reported about the possibilities offered by repair cafés: participants are instructed by professionals to repair their broken devices themselves and may use space and infrastructure for a voluntary donation. In general, the focus lies on small electronic devices, which are more expensive to repair than renew like a fan or toaster. However, the owner of the 'energie & reparatur café' argued that one may also join his repair café with a laptop, but highlighted that spare parts may not be available on-site. Consequently, I suggested participating together in a group of interested colleagues and repair a small broken device in order to make personal experience of being capable of successfully repairing it. Thereby, a relation to the belonging may be established, which supports repairing instead of replacing. Mr C2 was in favour of the idea by stating, *"Das ist sicher interessant. Es haben auch sicher nicht alle das nötige Werkzeug zuhause"* and additionally suggested taking Mr E4's laptop with the current VGA interface problem. Moreover, he indicated to include Mr C3 in our action meetings as he is well versed in hardware and therefore, may also be interested in joining a repair café. I agreed and confirmed to add repair café dates to my document.

Internal maintenance

As a second area of improvement we decided to focus on internal maintenance possibilities and thus, defining a new process. Mr C2 had several doubts whether laptops may be as easily opened and maintained as PCs. Additionally, continuing the discussion from the workshop about the optimal battery care, he expressed his willingness to change, if it makes sense: *"Ich habe den jetzt immer im Gerät, da ich ihn auch viel nachhause mitnehme bzw. bei Besprechungen brauche, da war es mir bisher einfach zu mühsam, ihn immer heraus zu nehmen. Das könnte man aber natürlich ändern, wenn es doch Sinn macht"*. Subsequently, he asked, if this issue was subject for discussion when interviewing the experts. Unfortunately, I received no clear answer within the expert

⁴ <http://www.reparaturnetzwerk.at/>

interviews as one argued that *“this is more a war of religion”*. Mr C2 immediately suggested informing himself about this topic on the Internet.

Apart from that, the following maintenance actions were strongly recommended by the experts: annual service including new set up, cleaning of devices and ventilation slots (e.g. with a hand vacuum cleaner). These services are also offered by members of the Viennese Repair Network, however, Mr C2 and I were convinced that it may be performed in-house. Nevertheless, he asked me about associated costs when making use of external services in order to compare them with internal employee costs for maintenance work. I added that external services are more favourable for private persons, who lack essential IT knowledge. Furthermore, Mr C2 argued that a system set up is not immensely time consuming, if data has been backed up regularly. As laptops may not be privately opened without losing the guarantee, we agreed on the cleaning from outside: *“Lüfter reinigen geht ja schnell, das kann man einmal bei allen Laptops machen. Das können wir ruhig öfter machen”*.

In order to define the new process properly, I suggested improving the documentation of laptops and PCs based on the created overview and monitoring sheet in Microsoft Excel. Mr C2 strongly agreed on the importance of reporting general properties of a device: *“Stimmt eigentlich, das wäre auch sehr wichtig. Weil wir haben nicht einmal irgendwo niedergeschrieben, wann wir welchen Laptop angeschafft haben. Klar, man kann auf Amazon nachschauen, aber grundsätzlich wäre es gut, wenn wir zusammenschreiben: was haben wir wann wo gekauft, wie schaut die Garantie aus”*. Moreover, he addressed the problem of traceability of performed upgrades, as they haven't been documented either. Thus, we discussed which additional information should be added to the monitoring sheet. Besides, the date of procurement, the length of guarantee and assembled components like the graphic chip, I suggested checking future devices regarding their reparability in order to purchase long-lasting ones. Mr C2 related his brother-in-law's poor experience with Lenovo, which nevertheless didn't prevent Omega Ltd from procuring one and fortunately, all employees are satisfied. However, he admitted that research regarding reparability beforehand would be useful. Furthermore, I had the idea of opening a laptop in-house and checking its reparability with own eyes. Mr C2 agreed, but not before guarantee expired in January 2016. Therefore, my task was to contact Lenovo via e-mail and to ask about their specifications and reparability properties.

Moreover, we discussed the necessity of defining a contact person for every process. Immediately, Mr C2 related the current practices and admitted that change is of considerable importance, as he will work half a year only part time from October onwards: *“Das stimmt. Weil es ist eigentlich so: Es kommt jeder zu mir und ich gehe im Endeffekt dann meistens zur Ms C1. Es kommt natürlich darauf an, was das Problem ist, aber als 1. Ansprechperson wahrscheinlich ich. Nur ist da das Problem, dass ich ab Oktober ein halbes Jahr nur mehr Teilzeit da bin. Da bräuchte man dann eine Vertretung, das wäre dann vielleicht der Mr E7, weil der immer da ist. Aber das müsste man sich dann natürlich noch überlegen”*.

As internal process changes are better off when being triggered from the inside, Mr C2 instantly suggested taking responsibility of this area of improvement. We decided to distinguish between annual / regular maintenance actions and to document them in the monitoring sheet: *“Dann könnten wir das auch im Excel aufnehmen, wann und was das letzte Mal gemacht worden ist”*.

4.6.1.2 Results

With regard to our discussion, we agreed to work out proposals until the subsequent meeting in order to reflect and evaluate them with Ms C1, which was of considerable importance to Mr C2: *“Ich würde gerne einmal mit der Ms C1 sprechen, weil sie besser Bescheid weiß und sicher mehr Ideen dazu hat”*. Moreover, we decided to stay in contact, if questions arise or feedback for intermediate results is necessary. The next meeting should be within a close time interval, which nevertheless permits enough time to work on the topics without influencing daily business excessively. Results were summarised in form of a to-do list (see Table 3).

In addition, I enquired about the further procedure planned regarding the setting down of vision and goals in writing. Mr C2 confessed that next steps still have to be talked through, otherwise, he fears that not much will happen.

Last, we discussed whether colleagues want to be informed about the on-going improvement process on a regular basis or solely at the end. Mr C2 will ask within an internal meeting about their preferences, but assumed the latter: *“Vielleicht kann ich morgen bei der internen Besprechung, falls sie stattfindet, fragen, was die anderen dazu sagen. Vielleicht möchten sie es gleich sehen, vielleicht möchten sie auch lieber warten”*.

Person in charge	To-do	Area of improvement
Mr C2	Research regarding general battery use and maintenance	Maintenance
	Process definition of the internal maintenance including contact person	Maintenance
	Adaptation of monitoring sheet	Documentation and maintenance
	Discussion with Ms C1 regarding participation in a repair café	Repair
	Discussion with Ms C1 regarding the setting down of vision and goals in writing	Organisation
	Discussion with colleagues regarding information frequency	Action meeting process
The researcher	Research regarding repair possibilities in Vienna including costs	Repair
	Research on repair cafés	Repair
	Summary of expert interviews including recommendations	Procurement, use, maintenance, repair, storage and processes
	Contacting Lenovo regarding reparability	Repair and procurement

Table 3 - Results of action meeting 1

4.6.1.3 Personal reflection

Mr C2 became more motivated during the first action meeting, which may be seen by expressing his own ideas and suggestions more frequently. When having a look at this answers in the post questionnaire of the workshop, he reflected that he now better realises the possibilities to change the status-quo. Moreover, he is in favour of improving the documentation, which is commonly perceived as extra effort without immediate positive change. He was also the only one to mention documentation during brainstorming section in the workshop.

However, I perceived him as slightly overstrained, because Ms C1 was missing and he was not informed, if he should have prepared himself for the meeting.

4.6.2 Action meeting 2

The second action meeting took place on the 25th of August with Mr C2 and Mr C3, as we couldn't find an earlier date and Ms C1 was on holidays from 24th of August till the 6th of September. As Ms C3 has been working since 2010 for the organisation and was also part of the procurement process, he was a qualified substitute for Ms C1. Moreover, his knowledge about hardware was a valuable enrichment. Within the two and a half hours session we reflected upon the assigned actions from the first action meeting and afterwards focused on two new areas of improvement: procurement and use of PCs and laptops.

Furthermore, I prepared a document focusing on the 'advantages and motivation for extending the use-time in organisations', which was then extended regularly. I suggested enhancing this document together, whenever an idea comes to their mind. Thereby, benefits may be made apparent.

The analysis and transcription of the expert interviews resulted in a summary of recommendations categorised into 'procurement', 'use', 'maintenance', 'repair', 'storage' and 'processes', which influenced the respective area of improvement within the action meetings.

4.6.2.1 Reflection and derived actions

Within the reflection part we discussed and evaluated the defined actions from the previous meeting. Thus, new actions were derived in order to iteratively develop the areas of improvement.

Repair possibilities in Vienna

Before the second action meeting took place, I had sent a draft of my document regarding repair possibilities in Vienna to Mr C2. His first comment was rather reluctant due to perceived high costs: *"Ich habe es mir einmal durchgelesen und da ist mir hauptsächlich aufgefallen, dass es für uns eh keinen Sinn macht, weil es viel zu teuer ist"*. Although, he forgot that the estimate of the costs will be deducted from the order, he didn't change his perception. I reported from the expert interviews, that most repairs cost between 150 and 200 Euros and Mr C3 confirmed *"Ich glaube über 200€ zahlt es sich eh nicht mehr aus. Weil wenn du 300 oder 400€ zahlst, überlegst du schon ein neues Gerät zu kaufen"*. Thus, I circulated the expert's information that a laptop may not be compared with a car, as it contains only few critical components and as long as obsolescence isn't planned like poor cooling of the graphic chip, the device is as good as new after the repair. Spare parts are being purchased by the repair shop and costs are directly passed on. According to one of the experts, some components are exchanged more easily or more often than others. Within my interview with Ms C1, she stated that repair costs may constitute at most one fourth of new acquisition costs and Mr C3 affirmatively responded *"Da bist du dann eh bei den 200, vielleicht 250€. Vor allem hat man dann den Vorteil, dass man nicht ein neues Gerät hat, wo man alles wieder installieren muss, bei uns halt zumindest oder für mich persönlich"*.

Following my presented facts, Mr C2 and Mr C3 started a discussion about a repair's financial aspects, where Mr C3 reflected in the subsequent way: *"[...] Für manche ist das wirklich einfach, der hat das in 5 Minuten. Dann zahlst du eben 70€, aber dafür hast du dein Gerät wieder und kannst es wahrscheinlich noch 2 Jahre verwenden. Anstatt, dass man ein neues kauft. Probieren kann man es ja"*. When they asked me about my recommendations, I immediately answered that although I haven't made any experiences myself so far, I am definitely in favour of giving repair a chance at one of the expert's service centres. Interestingly enough, Mr C3 suddenly reflected upon the fact, that within the estimate of the costs transfer and organisation costs are not included leading to a

higher final price: *“Wenn man es dort reparieren lässt, kommt es einem eigentlich teurer, als der Preis der dort steht. Es muss einer hinfahren, das hinbringen und es wieder holen. Wenn es nicht die Ms C1 macht, kostet das ja Arbeitszeit. Eigentlich kostet es auch die Ms C1 Arbeitszeit. Und wenn du von hier in den 5. Bezirk fährst”*. Thereupon, I explained them the possibility of making use of the transport service offered by the Viennese Repair Network in cooperation with several members. Mr C2 seemed interested in the related costs for bringing and collecting the laptop to one of the two recommended repair services and thus, I will contact the Repair Network to add this information to the document.

Last, I explained which devices are allowed to be taken to a repair café in order to fulfil the rule of thumb to bring only devices which may be carried with one hand. As I haven't made any personal experiences with repair cafés either, I aimed to participate in the upcoming on 10th of September. Mr C3 suggested to join in form of a firm's outing.

Internal maintenance

Mr C2 carefully researched the battery use of laptops and maintenance possibilities on the Internet. Regarding the laptop's battery, experts are in two minds about the optimal usage. Some argued that it lasts longer, when taken out of the device, but the differences are small. Others recommended to store the battery in the refrigerator and completely discharge it every thirtieth time. Mr C3 added that modern batteries' limits should not be exhausted, thus, neither completely charged nor discharged. I argued that laptops should not constantly be connected to a power source, which may be easily realised without removing the battery itself. Mr C3 reported that some colleagues including himself, who have meetings and don't work steadily on their desk, already practice the usage that way. Furthermore, he suggested researching a software advising the user, when the upper (e.g.) 90% and lower (e.g. 10%) limits of the battery level are reached.

As we were all irritated whether positive effects exist, Mr C2 expressed his doubts: *“Ich weiß eben nicht, ob es überhaupt wirklich Sinn macht, weil ich auch öfters gelesen habe, dass es eh egal ist. Der Akku hält zwar dann ein bisschen länger, aber im Endeffekt, ist es relativ egal. Ist eben die Frage ob es sich wirklich rentiert, wenn wir uns den Aufwand antun... Ich meine, so viel ist es nicht, aber trotzdem muss man darauf aufpassen oder ob wir sagen, dass der Akku nach 3 Jahren sowieso schlechter ist und man ihn dann vielleicht ersetzt. Aber wir können es ja einmal probieren, es so zu machen. Besser als gar nichts”*. Consequently, I suggested to primarily address colleagues, who never use their battery, which surely implies negative effects and Mr C2 confirmed to address this practise within the next internal meeting: *“Ja der Großteil hat es schon so, dass sie ständig am Strom hängen und arbeiten. Das werden wir einfach bei unserer nächsten internen Besprechung einmal kurz ansprechen”*. Furthermore, we agreed that the removal of the battery in no option due to inconvenience and negative consequences, if power supply is unintentionally removed.

Besides, Mr C2 found out that a laptop's battery should not overheat and therefore, suggested purchasing cooling pads. Although, Mr C3 has made poor experiences, Mr C2 stated to further research on that topic and associated costs: *“Da könnte man einmal recherchieren, ob das vielleicht einen Sinn macht. Weil wenn ein Cooling-Pad 20€ kostet und wir haben einen Nutzen davon, dann wird es sich wahrscheinlich schon rechnen”*. Further research results concerning maintenance revealed the cleaning of interfaces, ports, ventilations slots and the keyboard. In contrast to hardware care, an annual system setup, the installation of available updates and the regular check of installed software are recommended. However, most research results referenced to the optimal battery use.

Inspired by Mr C2's findings, Mr C3 suggested setting up both laptops as they are already one and a half years in use. My suggestion of a central installation was followed by a discussion regarding automated installation scripts, their time efficiency and opportunities. Mr C3 proposed to shortly research on this issue and based on their findings to decide how to continue. The optimal solution would contain a list to select or deselect features to be installed as configurations may vary on different devices. To customise the installation even more, a Windows login screen containing the logo of Omega Ltd was suggested by Mr C3. Mr C2 admitted, "[...] Wenn man es einmal hat, ist es sicher schneller". Through a central installation, detailed documentation may become obsolete, argued Mr C3. Moreover, as I addressed the issue of data backups, Mr C2 claimed that only Ms C1 is completely aware of their location and availability: *"Das weiß bisher nur die Ms C1 und wenn wir eine Sicherung benötigen würden, wüssten wir, als Mitarbeiter, gar nicht wie wir die bekommen würde. Da müssen wir mit der Ms C1 noch ein bisschen zusammenarbeiten"*. Although, Mr C2 explained that the installation of a new laptop takes only two to three hours, the time effort for creating data and configuration backups of a laptop in use must be taken into consideration. Some colleagues reject storing all their data on the central data storage. We agreed, that images may lead to problems and don't clean the system entirely. All these issues must be discussed with Ms C1 in connection with the definition of the internal maintenance process including persons in charge of the individual tasks. Findings so far have been documented in OneNote.

Additionally, I asked if it would be possible to start the first setup cycle within our cooperation in order to commonly evaluate time and resource effort. Mr C3 immediately suggested starting with Mr C2's and his laptops as both are the oldest ones of the new generation. Mr C2 agreed by stating *"Ja, ich würde es schon gerne machen"*. Two more laptops may be relevant as their users will be on holidays soon.

Apart from that, Mr C2 proposed contact persons for three areas of responsibility and stated that these will be communicated in written form. He doubted that more may be necessary to define.

Monitoring sheet

First advantages of the monitoring sheet became visible, when Mr C2 reported about the VGA interface problems of PC15 last time, which in truth turned out to be PC12. For the first time, infrastructure is being documented and assigned to users. Therefore, allocations may be easily identified correctly.

Moreover, Mr C2 presented his adaptations regarding the documentation of internal maintenance actions. The actual state of each device is rated with green, yellow and red dependent on the date of the last performed maintenance: *"Das Wichtigste ist, dass man die Wartung eintragen kann und eine Übersicht hat, was wieder einmal gewartet werden sollte. Das müssen wir dann eben auch regelmäßig ausfüllen bzw. müsste sich wahrscheinlich irgendwer darum kümmern, was wieder gewartet werden muss und das dann an die Mitarbeiter, die das Gerät haben, weitergibt. Und wer, was wartet, müssen wir natürlich noch definieren, z.B. Neu Aufsetzen, weil das kann eigentlich jeder"*. Simultaneously, we diagnosed further old laptops for the first annual setup session.

Due to lack of time, Ms C1 only had a short look at the current monitoring sheet, but reacted satisfied with the on-going development. Above that, I suggested to implement a column for each device's component representing its reparability. If a component may be easily removed or replaced, the respective cell is ticked. Mr C2 agreed to add this property until the next action meeting.

Contacting Lenovo

When contacting Lenovo for the first time, I explicitly asked about the following characteristics regarding the two laptop models procured by Omega Ltd:

- What life span may we expect when used properly? What is the expected use-time in case of an organisation?
- Where and how sustainably / fair does Lenovo produce? Are so called 'conflict minerals' contained within your supply chain? How does Lenovo control workers' conditions on-site? May you exclude child labour?
- How repair friendly are the purchased laptop models? May all components be replaced or are some permanently installed?
- How long are spare parts available?
- Does a repair service in Austria exist?
- Where and under which conditions are non-functional laptops gathered and recycled?

The response was somehow disappointing as it solely contained three headlines and associated links: two eco data sheets, ecology and human rights. However, I reported Mr C2 and C3 to research the links within the next iteration and write another e-mail if questions may not be answered through them. Additionally, Mr C2 suggested asking Lenovo about their optimal battery use recommendations.

E-Mails like this one are of vital importance to demonstrate that users care about their product's sustainability and footprint, manufacturing conditions, local repair services and expected use-time. Therefore, Lenovo's response should have taken requests of this type more seriously.

Furthermore, Mr C3 asked me to request information regarding the use of Bitlocker and if problems regarding the assembled SSD have been reported to Lenovo.

Document "advantages and motivation for extending the use-time in organisations"

When introducing my prepared document, Mr C3 immediately responded with an advantage of prolonging the use-time in an organisation compared to the private sector. He related that relatives prefer to keep their configuration as it is and are afraid of changes after a problem gets fixed. However, colleagues within Omega Ltd don't mind and are pleased with a freshly installed system running smoothly: *"[...] und wir freuen uns wenn alles frisch ist und der Desktop nicht mehr so voll ist. Also bei uns ist eher das andere ein Vorteil. Und bei uns geht das ja schnell, weil wir uns gut auskennen"*. Moreover, he reflected that a regularly new set up system including clean ups also comprises security benefits as sensitive data are under control. When I mentioned the convenience of a higher performance, he replied, *"Das ist fast, wie wenn du einen neuen bekommst. Vor allem wenn man es nicht selber machen muss"*. By comparing a well maintained laptop with a new one, I felt very satisfied with the progress we have been making.

All derived to-dos are listed in Table 4. Actions, which were dependent on Ms C1 may not be answered until the next action meeting, as she was on holidays. These were therefore marked italic.

<i>Person in charge</i>	<i>To-do</i>	<i>Area of improvement</i>
Mr C2 and Mr C3	Research on automated installation scripts	Maintenance
Mr C3	Research on battery protection tools (warning at 10% and 90%)	Maintenance
Mr C2 and Ms C1	<i>Discussion with Ms C1 regarding first setup cycle</i>	Maintenance
Mr C2	Discussion regarding battery use within the upcoming internal meeting	Maintenance
Mr C2 and Mr C3 delegate internally	Research on cooling pads	Use
Mr C2 and Ms C1	<i>Definition of the internal maintenance process (including tasks, person in charge and documentation within the monitoring sheet) in connection with discussion with Ms C1 regarding data backups</i>	Maintenance
Mr C2 and Ms C1	<i>Formal definition of internal contact persons according to the agreement with Ms C1</i>	Organisation
Mr C2	Adaptation of the monitoring sheet regarding reparability	Documentation and maintenance
Mr C2 and Ms C1	<i>Discussion with Ms C1 regarding the participation in a repair café in September</i>	Repair
Mr C2 and Ms C1	<i>Discussion with Ms C1 regarding repair possibilities in Vienna</i>	Repair
The researcher	Adaptation of the document regarding repair possibilities in Vienna regarding transport costs	Repair
	Contacting Lenovo regarding Bitlocker and optimal battery use	Maintenance

Table 4 - Derived actions from first reflection

4.6.2.2 New actions and discussion

After 75 minutes we finished the first reflection part and focused on two new areas of improvement. 'Procurement' was chosen because of its high importance, influence and extensive effort. Thus, a less challenging topic, the use of PCs and laptops, was additionally chosen.

Procurement

When asking about their spontaneous ideas to improve the procurement process, Mr C3 immediately replied, *"Also der Preis ist sicher eine Frage. Für uns sollte es eben ein relativ schneller Laptop sein und dass die Hardware gut ist"*. Additionally, Omega Ltd as a Microsoft partner doesn't require a pre-installed operating system. The current laptop generation was chosen mainly because of an extraordinary price-performance ratio. In the end, Mr C2 didn't care about purchasing a light weight laptop providing mobility anymore as the offers were too expensive.

To introduce another criterion apart from price and performance, I mentioned the first fairly produced mouse. Mr C3 thereupon admitted that fair production conditions must be difficult to achieve, but criticised that regarding the Fairphone you get less performance for the same price. Moreover he argued that customers quickly get enough of their current mobile phone and nevertheless replace it prematurely contradicting the Fairphone's intention and philosophy.

According to the expert interviews, laptops from the business line are longer-lasting and easier to repair and maintain. Mr C2 replied that they have not taken the laptop's type into consideration so far. Although, these models may also be procured via Amazon, we decided to research on

alternatives like the manufacturer itself or (online / local) shops. Mr C2 admitted that Amazon was only chosen, because they haven't planned to purchase more than ten laptops in the near future: *"[...] Wenn wir gewusst hätten, dass wir im Endeffekt 10 Lenovo Laptops haben, dann hätten wir wahrscheinlich von Anfang an besser geschaut"*.

Moreover, I suggested having a closer look at Greenpeace ratings and labels like energy efficiency in order to evaluate a producer's social responsibility. I considered this as an important step as the relevance and explanatory power of ratings as well as labels are typically unclear to most consumers. Consequently, Omega Ltd may define technical, but additionally energy efficient and ecological criteria for procuring laptops. Although, Mr C2 and Mr C3 agreed, they reacted contradictorily. First, Mr C2 responded, *"Da sagen wir welche Hardware wir gerne hätten und die Ms C1 sucht dann das grünste Gerät"* and thus, shifted the environmental responsibility to Ms C1. Later on, when I mentioned to perform the research on labels and ratings, Mr C3 agreed, because *"Das Grüne interessiert uns zwar, glaube ich, eher weniger, oder nur am Rande"*. Immediately, Mr C2 gave in and stated *"Naja, das würde ich jetzt nicht sagen"*. By these reactions I was quickly aware of the importance to communicate my results in a useful and practical way. Otherwise, their procurement practices will not change sustainably.

Another important aspect is a laptop's included guarantee as it is not compulsory, some components are excluded due to high abrasion and time periods vary. Most manufacturers offer support or guarantee extensions, but their advantages are not apparent. Thus, we decided to have a closer look, whether prolonged guarantees may be useful. The task was delegated internally.

In order to discover a longer-lasting laptop, one expert recommended the website notebookcheck.com, which additionally tests, apart from its technical components, properties like energy efficiency, reparability and robustness. While introducing this website, Mr C3 immediately searched for it and admitted that up to now only reviews available on Amazon have been taken into consideration. By analysing a laptop's characteristics into more detail, higher prices for more durable laptops become justified and easier acceptable.

The last new aspect, which we illuminated regarding an improved procurement, was the possibilities of IT-leasing and second hand devices. Provided that we will differentiate between employee's requirements (administration/development), alternative procurement models may be reasonable. As no research has been performed into this direction, Mr C2 argued very appealingly: *"Second Hand Geräte kann ich mir z.B. eher nicht vorstellen, aber recherchieren sollte man auf jeden Fall trotzdem. Weil wenn es ein Gerät ist, das jetzt nicht super gut sein muss, dann kann man auch ein günstiges neues kaufen. Aber muss man mal schauen, aber vielleicht macht es doch Sinn. Leasing ist, glaube ich, eher bei den Servern interessant, aber wäre natürlich auch bei einem Laptop denkbar. Also ich glaube, dass wir alles auf jeden Fall ein bisschen recherchieren sollte und dann einfach weiterschauen"*. He was definitely in favour of investigating these topics and will delegate this task internally. Additionally, Mr C3 reflected upon their current laptop and explained that its properties outperform their requirements as they mostly work remotely. However, he admitted to be unsatisfied with its high weight and would not repeat his decision due to its poor mobility. When defining their criteria, they may compare them with available business models and add portability for employees who need it. Mr C2 suggested the possibility to pass Mr C3's laptop on to the new colleague and purchase a light weight for him: *"Weil im Prinzip, wenn wir deinen neu aufsetzen, ist der ja quasi wie neu"*. Furthermore, Mr C3 suggested having a look at other manufactures, if they better fulfil their demand, but nevertheless prefer Lenovo if more than one is up for debate due to their positive experiences.

Use at work, while on the move and at home

After a short break, we continued with discussing the importance of taking care of one's laptop. Mr C3 suggested adding a docking station to their criteria list in order to prevent ports and interfaces from being worn out. I presented several actions like 'don't block a laptop's ventilation slots' and proposed to document them in form of a list. Simultaneously, Mr C2 and Mr C3 may check internally on the current situation and how colleagues have arranged their workplace. Although, Mr C2 remarked that the employee's careful use may be presupposed, he confirmed that it is a good idea to repeat it once again. In connection, he suggested mentioning to store all data on the central storage in order to prevent time-intensive backups and data loss. Apart from that, employees, who carry their laptops with them or work from at home, must be particularly careful to protect them and create workplace like conditions. By documenting rules as a guideline in written form, they may be seen as more binding than oral arrangements. Apparently, people rarely break their devices on purpose, but due to different use practices and priorities, damages or wear and tear occur, which may have been avoidable.

Final presentation and communication

We shortly discussed the necessity to think about how to communicate and present our final results to the remaining colleagues in order to change practices. All information, concepts and guidelines must be easily accessible and available. Thus, all core group members will think about possibilities until the subsequent action meeting.

Monitoring sheet

Last but not least, I had some additional ideas regarding the monitoring sheet. I suggested investigating the real use-time of each device including its history of users. In order to improve it, a goal value should be determined. Besides, replacement reasons may be an informative extension in order to detect similar defects within one laptop model. Both are in favour of this idea: *"Stimmt, dann kann man beim nächsten Mal darauf schauen"*. Moreover, pauses of use should be documented to make the use-time value more significant. Therefore, Mr C3 argued to add a proper table with employee, device number and time period of usage. *"Das wird schwierig, aber probieren können wir es auf jeden Fall"* responded Mr C2. He agreed to insert at least all current / future data and complete the remaining if traceable in their time tracking system.

Concluding, Mr C2 stated, *"Das hätten wir schon früher machen können, aber auf die Idee ist keiner gekommen"* and thereby, reflected upon the importance of all discussed topics.

4.6.2.3 Results

All discussed actions are summarised within the to-do list of Table 5. We aimed at dividing them based on our preferences, but also time availability.

Mr C2 reported that at the end of September a second session concerning the vision and goals will take place. I offered my support, however, they want to attempt it on their own, but will send me the results afterwards. As this is a very important intimate step, Ms C1 and her team should definitely take their time and develop it on their own. Nevertheless, the workshop was an important trigger and impulse. Moreover, he added that his colleagues prefer to be informed at the end of our action meeting process to get a complete and well-structured overview.

<i>Person in charge</i>	<i>To-do</i>	<i>Area of improvement</i>
Mr C3	Research on notebookcheck.com regarding current laptops and their reparability	Procurement
Mr C2 and Mr C3	Definition of procurement criteria including research on current business laptop models	Procurement
Mr C2 and Mr C3 delegate internally	Research on IT-leasing, second hand devices and producer's guarantee	Procurement
Mr C2 and Mr C3	Research on procuring directly from the producer	Procurement
Mr C2	Adaptation of the monitoring sheet regarding replacement reasons and use-time per user	Documentation and maintenance
Mr C2 and Mr C3	Determination of the goal value regarding use-time	Documentation and use
Mr C2 and Mr C3	Investigation on current use and workplace situation	Use
All	Brainstorming regarding communication and final presentation	Internal communication
The researcher	Research on labels, Greenpeace ratings and procurement guidelines	Procurement
	Research on guarantee and support extension services	Procurement
	Expanding document 'advantages and motivation for extending the use-time in organisations' by adding worries mentioned in post questionnaire	Action meeting process
	Creating a use guideline including central data storage	Use
	Analysing Lenovo's response and when appropriate asking further questions	Procurement and repair

Table 5 - Results of action meeting 2

4.6.2.4 Personal reflection

Both were very motivated and Mr C3 had several spontaneous ideas during the session. Mr C2 was not completely convinced by the repair possibilities due to higher labour costs. In contrast, Mr C3 seemed to be more in favour of giving repair shops a chance. Thus, I tried to extend the document by sample calculations to highlight the advantages. If we could commonly participate in a repair café, in order to make positive experiences with repair possibilities, it would be easier to convince him.

As research work on labels or ratings requires a considerable amount of time, I suggested taking responsibility of it. Moreover, they seemed not very interested in the ecological part of procurement. Thus, I assumed that their effort in researching it would have been quite low as they generally lack of time. However, one may argue, that if they had researched it on their own, they would have recognised the importance by themselves.

4.6.3 Action meeting 3

On the 3rd of September the third action meeting took place again with Mr C2 and Mr C3. Before the meeting I was invited for lunch and thus, Mr C2 and I had the opportunity to talk more personally as we sat next to each other. During the lunch I had the impression that all colleagues are quite calm and silent. Mr C2 tried to integrate two more colleagues into our conversation, which worked fine. All in all, I felt very comfortable and was invited to join them also before the subsequent meeting.

The nearly three hours session was very intense, as the actions within the area of improvement 'procurement' were a considerable excessive part. Both sides performed several research tasks and prepared noticeable amounts of information. However, Mr C2 reported that they had some technical issues within the organisation and thus, they couldn't prepare all to-dos and topics. I managed to prepare most documents, but also had to postpone two topics to the next cycle.

Within this session we focused again on the procurement part and started some thoughts about end-of-life possibilities, external (CSR) and internal communication. The latter also was an important part to discuss with Ms C1 after her holidays.

4.6.3.1 Reflection and derived actions

Due to the considerably high amount of already defined actions and addressed areas of improvement, the reflection part lasted nearly two and half hours.

Procurement

Mr C3 started presenting his research results and notes. First, he was positively surprised about the integrated notebookcheck.com link on the comparison platform geizhals.at. However, his arguments regarding the website were conflicting as he firstly mentioned to be uncertain about its usefulness. When he showed us his defined technical procurement criteria, I mentioned to take the exchangeability and cooling of the graphic chip into consideration. He replied, *"Genau. Das stimmt. Aber da hilft uns sicher Notebookcheck bisschen weiter. Ich glaube, dass es an gewissen Produktreihen liegt, dass die Kühlung nicht so gut ist"* and presented his researched links of new laptop models on geizhals.at. When I suggested comparing these laptops via the integrated notebookcheck.com link, he responded, *"Siehst du, an das hätte ich jetzt gar nicht mehr gedacht"*. Thus, I was confused, whether practices may change in future processes and again underpinned the advantages of considering reparability. By repeatedly using the website, its usefulness may be made apparent. Besides, I suggested expanding his definition by explicitly adding ecological criteria and both agreed. The possibility to protect ports and interfaces by the use of a docking station will be suggested to Ms C1, although Mr C2 argued that it might not be necessary as most employees only use their laptop at their workplace: *"Und es fährt bei uns kaum jemand mit dem Laptop nachhause. Die Meisten haben den Laptop immer stehen. Wir brauchen es nicht wirklich, glaube ich. Geschickt wäre es sicher, aber..."*.

When asking about their findings regarding the Lenovo website and its procurement possibilities, Mr C2 circulated the information from Ms E2 that the advantages come with the purchase of higher amounts. Moreover, not all configurations and models researched on geizhals.at were available. Mr C3 admitted the unpleasant truth about international wholesalers like Amazon: *"Es ist zwar im Allgemeinen nicht 'so leiwand', aber jetzt als Verbraucher oder Käufer ist es bei Amazon geschickt, weil die, die Preise so runter drücken. Die kaufen in großen Mengen ein und können es dadurch auch billig weiterverkaufen. Oft bekommt man es bei Amazon billiger, als wenn man es einzeln beim Hersteller kauft"*. Thus, we had a common look at Lenovo's website, because it distinguishes between private and business models. All so far researched laptops have been 'Ideapads' in contrast to 'Thinkpads' representing the business sector of Lenovo. According to all experts' recommendations, business models are indeed more expensive, but include more years of guarantee, are more robust and easier to repair as well as upgrade. Thus, we commonly started to search for 'Thinkpads' on geizhals.at and discovered that those within the possible price range are still equipped with a conventional hard drive. Interestingly to mention, Mr C2 immediately reacted, *"Wobei da kommt es darauf an. Weil eine SSD könnten wir auch selber einbauen, die sind*

nicht so teuer". I introduced a further aspect confirmed by all three experts, namely long-term cost savings, if a laptop may be easily repaired. Mr C2 reflectively acknowledged my suggestion by stating: *"[...] Weil vielleicht macht es alleine von dem her schon Sinn, dass wir 100 € mehr ausgeben für ein Think- statt einem Ideapad"*. We agreed to list some 'Thinkpads' as a basic scheme, which may be consulted when a new laptop is needed.

Regarding IT-leasing, Mr C3 reported that Ms E1 has researched several companies, but prices are not online available: *"Die Ms E2 studiert auf der WU und hat gemeint, sie hat gelernt, dass Leasing immer teurer ist, als neu zu kaufen. Du verteilst eben die Kosten auf einen längeren Zeitraum, aber im Endeffekt kommt's dir vermutlich wirklich teurer"*. We further discussed, that IT-leasing may not be cheaper, however, devices are regularly maintained, upgraded and exchanged based on current requirements, but without discarding them as they are passed on to other customers with less performance demand. Besides, we admitted that leasing only a few laptops for a small organisation may not be economical or even offered by the companies. Nevertheless, I suggested requesting an offer according to the previously defined criteria and additionally asked for the following information:

- May single laptops be leased?
- What are the annual costs?
- What range of products do you offer and why? Have you taken ecological criteria and reparability into consideration?
- How long is the use-time and in contrast, the life span?
- May single components be upgraded, exchanged or repaired?
- What happens to devices after the internal use-time?
- When are devices discarded?

The second part of Ms E1's research concerned second hand devices and contained one website. As we took a closer look at their offers, we realised that only laptops with low technical requirements are available. Thus, we agreed that this possibility is more interesting for private consumers, solely administrative departments / organisations or home offices. However, Mr C3 got a positive impression as he stated, *"[...] Aber es ist trotzdem schön, dass es so etwas gibt"* and consequently, I am convinced that it had a beneficial influence on both core group members.

As Mr C3 had to respond an important phone call, Mr C2 continued with his results regarding cooling pads. Although, he has observed that his laptop doesn't overheat, he argued that for the price of 25-30€ it may be worth the investment even if it helps just a little bit. An alternative would be to position the laptop elevated through books or CD cases as suggested by an expert in the interviews. Thus, Mr C2 announced to discuss the issue with Ms C1 as she will be the one to decide in the end.

Apart from these aspects, I introduced my research regarding green labels to them. All were listed with their logo, a short description and their rated transparency by the comparison website label-online.de supported by 'Verbraucher Initiative'. Additionally, I created an Excel sheet listing all certified Lenovo laptops and PCs, which mostly were again 'Thinkpads'. Thus, we realised that business models are not only better repairable, but also greener: *"Es wird schon seinen Grund haben, dass die einfach generell 200€ teurer sind"*. Both were pleasantly surprised and especially Mr C3 reflected upon the document's usefulness by stating: *"Und es ist insofern cool, weil wenn man es sich anschaut und man merkt sich die Logos ja doch irgendwie. Und wenn es einem dann zufälligerweise ins Auge springt, dann kennt man das Zertifikat und so nimmt man im Zweifelsfall"*

das. Auch wenn es ein bisschen mehr kostet, dann weiß man wenigstens, dass es halbwegs okay ist. [...] Ich kenn keinen, der darauf schaut zumindest. Darum ist es ja auch ‚leiwand‘, wenn wir jetzt das Dokument haben, weil man merkt es sich ja doch und es springt einem dann ins Auge“. He apparently admitted that neither he nor his friends have been aware of these labels and their value. Immediately, Mr C3 checked which devices in his surrounding are certified and discovered the ‘Energy star’ two times. Several labels (e.g. ‘Blauer Engel’) were recognised as familiar due to other areas of daily life.

My second researched document comprised Lenovo’s social and ecological responsibility. Therefore, I summarised all information available on their website and sent via e-mail. Some facts are important to mention like the five year spare parts availability or the online allocation of videos to properly dismantle laptops in case of repair. Generally speaking, a company’s self-representation does always sound impressive and throughout positive, thus, I suggested to critically reflect this information by ratings. Mr C3 introduced another interesting aspect by arguing: *“Auf der anderen Seite müssen sie auch schauen, dass sie Gewinn machen und ... Es ist auch schwierig in dieser Branche, dass man wirklich am Markt bleibt. Weil Nokia hat einmal nicht aufgepasst und ist weg. Bei solchen Sachen ist es halt immer: Wenn sich Unternehmen da ziemlich stark einsetzen, bringt es auch nichts, wenn sie sich aus dem Markt katapultieren und dann gar nicht mehr da sind. Weil dann hat es wenig gebracht und wenn sie es schön langsam machen...”*. We agreed that if a company’s intentions are real, sustainable changes may take time, but more and more consumers start demanding them.

As the current need to purchase a laptop for the new employee is rather time-critical, they will once again fall back on the previously chosen ‘Ideapad’. Nevertheless, Mr C2 highlighted that all new information and knowledge will be applied for further procurements.

Monitoring sheet

Mr C2 added a column ‘use-time’ to the overview of laptops and PCs. Thereby, Mr C2 argued, one may easily identify, that for instance PC11 has already been for five years within the organisation. Replacement reasons, the selective column ‘reparability’ per component and use-time pauses have also been included by him. Based on all these extensions, he realised the positive implications of maintaining this sheet: *“Und wenn man das rückwirkend, die Vergangenheit recherchiert und immer aktuell führt, dann hätten wir eine richtige Historie vom Laptop, von wann bis wann er wie von wem verwendet worden ist”*. Moreover, I suggested adding the intensity of use per user, as it considerably influences the overall use-time. Mr C2 was immediately in favour of my idea and stated, *“Das ist eine gute Idee. Das ist auf jeden Fall sehr wichtig zu wissen. [...] Bei dem Gerät muss man davon ausgehen, dass er noch länger funktioniert, einfach weil er nicht die gleiche Abnutzung wie ein Vollzeit-Laptop hat”*. Apart from that, we discussed to add all kind of costs (e.g. purchase, repair) and performed upgrades to the sheet.

When Mr C3 returned from his phone call, he mentioned that he hopefully doesn’t have to deal with this sheet in the future. Although Mr C2 agreed, he positively remarked, *“Ich hoffe, dass es dann irgendwer bei uns vernünftig wartet, weil dann sind das in ein paar Jahren sehr wichtige Informationen, die man dann gewinnen kann”*. Consequently, I replied that this is clearly the responsibility of the organisation’s administration, nevertheless, the development of such a sheet is better performed by technical experts.

Furthermore, we discussed to add a table documenting past and current problems in order to react more quickly when they appear the next time. All of a sudden, Mr C2 talked about planning to replace very old devices like Mr E6's PC in order to offer the affected colleagues better working conditions: *"Weil wir die schon über 5 Jahre haben und die sind eigentlich nicht mehr zeitgemäß. Aber da möchte ich mit der Ms C1 reden, das muss sie dann sagen. Weil arbeiten kann man natürlich noch damit, aber andererseits für Personen wie die Ms E1, die 40 Stunde pro Woche im Büro sitzt, ist es eigentlich – würde ich eher ein neueres Gerät vorschlagen. Aber das ist nicht meine Entscheidung, ich möchte nur einmal mit der Ms C1 darüber reden, was sie dazu sagt"*. Although, I was able to relate to his thoughts and knew they were led by positive intentions, I was very interested, how Ms C1 will react and if she will replace all involved devices. Moreover, I underpinned that the target use-time shall be seen as the minimum not the maximum.

Regarding the target value of the internal use-time, we reflected that within the conducted interviews Mr C2 has only proposed two to three years and in contrast, Ms C1 five years. When I commented that those five years have worked out quite well, Mr C2 argued, *"Ja, bei den älteren Geräte hat das auf jeden Fall funktioniert. Ich weiß eben nicht, ob die dann auch wirklich 5 Jahre halten. Aber als Ziel können wird es auf jeden Fall definieren, dann können wir versuchen das zu erreichen. Ich hätte eigentlich schon gedacht, dass 5 Jahre eher unrealistisch sind, aber es hat bei den anderen Geräten auch funktioniert. [...] Es wäre super gewesen, wenn wir bereits vor 1 ½ Jahren ein Business-Gerät und solche gekauft hätte, dann könnten wir die jetzt vergleichen. Aber das haben wir damals eben nicht bedacht bzw. habe ich das eigentlich noch gar nicht gewusst, dass da tatsächlich unterschieden wird"*. His statement was very important to me as it represented a considerable change within Mr C2's mind-set. It gave the impression that our previous discussions have influenced him profoundly, which made him rethink his previous decisions. All of us admitted that we have gained many new insights and helpful knowledge for future practices through our action meetings: *"[...] man lernt auf jeden Fall viel Neues und auch Einiges, was uns auf jeden Fall weiterhelfen wird. Das ist schon cool"*.

Internal maintenance

Both, the use of installation scripts and the optimal battery use were not addressed or further developed since the previous meeting due to lack of time. The first setup cycle and the process definition still need to be discussed and planned with Ms C1.

An aspect, which spontaneously came into my mind, addressed the approach regarding system version upgrades. Mr C2 reported that with a new setup the newest available Windows system is installed regardless of colleague's wishes, except Ms C1 who preferred to continue using Windows 7. In general, he was in favour of installing the same version for every employee, as it constitutes less effort needed. Besides, he always installs the English version, because more documentation of problems and related solutions are available. We agreed, to stay with this approach.

Repair possibilities

I received the response that broken laptops may be taken to the upcoming repair café. When asking about other non-functional devices, Mr C3 directly responded, *"Ich hab auch nichts zuhause, was nicht funktioniert, weil das schmeiß ich immer gleich weg"*. When Mr C2 sarcastically advised him of being such an honest person, Mr C3 remarked *"Nein, ich hab ja auch nicht gewusst, dass es so etwas gibt. Weil normalerweise hörst du immer, dass es sich nicht auszahlt das reparieren zu lassen"*. Through this short conversation I was confirmed in my motivation to change and influence

practices, not only within the organisation but also concerning their private consumption behaviours. Besides, Mr C2 argued that he has never thought about repairing for instance an alarm clock, which would only cost around 20€ in the shop and one may not count the private time needed for repairing it. Nevertheless, he concluded, *“Aber es macht sicher Sinn und so darf man dann eh nicht rechnen”*. Mr C3 related his feeling of achievement, when he once repaired his sound system with a 20 cents capacitor at home.

Furthermore, I presented my adaptations of the document regarding repair possibilities in Vienna regarding transport service and costs. Both were pleasantly surprised about listed prices and rated them as legitimate. Besides, I highlighted that as an organisation, taxes may be deducted from the mentioned costs and thus, Mr C3 responded, *“Das ist eigentlich wirklich billig. Vor allem für einen Mainboard-Tausch”*. Both now agreed to have a better impression of associated costs and know whom to contact in case of problems.

Use

Both confessed that they didn't have a closer look at the current workplace conditions, but stated to know that all are similarly arranged. Afterwards I presented my researched target use guidelines. I highlighted the usefulness of the standby modus during short breaks and switching off the display after several minutes of inactivity. We agreed that default configurations of the power saver mode within the Windows power plans should be selected. To ensure this configuration it may be adjusted by Mr C2 during a device's central setup. Those colleagues, who are effectively bothered may change these settings, however, both doubt this reaction. Moreover, Mr C3 suggested reducing the display brightness, if only the external monitor is being used in order to save battery. A switchable multi-way connector has already been installed throughout the offices. Last, the new guideline to store all data on the central storage was brought into relation with an improved use-time by Mr C3: *“Das hat dann indirekt auch wahrscheinlich eine Auswirkung auf die Nutzungsdauer. Und auch generell auf die Effizienz. Weil wenn das Gerät nicht so zugemüllt ist, dann braucht man es vielleicht weniger oft aufsetzen. Das Aufsetzen geht auch schneller und generell hast du auch nicht so viele Datenbewegungen wenn man nicht viel darauf speichert”*.

Contacting Lenovo

Lenovo's first answer regarding its social responsibility, which I have already mentioned within the previous meeting, was analysed and summarised within the area of improvement 'procurement'. However, I was not capable of answering all my questions with their response and thus, I contacted them again requesting more precise information regarding expected use-time, life span, reparability, exchangeability of components and repair service in Austria.

Moreover, I started a separate request concerning the use of Bitlocker and recommendations concerning the optimal battery care. As Bitlocker performs many read-/write-access, we were worried about its impacts on the SSD's life span. Lenovo responded within three days and stated that so far no problems regarding Bitlocker have been reported. Their battery use recommendations comprised the following notes:

- If a laptop is mainly being used stationary, the battery should be removed and stored in the refrigerator protected from condensation water. Otherwise it may lose up to 15% of capacity per day. However, a modern battery need not be removed from the device, but should be regularly maintained (e.g. energy manager tool offered by Lenovo).

- Although, modern lithium-ion or lithium-polymer batteries are rather robust, long-lasting heat may irreparably damage the battery.
- Each battery has a predetermined amount of load cycles, which are not published by their manufactures. Nevertheless, each connection to the power supply counts as one and is deducted. Multi-phase charging has no influence, as memory-effects have been eliminated.

All information was forwarded to Mr C2 and will be discussed within the subsequent action meeting.

Document “advantages and motivation for extending the use-time in organisations”

Based on the action meetings notes and consequently, the core group member’s comments, I further expanded the document. Mr C2 suggested performing a short brainstorming session to gather more aspects. Worries from the post questionnaire like high costs or demanding organisation effort have already been addressed within our action meeting. I proposed to document our actions taken in an additional column.

Concluding this very intensive reflection session, we summarised all remaining to-dos from the previous action meeting and newly derived ones within Table 6. As one may see, the majority of to-dos were dependent on discussion or coordination with Ms C1 and thus, her participation in the subsequent meeting was of vital importance.

<i>Person in charge</i>	<i>To-do</i>	<i>Area of improvement</i>
<i>Mr C2 and Ms C1</i>	<i>Discussion with Ms C1 regarding first setup cycle</i>	<i>Maintenance</i>
<i>Mr C2 and Ms C1</i>	<i>Definition of the internal maintenance process (including tasks, person in charge and documentation within the monitoring sheet) in connection with discussion with Ms C1 regarding data backups</i>	<i>Maintenance</i>
<i>Mr C2 and Ms C1</i>	<i>Formal definition of internal contact persons according to the agreement with Ms C1</i>	<i>Organisation</i>
<i>Mr C2 and Ms C1</i>	<i>Discussion with Ms C1 regarding the participation in a repair café in September</i>	<i>Repair</i>
<i>Mr C2 and Ms C1</i>	<i>Discussion with Ms C1 regarding repair possibilities in Vienna</i>	<i>Repair</i>
<i>Mr C2 and Ms C1</i>	<i>Discussion with Ms C1 regarding the purchase of cooling pads</i>	<i>Use</i>
<i>Mr C2, Mr C3 and Ms C1</i>	<i>Determination of the goal value regarding use-time</i>	<i>Use</i>
<i>Mr C3</i>	<i>Research on notebookcheck.com regarding current laptops and their reparability</i>	<i>Procurement</i>
<i>Mr C2 and Mr C3</i>	<i>Extension of ecological criteria to the definition of procurement criteria including research on current business laptop models</i>	<i>Procurement</i>
<i>Mr C2 and Mr C3</i>	<i>Investigation on current use and workplace situation</i>	<i>Use</i>
<i>Mr C2 and Mr C3</i>	<i>Research on automated installation scripts</i>	<i>Maintenance</i>
<i>Mr C2</i>	<i>Discussion regarding battery use within the upcoming internal meeting</i>	<i>Maintenance</i>

All	Brainstorming regarding communication and final presentation	Communication
The researcher	Research on Greenpeace ratings and procurement guidelines	Procurement
	Research on guarantee and support extension services	Procurement
	<i>Creating a use-guideline including central data storage, which may be transformed into a checklist after prior agreement with Ms C1.</i>	Use
	Analysing Lenovo's expected response regarding previously missing answers	Procurement, repair and maintenance
	E-mail request to IT-leasing companies	Procurement
	Little adaptations regarding 'Labels' and 'Repair possibilities'	Procurement and repair

Table 6 - Derived actions from second reflection

4.6.3.2 New actions and discussion

As several previous actions have not been further developed due to lack of time or the absence of Ms C1, we decided to discuss only the basics of the last two areas of improvement and focus on their elaboration within the fourth action meeting.

End-of-life possibilities

After the organisation's internal use-time, many possibilities are available ranging from donating old devices or passing them on to employees, if desired. Mr C2 mentioned an out-dated PC stored in the closet behind me: *"Der wäre z.B. ein Kandidat, wo man sagt, man upgradet noch einmal richtig fast alles oder man gibt ihn her oder verkauft ihn oder entsorgt ihn. Weil der ist wirklich schon recht veraltet"*. Consequently, I underpinned the importance of avoiding the disposal of old devices whenever possible and Mr C2 agreed, that somebody will still be able to use it.

Due to some sensitive data stored, the hard drive or SSD must be completely deleted. With regard to this aspect, I mentioned the cooperation between two experts I interviewed, where the refurbishment company guarantees for safety-related and certified deletion of data. Omega Ltd may either download the software and perform the deletion themselves, or make use of the refurbishment company's service. Mr C2 suggested delegating this research task internally.

Internal and external communication

In my opinion, all their internal effort should also be communicated to their customers and stakeholders. Thus, I suggested communicating their ecological improvements in form of a corporate social responsibility (CSR) strategy. Mr C3 proposed to integrate it into their website, however, Ms E13, who is in charge of updating it, is currently not available. Mr C2 confirmed that their practices have changed since we started the cooperation: *"Seit du das mit uns machst. Im Endeffekt ist es egal, warum wir es machen, solange etwas passiert"*. As it is not part of their daily business, most organisations need a first impulse to rethink their practices and take their time for necessary improvement. Unfortunately, I had to negate Mr C2's question if a certification possibility for small organisations exists.

Regarding the internal communication, we discussed to organise a 'use-time brunch' for all colleagues in order to commonly show our results. It was due to my suggestion to alternate in the presentation as it should represent our common work. All guidelines and concepts will be made

accessible in a separate notebook in Microsoft OneNote, used by all colleagues. Moreover, we will figure out interactive parts in order to make everyone participate.

4.6.3.3 Results

All actions discussed within the second part of the meeting are summarised within Table 7. As already mentioned, most tasks are dependent on Ms C1's ideas and desires.

<i>Person in charge</i>	<i>To-do</i>	<i>Area of improvement</i>
Mr C2 and Mr C3 delegate internally	Research on end-of-life possibilities	End-of-life
Mr C2 and Mr C3 delegate internally to Mr E7	Research on save deletion of hard drives	End-of-life
Mr C2 and Mr C3	Organising date for 'use-time brunch'	Internal communication
Mr C2, Mr C3, Ms C1 and The researcher	Discussion about external communication (CSR, integration on website)	External communication
	Discussion about internal communication	Internal communication
	Brainstorming 'advantages and motivation for extending the use-time'	Action meeting process

Table 7 - Results of action meeting 3

4.6.3.4 Personal reflection

We recognised that it is of great importance that Ms C1 participates in the next action meeting, as many decisions are dependent on her. Sometimes Mr C2 and C3 acted rather reluctantly, especially when it came to defining processes. Instead of creating a real proposal, they preferred to take several notes and discuss them with her later on. In addition, some technical problems occurred during her absence. Due to both circumstances we lost some important time, which we could have used more efficiently.

Except IT-leasing and procuring second-hand devices, all developed actions, researched information and summarised documents have been pleasantly accepted by both core group members. Even the repair possibilities were perceived as more useful when costs were added and the business models 'Thinkpads' became more attractive when longer guarantee and better reparability were highlighted. One last barrier may be the extension of ecological criteria for procuring laptops, which I aim to address in agreement with Ms C1.

4.6.4 Action meeting 4

The fourth and last action meeting took place only two working days after the third action meeting, as we wanted to discuss our suggestions and results with Ms C1 as soon as possible. Before the meeting I additionally joined them for lunch again. This time we were only four people, including Ms C1, and thus, we had the opportunity to easily talk to each other more personally.

The fourth action meeting was divided into three parts: reflection / discussion with and without Ms C1 and new actions / further work with Ms C2, as Mr C3 had to leave earlier. The first part took almost one hour, the second and third part nearly one and a half hours.

4.6.4.1 Reflection and evaluation with Ms C1

First, I shortly summarised out action meeting procedures. As we only had one hour with Ms C1 available, we presented the most important results or actions that needed consultation. The aim of this meeting was to react to her evaluation of the usefulness, practicability and open requirements / desires on her part.

Monitoring sheet

Mr C2 started to present the development of the monitoring sheet, its use and goals, which was not completely new to Ms C1. She was very satisfied with the outcome and reported about her research regarding past discarded devices: *“Ich habe mich jetzt einmal schlau gemacht. Wir haben bisher 2 Server entsorgt, aber von PC 1 bis PC 4 sind alle noch da und warten darauf entsorgt zu werden. Und ich habe gesagt, jetzt lassen wir das einmal so und warten einmal ab, was bei uns da alles rauskommt und dann schauen wir wie wir weitermachen”*. All four mentioned PCs were purchased between 1999 and 2001 and are therefore not worth being upgraded. I was delighted, when I heard she wanted to wait for our results in order to react properly.

When asking her about her evaluation, she argued, *“Ja, also bis jetzt finde ich es recht gut. Wie gesagt, wenn man einmal damit arbeitet, kommt man sicher noch auf das ein oder andere drauf, was Sinn machen würde. Aber so finde ich es schon einmal wirklich super”*. She is willing to integrate the monitoring sheet within daily business and document all developed aspects. Her acknowledgment was of considerable importance not only to me, but to all core group members.

Internal maintenance

In order to manage responsibilities and internal maintenance tasks, the definition of a process is needed. The focus may be on system setups, cleaning of ports / ventilation slots and the installation of updates. Tasks will be grouped according to their application frequency. Moreover, a main person in charge must be identified.

Ms C1 agreed and asked Mr C2 to make a suggestion, which we may complete commonly. She underpinned the importance, of defining this new process within our cooperation and simultaneously acknowledged that it will be an organisational effort to implement it: *“Aber ich glaube da werden wir auch dahinter sein müssen”*.

Later on, Ms C1 underpinned that system set ups should be properly defined and prepared in order to ensure that devices are quickly working again. Therefore, we agreed to focus on identifying either installation scripts or different auxiliary tools to fasten setup processes.

Furthermore, Mr C2 introduced to her our identified contact persons, which still need to be expanded until the final presentation. As this information is relevant to all existing, but also new employees, she suggested integrating it into the info page within OneNote: *“[...] zum Nachlesen für bestehende bzw. neue Mitarbeiter, damit sie sich ein bisschen informieren können. Ich finde, so etwas gehört dann eigentlich eh dort hin”*.

Regarding the missing knowledge about performed data backups, Ms C1 reacted astonished as she has already documented everything. However, she admitted that a central reference to her document is missing and should be complemented within the maintenance definition. Last, we may record that data shall not be stored locally in order to avoid high data access rates on the SDD and sensitive data loss.

Use

Then it was my turn to present my developed guidelines for optimal use at work, while on the move and at home. Although, some seem to be very obvious, Ms C1 agreed to write all criteria down: *“Einfach einmal niedergeschrieben. Das finde ich sehr gut, genau, das ist wichtig”*. When introducing our thoughts regarding the battery use, Ms C1 doubted its practicability likewise as

we did in the previous meeting. Still, we are uncertain about the suggested actions' beneficial impacts on the use-time and life span of the battery. Mr C3 proposed to search again for a software tool regulating how much of the battery is loaded. Nevertheless, we agreed that the permanent use of the power supply is not optimal and Ms C1 reported having her laptop's battery constantly removed without having made any negative experiences. However, she will not force any of her employees to follow her practice, if they are sceptical.

Concluding, she is in favour of creating a checklist and Mr C2 additionally evaluated its usefulness by stating *"Wäre ich auch dafür. Weil dann können wir Arbeitsplatz für Arbeitsplatz einmal durchgehen und aufzeigen, was vielleicht besser gemacht werden sollte"*.

Last, Mr C2 and Ms C1 have already discussed purchasing cooling pads for every employee and agreed on searching for one which additionally elevates the laptop. Thus, the device benefits in two ways: first, the cooling of components is being increased and second, ventilation slots are not blocked. Ms C1 evaluated this auxiliary tool as considerably useful as she has made very positive experiences over the last years: *"Ich habe das eigentlich schon ewig und ich habe meinen Laptop auch schon ewig"*.

All of a sudden, Ms C1 realised one of her daily practices being unsustainably. Every morning she turns on her laptop, although she hardly uses it due to her portable tablet: *"Das müssen wir noch überdenken. Das ist mir jetzt eigentlich auch bewusst geworden. Weil das stimmt, es gibt inzwischen Tage, wo ich kaum dort sitze. Ich werde mir das abgewöhnen, dass ich ihn in der Früh aufdrehe. Das bringt's nicht"*. Through our actions aiming to improve the status-quo, she started to self-reflect upon her behaviour as a matter of routine.

Repair possibilities in Vienna

When addressing the possibility to participate in the upcoming repair café, both, Mr C2 and Mr C3, realised that the event would be in three days and regretted to have no time. Nevertheless, Ms C1 liked the idea and Mr C2 responded, *"Aber irgendwann würde ich es mir schon einmal gerne ansehen. Weil es schon interessant klingt"*. Unfortunately, my plan didn't succeed, which was somehow disappointing as I supposed it to be an important step towards accepting repair and realising its opportunities. Therefore, I may only hope that they keep this possibility in mind, when little electrical devices fail whether in private life or at work.

Apart from that, Ms C1 was very convinced of the developed document regarding repair possibilities and generally its practicability. Mr C2 introduced one specific member of the Repair Network, which additionally joins the transport service and thus, represents the best and most inexpensive alternative. As the repair procedure may take some time, I suggested using a stored older device in the meantime. Moreover, I highlighted that taxes still need to be deducted from the listed prices in the document. Ms C1 agreed that related costs are neither shocking nor inadequate and evaluated the document in the following way: *"Auf jeden Fall. Und wenn man ein bisschen mehr Zeit hat, dann ist das überhaupt kein Thema. [...] Das ist auf jeden Fall sehr interessant"*.

Labels, business series from Lenovo (Thinkpads), social responsibility and ratings

As these topics are very comprehensive, I shortly introduced the advantages of a business laptop like Lenovo's Thinkpads: three year guarantee, better reparability and maintenance possibilities among other things. Thus, I argued that higher acquisition costs are justifiable in the long run and Ms C1 agreed. She mentioned to be highly interested in the results regarding labels, social

responsibility and ratings, but admitted that we need more time for discussing them. However, she absolutely wants them to be included within the final presentation.

Procurement criteria

We shortly presented all technical procurement criteria to her and I again suggested adding ecological attributes to it. Ms C1 agreed and additional criteria will be developed.

External and internal communication

Ms C1 immediately was in favour of organising a ‘use-time brunch’ in order to commonly present the final results from our cooperation and argued to schedule three hours: *“Aber wenn wir schon so einen Aufwand betreiben, dann sollten wir es schon alle Punkte, halbwegs detailliert, durchgehen. Das sollten wir schon wirklich aktiv machen”*. The development has been a considerable effort for all core group members and thus, every area of improvement should be addressed and presented properly. Just mentioning the availability of information is not enough as most colleagues won’t take their time to have a closer look at it. By actively presenting important results, guidelines and concepts, employees will be more likely to memorise them.

In contrast, I suggested communicating Omega Ltd’s effort and pro environmental attitude to externals like customers and stakeholders as it is no matter of course for a small organisation to care about resource protection. Ms C1 evaluated its usefulness and importance by stating: *“Stimmt, da hast du Recht. Ja, das ist eine gute Idee und ein guter Ansatz. Das sollten wir auf jeden Fall auch machen. Website würde ich auf jeden Fall sagen, an den Folder habe ich nicht einmal noch gedacht, ist aber auch eine ganz gute Idee. Finde ich super”*.

End-of-life possibilities

Ms C1 added ‘End-of-life’ as an important topic, which should be researched into more detail, as some devices have to be sorted out soon. I explained that we have only discussed the basics so far and results are being researched. We all agreed on focusing to develop useful results until the final presentation.

Concluding, Ms C1 evaluated the development and our intermediate results in the following way: *“So akut, wüsste ich jetzt nicht. Nein, ist mir jetzt nicht wirklich etwas abgegangen. Und für den Termin: Bitte bereitet einfach einen Vorschlag vor. Ich finde, ihr habt eh jetzt ein gutes Feeling dafür, wie viel man sagen soll und was zu viel wird. Das Neu Installieren sollten wir uns schon noch einmal genauer anschauen, also wenn ihr da noch ein bisschen Zeit habt, das zu recherchieren. Das macht schon Sinn. Ich weiß, wir sind noch sehr klein für so etwas, aber das geht in Richtung Standardarbeitsplatz-Installation”*. As a future-oriented head of the company, she has quick realised the potentials of our proposals and concepts. Therefore, she encouraged Mr C2 and Mr C3 to carefully prepare the new processes and guidelines for the final presentation. Admittedly, the core group members were considerably motivated because she has always stood behind our cooperation even when not being physically present.

4.6.4.2 Reflection and derived actions without Ms C1

Derived actions were discussed in more detail after Ms C1 left the meeting. Therefore, the to-do list including the respective person in charge was developed within this part of the meeting and was summarised within Table 8.

Procurement criteria, reparability, guarantee and ratings

One again, I suggested adding ecological criteria like reparability to the procurement definition. Surprisingly enough, Mr C2 replied, *“Gerade das ist ein Thema, das eher der Ms C1 am Herzen liegen wird, so ökologische Sachen, Umwelt”* and Mr C3 agreed, *“Ja, ich glaube, es ist relativ unnötig, weil das eine Label, das ein bisschen strenger ist, weiß ich nicht, ob wir uns auf das einschränken wollen. Und das Energy Star haben wahrscheinlich eh 99% aller Modelle. Vielleicht, dass wir auf das schauen, aber... Aber anscheinend sind wir mit Lenovo da eh nicht so schlecht dabei”*. When listening to these comments, I had the impression that both reverted to the old assignment of tasks, when environmental issues were not part of their responsibility. Moreover, labels and further non-technical criteria were perceived as limiting instead of a positive add-on.

Consequently, I highlighted the cost saving benefits of criteria like reparability as devices may be easier and quicker repaired or upgraded. Mr C3 agreed and mentioned the importance of the existence of screws to open the laptop. Furthermore, I underpinned that Lenovo offers three years of guarantee for Thinkpads in contrast to Amazon, which generally offers only two years. I additionally surprised them by revealing the fact, that Amazon's guarantee extensions are only valid for private customers. In general, guarantee extensions may be useful, however, cost-intensive without covering every damage. An interesting aspect, we haven't thought of so far, was addressed by Mr C3. He stated that guarantee in general may also be seen as a negative attribute as it is easily lost due to upgrades like exchanging the hard drive. Thus, I suggested requesting this information from Lenovo and later on, received an answer stating that memories and hard drives are so called customer replaceable units. Therefore, they may be properly replaced by the user. When I forwarded the e-mail to Mr C2, he responded *“Das freut mich!”*.

In order to underpin the importance of reparability, I presented Lenovo's website offering instructions and videos how to properly dismantle certain models. *“Den Akku selbst auszutauschen, bringen wir zusammen. Aber ab da wird es dann schon interessant”* commented Mr C2. Therefore, we watched two videos together demonstrating the exchanged of the mainboard and the graphic chip.

Besides, I introduced my research on electronics ratings to them. Both were surprised about certain companies being classified among the best ones. All three ratings led to different results and to better deal with the amount of information, I only summarised data regarding Lenovo in a document. I underpinned, that all ratings should be accepted with caution as different benchmarks and guidelines have been used to evaluate the companies. When asking about further remarks or desires, Mr C2 evaluated the document by stating the following: *“Nein, ich denke nicht. Besonders solche Sachen müssen wir uns noch genauer anschauen müssen. Das wird sicher einer von uns noch einmal ein bisschen recherchieren, weil das der Ms C1 besonders am Herzen liegt und dann sehen wir eh weiter. Aber es ist auf jeden Fall schon ein sehr schöner Einblick von den ersten Ratings und damit können wir sicher schon etwas anfangen”*. Both had to discover that no company has reached an 'A' grade or only approximately the maximum points.

In the end, both agreed to add ecological criteria to the procurement definition and research one or two business laptops as a reference. As Lenovo offers many green label certified Thinkpads, it shall not be to challenging.

Last but not least, I presented my gathered links to fair procurement and green initiatives including the first fairly produced mouse.

<i>Person in charge</i>	<i>To-do</i>	<i>Area of improvement</i>
Mr C2 and Ms C1	Research on automated installation scripts and discussion with Ms C1 regarding first setup cycle	Maintenance
Mr C2	Research on cooling pads with elevating functionality	Use
Mr C2, Mr C3 and Ms C1	Definition of the internal maintenance process (including tasks, person in charge, data backup, battery use and documentation within the monitoring sheet)	Maintenance
Mr C2 and Ms C1	Formal definition of internal contact persons	Organisation
Mr C3	Research on battery care tools	Maintenance
Mr C2	Creating a checklist for target use criteria and extension of current use situation to the monitoring sheet	Use
Mr C2 and Ms C1	Determination of the goal value regarding use-time	Use
Mr C3	Extension of ecological criteria to the definition of procurement criteria including research on current business laptop models	Procurement
The researcher	Contacting Lenovo regarding guarantee in case of exchanging the hard drive or memory	Maintenance and repair
	Adding Lenovo's answers to developed documents	Maintenance and repair

Table 8 - Derived actions from third reflection

4.6.4.3 New actions and discussion

Due to time constraints, Mr C3 had to leave our meeting earlier, but said to be available, if needed. Mr C2 and I continued with the last part.

End-of-life possibilities

I shortly presented two spontaneously discovered websites regarding donating or selling old devices. As I didn't have time to analyse them before the fourth action meeting, I suggested making a summary. Mr C2 was in favour of donating old laptops over this website as it transparently shows where they go, which school project they supported and how many are still needed: *"Das ist eh cool, wenn man irgendwie sieht, was damit geschieht. Und nicht einfach so, wenn du etwas spendest, du hast keine Ahnung was mit dem Geld passiert"*. Apart from these two websites, I will add AfB, a local company, which refurbishes old IT, to my document, as I had organised an interview with one of its representatives. Further research was delegated internally and results will be merged before the final presentation.

Final presentation

Furthermore, we discussed and coordinated the rough course of the final presentation. We agreed to split topics up according to their person in charge so far. Generally, Mr C2 and C3 will represent results regarding internal changes and I will focus on additional environmental information, repair and end-of-life. As OneNote is a commonly used tool within Omega Ltd, we created a separate notebook with our presentation's structure, making conventional slides obsolete. Documents and links may be embedded and thus, all results are easily available for everyone. Simultaneously, the notebook represents my master thesis's final outcome as regards content.

In order to prepare properly and discuss final adaptations made, we organised a preparation meeting two days before the final presentation. This was our internal deadline for completing all documents, concepts and guidelines. Consequently, we had one week of mutual feedback and reviews available.

When going through our topics, we discussed to leave out 'IT-leasing and second hand devices', as no company has answered my e-mails. Mr C2 admitted that further research would have been necessary to present valuable results: *"Man müsste es sich wahrscheinlich noch ein bisschen genauer anschauen, aber, ich glaube grundsätzlich, dass es für uns eh nicht in Frage kommen wird. Also dass wir jetzt ein Second-Hand Gerät anschaffen für uns in der täglichen Verwendung, kann ich mir nicht wirklich vorstellen. Und IT-Leasing, glaube ich, dass es nicht wirklich Sinn machen würd, wobei das meiner Meinung nach noch interessanter wäre, als jetzt z.B. ein Second-Hand Gerät. Aber andere Sache sind, meiner Meinung nach, auf jeden Fall wichtiger, dass wir eher einmal schauen, dass wir andere Sachen vernünftig machen"*. Thereby, he suggested focusing on more relevant topics and completing them properly. I agreed and stated to summarise so far findings, which may be used as a basis for further research, if interests change someday.

Further topics

Mr C2 stated that within the last week they had to quickly procure a new laptop for their new colleague and thus, felt back on the previously chosen 'Ideapad' due to time-critical reasons. However, he underpinned *"Wenn wir wieder in die Situation kommen, würde ich eher dazu tendieren, sowieso versuchen ein Thinkpad zu kaufen"*. Through all our discussions, he was convinced to change their procurement practices in the direction of a longer-lasting and easier to maintain laptop.

Unfortunately, further steps regarding the development of Omega Ltd's vision and goals haven't taken place up to now. Consequently, we were not able to include results referring to this planned action. However, Mr C2 suggested asking Ms C1 about extending our final presentation in order to complete it. Additionally, he will ask her about answering the gathered unclear questions from the workshop.

Regarding the external communication and CSR, Mr C2 proposed to shift the responsibility to Ms C1 as she surely wants to be part of its development. Thus, only basic ideas will be presented within the final presentation.

Besides, Mr C2 was in favour of my idea to interactively develop further advantages and motivation reasons as a separate part in our final presentation. We highlighted to select a proper method, which takes introverted colleagues more into consideration and makes it easier to participate. Our document will not be presented in advance.

Concluding the final presentation, I decided to address fears mentioned in the post questionnaire of the workshop and describe our actions taken against them, followed by introducing our document with further links regarding missing information likewise from the same source.

4.6.4.4 Results

The main results of the last action meeting concerned the proper preparation for the final presentation and were summarised in Table 9.

Person in charge	To-do	Area of improvement
Mr C2 and Mr C3 delegate internally	Research on end-of-life possibilities (except already mentioned options)	End-of life
Mr C2 and Mr C3 delegate internally to Mr E7	Research on save deletion of hard drives	End-of-life
Mr C2 and Ms E2	Date coordination regarding preparation meeting and final presentation	Internal communication
Mr C2	Completion and preparation of his final presentation topics: <ul style="list-style-type: none"> • Monitoring sheet • Internal maintenance definition • Contact persons • Target value of use-time • Target use guideline as checklist 	Internal communication, documentation, maintenance, organisation, use
Mr C3	Completion and preparation of his final presentation topics: <ul style="list-style-type: none"> • Procurement including technical and ecological criteria • Reference models including labels • Shop alternatives 	Internal communication, procurement
Mr C2 and Ms C1	Discussion of further steps regarding: <ul style="list-style-type: none"> • Vision and goals • Answering of unclear questions • CSR • Introduction and Conclusion of the final presentation 	Organisation, external and internal communication
The researcher	Research on end-of-life possibilities <ul style="list-style-type: none"> • Two websites • Local company 	End-of-life
	Completion and preparation of his final presentation topics: <ul style="list-style-type: none"> • Repair possibilities in Vienna • Ratings and labels • Social responsibility • Guarantee • End-of-life possibilities • Interactive method for brainstorming • Fears and missing information (including creating a document) 	Internal communication, repair, procurement, end-of-life, action meeting process

Table 9 - Results of action meeting 4

4.6.4.5 Personal reflection

Ms C1 especially liked the idea of more documentation, gathering data in the monitoring sheet and introducing an internal maintenance process. Moreover, she confirmed that repair services in Vienna seem to have a good price-performance ratio as we showed her the pricelist in connection with the transport service offer. In future, she underpinned to take more care about labels and ecological criteria when procuring new laptops. Besides, she mentioned being in favour of publicly communicating all their effort regarding sustainability by integrating a CSR page into their website. From our point of view, it is valuable to state that a small organisation may also take care of the environment during their daily business as this cannot be taken for granted.

However, it is important, that also the employees start thinking in the right direction and consequently, change their practices. During our four meetings, I recognised that occasionally some old practices appeared, which were 'corrected' after a second of realising them. I supposed that this is an essential step towards sustainable change. On the other hand, many positive comments about future practices have been mentioned, which underpinned my impression of profoundly changing the status-quo through our meetings. Especially Mr C2 seemed to change his reflections about his practices and past decisions.

Due to these facts, I suggested to brainstorm for further advantages and motivation of prolonging the use-time at the end of our final presentation. This section should be interactive and give everyone the opportunity to participate easily.

Moreover, I think it was a valuable decision to split up our presentation parts within the 'use-time brunch' in order to communicate the involvement of all core group members and not just my personal opinion. If Ms C1 kicked off and ended up the presentation with 'words from the management', even more importance would automatically be attached to the topic use-time.

Directly after the fourth action meeting I expressed how deeply impressed I was by their effort during these action meeting weeks. Thereupon, Mr C2 agreed that without my impulse they would not have started to improve the status-quo and thus, all are very thankful for my engagement. Moreover, he stated that he has learned many useful facts through our intense research work, which he definitely will take into consideration for future practices.

4.6.5 Lessons learned

First of all, I think it would have been useful, if I had sent the to-do list per meeting to all core group members. Although, Mr C2 and C3 always took notes and wrote down a to-do list themselves, I have understandably never controlled their wording. Thus, some actions were addressed more than once or have been omitted over time. A common to-do list, shared by all, would have been more effective and supporting.

Besides, I got the impression that due to time constraints we were not able to develop and discuss some processes like maintenance or battery use into more detail. Although, we had one more month than originally planned available, I regretted that we had no time to participate commonly in a repair café or to purchase the last laptop already according to our newly defined criteria. However, it was always difficult for the core group members to reserve time for researching on a specific topic, defining concepts or participating in an action meeting.

Apart from that, we realised that Ms C1's presence would have been considerably important in all four meetings as we had too many decisions pending, which we couldn't further develop. Apparently, Mr C2 and C3 became more self-confident throughout the three action meetings, nevertheless, they mostly referred to the need of Ms C1's consultation.

4.7 Final presentation

To conclude our action meeting process, we organised a final presentation, which took place on the 23rd of September and lasted three and a half hours including a brunch. All employees, except two, participated and were generally very attentive during the presentation. Ms C1 opened and closed the session. During the first half, results were presented by Mr C2, Mr C3 and myself, followed by a break to enjoy the catering. After that, we continued with a discussion and an interactive part to develop ideas and answers for two research questions. The final presentation

was audio recorded and transcribed. Derived topics or open steps were then discussed during the final reflection meeting on the 30th of September with Ms C1 and Mr C2.

It was a good, relaxed, but also productive atmosphere, where suggestions and comments were welcomed and expressed. Although, some participants shifted too far away from the subject and breaks lasted longer than planned, I was convinced of the relevance to make room for personal remarks in order to get constructive comments afterwards. Ms C1 supported us in the best possible way by giving a motivated introduction to the topic, explaining the importance of participating and the implementation in the future. In general, Ms C1 has always attached importance to the integration of every employee. All in all, she seemed to be very satisfied with our progress and results.

Our course of the final presentation was themed ‘from the beginning till the end – a laptop’s internal use-time cycle’ leading to a clear and easy to follow structure (see Table 10).

#	<i>Section and topics</i>	<i>Presenter</i>
1	Introduction	Ms C1
2	What have we done? How was our process?	The researcher
3	Contact persons <ul style="list-style-type: none"> • Interactive extension 	Mr C2
4	Procurement <ul style="list-style-type: none"> • Criteria • Notebookcheck and Thinkpads as reference • Labels • Ratings • Fair procurement • Lenovo’s social responsibility • Lenovo’s guarantee and reparability 	Mr C3 Mr C3 The researcher
5	Monitoring sheet and documentation	Mr C2
6	Use <ul style="list-style-type: none"> • Guidelines and Checklist 	Mr C2
7	Maintenance	Mr C2
8	Repair possibilities in Vienna	The researcher
9	End-of-life	The researcher
-	<i>Break</i>	-
10	Discussion and feedback	Alle
11	Interaction: Brainwriting (6-3-5 method) in order to answer the following questions in two groups: <ul style="list-style-type: none"> • What advantages may be derived from a prolonged use-time? • What motivates you as an employee to use your PC / laptop longer? 	The researcher
12	CSR and personal motivation	Ms C1
13	Next steps: <ul style="list-style-type: none"> • Vision and goals • Unclear questions • Environmental officer 	Ms C1
14	Closing words: <ul style="list-style-type: none"> • Post questionnaire • Additional information 	The researcher

Table 10 - Course of the final presentation

4.7.1 Preparation meeting

Until Monday, 21st of September, we aimed to finalise the documents for OneNote in order to discuss them in the preparation meeting. All three core group members were present and it took nearly three hours. We decided to write down a description and the risks, mentioned in the post-questionnaire of the workshop, including their respective actions taken for every section of the presentation. The meeting was audio recorded, but, due to time constraints and manually taken notes, not transcribed.

As Mr C2 and Mr C3 were not completely finished with their work due to high workload, we stayed in contact until Tuesday evening, the day before the end-presentation. However, I was very impressed by their engagement and motivation to present valuable results, which strengthened my decision to integrate them into the presentation process.

To re-check the details and structure in OneNote, Mr C2 and I met one hour before the final presentation. Besides, some documents had to be updated.

4.7.2 Presentation of the results in OneNote

Based on the discussions, actions taken, reflections and evaluations during the action meeting phase, we documented our results in form of a notebook in OneNote. As OneNote is used on a daily basis, new processes, guidelines and checklists are easily available to every employee. Instead of using separate presentation slides, we decided to present our results following the structure in OneNote. Although, the process may be similarly performed in other small organisations with comparable characteristics, the results are considerably dependent on the status-quo, the basis of the action research.

1. Introduction

Ms C1 opened the session and shortly introduced its aim to present our iteratively developed results. As she has already got first insights two days earlier, she underpinned her evaluation and perception in the following way: *“Ich finde es sehr, sehr super. Ich muss echt gestehen, ich war am Anfang ein bisschen skeptisch, als der Mr E5 gekommen ist und gesagt hat ‚Da macht jemand eine Arbeit über Nutzungsdauer‘ – ‚Hm! Was können wir da tun? Was bringt’s uns?‘. Aber es ist wirklich gut geworden. Es ist super, muss ich sagen, ich bin echt begeistert und bin gespannt, was ihr dazu sagt’s”*. By her words, employees became more attentive and realised the relevance for Omega Ltd. The head of the organisation’s motivation is the basis for any improvement or change in daily business practices. However, the employees’ support is of considerable importance as well and thus, it was our goal to convince them likewise.

2. Contact persons

Before we started with the actual use-time life cycle, Mr C2 addressed the absence of a contact person definition. During the interviews and action meetings it became prevalent, that employees are not aware of a specific person in charge for their problems or issues: *“[...] wir schauen uns einmal unsere Ansprechpartner an, weil es auch nicht immer ganz klar war, wer wofür zuständig ist oder zu wen man gehen kann, wenn man eine Frage zu welchem Thema auch immer hat. Ich habe jetzt ein bisschen was zusammengeschrieben und würde euch aber bitten, wenn euch etwas einfällt,*

dass wir das gleich hinzufügen". All core group members have realised the importance of experts being responsible for a certain topic. Although, Omega Ltd is a rather small organisation, some employees haven't reported their problems due to missing processes and structure. They continued their work and for instance didn't mention difficulties with speed or the broken monitor. Thus, no maintenance or repair process may be started and consequently, these circumstances negatively influence the device's use-time and the user's satisfaction. Besides, people feel safer when structures supporting their daily business are defined. However, one employee argued that they shall not be limiting or too formal in order to keep the familiar atmosphere in a small organisation.

Therefore, Mr C2 asked his colleagues to participate in the extension process and to name further contact persons to be added in OneNote: *"Fällt euch noch etwas ein, was wir da gleich aufnehmen könnten? Und wenn nicht, dass wir vielleicht in Zukunft ein bisschen darüber nachdenken, damit man einfach wirklich gesamt an einem Ort nachschauen kann, wenn man irgendeine Frage hat, zu wem man am besten geht".* Mainly Mr E5, Mr C3, Ms C1, Mr E10 and Mr C2 contributed to the discussion and the page within the notebook was successfully extended.

3. Procurement

Short description: The section 'procurement' comprised on the one hand technical and ecological criteria for future laptops, Lenovo 'Thinkpad' reference models (business model, qualitative materials, better reparability) and on the other hand information regarding labels, producer ratings, fair procurement and Lenovo's social responsibility, guarantee and reparability. If at some future point in time a different producer than Lenovo is chosen, this section will have to be considered, researched and updated accordingly.

Contact person: Mr C3

Mr C3 first introduced the **criteria definition** and which new aspects will be relevant for the purchase of future laptops. Technical requirements and a good cooling of the graphic chip are the first specifications, followed by an acceptable battery and a reliable workmanship of the device: *"Und was dann auch wichtig ist, eben auch wegen der Nutzungsdauer, weil wir mindestens 3 Jahre bzw. bis zu 5 Jahren Nutzungsdauer erreichen wollen, eine gute Verarbeitung, damit das Gehäuse, Tastatur, usw. bisschen stabiler ist und vielleicht das Gehäuse nicht unbedingt ein ganz dünnes Plastik ist und dass die Geräte auch länger halten".* Moreover, reparability and extendibility are of vital importance in order to be able to perform upgrades and thus, use devices longer. In order to find laptops meeting the defined requirements, the website notebookcheck.com offers valuable reviews including these additional aspects and therefore, will be consulted before each procurement process. Furthermore, Mr C3 stated that ecological labels are now taken into consideration.

According to all these criteria, business models are the best valuable option. As Omega Ltd has already made positive experience with Lenovo, Mr C3 presented three 'Thinkpads' as reference models, which fulfilled the new requirements as well as labels and were within an acceptable price range: *"Das hat eine sehr gute Verarbeitung, ist auf eine lange Nutzungsdauer ausgelegt, hat eine gute Hardware-Qualität, die eben auch für die Nutzungsdauer ausschlaggebend ist. Die Ausstattung ist auch für den Business-Bereich ziemlich gut, da hat man eigentlich alles was man braucht. Was ich vorher schon angesprochen habe, da bieten sie eben an, dass man die Garantie bei Festplatten- und*

Arbeitsspeichertausch eben nicht verliert [...] Meistens gibt es so Wartungsdeckel. Da braucht man nur so einen Deckel herunternehmen oder herunterschrauben und dann kommt man gleich schön zum Arbeitsspeicher oder zur Festplatte dazu. Das ist eben gescheiter, als wenn man gleich das ganze Gerät auseinander schrauben muss". To demonstrate the usefulness of notebookcheck.com, we had a look at one of the reference models and its reviews together. Moreover, the Lenovo online shop offers users to configure available models according to their needs, although, some are equipped with a conventional hard drive by default. Consequently, Mr C3 explained that an in-house upgrade to a SSD is more cost-efficient and represents a practical possibility in the future. Additionally, he mentioned to check for further needed cables or external peripheral devices during the procurement process in order to make one bigger instead on several smaller orders.

However, I want to highlight that this criteria definition and research may be performed for any producer's business series.

Afterwards I presented additional ecological information in order to give all participants an overview and raise awareness. Starting with the **labels**, I introduced the developed document describing the following green labels relevant in the area of laptops and PCs: *TCO Certified*, *EPEAT*, *Energy Star* and *Greenguard*. Two more labels, *Der Blaue Engel* and *EU-Ecolabel* are relatively strict and thus, only a few producers have accomplished to certify their devices until now. All labels were visualised with their logo, shortly described and rated according to their requirement, independency, controlling and transparency. Moreover, I presented an Excel sheet listing all certified Lenovo models, which must be maintained in the future to stay supportive. Next, I summarised our findings regarding **producer ratings** and explained, that these shall be seen as benchmarks. It is interesting to observe a producer's development and if they constantly improve their conditions. I highlighted the fact, that no manufacturer has been rated as completely sustainable or considerably outperformed. Ratings were followed by the introduction of our link collection regarding **fair procurement**. It was structured into 'how to' guides and initiatives to 'clean IT', raising participant's awareness that demand for fair production conditions is increasing and that every customer may influence the status-quo. As an example and first step into the right direction, I highlighted the existence of a fairly produced mouse.

Concluding this section, I presented some important facts regarding Lenovo's **social responsibility** and their products' **guarantee and reparability**. Again, I want to underpin, that this research should be done before choosing a different manufacturer in order to take ecological characteristics into consideration. As Omega Ltd has stated to stay with Lenovo for now, we performed all our research on this specific producer. However, one has to remark that Lenovo outperforms regarding its reparability and workmanship: the allocation of videos and online instructions to dismantle laptops, no guarantee loss if memory or hard drives are properly upgraded and eco sheets stating the five years availability of spare parts. Moreover, their business line comes with three instead of typical two years of guarantee. In the end, all my requests per e-mail were answered satisfyingly and within short response times. Besides, Lenovo's customer service stated in one of the e-mails, that one may calculate with a minimum use-time of five years. Therefore, we felt confirmed in the realisation and feasibility of reaching our defined target use-time value of likewise five years. Regarding Lenovo's social responsibility, I introduced a document structured into the following topics: sustainability report, environmental certificates and green products, environment (climate change, renewable energy, product packaging, energy efficiency, and use of environmental friendly materials), global supply chain (conflict and critical minerals, production sites and logistics), product recycling programs, repair, employees and non-

profit investments. All information was taken from the official website⁵ and summarised in order not to overwhelm participants with the amount of data. However, I highlighted apparent differences between a company's self-portrayal and previously mentioned ratings for instance regarding living wages in production sites.

Additionally, we had a look at the German initiative 'MURKS? Nein Danke!'⁶ and searched for Lenovo. As results encompassed only one device, **planned obsolescence** seemed not to be prevalent or frequently reported. This was also made obvious by the provided 'Murksbarometer' on the website (see Figure 10).

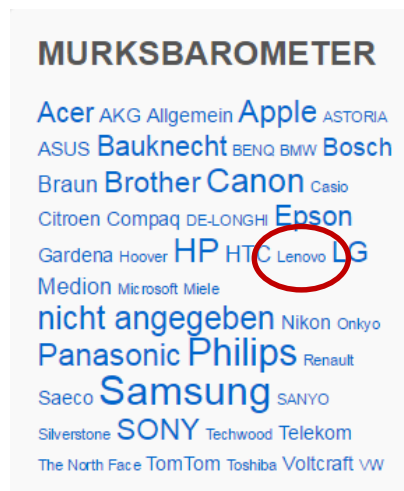


Figure 10 – Murksbarometer (www.murks-nein-danke.de)

As we have decided to leave out 'IT-leasing and second hand devices', I only mentioned the existence of a first research, which may be used as a basis if interests change in the future.

4. Monitoring Sheet and Documentation

Short description: The monitoring sheet included a history of all PCs / laptops and their internal use. Therefore, one may document who used which device for how long, which problems occurred, which upgrades and maintenance actions were performed and which costs were consequently generated. This overview will be updated for current and future devices. For old devices, data was only partly available.

Contact person: Mr C2

Mr C2 introduced the monitoring sheet for the first time to his colleagues and started by clarifying the aim of this new kind of documentation: *"Wir haben jetzt eine Übersicht im Excel erstellt, weil es eigentlich bis jetzt nie eine Übersicht über unsere Geräte gegeben hat, wie lange wir die schon haben, wer sie verwendet, usw. Deswegen werde ich euch jetzt einmal das Excel zeigen"*. The sheet will basically be maintained by the administrative assistants, but also partly by the employees themselves and is divided into nine worksheets.

⁵ http://www.lenovo.com/social_responsibility/at/de/

⁶ <http://www.murks-nein-danke.de/murksmelden/>

He started demonstrating the **employee overview** including name, position, hiring date, leaving date, type of employment and who uses which PC or laptop. As some have two laptops in use, one at work and one at home, both may be reported in different columns. Additionally, Omega Ltd planned to develop a similar documentation for monitors, thus, a column was added at the end. Moreover, the introduction of stick-on labels indicating the device's id is intended.

Second, a **device overview** was introduced including id, IP, type (PC / laptop), description, purchase date, leaving date, use-time, operating system, vendor, guarantee, acquisition costs, type (private / business) and comments. All devices were coded with a colour representing their current status: in use / functional, but not in use / sorted out / non-existent / must not be used. The last two codes emerged due to wrongly allocated ids and thus, those shall not be assigned. Mr C2 explained that their current laptops are 'Ideapads' from the private series and thus, less robust and qualitative as 'Thinkpads' mentioned during the procurement section. Besides, he highlighted the relevance of calculating the use-time, but simultaneously underpinned the need for critically interpreting the value by stating the following: *"Und da kann man bei diesen Geräten auch sehen, dass wir die bereits sehr lange haben und die unseren Zielwert von 5 Jahren sogar schon übersteigen. Diesen Wert kann man natürlich nicht für bare Münze nehmen, weil nicht jedes Gerät immer voll verwendet worden ist. Es gibt Geräte, die sind dann vielleicht einmal ein Jahr herum gestanden, was die Nutzungsdauer natürlich verfälscht"*. Pauses in use-time may only be discovered in a separate worksheet called **use-time**, where the period and intensity of use per user is documented. As the table was not completely filled out, Mr C2 explained the problem of non-traceability of past data as this is the first documentation of its kind in Omega Ltd: *"Da ist eben das Problem eben auch, dass wir in der Vergangenheit sehr wenige Informationen noch haben. Das heißt, ich habe einmal den PC 5 verwendet, aber von wann bis wann, kann man nicht mehr sagen. Da ist es einfach geplant, dass wir das in Zukunft dann wirklich besser verwenden. Weil dann kann man wirklich sagen: Das Gerät ist 6 Jahre in der Firma gewesen, aber nur 4 Jahre verwendet worden. Dann wird eben der 'falsche' Wert, den wir vorher gesehen haben, richtiggestellt und damit man weiß, wie es wirklich war"*. By providing an example, the relevance of pauses and intensity became clear to all participants. Thus, only the real value will be taken into consideration.

Besides, Mr C2 stated that the desired target use-time value was set to five years and three years should at least be reached. He argued to prolong the use time by implementing all developed improvements regarding use, maintenance and repair: *"Wir haben uns einen Zielwert von 5 Jahren gesetzt und wollen mindestens 3 Jahre erreichen. Wenn das aus verschiedenen Gründen nicht geht, kann man nichts machen, aber wir wollen es zumindest versuchen durch bessere Nutzung, Wartung und eben auch Reparatur die Lebensdauer, die Nutzungsdauer zu verlängern"*.

The last column within the device overview concerned the annual system set up as a maintenance task. Its data is based on an extra worksheet called **installation**. Each system set up shall be recorded with the device's id, date and a short description. Additionally, the colour code (green / yellow / red) of the column indicates, where and when maintenance is required.

Next, Mr C2 presented the worksheet **components**, which lists all device's parts like processor and their reparability. The latter is selected if research (e.g. on notebookcheck.com) revealed the possibility to exchange this specific component. Again, old devices are not completely listed as the data identification would be considerably time-intensive. Moreover, one has to admit that current and future data are more relevant than investigating on non-functional or unused devices.

Furthermore, Mr C2 introduced the worksheets regarding **upgrades** and **problems**. The former also leaks of data, but aims at documenting all performed upgrades including the device's id, date, responsible person and a short comment. Problems shall be communicated by the users themselves in the future, in order to improve the willingness to report. By providing the following columns, the solution process may be easily reproducible: device's id, date, reported by, comment, person in charge, solution and state.

Last, but not least, the worksheet **use checklist** was shortly demonstrated. According to the new use guideline (see 5. *Use*), the current workplace of each employee shall be checked. Every staff member is responsible for implementing the new guideline and complying with the new rules. Therefore, every column (e.g. use of cooling pad or no locally stored data) shall be ticked afterwards and regularly rechecked: *“Das soll dann bitte jeder bei seinem Gerät durchmachen. Wenn es sein muss, auch unter Anleitung. Einfach noch einmal nachfragen, wie macht man das, damit wir alle unsere Arbeitsplatzgestaltung so haben, wie wir uns das vorstellen”*. As a contact person, Mr C2 offered his supervision when performing the check-up for the first time.

5. *Use*

Short description: The use section comprised essential information regarding the arrangement of the workstation and the usage while on the move and at home in order to treat the device with the best possible care. Enhanced by the checklist within the monitoring sheet, each employee may verify his or her workstation.

Contact person: Mr C2

First, Mr C2 addressed changes regarding the use of the laptop's battery and explained the various recommendations from the experts and his research on the Internet. Optimally, the **battery** is never fully charged or discharged. Although, the removal of the battery during permanent power supply would be the best option, no employee is forced to put it into practice. However, devices shall never be exposed to intense heat like leaving the laptop in the sun.

Furthermore, the **use guideline** was explained into more detail by Mr C2. He underpinned, that the aim is to *“Bewusster einkaufen, länger nutzen – haben wir teilweise schon mit Mr C3 besprochen und kommt jetzt auch im Rahmen der Nutzung und der Wartung noch genauer. Und die Altprodukte soll man so lange wie möglich benutzen und weiterverwenden und nicht wegschmeißen, sobald eine Kleinigkeit kaputt ist”*. Through conscious procurement, one may use devices for a longer time period with the support of good treatment, maintenance and repair and thus, discard less. The use guideline was structured in the following way:

- Workstation arrangement: use of external peripheral devices (e.g. monitor, mouse, keyboard), positioning of liquids (e.g. lemonades) aside, unblocking of ventilation slots (e.g. cooling pad), protect interfaces, avoid heat
- Energy efficient work: use of standby-mode, activation of the power saver mode within the Windows power plans, reduce display brightness, deactivate screen saver, use of switchable multi-way connectors
- Data storage: use central storage instead of local hard drive, tidy up data to prevent having sensitive data on hard drive

- While on the move / at home: see *workstation arrangement*, use protection sleeves, unplug all devices / receivers (e.g. wireless mouse) before transport, prevent shocks, don't use laptop in bed or on your lap
- Lenovo specific information: battery use, energy manager

Recommendations resulted from our discussions and expert interviews, except the last, which represented the e-mail responses from Lenovo's customer service.

Regarding the workstation arrangement, Mr C2 introduced the newly procured cooling pad with an elevating function. If nobody has any objections, the cooling pad will be purchased for every employee aiming for a better cooling of the graphic chip and improved air supply for the ventilation slots. When Ms C1 asked for his first impressions, Mr C2 replied that it must be longer in use in order to recognise its benefits, nevertheless, he rated the cooling pad as an useful investment.

6. Maintenance

Short description: The section 'maintenance' included tasks, which shall be performed annually, quarterly, monthly or weekly. All activities, except the annual system set up, are managed and supervised via the Jira tool, an issue and project tracking software. The exception is handled through the monitoring sheet.

Contact person: Mr C2

Starting with the **annual** task, Mr C2 repeated the importance of system setups as they increase a device's performance, which may then be regarded as good as new. Until that point in time it was still undefined, whether the activity will be performed centrally or by the employees themselves through an automated installation script. Afterwards, the system set up shall be reported in the monitoring sheet controlled by the administrative assistants.

This maintenance task is followed by some more frequently required activities. **Quarterly**, ventilation slots, interfaces and in general the device itself shall be cleaned. Next, desktops on the local device as well as on the server and download folders shall be tidied up on a **monthly** basis. Thereby, one must not forget about emptying the trash bin. **Weekly**, all available updates shall be downloaded and installed. These must be checked online from Microsoft Update and were introduced with a screenshot in OneNote. All frequently required tasks were created within Jira and will be monitored by Ms E3 in the future. Thus, employees will be reminded via notifications when maintenance activities are necessary.

7. Repair possibilities in Vienna

Short description: The repair section contained possibilities in case of problems or upgrades, which may not be solved or performed in-house. Repair shops of the Viennese Repair Network and repair cafés have been researched and summarised. These may easily be contacted as personal contact has already been established.

Contact person: Mr C3

Within OneNote, a document providing all information regarding repair possibilities was linked. First, I introduced the **Viennese Repair Network**, founded in 1999 and cooperating with about seventy members. The repair services prefer repair and thus, don't over-hastily recommend purchasing a new device. Advantages range from the prolonging of the use-time, conservation of resources to the establishment of workplaces. All members offer the same price for making an estimate of costs, which will then be deducted from the order. The brochure including all contact addresses was linked within OneNote. Some member repair services additionally cooperate with the **transport service** offered by the D.R.Z. (dismantling recycling centre), which is less expensive than paying an employee to bring and collect the device. Consequently, we marked one repair service as highly recommendable as I conducted a personal interview with its owner. A price list was requested and listed in the document in order to get an improved feeling for associated costs. Moreover, the **repair and service centre** (R.U.S.Z.) was listed as a considerable option in case the transport is combinable with another route in the same direction. As it offers workplaces for long term unemployed, refurbished devices with a twelve months guarantee and works on a whitelist of durable and repair-friendly devices, it represents an ecological and social worthwhile organisation.

Besides, we attempted to participate in a **repair café**, which occasionally offer the possibility to repair even laptops or PCs. In general, one may repair small electronic devices him- or herself under supervision of an expert. Thus, successful experiences strengthen the relation to the respective belonging and customers get enabled to maintain their devices themselves instead of immediately replacing them. Repair cafés have been established in many Austrian cities and may be encountered in many states worldwide⁷. Two repair cafés were listed with gathered information from conducted expert interviews. However, due to time constraints and illness we were not able to attend one within our cooperation. Nevertheless, I recommended making use of this valuable option in the future.

8. *End-of-life*

Short description: The section 'end-of-life' comprised possibilities for old devices in order to prevent them from being discarded or disposed and give them a 'second life'. Especially, stored old devices, which don't have any application within the organisation, may be well continued to use.

Contact person: Ms C1

We considered it as considerably important to provide organisations with possibilities preventing disposal, if they phase the necessity to sort out devices below their requirements. First, I introduced the Viennese location of the company AfB offering the **certified data deletion and/or refurbishment of old IT-hardware**. Additionally, it provides workplaces for people with disabilities. No costs are generated as long as 75% of the allocated old devices may be put on the market successfully. Partners receive a certificate stating the resulted ecological impact and social engagement. Moreover, employees have the opportunity to reserve their old device and buy it for a considerably low price, an option mostly used by bigger organisations where devices are more

⁷ <http://repaircafe.org/en/visit/>

often replaced. Further information may be found in chapter 5 as I have conducted an interview with one of its representatives.

As Omega Ltd's internal technical knowledge is reasonably high, the same certified **data deletion** by blanco may also be performed **in-house**. Therefore we researched price and licence models. This possibility is only relevant, if old devices will be **donated** for instance to the non-profit network Labdoo⁸. Volunteers install education software on still functional devices like laptops or tablets. These are then transferred to schools in need by people traveling to this state anyway. Consequently, the process is based on the collaboration of all participants in order not to generate ecological or economic costs (see Figure 11). The amount of needed, in transit and delivered devices is transparent to everyone.

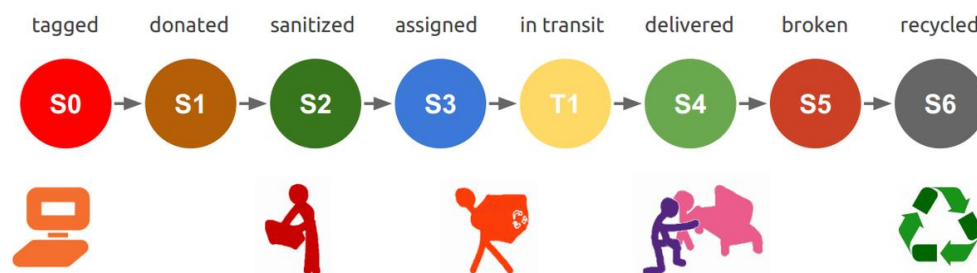


Figure 11 - The process of Labdoo (www.labdoo.org)

Besides, old laptops or PCs may also be **sold online** for instance via Flip4. The website calculates the price based on the device's characteristics and properties. The newer a device is, the higher the value as the organisation similarly attempts to refurbish and sell them. Additionally, they focus on an ecological process chain ranging from CO₂ neutral transport, use of recycled materials to energy efficiency.

In the end I highlighted that all possibilities may also be used by a private persons.

9. Corporate social responsibility (CSR), vision, goals and unclear questions

As we had no more time left to address these topics within the use-time brunch or generally within our cooperation, Ms C1 gave outlook in order to make her plans transparent: *“Generell ist es so, unsere soziale Verantwortung als Omega Ltd – ich habe da so meine Vorstellungen, das wisst ihr eh – aber ich würde so gerne einmal wissen, wie ihr dazu steht. Und das heißt, aber wirklich, dass wir darüber reden und dass ihr auch wirklich sagt, wie eure Meinung dazu ist. Denn ich finde, zum einen kann man so etwas ja nicht diktieren, das ist sinnlos irgendwo und zum anderen möchte ich auch gerne die Einflüsse von euch miteinbeziehen in das Ganze. Und darum habe ich mir gedacht, ich hätte gehofft, dass wir noch ein bisschen mehr Zeit haben, dass wir das jetzt auch tun können. Aber das geht jetzt einfach nicht mehr und dass wir das doch noch in einen eigenen Termin packen. Ich muss auch gestehen, ich habe die offenen Punkte noch nicht angeschaut. Das heißt auch die würde ich mit euch gerne noch durchgehen. Und Vision ist einfach zu formulieren, wir wollen es ja dann irgendwo auch leben und ich möchte es auch, weiß ich noch nicht, vielleicht nehmen wir es auch auf unsere Seite mit auf, unsere Homepage, also irgendwie auch für uns irgendwie fixieren. Und ja, ich würde echt sagen, ist vielleicht jetzt kein Punkt für unsere Weihnachtsfeier, aber irgendwie in so einem*

⁸ <https://www.labdoo.org/content/about-labdoo>

Rahmen wie heute, dass wir uns noch einmal eine Stunde nehmen und das einfach durchgehen". I regarded her comment as considerably important to clearly communicate further steps regarding CSR, the development of a common vision, derived goals and answering unclear questions from the interviews. Thereby, she convinced all employees that although our cooperation will end soon, the process is going to continue. Therefore, I hope that they will take their time to further improve the new status-quo.

10. Further steps and closing words

First, Ms C1 concluded the final presentation by stating the following: *"Darum ist es, glaube ich, jetzt einmal, nachdem wir ja schon bisschen überzogen haben, würde ich einmal sagen: Dankeschön! Es war super und es sind eigentlich von meinem Gefühl her, kommen auch noch gute konstruktive Sachen, die wir noch mit aufnehmen werden. Ich bin auch sicher, es wird sich noch einiges verändern zu dem was wir jetzt einmal so im Plan drinnen haben. Aber so wie ich das jetzt sehe auf jeden Fall zum Positiven. Ja, in dem Sinne noch einmal Danke an euch, Danke an dich besonders auch".* She underpinned her conviction that Omega Ltd will further develop the guidelines as several constructive comments have already been mentioned during the final presentation.

Corresponding to her statement, I also thanked everyone involved, the core group members and especially Ms C1 for their engagement, which I have never taken for granted. Only through them I was able to conduct my action research process and enhance my master thesis profoundly. Furthermore, I asked all participants to fill out the final post questionnaire in order to give me the possibility of evaluating the improvement. Last, but not least, I mentioned the availability of the link summary regarding missing information during the workshop in OneNote.

4.7.3 Discussion, feedback and derived actions

During and at the end of the presentation, questions were asked and feedback was given. Within this chapter I aim to summarise the most important comments and derived actions addressed in the final reflection meeting later on.

First, Ms E2 asked if a two year guarantee is actually important as a device automatically comes with a two year warranty. Mr E6 mentioned the shifting of the burden of proof, but couldn't describe it into more detail. I explained that guarantee obliges the producer and warranty solely the vendor. However, I offered to research on this topic for the final reflection meeting as our discussions contained several ambiguities and uncertainty. Afterwards, the result will be added to the guideline in OneNote.

Next, Mr E6 asked why former employees are still included in the monitoring sheet. Mr C2 argued that they are part of the use-time history and therefore, their data is being kept: *"Und da ist es dann unter Umständen auch interessant, dass er den Laptop 12 gehabt hat".*

When talking about the use checklist, which should be implemented and filled out by each employee, Mr E10 asked how to find out his laptop's id. Mr C2 explained that everybody has access to the monitoring sheet and may easily discover his or her device's id. Additionally, he talked about Omega Ltd's plan to mark every device with a stick-on label stating the id and optionally further information: *"Das machen wir noch. Wir wollen auch auf der Unterseite vom Laptop überall ein Pickerl darauf picken mit der Nummer und vielleicht auch andere Informationen. Das Gleiche wird dann auch für die Monitore gelten. Wenn jemand nicht weiß, welches Gerät er hat, wenn er jetzt z.B.*

wirklich irgendein Problem eintragen will - einfach auf der Unterseite nachschauen. Das wird in den nächsten Wochen gemacht werden. Damit es da keine Verwirrungen mehr gibt. Oder im Zweifelsfall im Excel nachschauen, da steht es auch drinnen”.

Later on, Mr E9 addressed the suggested use of a laptop’s battery and asked if the device should be unplugged each time it is fully loaded. More employees, including Ms C1, doubted the practicability of this guideline. From Mr E7’s point of view, no charging cycle is lost between 90 and 100% as this is the so called battery protection mode. I underpinned the importance of sometimes making use of the battery instead of a permanent power supply. Concerning all these ambiguities, Mr E7 suggested researching on this topic again and installing a tool if appropriate. Consequently, we agreed to redefine the battery use guidelines and take Lenovo’s recommendations more into account. In the end, Mr C3 mentioned that positive impacts are difficult to measure. This outcome matched with one of the expert’s advice that batteries may be seen as wearing parts and must be exchanged after a certain time period either way.

Regarding the ratings, Mr E5 was surprised about the good positioning of one specific producer as he has read many negative articles about its production sites and worker’s conditions. However, Mr E7 argued that may be due to its sustainable innovations in the area of hardware. I again underpinned that ratings are solely benchmarks and must be accepted with caution.

As we introduced the use guideline, employees were urged to take more care of their devices. Mr C3 mentioned, that he doesn’t want to remove his cordless mouse’s dongle each time he takes his laptop home or to an external meeting. However, Mr C1 confirmed the importance of protecting ports and asked him to take this new practice into consideration in the future. Wear and tear of the interface is already apparent through the damaged protection sleeve at this certain position. Ms C1 recommended the use of the parking slot for the dongle on the underside.

Moreover, Mr E9 was interested in the possibility of expressing individual requirements for future procurements like mobility or smaller displays. Mr C2 confirmed that this hasn’t been possible until now, but will change for future purchases and existing employees.

Importantly, Ms C1 asked for alternatives for international wholesalers like Amazon in order to act more sustainably. Suddenly all participants started smaller discussions exchanging their experiences with different online or local shops. Mr E9 added that Amazon accommodatingly reacts regarding returns. Consequently, Mr C3 suggested staying with the same vendor, but placing fewer orders with more positions. In addition Ms E2 remarked that prices tremendously vary between producers and online shops. Thus, I proposed researching on alternatives and presenting them in the final reflection meeting.

After the interactive part of the final presentation, a notably discussion arose. When talking about cost saving as an advantage of an extended use-time, Ms C1 argued that the planned annual system setup must also be taken into consideration. Although, Mr C2 underpinned that it may be fastened through automated installation scripts, Mr E7 generally questioned its usefulness of a strict system setup per year. As most software and data is not installed and located on the laptop’s system respectively, but on the server, he suggested to use a cleaner. Mr E10 reported from his positive experience with his private laptop, which he has only maintained with a cleaner for seven years without having any performance problems. Ms C1 suggested adding this aspect to the maintenance process, nevertheless, data must be regularly tidied up in order to be always ready for a system setup.

4.7.4 Actions taken against fears

Within the post questionnaire of the workshop, participants had the opportunity to express their fears regarding the development and implementation of improvements. These were gathered and addressed within our action meeting process in order to convince all employees from our guideline. Additionally, we agreed that we may only win the colleagues' attention and support by taking their interests, but also their fears into consideration. Therefore I aim to state, which actions were taken.

"Costs" and "potentially expensive"

Costs were researched for each new action, discussed within the meetings and evaluated. The economical profitability of an investment or repair was always taken into account. All results were listed and included in the final documents available in OneNote.

"Lack of time and resources for meaningful actions" and "organisation"

We regularly met and stayed continuously in contact. The motivation was throughout the cooperation noticeably high. All core group members reserved a considerable amount of time to successfully perform our cooperation. Therefore, we were able to decide on new actions within each meeting and work on concepts and future processes until the subsequent session. In order to implement them successfully, we defined contact persons for each area of improvement represented by the sections in OneNote.

"People are often lazy and sloppy. By that, I think, much potential is often being lost or wasted"

The developed evidence-based guideline, new processes and checklists shall support the implementation and additionally convince colleagues to take more care of their devices. Moreover, defined contact persons may on the one hand monitor the realisation, but on the other hand supervise in case of questions or ambiguities. Thereby, employees are urged to act sustainably within their work environment and through routine, practices are likely to change.

"Use-time is limited or given due to necessary performance within certain areas / tasks" and "poorer performance of the device, less working time"

Different user requirements must be identified in order to enable precise device exchanges between colleagues according to their performance demand. Moreover, maintenance tasks like system setups or the cleaning of ventilation slots were defined and planned to be performed on a regular basis. Some activities like tidying up the desktop or installing updates shall be executed by the employees themselves in order to include them in the process. Consequently, the performance will improve and be comparable with a new device. If economically and technically possible, hardware upgrades may be performed.

"The producers cannot be (easily) influenced" and "producers"

Systematic requests like contacting the producer or asking the vendor for environmental-friendly products reflects the consumer's demand. Thus, it is of vital importance to address topics like sustainability, worker's conditions, assembled materials, production sites or expected use-time. Consequently, we contacted, in the case of Omega Ltd, Lenovo and requested a considerable amount of relevant information (see *"Contacting Lenovo"* within the action meetings).

Furthermore, initiatives and organisations exist demanding fair, green and long-lasting IT: NAGER IT, Clean-IT, Electronics Watch, Good Electronics, makeITfair, PC Global, China Labor Watch and 'Murks? Nein Danke!'.

4.7.5 Interactive development of advantages and motivation

Within this part of the final presentation we tackled my two sub-research questions:

1. Which advantages of an extended use-time can be derived?
2. How can employees become motivated to care about the use-time of PCs and laptops?

Therefore, I decided to use a modified version of the brainwriting 6-3-5 method. The participants, except the core group members and myself, were split into two groups. Each group developed their answers for one question by writing down three new and/or derived ideas on a handed-out worksheet within approximately three minutes. After each round the sheet was passed on to the colleague on the right side until the sheet reached its creator (see Figure 12). The original method suggests six participants writing down three ideas within five minutes, which also is the etymology of the approach's name. However, we adapted the version based on our situation and time constraints. Before we started the first round, Ms C1 strengthened the importance of participating in this process: "Ich bin auch sehr, sehr gespannt, was dabei herauskommt. Bitte macht's gut mit".

Frage: Was motiviert dich als MitarbeiterIn deinen PC/ Laptop länger zu nutzen? ①

Idee #1	Idee #2	Idee #3
Verantwortung dem Unternehmen gegenüber	Längere Nutzungsdauer → mehr Wirtschaftlichkeit → sicherer Arbeitsplatz	neuer Laptop/ Computer → "secher" Anschaffung
Verantwortung der geg. Anb. der Umwelt	Langer o. Nutzungsdauer → weniger Zeitaufwand für Umstellung → mehr mehr Zeit für Arbeit	✓ neuer Laptop → produktiv
	mehr Freude mit einem PC :)	
Wenn die Konsumenten auf o. beim Kauf der Produkte auf die Wirkung Nutzungsdauer achten, sind Unternehmen angehalten, langlebige Produkte zu entwickeln	gleichbleibende Arbeitsituation → Kontinuität im Arbeitsleben	
Als Unternehmen größeren Druck auf Hersteller ausüben	hohe Stabilität am Arbeitsplatz	Verringertes Fehlerpotential, da bei weniger in bestehende Infrastruktur eingegriffen wird

Figure 12 - Brainwriting result

In general, we chose the method because it is an easy and straightforward approach, which ensures an active participation of everyone also including more introverted employees and requires no experienced supervisor. By exchanging and sharing knowledge, different backgrounds are taken into account and participants may get inspired. However, as nothing comes

without disadvantages, we accepted the method's drawbacks of participants having troubles formulating their ideas or reading the colleagues' handwriting. Some employees also mentioned their perception of being in an exam situation due to time constraints, which I tried to ease by intervening. Since there are not intermediate group discussions, similar ideas may arise leading to less innovation.

The interaction resulted in very detailed facets of similar ideas and answers. Thus, the participants seemed to be a little irritated and had the impression of moving in a circle, however, in my opinion, the results were highly interesting. Moreover, many aspects, which I had thought of before, were missing and obviously not present. In order to analyse the results, I digitalised the sheets and structured similar ideas into one group. Thereby, I especially focused on not biasing the sense or meaning of different ideas. In the following paragraph I want to highlight some main results within the groups, which were ranked according to their votes. In addition, I added some ideas mentioned by core group members during our action meetings or by experts during the interviews.

Ad 1: What advantages arise due to a prolonged use-time from your point of view?

Four employees, two women and two men, focused on answering this question. One mentioned to be glad to work on 'advantages' as it was perceived as the easier task. In general, the group was less concentrated at the beginning, but became more engaged from the second round onwards.

1. Saving resources and sustainable use of resources

The main aspect was that through longer use and fewer replacements, resources may be saved. Sharing laptops or internally passing devices on leads to less waste as well as decreased disposal, which is considered as environmental friendly and prevention of ecological impacts. One employee also mentioned the aspect of 'Green IT' in this context.

2. Cost saving

Several participants argued that through properties like better reparability and longer use-time, costs may be saved in the long-run. These savings are a result of a fixed cost degression including less procurement, transport, overhead and employee costs. Each new purchase of a laptop requires research, coordination and ordering. Moreover, the new device has to be set up, which implies not only time effort for the employee in charge but additionally the occurrence of problems that are, in case of a new laptop, unknown and challenging to solve. Thus, saved budget may be used in other areas like customer acquisition, marketing, advanced training courses or goodies.

After finishing the interactive part, Ms C1 started a discussion by arguing that she is not yet convinced, if costs may be saved, *"Was ich interessant finde, dass ihr eigentlich alle wirklich Kostenersparnis seht. Das ist etwas wo ich eigentlich nicht so sicher bin [...] weil die Anschaffungskosten höher sind von diesen Geräten. Und ich bis jetzt eigentlich noch nicht bestätigen kann, dass die anderen Geräte, die wir da jetzt gekauft haben, auch wirklich um so viel kürzere Nutzungsdauer haben werden"*. The employees explained that from their point of view, costs can be saved, if a device may be used five instead of only three years. However, from an economic point of view, Ms C1 and Ms E2 agreed that depreciation, which is set to three years for laptops and PCs by default, has a direct positive or negative influence on profit and loss. Moreover, Ms C1 illustrated that the recommended time period motivates organisations to replace devices: *"Wie gesagt, ich bin mir nicht ganz sicher, ob es wirklich so ist, weil ich glaube nämlich auch, dass die Form*

der 3-jährigen Abschreibung... Das zielt eigentlich alles darauf hinaus, dass die Firmen eigentlich dazu motiviert werden wirklich wieder neu anzuschaffen und rauszuschmeißen. Und ja, es sind ja auch immer wieder die Empfehlungen des Steuerberaters: Investiert's!'. Ms E2 added the aspects of decreased indirect and overhead costs due to fewer purchases: "Weil wenn es den alten Laptop nicht mehr gibt, schauen einmal drei Stellen oder vier nach, was könnten wir für einen neuen beschaffen. Indirekte Kosten verursacht das eben in dem Fall". Thus, we focused on this aspect within our final reflection meeting.

3. Higher employee motivation due to personal device

First, an improved procurement takes different employee's requirements better into consideration and includes staff members in the decision making process. By conducting regular updates and careful treatment, the device stays in a better condition and thus, increases the user's satisfaction through its good performance. Moreover, the employee is used to the device, which consequently provides higher convenience. All in all, it may be considered as a personal device implying a closer relationship and thus, is automatically treated with more care.

4. Many equal devices / same producer

When procuring similar hardware from the same brand, synergy effects arise. The installation may be automated, necessary drivers are known and less research in case of problems or different use cases must be conducted as most employees have already been used to their device. Above that, spare parts from older laptops may be taken to repair the current models.

5. Improved image of the organisation

By acting sustainably, the image of the organisation is being improved. Customers may attach importance to environmentally conscious strategies and realised actions, thus, leading to new acquisitions and a profit gain. One participant raised the possibility of certifying an environmental-friendly organisation. In addition, one of the experts highlighted the importance of living CSR, publicly stating that long-lasting products are in use and focusing on resource protection. An organisation may also benefit from being a first-mover within the concept of a circular economy (see chapter 2.3.3).

6. Time saving

Coupled with cost saving, also time may be saved. By performing fewer purchases, less research work and discussions are necessary. Additionally, a central and automated system installation disburdens the employees. Furthermore, through a better documentation (e.g. the monitoring sheet) one has a better overview of the current situation and when upgrades or new devices are probably required.

7. Support of repair services

By supporting repair shops, skilled jobs are established and preserved. This was also an important aspect, which the experts mentioned. A shift from production to services shall be the aim of the new business model. Thus, a sustainable economy may be initiated.

8. Data security

Mr C3 once mentioned in an action meeting the benefit of regularly tidying up a system, namely controlling sensitive data. If the user has no overview over his local data, data security may not be guaranteed towards the customers.

Ad 2: What motivates you as an employee to use your PC or laptop longer?

The second group was formed by five male employees. All seemed concentrated from the beginning onwards, but became irritated when they had the impression of moving in a circle and repeating already mentioned ideas. Therefore, I tried motivating them to think 'out of the box'.

1. Less change

Most motivation may be sourced from convenience and being used to a device. Less adaptation phases in case of a new laptop lead to more productive, efficient working time, continuity and a stable work environment. One employee mentioned that a new laptop signifies a considerable time effort for its configuration and may even be obsolete, if performance remains the same. Besides, a consistent infrastructure, which is not interrupted entails less potential for errors. Thus, high staff motivation with regard to work equipment results in a more positive work environment.

2. Environmental protection

Employees become motivated when the organisation takes responsibility for the environment and future. Thereby, they may work with a good conscience and improve their working time by a more positive attitude to life and feeling of self-worth. Moreover, the organisation saves energy costs, creates less waste, decreases its disposal costs and thus, makes an active contribution to environmental protection.

3. Environmentally conscious organisation

By having a contemporary strategy with regard to sustainability and use-time, employees feel motivated being part of the organisation. They explicitly stated that they may be proud of their employer, who is then considered as a role model not only internally but also towards other organisations. Interestingly enough, one employee reflected upon a sustainably acting organisation also being a long-lasting company. This fact is strongly connected with providing a safe work place (see 5. *Safe work place*). Besides, the question, if a possibility to receive a promotion for operating sustainably exists, was raised.

4. Cost saving for the organisation

The aspect of cost saving, which was already developed as an advantage, simultaneously arose as a motivation for employees. An efficiently working organisation, which reduces the effort of device replacements, gains more profit, may expand and thus, is able to invest more budget in salaries, company outings, innovations and system development. Thinking of bigger organisations with many employees and more complex structures, staff members within the IT-support and responsible for the coordination of IT-infrastructure are disburdened.

5. Safe work place

As I perceived the mentioned aspect of having a safe work place as relatively important, I explicitly stated it, although, it is tightly connected with being employed in a sustainably acting and long-

lasting organisation. A longer use-time and less cost lead to an increased profitability, which enhances the possibility of preserving work places.

6. Change demand

Two employees developed the idea of influencing and exerting higher pressure of producers as an organisation. If consumers pay attention to use-time when buying devices, manufacturers are confronted to change their strategy towards long-lasting products.

7. Employee's responsibility towards the organisation

As employees are using the organisation's properties, they are responsible for treating them in a proper manner. Consequently, they are motivated prolonging the use-time as it is beneficial for the organisation (e.g. cost saving, less time effort).

8. Premium

One employee mentioned the possibility of receiving a premium for using devices longer. As it was followed by a smiley, I didn't take this option into serious consideration.

All in all, several important answers have been developed in detail including interesting aspects of prolonging the use-time like having a safe work place or the support of repair services. However, some topics such as 'protection of the environment' were generalised and not deeper analysed. After reading the sheets, I was wondering whether all participants have thought of the same aspect when writing 'environment'. For instance, one may think of less e-waste leading to less landfill, decreased soil pollution and child labour. As another example, one may address a device's production phase, whose frequency may be reduced and thus, leading to less CO₂ emissions and a weakened chance for climate change. Additionally, none of the employees mentioned the aspect of improving worker's conditions in production sites or dismantling areas, which I thought would be prevalent due to the common workshop. Moreover, the effects on an employee's private life were likewise excluded. Nobody developed the idea of being a role model for family or friends when prolonging a device's use-time. Another aspect, which I have thought of before, was to save resources for future generations including my unborn children.

As employees were not used to participate in an interactive approach out of their field of expertise, most ideas were expressed in a generalised manner and only some participants developed them into more detail. However, I am convinced that it was an important experience for all involved leading to interesting insights and findings.

4.7.6 Post questionnaire

The last post questionnaire aimed at measuring the final presentation's influence, the development since the workshop and the employee's perception of the cooperation in general. Based on my action research log, the previous surveys and action meetings, I created questions structured in five sections. This time I asked more open questions to encourage participants to reflect upon the last months. Therefore, Mr C2 stated in the final reflection meeting that it took him almost half an hour to answer the post questionnaire. It was sent out one day after the presentation via e-mail and was answered by all participants including Ms C1. Important answers and comments are listed as direct quotes in order not to bias the general tenor after the final presentation.

1. Final presentation of developed improvements

The first section comprised questions regarding the use-time, our internally developed improvements and the process as such. Additionally, participants were given the chance to rate our consideration of their suggestions and fears.

Q1: "How important do you perceive the topic 'use-time' after the final presentation?"

Results after the first online survey	Results after the workshop	Results after the final presentation
Extremely important (0)	Extremely important (1)	Extremely important (1)
Very important (3)	Very important (6)	Very important (9)
More or less important (10)	More or less important (2)	More or less important (2)
Less important (0)	Less important (0)	Less important (0)
Not important at all (1)	Not important at all (0)	Not important at all (0)

Table 11 - Influence of final presentation on use-time

As not all employees participated in the three questionnaires, comments are necessary to interpret the results correctly. Ms C1 did not fill out the post questionnaire of the workshop, but her perception changed from 'very important' to 'extremely important'. Thus, the management had completely been convinced from the topic's importance. The internship, who voted 'extremely important' after the workshop, has already left the organisation when the final presentation took place. Although, one employee stated that his opinion has positively changed due to the final presentation, he downgraded the importance (e.g. from 'very important' to 'more or less important'). Therefore, I assumed he could not remember his answer from the previous questionnaire and selected the 'wrong' answer. Besides, the new employee participated for the first time in our process and selected 'more or less important' after the final presentation. Analysing his further answers made clear, that he had missed an introduction to the topic and by that, was not completely convinced of its importance. Both employees, who rated 'more or less important' after the workshop changed their perception to 'very important'. Thus, we were able to achieve a second shift towards a higher importance.

Q2: "Why has your attitude to the topic 'use-time' (not) changed after the final presentation?"

Half of the participants replied that their attitude has changed and argued in the following way:

- *"Es schafft natürlich mehr Bewusstsein, wenn man sich näher mit dem Thema beschäftigt."*
- *"Mir wurden neue Ideen gezeigt, wie man die Nutzungsdauer eines Laptops bzw. eines anderen Gerätes verlängern kann."*
- *"Mir ist jetzt mehr bewusst, welche Maßnahmen man treffen kann und welche Möglichkeiten man hat, die Nutzungsdauer zu verlängern"*
- *"Neue Informationen die ich noch nicht wusste"*
- *"Durch die Erarbeitung der Vorteile der längeren Nutzungsdauer, vor allem der Teil bezüglich der Umwelt und Ressourcenschonung."*
- *"Schaden für die Umwelt; Kosten/Nutzen bei Reparaturen doch besser als zuvor angenommen"*

Through more available information and the common development of improvements, awareness about possibilities to prolong the use-time was raised. Some mentioned the environmental impact, which made them change their mind. Interesting enough, one highlighted that the price-

performance ratio of repair services was better than expected, which was one of my aims to communicate this fact.

Although, the remaining participants selected 'no', five stated that they have already been interested and aware of the topic's relevance before the final presentation. Therefore, their attitude has not been changed but confirmed: *"Ich hatte bereits vor der Endpräsentation eine Meinung zu dem Thema durch die erste Präsentation. Diese Meinung wurde durch die Endpräsentation nochmals bestätigt"*. The last participant argued that organisations should pay more attention to a device's use-time regardless the end of its depreciation: *"Privat ist so etwas immer wichtig, alleine schon wegen den Kostengründen. (Alte Rechner weiterschieben im Familien/Freundeskreis). Für Firmen sollte es auch wichtiger sein - auch wenn die Geräte nach 3 Jahren abgeschrieben sind"*.

Q3: "How realistic do you perceive the future realisation of developed improvements?"

The majority selected 'very realistic' and explained their answers by stating:

- *"Die genannten Vorschläge sind nicht so schwer zu realisieren, wenn man sich ein bisschen Mühe gibt und daran denkt."*
- *"Ziele sind nicht zu groß gesteckt, halten sich in einem realistischen Rahmen."*
- *"Einige Punkte, die wir erarbeitet haben sind schon länger geplant. Jetzt haben wir erstmals die Möglichkeit sie auch wirklich umzusetzen."*
- *"Die Verbesserungen sind gut und wichtig, deshalb werden sie auch bestimmt umgesetzt."*
- *"Manche Sachen werden, denke ich, durch Zeitmangel nicht eingehalten werden, doch die meisten Verbesserungen sind sehr positiv und wir werden uns daher sicher bemühen diese umzusetzen."*
- *"Das Thema wurde bei uns firmenintern nun sehr intensiv mit der Projektgruppe behandelt."*

Employees underpinned that most improvements are not too difficult to realise. Some have already been planned or discussed before our cooperation and are now more realistic due to our intensive development. Only one participant mentioned time constraints as an eventual reason for not realising all suggestions. Additionally, Ms C1 argued that Mr C2 has already started to work on the realisation under her supervision. Therefore, it is important to mention that the management is also convinced of implementing the improvements.

Apart from that, five participants rated the realisation as 'more or less realistic' and were more sceptical:

- *"Es ist natürlich schwierig das langfristig zu betreiben. In der Anfangsphase wird man sicher auf die genannten Dinge achten. Aber in Laufe der Zeit besteht natürlich die Gefahr, dass man manche Aspekte wieder schleifen lässt. Da muss man jemand drauf schauen, dass sich alle wieder an die vereinbarten Punkte wieder hält."*
- *"Besser auf die Geräte aufpassen und verwalten ist sicher realisierbar. Nutzungsdauer wird sich zeigen (auch weil Ms C1 gemeint hat das der Steuerberater sagt nach 3 Jahren neue Hardware kaufen zum abschreiben...)."*
- *"Realistisch: Wartungsprozess sinnvoll und nicht zu aufwändig. Unrealistisch: Akkulaufzeit durch ein-/ausstecken verbessern ... Memory-Effekt heutzutage mMn vernachlässigbar und gibt zu viele unterschiedliche Meinungen ob es wirklich etwas bringen würde."*

- *"Akku-Nutzung wird wahrscheinlich nicht umgesetzt werden. OS 1 x im Jahr neu aufsetzen wird in der Praxis wahrscheinlich nicht (immer) so gemacht werden."*
- *"Oft siegt die Faulheit; Auch wenn Kosten/Nutzen evtl. besser, als gedacht ist, kann Austausch trotzdem billiger sein."*

One addressed the importance of having a person in charge being responsible for the observance of the new processes. In general, we have determined them for each area of improvement, nonetheless, Ms C1 must keep an eye on these new tasks. Documentation, maintenance and a better treatment are ranked as realistic, however, the suggested use of the battery had already triggered a discussion during the final presentation. Especially this topic needs internal revision before employees are willing to implement it. The last comment referred to humans often being too lazy to improve the status-quo. Although, he argued that the price-performance ratio was better than expected, replacement may still be the cheaper and easier alternative. From my point of view, implementing new processes like making use of repair services are considerable barriers as they imply time effort when being performed for the first time. Only after that, one may speak of a sustainably changed practice.

Q4: "Which developed improvements do you rate as important?"

Although, participants weighted aspects differently, they often highlighted the importance of having consistent guidelines, defined criteria and a coherent documentation. Moreover, raising awareness was rated as important to improve the status-quo. New processes in the presented areas make possibilities as well as positive impacts visible and easier to implement. In order to not bias the given answers, I listed all comments:

- *"Ich finde den Umweltgedanken wichtig. Jeder sollte auf die Geräte achten und pflegen, damit sie lange halten und nicht gleich bei jeder Kleinigkeit die Geräte ausgetauscht bzw. weggeworfen werden."*
- *"Die Beschaffung - die richtige Wahl des Gerätes."*
- *"Beschaffung, Rechnerdokumentation, Nutzung, Wartung, End-Of-Life"*
- *"Festgelegte Kriterien, Einbeziehung von Labels. Awareness schaffen ist der erste Schritt, auch wenn man im Kleinen nichts direkt bewirkt."*
- *"Bewusster Umgang mit technischen Geräten, genauere Überwachung der Nutzungsdauer."*
- *"Einheitliche Richtlinien für Bestellungen, laufende Wartungen."*
- *"Einheitliche Gerätebeschaffung (macht die Wartung einfacher), Geräte-Excel, Reparaturmöglichkeiten"*
- *"Rechner-Übersicht in Excel, Wartung und Reparaturmöglichkeiten in Wien."*
- *"Maßnahmen um die Akkulaufzeit zu verbessern; Möglichkeit der Reparatur bei versch. Anbietern (inkl. Abholung und Zustellung)."*
- *"Übersicht der Geräte, jährliche Wartung der Geräte."*
- *"Wartung (Reinigung sowie Updates und lokale Daten), Beschaffung, Nutzung, Rechner-Übersicht."*
- *"Beispielsweise das Cool-Pad zur Steigerung der Lebensdauer der Laptops und ergonomischen Verbesserung."*

Several employees mentioned conscious procurement, careful treatment and frequent maintenance as important improvements regarding the device's life span. Interesting enough, only one participant explicitly stated the environmental aspect in this context.

Q5: *“Have you recognised the development of improvements within the last months?”*

Although, we decided to communicate our results solely at the end of the process, 75% stated that they have recognised the development of improvements. They mentioned for instance longer discussions for procurement, our regular meetings and the cooling pad. As some tasks were internally delegated, one employee stated her research regarding IT-leasing, second hand laptops and partly the definition of procurement criteria. Another participant recognised also the closer teamwork between Mr C2 and Mr C3 by often talking about this topic to each other. Ms C1 stated that Mr C2 has frequently informed her about the on-going process. Interesting to mention, from Mr C2's point of view he has only recognised the development, because he was part of the core group: *“Diverses, aber auch nur weil ich beteiligt war. Sonst dürfte kaum jemand etwas mitbekommen haben”*. In fact, only the new employee and two others didn't realise our process.

Q6: *“Have you already recognised improvements or changes in your daily business?”*

I found it interesting, that Q5 and Q6 were answered remarkably contradicting. Only one employee responded both Q5 and Q6 with 'no'. Five participants answered exactly the opposite, thus, had recognised the development, but no changes afterwards or the other way round. Generally, eight employees have noticed changes like the cooling pad being the most prominent mention, a better sitting posture, switchable multi-way connectors, different procurement of the last laptop and the positioning from drinks aside. Again the new employee and three others didn't recognise any improvements. Clearly, most improvements and changes were not observable just a few days after the final presentation, however, I wanted participants to reflect upon their daily business and practices, which may reveal even minor improvements like the positioning of lemonades.

Q7: *“Would it have been in your interest to partake more in the development of improvements?”*

The question aimed at discovering the interest beyond the sole participation in common workshops and presentations. It may reveal employees, who would favour being part of a sustainable change within the organisation and eventually interested taking more responsibility like an environmental officer. Thus, I was positively surprised that two participants answered 'yes' and were not core group members. Moreover, these two employees may be motivators within the organisation when improvements are being realised or further developed.

Q8: *“In how far do you agree with the statement, that your fears were taken into consideration during the development of improvements?”*

Q9: *“Have we managed to counteract your fears within the development of improvements?”*

Answers to Q8	Answers to Q9
Strongly agree (3)	Yes (2) I didn't have any fears (1)
Somewhat agree (1)	I didn't have any fears (1)
More or less agree (1)	I didn't have any fears (1)
I didn't have any fears (7)	I didn't have any fears (7)

Table 12 - Answers to Q8 and Q9 in the final presentation questionnaire

Unfortunately, these two questions revealed misleading for two reasons. First, I named the mentioned fears, 'problems' in the workshop questionnaire (see Q26: *“Where do you see problems regarding the improvement of the use-time?”*). Although, eight employees filled out perceived problems, that may arise during our development of improvements, all of them selected 'I didn't

have any fears' for Q9 in the final presentation questionnaire. Thus, these two questions were not connected from the participants. Those two employees, who answered 'yes' for Q9 did either not participate or fill out the workshop questionnaire. Moreover, fears / problems mentioned at the end of the workshop discussion were also not considered when answering Q9. However, four employees agreed that their fears / problems were taken into account, when answering Q8. Thus, these results are an essential lesson learned and will help me improve questionnaires in my future career.

Apart from that, all attendees answered that no new fears arose due to the final presentation.

Q10: "In how far do you agree with the statement, that your suggestions / wishes were taken into consideration during the development of improvements?"

- Strongly agree (4)
- Somewhat agree (1)
- More or less agree (1)
- I didn't have any suggestions / wishes (6)

One may say, that all employees felt included to a certain extend and taken seriously. Although, one rated 'more or less agree' he would not have done anything differently during the development (answer to Q11). As he made some suggestions regarding the battery use during our discussions in the final presentation, his answer may refer to this situation. Interestingly enough, one core group member didn't have any suggestions / wishes according to his answer, which is definitely contradicting our common process during the action meetings.

Q11: "What would you have done differently during the development of improvements?"

Six employees would not have done anything differently, one of them reflected upon the future implying further development of ideas, concepts and improvements: *"Für jetzt nichts. Mit der Zeit werden wahrscheinlich auch neue Ideen dazukommen. Jetzt ist es wichtig, an Verbesserungen zu arbeiten. Jeder hat sich bereits mit dem Thema beschäftigt, weshalb es leichter sein sollte, den Verbesserungen nachzugehen"*. Likewise, I considered this aspect as essential for continuous and sustainable change in the long-run.

Furthermore, five participants answered the question by underpinning that they considerably liked the results and presented improvements, consequently, no changes would have been necessary: *"Ich persönlich empfand die erarbeiteten Verbesserungen als sehr gelungen und hätte dabei auch nichts anders gemacht"*. Due to time constraints, one employee could only participate in the final workshop and therefore had no suggestions.

Q12: "How important was the possibility to participate in the final presentation to you?"

- Extremely important (2)
- Very important (8)
- More or less important (2)

Generally speaking, all were satisfied in being able to participate in the final presentation. As our results, concepts and processes concern the entire organisation, we considered it important to inform all employees, communicate changes and give participants the chance to discuss and further develop them by new ideas.

Q13: "What did you like/dislike about the presentation of developed improvements?"

Our efforts in developing and presenting the improvements regarding use-time were highly appreciated: *"Was mir sehr gut gefallen hat, das mir ein vollkommen neues Thema gut präsentiert wurde. Ich konnte viel mitnehmen, natürlich auch für den privaten Bereich"*. Their praises ranged from shortly and clearly formulated important information to a well-structured and informative presentation with all results accessible via OneNote: *"Es war gar nicht eintönig, nur wichtige Sachen, abwechslungsreich, interaktiv, kurzweilig, sehr gut"*. One mentioned the positive aspect of dividing the presentation between the three of us, but being additionally familiar with all colleagues' topics. Additionally, further information to read was perceived as useful and positive.

Apart from that, some answers were contradicting as someone's like may be another person's dislike. For instance, two employees addressed the informal atmosphere, which welcomed questions and discussion as a positive aspect: *"Sehr lockere Atmosphäre, dadurch fiel es leichter Fragen zu stellen"*. On the other hand, a core group member described the same situation by mentioning too long pauses, deviation from the subject and not being taken seriously enough: *"Wurde teilweise nicht ernst genug genommen, zu lange Pausen/andere Themen besprochen"*. Two other employees claimed that the time management may be improved and the presentation could have been partially more clearly structured.

Constructive critics were additionally mentioned by two participants, who seemed to be interested in the topic not only as an employee, but from a private customer perspective: *"Ich persönlich hätte mir mehr Informationen zur Suche privater Laptops gewünscht (auch wenn ich natürlich verstehe, dass dies in der Arbeitsumgebung nicht unbedingt möglich war)"*. Moreover, he suggested a comparison of producers as an alternative for future procurements. Although, I agreed with both beneficial ideas, we were not able to research more than one producer due to time constraints.

Last but not least, we missed to introduce the topic to the new employee. Thus, he reported being a little bit disoriented: *"Nachdem ich neu bin, fehlt mir den roten Faden. Oder eine kurze Einführung um was es eigentlich geht (Ziele der Arbeit, etc.)"*. Three participants were completely satisfied and stated no critics.

2. Interaction brainwriting

Q14: "Have you discovered new ideas through the interactive process regarding advantages and motivation?"

As this was one of our aims to inspire employees by the answers of their colleagues, I was surprised that only seven out of twelve agreed. However, I may partly explain the result by analysing their critics in Q17, which referred to the problem of moving in a circle and developing similar ideas. Additionally, for all, except one, employees the method was new and consequently, they were not used to the approach of brainwriting.

Q15: "Are you motivated to contribute to a prolonged use-time and to realise the developed improvements?"

100% answered this question with a clear 'yes', which simultaneously reflected my impression of their motivation. Nevertheless, it will be important to have persons in charge and the management's supervision to implement all new processes in the daily routine.

Q16: *"Why are you (not) motivated as an employee?"*

As all employees are motivated to prolong the use-time, I listed several arguments in order to demonstrate how multi-faceted they were:

- *"Weil ich natürlich einen positiven Beitrag leisten. Dazu zählen geringe Kosten, mehr Umweltbewusstsein, und natürlich mehr Freude mit einem PC (ohne ständiges Einrichten und Eingewöhnen von neuen Geräten)."*
- *"Weil alle Mitarbeiter ähnliche Meinungen haben. Das heißt, dass alle sich Gedanken gemacht haben und interessiert an das Thema sind. Es ist schön ein Teil davon zu sein und mit den Verbesserungen an die bessere Zukunft des Unternehmens und der Umwelt beizutragen."*
- *"Weil es einen positiven Effekt auf die Umwelt und auch teilweise auf das Unternehmen hat."*
- *"Weil es der Ms C1 wichtig ist und ich auch so privat auf meine Geräte achte."*
- *"Lange Nutzungsdauer von Geräten ist mir generell ein Anliegen."*
- *"Durch die Verlängerung der Nutzungsdauer entstehen positive Synergieeffekte."*
- *"Weil ich meine Umwelt achte und möglichst wenig Schaden hinterlassen möchte."*

In conclusion, nine out of twelve participants highlighted the preservation and protection of the environment as a motivating factor. Some mentioned a higher user's satisfaction due to less change and better maintained device. Moreover, a prolonged use-time may also imply benefits for an organisation's profitability, which was also a motivating aspect for three employees.

A comment, which I want to highlight, assumed that organisations may be the beginning of a sustainable change in our so-called 'throwaway society': *"Ich schütze gerne die Umwelt und möchte mich um meine Geräte möglichst gut kümmern. Es muss ein Umdenken in unserer Wegwerfgesellschaft passieren und ich denke Unternehmen können da den Anfang machen"*. As they have a considerable impact on economy and demand, producers may react quicker.

Q17: *"What did you like/dislike about the interactive process?"*

Many employees were satisfied with the opportunities offered by the interactive process and argued, that due to a high motivation new ideas have been discovered through the approach: *"Durch das Weitergeben der Brainstorming-Sheets konnte man an den Anregungen und Ideen der Kollegen weiterarbeiten und auf diesen aufbauen"*. Moreover, they realised its benefits for more introverted participants, which were given the chance to actively contribute as they don't generally lack of ideas, but of courage to speak up: *"Jeder konnte in Ruhe die Fragen beantworten, konnte Vorschläge der anderen lese/verbessern; Durch diese Art der interaktiven Zusammenarbeit konnte aber sichergestellt werden, dass auch alle einen Beitrag leisten (können)"*. However, participants additionally realised the downside of the method and described it as ideas moving in a circle. One blamed the question regarding an employee's motivation for not being adequate within this specific method, another employee accused the time period being too long.

Although, several participants liked the method's compact format, two criticised the time pressure and suggested more time to develop more ideas, contradicting the last argument in the previous paragraph: *"Eventuell beide Fragen hintereinander, da jeder andere Ideen zu beiden Fragen hat ... benötigt zwar mehr Zeit, aber dafür mehr Ideen"*.

Concluding, most employees liked the participation and interaction as it eases the atmosphere, is a welcomed change and supports colleagues to reflect.

3. Workshop – further material

Q18: “Have you already had a look at some links / videos from the section ‘further material’ since the workshop?”

Q19: “At which links / videos did you have a look at or why haven’t you had a look at further materials?”

Only one employee had a look at further materials since the workshop and listed guidelines, projects and networks. Two participants claimed that they haven’t received any e-mail with the slides attached, which was contradicting with Ms E1’s statement. The remaining nine employees, including Ms C1, reported lack of time as an explanation. By this result, I was again convinced by the importance of presenting main concepts and guidelines to the employees. Though further materials were perceived interesting after the workshop and 100% stated to have a closer look at them in the near future, not even half of the colleagues did.

Q20: “In the last post questionnaire you had the opportunity to report missing content or information. Have your comments been taken into consideration by creating the link summary with additional information?”

Again participants partly didn’t remember their answers from the last questionnaire. Five employees had reported missing content or information in the post survey of the workshop, one of them unfortunately missed the final presentation. From the remaining four only two remembered their comments and stated that they have been taken into consideration by creating the link summary. The other participants, except three who did not attend the workshop, answered that no information was missing during the last session. Ten out of twelve are planning to have a closer look at the link summary with additional information. However, I am not completely convinced whether they will take their time or forget about it like with the further materials from the workshop.

4. Changes

Q21: “How long do you expect your current / next PC / laptop to work properly, in order the investment paid off?”

<i>Expected time period</i>	<i>Did your expectation change due to new information and dealing with the topic?</i>	<i>Result from interview during analysis phase</i>
As it is not a new laptop: at least 3 years	Yes	4-5 years
At least 2 more years (it is already 1 ½ years old)	Yes	3-3 ½ years
3-5 years	Yes	2 years
3 years	No	2 years
3-4 years	Yes	2 years
3 years	No	3 years
5 years	Yes	-
5 years	No	-
3 years	No	-
3 years	No	-
4 years	No	-
3-4 years	Yes	-

Table 13 - Changes regarding expected use-time

Regrettably, I asked for the current or next device in Q21 and Q22 leading to unambiguous results. Two employees clearly referred to their current laptop, the remaining answers were considered as general statements for future devices.

Colleagues with whom I conducted interviews in the analysis phase reported considerable changes regarding their expectations. I assumed that the closer collaboration from the beginning on led to a higher involvement with the topic. Unfortunately, one interview partner did not participate in the final presentation. Interesting to highlight, none declared to expect a use-time less than three or longer than five years after the cooperation. The range may result from our defined target use-time presented in the final presentation, thus, limiting employees to state different values. However, three years, which was reported by the majority of participants, is still a short period of time for a highly technical device. Consequently, I asked for replacement reasons in Q23 in order to be able to comprehend their motivation.

Q22: "How long do you desire your current / next PC / laptop to work properly?"

<i>Desired time period</i>	<i>Did your desires change due to new information and dealing with this topic?</i>	<i>Result from interview during analysis phase</i>
Still 5 years	Yes	5 years or longer
2-3 years	Yes	Longer than 3 years possible, but not up-to-date anymore
3-5 years	No	4 years
4 years	No	3 years
5 years	Yes	2-3 years
5 years	No	5 years
5 years	Yes	-
5 years	No	-
3 years	No	-
-	No	-
4 years	No	-
5 years	Yes	-

Table 14 - Changes regarding desired use-time

Likewise to the previous question, similar findings regarding interview partners are prevalent. However, the fact that five employees reported the same expected and desired use-time, which I marked in bold, astonished me. According to my interviews and discussions, the desired use-time was generally longer than the expected one, which was explained by experiences made and new available technologies. It would be interesting to know, whether they misunderstood the question or why they answered differently compared to their colleagues.

Furthermore, only one employee stated to desire a longer time period than five years for the current laptop. Again, I assumed that our target values were limiting the participant's answers. Although, we introduced them as a minimal time period, the values were partly perceived as being optimal.

Q23: "What reasons could lead to a replacement of your PC / laptop? When is a device not further useable?"

Only three participants, including one core group member, stated that their reasons for replacement have changed. When subsuming all reasons into groups, the structure reminded me

of the results from the qualitative interviews. Primer reasons are still performance, slowness and broken hardware components, which may not be repaired due to enormous effort or high costs. Repair must not exceed acquisition costs stated one of the participants. One employee, who wants her current laptop to be replaced soon, argued that it is extremely slow and has already been used for a considerably long time (remark by the author: since June 2010). Additionally, another employee indicated such a condition as not reasonable to work with. Furthermore, through new software or technical requirements as well as unsupported hardware by the future operating system, a device may become unusable. Apart from that, two participants reported that the laptop must be completely broken, i.e. it cannot be turned on, in order to replace it. On the contrary, one employee named the personal desire for a smaller display as a reason sufficient enough to exchange the current laptop.

Concluding, one has to admit that after a certain period of time, a device's performance gets weaker and hardware problems are more difficult to repair. However, if users start demanding longer-lasting products, producers may offer different business models and price policies to make upgrading and repairing more attractive for both sides. The role of organisations shall not be underestimated when it comes to market power.

Q24: "Have you already changed some personal practices (e.g. activities, procedures, decisions, etc.) since the workshop?"

Five stated that they have changed personal practices like using a cooling pad, minimising the local data amount, cleaning up the desktop, installing Bitlocker and trying not to reach the battery's limits. Moreover, the management and two employees are planning to take new procurement criteria, ratings, labels and guidelines for fair products into consideration for future purchases. The remaining participants argued that no personal practices have changed as most have always taken care of their devices and attached importance to use them for a long period of time. One expressed his general willingness to care by mentioning his private laptop, which has been in use for four years and additionally, he only exchanges smartphones if the old one may be passed on. Unfortunately, Mr E6, who still uses a PC, explained that most practices and guidelines are not relevant as our focus was primarily on laptops.

As the post questionnaire was sent out one day after the final presentation, new processes and guidelines have not been implemented yet. Thus, I was positively surprised by the variety of answers given by the employees, who had already tried to change their status-quo since the workshop.

Q25: "Which personal practices are you planning to change in the future?"

When asking about future changes in practices, nine employees reported a wide range of activities. They want to better protect the laptop's battery in order to use it longer, purchase greener, longer-lasting products with regard to use-time, clean ventilation slots and devices' cases, frequently maintain, perform system setups and empty the system's recycle bin. Moreover, employees considered cooling pads as useful tools and are willing to take even more care of their devices. Nevertheless, three employees are not planning to change personal practices in the future.

Unluckily, I may not be able to ask several months later, which practices have actually changed in daily business. However, our cooperation seemed to have a positive impact on their willingness to change their future practices, activities and decisions.

Q26: "Will you draw your family members / friends / acquaintance's attention to the topic 'use-time of PCs / laptops' and its consequences (e.g. 'e-waste')?"

More than half of the participants stated to inform their social environment about the importance of use-time and its impacts. Thereby, I aimed at giving an insight in the employee's personal involvement and in how far they may forward information. Although, this field of investigation is out of scope of the master thesis, it would be interesting to research in how far employees given a specific training at work can be considered as multipliers in their private environment. In total, only four reported to not draw their relative's attention to the topic. Nevertheless, also one of the core group members answered with 'no', which apparently surprised me the most as they had the highest involvement with the topic. I may only assume reasons ranging from not actively wanting to take action to having the perception that friends might not be interested. It would have been appealing to ask for the reasons.

5. Personal feedback

Within the last section I asked all participants to write a personal comment. Generally, I felt confirmed that they enjoyed the close collaboration and team work over the last months. Several underpinned that the topic was surprisingly interesting, even for those with less experience and/or knowledge in this area. One participant supported the importance for organisations to deal with the topic 'use-time' and take its impacts into account: *"Die Thematik ist generell äußerst interessant und sicherlich ein wichtiges Thema für alle Unternehmen, die PCs am Arbeitsplatz einsetzen"*.

For the majority, our process revealed much new information and improvement possibilities, which they haven't thought of before: *"Danke für alle Informationen, die du uns gegeben hast. Ich habe nicht wirklich an viele der genannten Vorschläge aktiv gedacht"*. Moreover, they appreciated the friendly and open atmosphere I created, which motivated all employees to participate. One employee highlighted the additional impact on private life through raised awareness: *"Es war sehr informativ, die Mitarbeiter wurden sensibilisiert besser auf die Geräte aufzupassen - auch im privaten Bereich"*.

According to one of the younger employees, taking the environmental aspect into consideration was especially important: *"Ich finde es gut, dass besonders der Faktor Umwelt sehr stark berücksichtigt wurde"*. From my point of view, the next generation's interest in sustainability and taking action towards environmentally conscious behaviour like purchasing organic food or recycling has increased over the last years. Nonetheless, the electronic sector is still far behind.

Focusing on the core group, as we intensively developed guidelines, discussed improvements and presented results, I felt affirmed by the following comment: *"Vielen Dank für die viele Zeit, die du in dieses Projekt gesteckt hast. Wir und besonders auch ich haben dadurch sehr viel gelernt und werden unsere Nutzung beruflich wie privat verbessern. Dadurch, dass wir in der letzten Zeit stark gewachsen sind, hat uns in einigen Bereichen eine gewisse Struktur gefehlt, was sich jetzt sicherlich verbessern wird"*. Through our cooperation they realised their current status-quo of being an expanding organisation and their potential for improvement in structure, organisation and documentation.

As Ms C1 filled out the post questionnaire nearly two months after the final presentation due to time constraints, she was able to reflect more sophisticatedly about the development after our process: *"Ich hatte das Gefühl, dass alle verstehen worum es geht und durchaus auch bereit sind*

mitzuarbeiten. In den letzten Tagen wurde ich jedoch etwas nachdenklich. Mitarbeiter wollen jetzt ohne Rücksicht auf das Alter und die noch volle Funktionsfähigkeit ihres Laptops ein neues Gerät. Gründe 'ein kleineres Gerät ist leichter zu transportieren', 'es gibt keine schöne Tasche für das große Gerät'. Das zeigt mir, dass der persönliche Bezug zu der Thematik doch nicht so leicht herzustellen ist. Von verstehen zu umsetzen ist doch ein weiterer Weg als ich dachte. Aber wir machen weiter!"

She exactly addressed the difficulty of establishing a sustainable change of practices. The willingness to adapt daily business and realising the impacts of use-time is an important first step, which we achieved through our cooperation. However, the path to actually change the status-quo and act sustainably may not be underestimated. The management and persons in charge have to take responsibility of monitoring new processes as well as supervising the realisation of guidelines.

4.7.7 Lessons learned

Admittedly, time constraints and the limited physical presence of Ms C1 during our action meetings phase due to holidays became apparent as some new processes were not completely defined. For instance, the optimal use of a laptop's battery or the specific responsibilities regarding maintenance activities was still unclear during our presentation. However, I considered our process and results as a considerably important trigger for continuous improvement in the future. The management is highly motivated pursuing the goal of being an environmentally conscious organisation taking responsibility for generations to come. Moreover, we achieved raising awareness throughout the employees, who are willing to support the organisation's strategy and intentions.

Although, some employees criticised the similar outcome of the interactive part in the final presentation, I am contented that I chose this method in order to make every participant interact and reflect on his or her motivation. The resulted facets were interesting findings in perceived advantages and incentives by prolonging the use-time. Apart from that, the meeting's time management could be improved in future projects. However, the relaxed and friendly atmosphere welcoming questions and discussions partly resulted from the loose time schedule.

Last but not least, I recognised how to improve my style and way of asking questions in a survey in order to achieve unambiguous results and measure developments. To my regret, I only asked within the interviews about expected and desired use-time. Therefore, the development and comparison of all staff members were only partly measurable. Because of the limited time given by a master thesis, I was not able to conduct additional short interviews after the final presentation, which indeed would have added more value to the findings. Moreover, I used different terms for the same topic like 'problems' in the post workshop questionnaire and 'fears' in the last survey.

4.8 Final reflection meeting

The final reflection meeting took place on the 30th of September with Ms C1 and Mr C2. It lasted one hour, was again audio-recorded and transcribed. I prepared one last document, where I gathered links for two open subjects derived from the discussions during the final presentation: guarantee vs. warranty and local alternatives to Amazon. Both core group members were very satisfied with the extra document and it seemed to be a beneficial extension. The fact that a Lenovo store in Vienna exists, offering individual configurations, could be a valuable alternative to an international wholesaler.

Within the European Union a warranty by the vendor is regulated by law and defined as two years in Austria, where the burden of proof shifts after six months. A producer's guarantee is not mandatory and can be specified by the producer before the conclusion of the contract. Normally, it is also set to two years, however, everything between one and five years is possible. Concerning IT-infrastructure some component's warranty like storage-battery is limited to one year, because of high defect and abrasion rates (ECC-Net 2015). In general, a defect within the first six months shall be treated within warranty, afterwards it is recommended to call on the guarantee. Therefore, a longer guarantee is favourable (ORF 2015).

First, I recommended some further actions concerning missing contact persons, additional columns in the monitoring sheet and responsibilities for maintenance tasks, which I recognised while listening to the audio file of the final presentation. Mr C2 confirmed that several processes need refinement and internal consulting.

When I asked about the next steps planned, Ms C1 addressed the importance of a meeting to clarify open issues, responsibilities and to transfer coordination tasks from Mr C2 to the administrative assistants. Maintenance activities like the cleaning of ventilation slots or system setups and the sorting out of old devices in an environmentally conscious way will be prioritised within the upcoming months. The suggestion to make use of cleaner software instead of annual system setups or automated installation scripts will be researched in order to design maintenance more efficiently and move in the direction of standardised work environments. Regarding the optimal battery use, both core group members questioned the benefits of changing the user's behaviour. Installing a regulating software like Lenovo's energy management tool or adapting BIOS configurations have been the only practical solutions discovered so far, which need to be researched and tried out. Additionally, I suggested making full use of a load cycle, if the laptop had been unplugged from the power supply before. Besides, the checklist for optimal use shall be filled out by the employees under supervision. Reminders for frequent tasks like sorting out local data or installing Windows updates will be implemented with JIRA⁹, an issue and project tracking software already in use within the organisation. During the discussion I underpinned to focus on the practicability of improvements in order not to demotivate or frustrate employees.

The next steps were followed by a discussion regarding Ms C1's comment during the final presentation about her tax consultant's recommendation to replace devices after full depreciation, which generally amounts to three years in case of PCs or laptops. She additionally discovered that many laptops in use have already been fully depreciated, which is "*complete nonsense*" from an economical point of view.

From a legal perspective, the Austrian Income Tax Act explicitly defines only in specific cases like buildings or cars the useful life of tangible fixed assets. Generally, the depreciation period can be chosen by each organisation individually (Federal Ministry of Finance 2009). However, concerning the Wage Tax Guidelines a minimum useful life of three years for personal computers can be assumed (Lechner 2007). Thus, the theoretical flexibility of depreciation in Austria can be a driver to prolong the use-time of IT-infrastructure, under the assumption that technology and efficiency needs are fulfilled. On the contrary, Germany has fixed depreciation periods, e.g. three years for personal computers, which limit an organisation's possibility to act sustainably (Deutsches Bundesministerium für Finanzen 2000).

⁹ <https://de.atlassian.com/software/jira>

However, as depreciation rates are annually deducted from the revenues, profit is decreased and less tax has to be paid. Moreover, she highlighted that Austria has no progressive tax rate, which means that a Ltd always has to pay 25% of corporation tax. Thus, Ms C1 concluded that the economic system apparently contradicts environmental consciousness: *“Das heißt, da widerspricht sich eigentlich die Wirtschaftlichkeit mit der Umweltfreundlichkeit. Das sind so grundsätzliche Sachen, wo ich finde, wo der Staat einfach etwas tun könnte, unterstützend wirken könnte. Und zwar wirklich massiv. Ich mache es jetzt einfach so, weil es ist meine Überzeugung. Punkt, ist so. Aber wir sind nichts gegen die vielen großen Firmen, die dann einfach nach dem anderen System arbeiten. Also in der Privatwirtschaft wird einfach weggeworfen und gekauft. Weil, wenn du reparieren lässt: Das heißt, du musst einen Mitarbeiter dorthin schicken oder das managen lassen. Du hast Zusatzkosten auf jeden Fall. Das Gerät selber kostet, es ist noch immer alt und es kann in 3 Wochen schon wieder etwas haben. Wie entscheidest du? Ist einfach so. Das finde ich sehr schade und sehr traurig. Wir werden ja hin erzogen zum Wegwerfen und nicht zum Reparieren. Also ich habe einmal vor vielen Jahren einen Bericht von Kuba gesehen, was die alles machen, was die reparieren, wie die leben. Und wenn du dann schaust, wie es bei uns läuft. Das ist ein Wahnsinn”*. However, Ms C1 was optimistic that ideas as well as solutions like public incentives, subsidies or governmental policies for greener devices and longer use-times in order to move into the right direction may be available soon.

In the second half of our meeting we reflected on the process itself, its usefulness for the organisation and potential difficulties in the future. In Mr C2's opinion the process was very useful and well done. He was interested in having a closer look at the whole product lifecycle from purchase to end-of-life in order to discover alternatives and deal with certain areas more in detail. The time frame between meetings was absolutely necessary to research and conceptualise actions, although, it did not always worked as desired. Additionally, he underpinned the importance of developing the details concerning the monitoring sheet, maintenance and battery use during daily business. Consequently, he had the impression that not many changes have been apparent until now. Contradicting, Ms C1 has already perceived considerable changes regarding certain train of thoughts and positive effects due to increased awareness: *“Ich möchte eigentlich schon sagen, dass es für meine Begriffe, jetzt schon etwas bringt. Man merkt ein gewisses Verständnis und auch gewisse Gedankengänge bekommt man schon mit, die sehr wohl in die richtige Richtung gehen, die vorher vielleicht nicht so deutlich zu merken waren. Und ich finde, damit fängt es eigentlich an, dass man einmal überhaupt das Bewusstsein schafft und dann geht es eh weiter in die richtige Richtung, wenn man eben dann dahinter bleibt – natürlich das gehört auch dazu. Also ich finde es sehr positiv und es war, von meiner Perspektive aus, okay so wie es war, auch vom Aufwand her. Dass es natürlich im Tagesgeschäft immer störend ist, das ist eben einfach so. Aber man braucht so etwas – wenn du da nicht heraus gerissen wirst, dann kommst du auch nicht weiter mit solchen Themen”*. With the last sentence she highlighted the necessity of interrupting daily business in order to be able to focus on overarching topics like use-time.

Concerning possible difficulties for implementing new processes and improvements, Ms C1 argued that through trial and error and simply living them, they will develop. After a certain period of time, she has planned to reflect again on the guidelines and redefine concepts in order to adapt them accordingly. Her only fear was that daily routine will retreat these topics into the background: *“Die große Sorge, die ich immer nur dabei habe, ist dass es aufgrund des Tagesgeschäfts ... dass diese Dinge wieder in den Hintergrund rücken. Und da müssen wir, glaube ich, ziemlich an uns arbeiten, dass das nicht passiert”*. Thus, Mr C2 emphasised the importance of determining persons in charge for monitoring and managing the developed actions, who have the required

time to handle them properly. He circumstantiated the necessity by reporting that “*nothing happened*” since the final presentation as he lacked of time.

Apart from that, Ms C1 was still convinced to nominate an environmental consultant within the organisation in order to act more sustainably in further areas. All next steps including the formulation of vision and derived goals will be addressed in an additional meeting. The exact date was not clear at the end of our cooperation. Last, we decided to keep in touch and exchange results regarding their upcoming meeting and my master thesis.

4.9 Outcome: evidence-based guidelines

Within this chapter I present a set of evidence-based guidelines derived from the previously mentioned results as a main outcome of the action research process. All our gained knowledge is based on the analysis of the status-quo, conducted interviews, workshop, discussions, reflections and evaluations, and additionally on the performed expert interviews. These results led to a structured and condensed set of evidence-based guidelines for improving the use-time of PCs and laptops in (small) organisations. It was structured to accompany a complete product lifecycle including overarching issues (e.g. documentation, communication) and developed by the example of Omega Ltd. For its exemplary application at Omega Ltd, please see the appendix. However, several recommendations are also relevant for individuals and private use.

4.9.1 Documentation and monitoring

1. Define a target and minimum use-time value

On the one hand, the target value shall support the common goal of improving the use-times and encourage employees to achieve it. On the other hand, it shall help to develop a more accurate feeling for possible, maybe even longer periods of use-time. Within the defined minimum use-time, repair, upgrades and maintenance are preferred over replacement.

2. Develop a central monitoring sheet

This sheet may become the central tool to monitor, manage and evaluate all newly introduced improvements. The following structure was considered recommendable:

- Employee overview: List all employees with their PCs / laptops in use.
- Device overview: List all PCs / laptops with their non-technical¹⁰ properties and their current status¹¹. Additionally, let the sheet calculate the device’s use-time since purchase.
- Use-time analysis: Document the period and intensity of use per employee for each device in order to discover pauses in use-time.
- Maintenance: Document tasks like system setups to monitor a device’s condition.
- Components: List all PCs / laptops with their technical properties¹² and their respective reparability.
- Upgrades: Document all performed upgrades and their related costs.
- Problems: Platform to report software as well as hardware problems, monitor their current status and document their solution process for (similar) future problems.

¹⁰ (e.g. purchase date, leaving date, vendor, guarantee, acquisition costs)

¹¹ (e.g. in use; functional, but not in use; stored and non-functional; discarded)

¹² (e.g. processor, graphic chip, mainboard)

- Use checklist: Employees shall regularly re-check, if their use and work environment corresponds to the defined guideline.

3. Define contact persons and responsible employees

Employees tend to ignore negative circumstances (e.g. software/hardware problems, decreased satisfaction with device), if they are not aware of whom they shall inform. Thus, essential processes like maintenance or repair may not be triggered in time, eventually worsening the prevalent problem. Therefore, contact persons must be defined and transparently communicated to all employees. In addition, certain employees shall be in charge of monitoring as well as supervising the application of new processes, guidelines and tasks to improve the use-time.

4. Perform regular reflection meetings to review the progress

New processes and rules derived from this set of evidence-based guidelines need to be integrated into daily business. Thereby, certain adaptations to fit the organisation's specific setting and practices may be necessary. First, regular reflection meetings shall encounter the challenge of daily routines retreating new processes into the background. Second, they shall help to evaluate the guidelines' impact and success. It is recommendable to start with shorter time intervals (e.g. 1-3 months) and increase them as new processes become part of the work practices.

4.9.2 Procurement

1. Define technical and ecological criteria

By defining minimum technical requirements, it is possible to recognise the employees' real needs. A good price-performance ratio is not necessarily the best and most economic option for the organisation. Additional criteria like a good cooling of the graphic chip to prevent overheating and ecological criteria like energy efficiency standards may lead to sustainable cost savings in the long run.

2. Take producer's social responsibility, guarantee, green labels and ratings into consideration

First, it is recommendable to have a closer look at the producer's website and identify in how far social and environmental responsibilities are being targeted. Second, a guarantee of at least three years is beneficial as it may represent the product's durability. Next, *label-online.de* efficiently rates green labels according to their independency, requirements controlling and transparency. Relevant labels of laptops and PCs are: *TCO Certified*, *EPEAT*, *Energy Star* and *Greenguard*. In the future, *Der Blaue Engel* and *EU-Ecolabel* will become more important, if producers start fulfilling their strict requirements. Several labels (e.g. *TCO*¹³) offer databases to search for certified products. In order to qualify the producer's information, revising these ratings is of vital importance: *Greenpeace Guide to Greener Electronics*¹⁴, *Ethical Consumer Rating*¹⁵ and *Electronics Industry Trends*¹⁶.

¹³ http://tco.brightly.se/pls/nvp/tco_search

¹⁴ www.greenpeace.org/international/en/campaigns/detox/electronics/Guide-to-Greener-Electronics/Green-Gadgets

¹⁵ www.ethicalconsumer.org/buyersguides/computing/laptopsandnetbooks.aspx

¹⁶ www.baptistworldaid.org.au/assets/BehindtheBarcode/Electronics-Industry-Trends-Report-Australia.pdf

3. Research (green) reference models in the business sector

Based on the results of step 1 and 2, (green) business models shall be researched and documented as a reference for future procurements. Thereby, overhead effort may be minimised. Business models, in contrast to consumer products, come with the advantages of more qualitative materials, better durability and reparability. Watch out for customer replaceable units, which offer essential upgrade possibilities (e.g. memory, hard drive) without losing the guarantee. Moreover, the application of screws on the bottom of a laptop is a good sign for its reparability. Websites like *notebookcheck.com* offers valuable reviews, which take all these additional aspects into account.

4. Check for reported 'planned obsolescence' cases

By accessing the website of the initiative *MURKS? Nein Danke!*¹⁷, cases of reported 'planned obsolescence' may be easily identified. If a broken device gives the impression of being intentionally obsolete, consider reporting it for the sake of other customers.

5. Establish contact and partnership to local vendors

Local vendors come with the advantage of offering direct contact persons and support in case of problems, time-critical issues and guarantee claims. However, avoid suspicious cheap offers from big retailers as they often imply high life cycle costs and non-durable products.

6. Consider IT-leasing and second hand concepts

Possessing devices is not always necessary. IT-leasing services may be a valuable and eventually cost-saving alternative like leasing server landscapes. Service partners are highly interested to offer durable and qualitative products, which in return become an advantage for the organisation. Second hand devices are considered recommendable for employees with less technical requirements (e.g. administration), if there is no internal device available to be passed on.

4.9.3 Use and maintenance

1. Develop rules for use

Employees follow individual behavioural patterns, which may unintentionally contradict the optimal use of an organisation's device. Therefore it is considerably recommendable to develop certain rules for using PCs and laptops at work, while on the move and at home. The following structure shall be supportive and give an idea of possible improvements:

- Workstation arrangement: use of external peripheral devices, positioning of liquids aside, unblocking of ventilation slots (e.g. cooling pad), protect interfaces, avoid heat
- Energy efficient work: use of standby-mode, activation of the power saver mode, reduce display brightness, deactivate screen saver, use of switchable multi-way connectors
- Data storage: use central data storage (if available), structure and regularly tidy up data (e.g. prevent loss of sensitive data)
- While on the move or at home: in addition to *workstation arrangement*, use protection sleeves, unplug all devices / receivers (e.g. wireless mouse dongle) before transport, prevent shocks, don't use laptop in bed or on the lap
- Producer specific information: e.g. battery use, energy manager

¹⁷ www.murks-nein-danke.de/murksmelden/

2. Develop regular maintenance tasks

It is recommendable to structure maintenance tasks based on how frequently they shall be performed:

- Annually: system setup, cleaner software
- Quarterly: clean ventilation slots interface and in general the device itself
- Monthly: structure and tidy up data, empty trash bins / download folders
- Weekly: install all available updates

In order to remind employees about their duties, more frequently tasks may be implemented and monitored with an issue tracking tool like Jira¹⁸. Thus, they become part of daily business routines.

4.9.4 Repair

1. Establish contact with a trustworthy repair service

If upgrades or repair may not be performed in-house, a professional repair services like *R.U.S.Z.*¹⁹ shall be easily contactable. For example, all members of the *Viennese Repair Network*²⁰ offer the same price for making an estimate of costs, which will then be deducted from the order. Several member repair services cooperate with a transport service, like the one offered by *D.R.Z.*²¹, leading to decreased overhead effort as well as costs in an organisation. It is recommendable to proactively decide on a repair service and make contact details quickly accessible.

2. Learn to repair in-house by attending a repair café

One may learn how to repair small electronic appliances him- or herself under the supervision of an expert. By participating in a repair café in form of a firm's outing, successful experiences may strengthen the employees' relation to their devices and encourage them to prefer repair over replacement. Repair cafés have been established in many cities worldwide²². The following exist for example in Vienna: *energie & reparatur café*²³, *Repair café Wien*²⁴ and *Schraube 14*²⁵. In this context, the website *IFIXIT*²⁶ may also be recommended.

4.9.5 End-of-life

1. Erase data with a certified data deletion tool

Considering the secure deletion of data when PCs and laptops leave the organisation is of vital importance. It is possible to either establish a cooperation with a refurbishment company, which takes full responsibility (see step 2), or perform the deletion in-house by using a software like *blancco*²⁷.

¹⁸ <https://de.atlassian.com/software/jira>

¹⁹ www.rusz.at

²⁰ www.reparaturnetzwerk.at

²¹ www.drz-wien.at

²² <http://repaircafe.org/en/visit/>

²³ www.tschuertzs-services.at/projekte/energie-reparatur-cafe/

²⁴ <http://repaircafe.wien/>

²⁵ www.rusz.at/967/ - doesn't offer the possibility to repair laptops or PCs

²⁶ <https://de.ifixit.com/>

²⁷ www.blancco.com

2. Establish cooperation with a refurbishment company

Several companies collect and refurbish old IT in order to resell it to private customers. For instance, *AfB*²⁸, a member of the *Viennese Repair Network*, additionally offers a certified and transparent data deletion process. By such a cooperation, a win-win situation for both sides is established, leading to a prolonged use-time and thus, to saved valuable resources.

3. Donate functional devices to non-profit organisations

Non-profit organisations or networks like *Labdoo*²⁹ collect old devices, which may support schools in need for equipment. The device's use-time gets prolonged until they have reached the end of life span. Afterwards the network takes responsibility of an accurate recycling process. Thus, the 'second life' of refurbished PCs and laptops is highly beneficial in several locations around the world.

4.9.6 Communication

1. Integrate environmental aspects in the organisation's internal communication

An environmental conscious organisation should consider including their ecological effort taken in their vision as well as derived goals. Moreover, the serious development of a corporate social responsibility strategy is of vital importance, not only to increase the organisation's image. For example, partners of AfB receive a certificate confirming their positive ecological and social impact through the cooperation. Thus, the CSR strategy becomes a transparently communicated goal of the company and in return, employees will appreciate working in an organisation taking responsibility for their environment.

2. Integrate environmental aspects in the organisation's external communication

In addition, the above mentioned CSR strategy shall not only be communicated internally, but also externally. By that, (potential) customers and stakeholders will realise the ecological efforts taken.

²⁸ www.afb-group.at

²⁹ www.labdoo.org/de/LabdooDACH

5 Expert interviews

By performing the expert interviews, I aimed at gaining profound insights into the processes in the City of Vienna and the repair scene itself. The first three interview partners are strongly connected through their daily businesses and provided expert knowledge in the field of public procurement, end-of-life or sustainability regarding PCs and laptops. The second half concerned repair possibilities in Vienna reaching from professional services to do-it-yourself initiatives like repair cafés, which were additionally reused as recommendations or basis for discussion during the action meetings process.

5.1 Interview partners characteristics

The information was partly taken from the respective website or information material and partly from the interview partner's self-portrayal at the beginning of the conducted interviews.

5.1.1 *Municipal Department 14*

The MA 14 is responsible for the Automated Data Processing, Information and Communications Technology (ICT) at the City of Vienna. It supports, services and consults the municipal departments in order to satisfy citizen needs. Mr Walter Schuster is part of the advisory committee of the environmental management programme in the Vienna City Administration (PUMA), which aims at supporting the City of Vienna to become even more environmentally friendly in the fields of energy consumption, waste management and procurement. Furthermore, Mr Schuster is responsible for coordinating processes regarding the procurement of ICT services. In order to handle old IT properly, the MA 14 engaged in a cooperation with AfB.

Statistics revealed, that although, the overall amount of PCs, laptops and thin clients increased from 19.060 in 2009 to 19.177 in 2013, electricity consumption has been decreased from 3.556 MWh to 1.129 MWh due to centralisation and more energy efficient devices. On average, more than one third of old devices per discard were refurbished and resold through the cooperation with AfB.

5.1.2 *AfB social & green IT*

AfB (*mildtätige und gemeinnützige Gesellschaft zur Schaffung von Arbeitsplätzen für behinderte Menschen mbH*) collects and refurbishes an organisation's old IT-hardware in order to resell it to private customers. Data deletion processes are certified and transparent. By prolonging the device's life span, the company saves valuable resources, protects the environment and supports organisations with their corporate social responsibility work. Partners receive a certificate confirming their positive ecological and social impact through the cooperation. Moreover, AfB employs 50% people with disabilities and helps long-time unemployed to reintegrate in the job market. Mr Dieter Hundstorfer is key account manager in Vienna and expert in the field of waste management. Besides, he had worked over twenty years for the Vienna City Administration.

The Technical University of Berlin has analysed the AfB process and confirmed, that CSR-partnerships with AfB achieve a positive ecological impact through the prolonging of life spans and the reduction of new productions of IT devices. In 2014, AfB accomplished an ecological contribution of nearly 25 million kWh energy and over seven million kilograms CO₂ equivalents through all partnerships.

5.1.3 Municipal Department 22

The Municipal Department for Environmental Protection aims to improve both, the quality of the local environment as well as the overall quality of life in Vienna. Mr Thomas Mosor is internal manager of the programme 'ÖkoKauf Wien' for sustainable public procurement and coordinates fifteen workgroups. These consist of experts and buyers from different municipal departments, who work on ecological criteria for purchasing goods and services by means of tenders. Furthermore, 'ÖkoKauf Wien' focuses on the internal and external acceptance by providing research results and information to employees and private customers. The programme is strongly interrelated with the above mentioned programme 'PUMA' and the City of Vienna's climate protection programme. Relevant to mention, it has been commended by the European Union commission as one of the most successful sustainable procurement initiatives to promote resource efficiency.

The effect analysis from April 2014 with a period under consideration from 2008 to 2012 revealed annual electricity savings of about 350MWh, whereas two third concern IT and office equipment. Operating costs (electricity, water) in the same area have been reduced by 113.000€ per year.

5.1.4 R.U.S.Z.

The repair and service centre was founded by Mr Sepp Eisenriegler in 1998, who had worked as an environmental consultant for the City of Vienna and was co-founder of the Viennese Repair Network. Skilled electrical and mechanical engineers offer serious repair services and transform broken devices from waste into a product again, giving them a second-life. Moreover, long-term unemployed and people at risk of socio-economic exclusion are retrained and given the opportunity to learn new skills in order to reintegrate in the job market. In 2003 he founded the Dismantling and Recycling Centre (D.R.Z.), which was designed to serve as the missing link to secondary raw material production in cooperation with the recycling industry. Furthermore, he engaged in European-wide work as a founding member and president of RREUSE in 1999, representing active reuse, repair and recycling networks, which had considerable impact on the enactment of the EU WEEE and Waste Framework directives.

Regarding resource protection and waste avoidance, R.U.S.Z. prevents about 1.000 tons of problematic waste, 5.000 tons of CO₂ and 15.000 tons of primary resources through the prolonging of use-times per year. In the first ten years of its existence, Mr Eisenriegler strongly supported over 400 long-time unemployed workers and their opportunities to re-enter the job market. 'Schraube 14' is the weekly repair café to encourage private consumers to repair small electronic devices like toasters or hair-dryers themselves.

5.1.5 EPC-Computerservice GmbH

Mr Egmont Perthel, founder of the EPC-Computerservice GmbH, is member of the Viennese Repair Network and has worked for Greenpeace before he entered the field of informatics. 2005 he made his hobby to his profession and now offers repair services including software installations and elimination of computer viruses. He is a certified waste treatment operator and collector supporting private customers and organisations when sorting out old IT-hardware. Within the interview he said, *"Ich möchte auf einen Berg von recycelten Material zurückblicken können, wenn ich einmal sterbe ... Sepp Eisenriegler ist natürlich noch viel weiter vorne, den werde ich nicht einholen, der hat natürlich Gebirge [...]".*

5.1.6 Energie & reparatur café

The energie & reparatur café was initiated 2013 by Mr Heinz Tschürtz, founder of tschürtz services e.U. He is proud of finishing second with his project at the 'Klimaschutzpreis Josefstadt 2013'. Participants are being integrated and encouraged to actively engage in the two regular events 'offener werkstatt(t)raum' or 'beratungsraum'. Thus, private customers are supported to repair their broken devices, which are portable with one hand, under professional supervision and are offered the possibility to discuss certain topics like energy, sustainability, repair and resource efficiency. Moreover, Mr. Tschürtz focuses with his work on consulting and supporting people, for instance to save energy costs, rather than only repairing devices. He is convinced that sustainability has to be lived by and with people.

5.2 Analysis and results

All interviews took place during the cooperation with Omega Ltd, were audio-recorded and transcribed. Afterwards, interesting, conflicting or outstanding comments were highlighted and coded, leading to the structure below. Several topics were underpinned by reported processes within the Vienna City Administration as an example.

5.2.1 Status-quo and responsibility

As the current situation regarding the use-time of PCs and laptops has a complex structure, experts agreed that all stakeholders involved are to blame. Mr Eisenriegler highlighted the failure in the system as the economy is still growth-oriented, although, we are living on a finite planet with limited resources. Thus, nowadays production methods are not designed to make goods repairable, but to easily replace them due to their cheap prices. Through this wrong price policy, users attach no real value to their belongings and are not willing to use them accordingly, quite the contrary, waste is systematically generated. Consequently, users, who purchase cheap products from the consumer sector or who always tend to buy the latest gadget are equally responsible, argued Mr Perthel and Mr Schuster. They represent the demand and thereby support quicker and less qualitative production. Producers, eager to increase their sales volume, are not interested in repairing, but outsourced their manufacturing plants to less developed countries with lower social and environmental standards, decreasing their costs. Simultaneously, users started to accept circumstances like non-removable batteries in mobile phones or in general shorter life spans due to the cheap price policy. Certain producers are even willing to paralyse the repair sector by limiting the availability of their spare parts to non-authorised or non-contractually bound repair services. Experts additionally suspected their actions as attempts to prevent obsolescence research on their broken components.

In the business sector, Mr Schuster named three influencing factors for shorter use-times. First, the work environment and infrastructure limit the actual internal use-time. Second, user's requirements demand different technological performance properties. Last, all organisations aim to provide stability in their systems in order to guarantee properly working tools and conditions.

Half of its environmental burden had already happened before a laptop was turned on for the first time, highlighting the severe impacts of nowadays production, explained Mr Eisenriegler. Until now, no fair laptop initiatives or projects exist. Mr Mosor only mentioned the independent monitoring organisation 'Electronics Watch', which aims at achieving respect for labour rights in the global electronics industry by performing spot checks, comparable with the 'Fair Wear Foundation' in the textile industry. However, he claimed with regret that we all accept the fact, that our laptops or PCs are not fairly produced as they essentially support and improve our daily

work. Rankings of green electronics are mostly dependent on the organisation's transparency and their provided information, making it difficult for non-profit organisations like Greenpeace to evaluate the trustworthiness, stated Mr Perthel.

Compared to the interviews within Omega Ltd, most employees blamed either the users or the producers for short use-times. Users were blamed to lack of competences when deciding on a cheap offer and for not taking enough care while using their device. In contrast, producers were not willing to repair a broken device, but replaced it immediately. Moreover, they argued, that it must be the producer's fault and intention if a well-treated device brakes. Most employees noticed, that previous laptop generations lasted longer. Only the management and one employee addressed the system's responsibility for not supporting the right conditions for a sustainable economy. For me as a researcher it was prevalent that before we started the cooperation, all employees tended to accept the status-quo and had few ideas of how to change the current situation or little motivation to actively work on their mentioned responsibilities as a user. They argued, that they *"already use it as long as possible"* and *"couldn't change any practice, which would prolong the laptop's use-time"*.

5.2.2 Replacement reasons

Throughout the interviews, several different replacement reasons were named: technological innovations, style, status symbols, non-replaceable hardware components, operating systems, compatibility and speed problems. Mr Perthel made the experience that devices are only exchanged due to economical not ecological reasons. For instance, the economic crisis lead to certain saving measures within organisations and thus, he perceived on-going changes in the direction of longer depreciation and use-times. In almost the same manner, the Vienna City Administration tries to avoid unplanned costs resulting from unexpected use-times. As they are using taxpayers' money, cost efficiency has to have priority. However, the MA 14 does not automatically replace devices after a certain period of time. For example, there are still 433 PCs and laptops from 2008 in use and maintained. The point for replacement, described Mr Schuster, as a combination of increasing defect frequency, software compatibility and age, which reduces the probability of available spare parts.

In contrast, Omega Ltd's management was very concerned about its environmental impact and thus, kept devices despite the fact, that they have already been fully depreciated after three years. Nevertheless, one may not automatically conclude that the majority of organisations follows this sustainable principle and shows interest in the use-time of their infrastructure. The Vienna City Administration may also be rated as a pioneer by fulfilling their programme criteria of 'ÖkoKauf' and 'PUMA'.

Interesting to mention, Mr Mosor addressed his personal experience, that users are less emotional about their laptop than their mobile phone, although, we use both frequently each day. While conducting the interviews with Omega Ltd's employees, I had the similar impression that computers, monitors and keyboards were perceived as commodities, which need to fulfil certain requirements. However, none of the employees mentioned a personal binding to their devices, neither at work nor at home.

Two experts introduced the existing tensions between ecological cost of production and high energy consumption. If a device is longer in use, more energy efficient versions enter the market in the meanwhile. One may ask him- or herself, whether the energy savings by the new device

outweigh the ecological burden generated through its production. Additionally, the old device has likewise embodied energy, which will be lost upon disposal.

Above that, all experts working in the repair sector reported the problem of broken laptop's graphic chips due to their inappropriate cooling. Moreover, they are mostly glued to the mainboard, making it a considerably expensive and difficult component to access and repair. One may assume this to be a case of planned obsolescence mainly driven by saturated markets, high competition and the pressure to increase volume sales. Again, the majority of cheap and highly discounted consumer laptops are affected.

In general, replacement reasons mentioned by the employees and the management overlapped with the expert's perception. Sometimes the defect of a single component like the graphic chip or mainboard is sufficient to replace an already old device. Demand for new technologies and innovations originated more from the employees as private costumers and was less relevant in the business setting. Only if devices were perceived as *"too slow to work with"*, employees expressed their need for performance and basic speed.

5.2.3 Use-time in organisations

When asking the experts about their estimation and experience regarding the use-time of PCs and laptops in organisations, most distinguished between bigger and smaller companies. Generally speaking, PCs reach longer use-times, similarly structured organisations use similarly and smaller organisations tend to use devices longer – facts, which I may confirm by the investigation in Omega Ltd and the results from the conducted interviews. According to Mr Perthel, bigger organisations use their laptops between three and four years. In contrast, Mr Hundstorfer noticed a change from the traditional three years based on the economical depreciation towards four to five years. Mr Schuster compared the Vienna City Administration with banks requiring certain minimal standards regarding performance and safety, which lead to an average use-time of four years for laptops and five years for PCs. Furthermore, while he has been working at the MA 14, he realised that most employees are 'creatures of habit', who are used to their device and need not be motivated to use it longer. Mr Perthel agreed that employees enjoy a certain convenience, if their working tool stays the same. Through regular maintenance and quick system set ups, laptops are perceived *"as good as new"*.

Apart from the main advantage of a prolonged use-time for employees, Mr Eisenriegler also addressed the management, which may improve its image by acting sustainably. As the EU is already committed to the concept of a circular economy, organisations could act as first movers declaring to participate voluntarily in this environmental friendly strategy (see chapter 2.3.3). Through the interactive part of the final presentation, many more advantages and motivating aspects were revealed including cost, time and resource saving, support of repair services, using similar devices, less change, safe work place and influence on demand (see chapter 4.7.5).

5.2.4 Possibilities to improve the use-time

Throughout the interviews, several interesting possibilities to improve the status-quo were mentioned. Apart from the design of the work environment, the correct positioning on the desk and maintenance as a life-prolonging action, which was further developed during the action meetings, all experts mentioned the importance of including the users in the change process. People's awareness needs to be raised and addressed by letting them participate in discussions and reflections on topics like e-waste, the origin of products or implications of short use-times, recommended Mr Tschürtz. Users should start to question the status-quo like exceptionally cheap

offers of global retailers and ask for long-lasting products when planning to buy new goods or talking to shop assistants. Even a non-expert may investigate a laptop's reparability by searching for screws, a removable battery and customer replaceable units. Although, a single opinion doesn't weigh very much, demand may change if more and more consumers start to rethink. Moreover, these private persons are simultaneously able to influence (smaller) organisations as conscious staff members.

Through my cooperation with Omega Ltd, I realised the importance of including employees in a change process. Colleagues were more motivated, when members of the core group presented the final outcome like new concepts, guidelines or tasks. It was additionally essential to give everyone the opportunity to ask, reflect and criticise in order to correctly relate to the organisation's practices. Several concluded in the last post-questionnaire, that they will additionally try to improve their private behaviour and inform friends or family. However, the evaluation of the implementation and long-term development was out of scope due to time restrictions.

In contrast, the management may also have an essential influence on their employees, if sustainable use of electronics like passing them internally on or cooperating with a company like AfB was communicated and made transparent. Through AfB, employees have further the possibility to make a reservation for their former laptop at work and purchase it for private use: refurbished, with guarantee and for a considerable small price. According to Mr Hundstorfer, a service very intensively used at the moment. Two out of six interviewed employees from Omega Ltd were also in favour of prolonging the use-time through private use, which positively surprised the management.

Mr Schuster suggested to establish partnerships for procurement and repair in order to have reliable contact persons. At the MA 14, procurement requirements are always oriented close to the highest possible standards available on the market, which are afterwards tested for correctness. Important to highlight, requirements shall be measurable in order not to be dependent on the producer's information. Moreover, not every operating system's development cycle has to be implemented in the current IT landscape, but may be skipped, if systems are working properly and are still maintained with safety updates by the producer. Thereby, compatibility problems leading to premature replacement can be decreased – a practice, which was already present at Omega Ltd, although, they are Microsoft partners.

Addressing overarching conditions, Mr Eisenriegler was highly in favour of the circular economy concept commended by the European Union, which aims at longevity, reparability and re-use. One of its instruments is the amendment to the eco design directive in order to extend it by resource efficiency. For transparent communication to the customers, labels need to be adapted. Furthermore, he proposed to eliminate the shifting of the burden of proof after six months and an application only at the expense of the producer. An additional change from a contractual to a statutory extended guarantee would be an outstanding success for improving a product's longevity and thus, its use-time. To increase the producer's responsibility seems to be an important step in the right direction, suggested by all experts.

Mr Mosor introduced the possibility of procuring according to life cycle costs, which take not only acquisition, but also operating, maintenance and repair expenses into account. It often reveals that the cheap products entail high costs during use as for instance labour costs of repair workers are the most expensive part. This concept is one of the main goals in the MA 22 and has already been implemented at the MA 48 concerning its fleet of trucks. Thus, the prejudice of ecological

procurement being higher priced is not correct per se, as it often presupposes better quality. Besides, the European Union suggested to change the contract award criteria at tenders from the cheapest price to the highest total amount of points. Each offer's property like energy efficiency, CO₂ emissions per kilometre or price shall be rated with points leading to a winner. Thereby, life cycle costs may be taken into consideration, however, procurement effort will drastically increase. Moreover, he proposed the increase of market power by building procurement networks. However, it will come with the downside of decreased individuality of requirements. Although, the Vienna City Administration is apparently more powerful than private customers, Mr Mosor has never noticed a real market power against the internationalised and globally acting electronics industry. He assumed, that the biggest power may be achieved by technology deniers.

5.2.5 Repair and reparability

Mr Tschürtz supported the importance of improving overarching conditions and addressed the repair sector, which shall be fostered in order to ensure serious services to users. Only independent repair services are indeed interested in repairing not replacing. Moreover, the success of prolonging a device's life span and preventing the generation of e-waste is strongly dependent on the technician's knowledge. However, according to Mr Eisenriegler's and Mr Perthel's experience, organisations are rarely or not making use of their repair services. I assumed that bigger organisations like the Vienna City Administration have partners responsible for repair and maintenance, nevertheless, the market of small to middle-sized companies was not being targeted by both. Omega Ltd's management reported about her bad experiences made with unreliable repair services and therefore, it was one of our main goals to identify serious possibilities in Vienna. Besides the technician's professionalism, a repair's economic efficiency is strongly dependent of the device's inner structure and the utilisation of the user. From Mr Perthel's point of view, tensions between replacement and repair costs, which shall not amount to more than one half to one third of the acquisition costs, are influencing the owner's choice. Likewise, Ms C1 confirmed that repair costs shall not exceed one fourth of new acquisition costs, resulting in 200 to 250€. In contrast, Mr Eisenriegler underpinned that the ecological production costs must be taken into consideration to outweigh repair costs.

Generally speaking, producer's business series are of better quality and easier to repair, agreed all experts. The cheaper the product, the worse the reparability underlined Mr Perthel. He additionally added, that the higher acquisition costs and latter repair pays off in the majority of cases, as only a few neuralgic positions exist – by replacing the concerned spare parts the device is as good as before and its life span high again. As Omega Ltd has not procured business series models so far, it would have been very interesting to commonly evaluate apparent performance and cost differences after several years.

Nevertheless, reparability is still not of priority to producers claimed Mr Eisenriegler. He is currently working on a seal of approval for long-lasting, repairable electrical and electronic devices and has already tested 27 washing machines according to his requirements. As a result, none of them would have deserved to be ranked on his whitelist so far due to a lack of information available. The testing of laptops and PCs is planned in the near future and may be of considerable interest.

5.2.6 Alternatives to procurement

Another possibility to improve the use-time of PCs and laptops may be achieved by alternative business models. Mr Eisenriegler proposed the concept of using instead of buying. By establishing a cooperation with a leasing company, one doesn't have to procure new products. However, this

strategy needs a change and shift in the people's mindset. For decades people were acknowledged by their belongings and ability to afford them. Having less generally meant earning less or being less successful in life. The joy of possessing has also been in the focus of interest. Moreover, he made the experience that people take more care about their own property compared with using someone else's device. Besides, he rose the question of which model being more expensive and assumed that with the accurate partner and contract, leasing shall be more economical. As a prominent example, the Vienna City Administration has changed its processes from possessing devices to procuring ICT services. Thus, their partner is interested in offering qualitative and long-lasting PCs and laptops in order to have only few repairs. Mr Schuster confirmed, that this procurement model has changed the interests from all involved in a considerably positive way. The MA 14 regularly selects its partner from a public call for tenders and agreed through the programme 'PUMA' to a minimal use-time of four years. As they must not be disposed beforehand, the further use of younger devices, either internally or externally by the second partner AfB, must be guaranteed.

Mr Perthel additionally suggested the option of purchasing refurbished second-hand devices for home office or administration businesses with lower performance requirements. According to him, currently new laptops are not automatically better due to decreasing quality compared to past generations. Whether a refurbished device is still marketable, is dependent on two properties explained Mr Hundstorfer: a maximum of seven years of age and at least a dual-core processor. Otherwise, the European market is not interested anymore and devices are reliably sold via a broker abroad. Alternatively, international organisations pass old IT on to subsidiary companies in Southeast European or Asian regions. For these reasons, Mr Schuster attempts to pass old laptops on to AfB at the age of four in order to establish a prosperous partnership for both sides.

However, both procurement alternatives were not attractive to Omega Ltd at the moment. The concept of leasing seemed unrealistic for a small organisation to be profitable or even feasible. New laptops are only needed once in a while and not in higher amounts. Besides, older or slower devices are internally passed on to the administration assistants in order to prolong the use-time. Thus, purchasing refurbished second-hand devices seemed obsolete.

5.2.7 Evaluation of a prolonged use-time

Possibilities to evaluate an improved use-time was not an easy question to answer, said Mr Schuster. He considered it an interesting aspect to investigate the impacts of using a laptop five instead of four years. After twenty years, the organisation would have saved one device and its production phase. For a proper evaluation, one must know the embodied energy of a laptop in order to calculate the ecological savings. The exact comparison would have been out of scope within this master thesis, however, highly recommendable for future work in the direction of improved use-times in organisations.

In contrast, Mr Eisenriegler proposed the economic evaluation according to a management's accounting. The comparison between the generation of the past three years with the sustainable and reparable devices of the following three years, should militate in favour of the latter. However, the management must take into consideration not to measure the differences between older and current devices as the planned obsolescence in this industry has started approximately five years ago. Laptops before that time were more robust and apparently working longer. Until the end of our cooperation, Ms C1 was uncertain about the financial benefits of using devices longer. Again, a numerical evaluation would apparently have helped to convince Omega Ltd's management even

more and may have eliminated doubts concerning given tensions between the financial depreciation period and a prolonged use-time.

5.2.8 Life span

As Mr Eisenriegler was convinced that laptops may have a life span up to twenty years, in contrast to its use-time, we further discussed its implications. Mr Perthel addressed the resulting tensions between the producer's additional costs of manufacturing long-lasting devices and the user's shorter willingness to keep. The question is, whether producers make an unprofitable investment, economically or ecologically, if durable goods are shorter used and earlier disposed than designed. One interviewed employee considered a longer life span like ten years to be in fact a disadvantage for the user as he would miss the pleasure of procuring new or up-to-date devices.

Similarly, improving a device's recyclability and thus, its life span, may lead to even shorter use-times, argued Mr Schuster. Users get the impression of being able to replace current devices by innovations more easily without having a bad conscience about disposing them. Consequently, as an increased recyclability is a considerably valuable property, transparent communication to the users according to the waste hierarchy, reuse over recycle (see chapter 2.3.3), because of high energy amounts, CO₂ emissions and resource inputs during the production phase, must be fostered.

All employees of Omega Ltd agreed that a device's life span is definitely higher than its actual use-time as it gets prematurely replaced due to already mentioned reasons. However, none named a longer possible life span than six years.

5.2.9 Trends and future developments

The desire for long-lasting products definitely exists, noticed Mr Eisenriegler. Nevertheless, expressed opinions and real behaviour in practice are still diverging – a phenomenon, which was one of the main drivers to conduct action research within Omega Ltd. Additionally, Mr Tschürtz has recognised a trend, especially among young people, towards longer use-times, upcycling, repair and do-it-yourself initiatives like his repair café. Raising awareness at the level of new generations is highly important. Interesting to mention, the core group members have never heard about the possibility of attending a repair café. Some employees mentioned that repair or upgrade have become more difficult over the last years. Although, we didn't manage to organise a common participation in a repair café during our cooperation, they seemed very interested in self-repairing under supervision. Moreover, in most interviews, the desired use-time exceeded the expected one.

Within the Vienna City Administration, a shift towards centralised IT infrastructure, thin clients and virtualisation has taken place. The newly introduced concept led to better energy efficiency results and savings of electricity costs. Likewise, Omega Ltd works remotely to access centrally stored data. Nevertheless, most employees need a laptop to work efficiently during meetings and customer contact. However, Mr Mosor addressed the derived emerging problem of increased data storage and its simultaneously elevated energy use.

One of Mr Eisenriegler's aims is to keep devices as long as possible in the use phase. Although, Mr Schuster agreed, he claimed it to be only internally feasible, if devices are still safe and economically useable. Otherwise, they are handed over to AfB, which is responsible for prolonging the use-time outside the organisation. As Omega Ltd had no defined process for sorting out internally non-usable devices, we gathered possibilities in Vienna and established the first contact

to AfB through the expert interview. Until the end of our action research process, Ms C1 had not decided on a partner to corporate with.

However, reasons for longer use-times may not be as voluntarily happening as it sounds. Five out of six experts addressed the emerging problem of resource exploitation and scarcity. Mr Eisenriegler explained the current situation in the following way: the first exploitation takes place at the level of resources in southern regions induced by profit-oriented, international consortia. These resources are exported to emerging economies like China, India or Southeast Asia and processed to cheap products under repeated exploitation of local workers.

“Das ist [...] Ressourcenverschwendung mit der Verletzung eines ethischen Prinzips, weil wir Leben auf Kosten der nächsten Generation [...]” (Mr. Eisenriegler, p. 2).

Therefore, the point in time, where markets have to react and increase resource prices, will be unnecessarily pulled from the future into the present. Consequently, higher end product prices will force consumers to use devices longer. A positive side-effect may be the increased pressure to improve entire recycling methods, which is possible according to Mr Hundstorfer, to regain more valuable resources. Producers will then be forced to improve a device's recyclability, its structure and publish information for dismantling organisations in order to buy cheaper resources from the secondary market. Even the prevention of illegal recycling at a rudimentary level may be an achievable goal. Mr Schuster emphasised the importance of finding the right mixture between technology and renouncement in order to enjoy life to the fullest while protecting resources.

Similarly, results from the conducted interviews at Omega Ltd revealed that employees see beneficial potentials like less CO₂ emissions, less environmental pollution, less procurement and saving resources in prolonging a device's use-time. Through the workshop and presentation concerning environmental impact facts, employees better realised the relation to sustainability, next generations and the importance of the topic.

6 Discussion and critical reflection

This chapter aims at answering the research questions (see chapter 1.3), discussing and comparing the main findings with related state of the art literature and critically reflecting relevant results to increase the scientific knowledge base. As all observations and results are based on one single cooperation, it should be stressed that excessive generalisations shall be avoided. Nonetheless, the action research process revealed deep and valuable insights in the practices of use-time in a small organisation, which would have been invisible in a different setting or with an increased sample size. Finally, recommendations for future related work are made. The limitations of the present thesis are directly addressed in the respective sections.

6.1 Current practices

In general, PCs and laptops supported nearly all practices of the employees' daily business and therefore, were considered as essential to work at Omega Ltd. Most of their reported tasks were performed remotely, implying rather low requirements with regard to computing power in fact. However, the demand for mobility has increased leading to the procurement of solely laptops, which were acknowledged to be more difficult to repair and maintain, resulting in a lower life span than PCs. Up to now, **the price-performance ratio was the most important criterion for choosing the current laptop models**, somehow contradicting the low performance demand. The development of an overview and monitoring sheet in parallel with the analysis of the current IT inventory made apparent, that all laptops were consumer and not business models due to a lack of knowledge about the essential differences. Although, the management's willingness to upgrade (e.g. SSD, memory) and repair in-house was still prevalent, the importance of reparability and durability were not communicated to the technical experts, who were responsible for suggesting the next laptop. The management and several employees underpinned that they made **poor experiences with external repair services, either with regard to expenses in contrast to replacement costs**, high overhead effort (e.g. transport, management) or missing availability meanwhile, and thus, self or in-house repair were constantly preferred. Likewise, Cooper's study revealed that cost was the main factor against repair according to individuals (Cooper 2004). Additionally, several employees confirmed their low expectations regarding the remaining life span after repair. Moreover, environmental aspects like energy efficiency and green labels were only partly taken into consideration by the management. Besides, the interviews gave evidence, that **many essential processes were either unclear³⁰ or non-existent** like maintenance, optimal use³¹, end-of-life possibilities³², documentation, monitoring, vision, and goals, as they have not developed accordingly with the continuously growing organisation. The potential which emerges from the absence of sustainable end-of-life possibilities and use guidelines confirmed the finding from Cox et al., who uncovered that little knowledge about reuse channels of electronics existed, and that computers were not always treated with care (e.g. missing use of protection sleeves) by the participants (Cox et al. 2013). Although, their study was conducted on an individual level, the present thesis gave evidence that the **employees' influence in smaller organisations is typically higher** (e.g. may take part in decision making processes) and needs to be taken particularly into consideration.

³⁰ (e.g. 'what shall I do in case of problems?')

³¹ (e.g. positioning of liquids to prevent its pouring out, unplugging of wireless mouse receivers)

³² (e.g. avoiding long-time storage in-house until disposal)

One of the main findings revealed that **none of the interview partners knew how long PCs or laptops are being used** at Omega Ltd. They grounded their estimations based on their hiring date and past device(s) used, which resulted in **an average of nearly four years**. Through the already mentioned overview and monitoring sheet, they discovered the real amount of PCs and laptops (1) in use including their acquisition date, (2) stored, but functional and (3) stored / disposed and non-functional. The oldest PC in use was already nine years old, the oldest laptop aged seven years. Pauses in use-time were not traceable as no documentation had existed so far and thus, could not be considered. As the organisation has significantly grown in the past two years, it purchased six new laptops in 2014 and four new laptops in 2015 via Amazon. Consequently, the majority of the inventory in use was under three years old, five devices were older. The CEO highlighted that she has not developed any feeling yet of how long the new generation will last in contrast to the past laptops, which were considered as rather durable and long-lasting. Besides, four devices, between five and thirteen years old, were stored, but still functional and five either waited for disposal or have already been disposed as they were not considered as functional or repairable anymore. Through these circumstances and the fact, that all technical employees received a laptop of the new generation, the average use-time was difficult to estimate, but would be interesting to observe in the upcoming years. Furthermore, **employees estimated that individuals use PCs and laptops for a briefer or similar time period compared to organisations** – be it due to their personal (higher) requirements, their above-average interest in IT or their experiences and observations made within their social environment. Recent studies on the level of private households, uncovered comparably low use-time as well as life span results: a condensed expected lifetime of three to four years for computers (Cox et al. 2013) and an average use-time of 4.1 years for laptops (Wieser / Tröger 2015). Although, people considered a life span of nine years for computers as ‘considerable’, most appliances discarded in disrepair were younger (Cooper 2004).

In contrast, the management stated **the expectation of at least three years and the desire for five years of use-time** within Omega Ltd. According to the interviewed employees, the expected use-time mostly coincided with the estimated average use-time between two and five years, however, their statements with regard to the desired use-time were rather inconsistent. Some were already satisfied with the expected / average use-time, some desired a longer use-time and one person explicitly addressed the **disadvantage of not being able to purchase up-to-date technologies if devices lasted longer**. However, he qualified his comment by the possibility of passing old devices on to people with less requirements. In contrast, three employees rated a longer use-time as well as life span as purely beneficial. These contradicting findings remind of Cooper’s study, which revealed that several respondents felt locked into the prevailing technology and stated that appliances designed to last longer may be a disadvantage (Cooper 2004). Important to mention, results were much lower compared to a recent study, which concluded with a desired life span of seven years for laptops (Wieser / Tröger 2015).

Concluding the analysis of the status-quo, interesting findings regarding **replacement reasons** for PCs and laptops were revealed. According to the employees, replacement comes into practice if they are completely broken or too slow to work properly, if a broken hardware component is not easily exchangeable or part of an old device and if its repair service has a poor price-performance ratio compared with its replacement costs. In contrast, the CEO highlighted that within the first three years she tries her best to facilitate the device’s repair, but has already experienced limitations of repair possibilities for older devices due to components, which became incompatible, or spare parts which were not available anymore. The predominant majority of

described phenomena can be assigned to 'relative obsolescence', in particular to 'technological' or 'economic obsolescence' introduced by Cooper (2004). Within Omega Ltd, the management intends to avoid the financial influence of full depreciation as environmental aspects are taken into consideration. Nonetheless, a general economic **depreciation period of three years for PCs and laptops was found counterproductive for environmentally conscious behaviour** as other organisations were perceived to replace after this fixed period of time, creating unnecessary tons of e-waste (for further critical reflection on this topic see chapter 6.3). Moreover, replacements are typically easier for organisations due to quickly set up systems, however, several employees stated their preferences for less change and keeping their personal settings. In fact, they considered a well maintained working tool with the respective performance as motivating.

6.2 Outcome and process of improvements

At the beginning of the cooperation, **only few ideas how to prolong the use-time** existed and the manager was rather sceptical about whether improvements were even possible and in how far they would be useful to the organisation, although she followed a notably pro-environmental attitude. Nonetheless, nearly all employees, including the management, were in favour of giving the common development of feasible improvements a trial, especially in the areas of maintenance, procurement and repair. In addition, the CEO rated end-of-life possibilities highly important due to the previously described current practices. Evidently, many doubts and a certain lack of knowledge concerning these areas were prevalent, perhaps constituting their increased interest. These characteristics – **practicability and motivation** - are close to those of Muster (2011), who **constituted crucial preconditions for inducing change**. As shown in the results of the workshop, discussions encouraged first ideas and suggestions for the future changes: the desire for a fair laptop by 2020 and initiatives / websites offering information regarding product's use-time / life span, the need for producer ranking concerning their environmental footprint and durability, and the importance of taking unclear impacts of practices (e.g. laptop's battery use) into consideration.

Previous chapters have shown the continuous development of the evidence-based guideline, the main outcome as regards content, through the action research process and the additionally conducted expert interviews. However, it is rather important to highlight the main findings as well as interesting insights uncovered through the iterative action research cycles. These are **considered of vital importance for inducing use-time improvements in small organisations with a comparable setting and environment**. As the entire product lifecycle was addressed, two to three new areas of improvement were taken into account per meeting, which resulted in four meetings in total. The necessity for creating a **central tool** - the overview and monitoring sheet - supporting all areas under consideration (e.g. maintenance tasks, use checklist) and including the history as well as all use-time relevant information (e.g. inventory, allocation, pauses in use-time) became quickly apparent. It may be integrated in daily business and become useful for future decision-making processes (e.g. How durable was the last laptop generation?). Setting a target value for the internal use-time (in this case five years) was on the one hand vitally important, to establish improvements towards a common goal and to develop awareness of feasible use-times. On the other hand, the uncovered real ages of devices motivated one core group member to think about replacing those exceeding the target value and used by full-time employees in order to increase their performance and satisfaction. Clear communication throughout the process, and especially with regard to the positive, not negative implications of outperforming the use-time

target value became essential (for further implications see chapter 6.3). Although, a study conducted by Bakker et al. resulted in a recommendation of at least seven years of use when considering lifecycle costs (Bakker et al. 2014), five years were already considered as difficult to achieve by simultaneously ensuring a proper performance standard at Omega Ltd. Within the present study, financial aspects (e.g. repair costs) have been taken into account, but didn't follow a life cycle assessment model, whose application in an organisational setting would most probably reveal further interesting insights.

Searching for **greener products or defining ecological procurement criteria was subtly resisted** by the core group members - be it due to the limited variety of devices to choose from or the increased research effort. In the first place, the responsibility was shifted to the management until the CEO approved and encouraged them to include these aspects themselves. This example contributed to the **notable importance of the management's acknowledgements, ideas and feedback from an employee's perspective**. This is similar to experiences made in the study conducted by Muster, who concluded that distrust and resistances may be prevented by involving employees and a participatory management style (Muster 2011). Interesting to note, higher prices of business models were accepted by highlighting properties like better reparability, existence of customer replaceable units without losing guarantee, durability, availability of videos with dismantling instructions, extended guarantee (e.g. three instead of the typical two years) and certification through labels. As the internal upgrade, maintenance and repair expertise was existent to an above-average extent, all these characteristics might contribute to cost savings in the long run. The core group hasn't been aware of labels, although they partly recognized some from different household areas (e.g. blue angel), and thus, underpinned the usefulness of introducing logos, as they are easier to remember and may support the decision between two products in case of doubt. It is important to note, that easy to use tools and websites like notebookcheck.com, offering test results regarding energy efficiency, reparability and durability among other things, which support ecological procurement, were perceived motivating.

Truly beneficial for the overall improvement, the **action research process revealed use-time influencing practices, which would not have been apparent to superficial investigation**. This is emphasised by the example of the missing definition of contact persons, trouble-shooting processes and communication structure, which led to the prevalent practice, that problems - be it hardware or software related - were either not or at a later point in time reported, inhibiting that maintenance or repair was triggered in time. As the device's condition evidently influences the user's satisfaction, it additionally influences use-time related decisions. Moreover, the action research process **uncovered interdependencies between different practices, which were important to be taken into consideration in order to improve more than just one side**. The development of the use guideline revealed the common practice, that data is not always stored on the central storage, but temporarily on the local hard drive due to convenience. By that, the regular maintenance task of a system set up becomes unnecessarily complicated, vulnerable to unintended data loss and implies a security leakage, if sensitive data is stored locally. Furthermore, the definition of the maintenance task revealed that the location and availability of the central storage's data backups were only known to the management, constituting a single point-in-failure in case of her absence. Apart from these two aspects, the **intensive collaboration and discussions encouraged self-reflection**, especially among the core group members. For instance, the CEO suddenly realised her own unsustainable daily practice of automatically turning on the laptop in the morning, although she mostly uses her tablet. This recognition triggered her desire to change this practice in the following days. However, not all discussed issues were

unambiguously improvable. As shown in the analysis of the discussions during the cooperation, no clear results regarding the optimal battery use while being plugged in were achieved. Experts' opinions, the producer's recommendations and experiences made highly diverged within and in-between, leaving it an unimproved practice.

Repair was eventually considered as an attractive, useful and feasible possibility, when financial aspects were included. Especially important was the focus on minimizing the overhead effort and the implied internal labour costs for transport and management. The finally listed prices and example calculations including repair and transport were not perceived as shocking or inadequate by the management. As a rule of thumb, about $\frac{1}{4}$ of the new acquisition costs constituted the maximum investment, which in this case resulted in 250€ per repair. In this context, discussions revealed that the **core group members were unaware about the existence of repair cafés**, but considered them appealing due to lack of appropriate tools at home and/or at the office. Whether their lack of awareness was due to the relatively new introduction of the concept in Vienna (since 2013), the missing advertisement and participant acquisition effort or the wide-spread belief that repair doesn't pay off, is an unsolved question. However, the participation in form of an informative firm's outing, which was intended, but not realised within the cooperation, may open many prosperous possibilities and is thus, highly recommended for future work. Chances might range from gaining skills also relevant for the employee's private life, increasing the relationship between the user and his/her device to the prevention of immediate disposal, if small and rather cheap electronic devices fail. All involved individuals and the organisation itself may contribute to a crosscurrent of the often discussed 'throw-away society', representing a changed demand from the customer's perspective. By its realisation, the gap between workplace-related actions towards sustainable behavioural patterns and private consumption practices, likewise addressed by Muster (2011) as spillover effects, may be overcome, leading to a win-win situation for both sides (further evidence is discussed in the subsequent chapter 6.3).

The importance of interrupting daily business and including employees in the elaboration and presentation of improvements, as analysed in the previous chapters, was considered a valuable contribution to increase the scientific knowledge base in the field of inducing pro-environmental change in organisations through action research. Through the analysis of the status-quo, common sessions, discussions, evaluations and reflections in the continuous process **many different perspectives on use-time were taken into account, uncovering unsustainable practices, the need for certain processes, interdependencies and implicit influences.** In addition, the core group members were motivated to prepare a useful and valuable outcome for their colleagues, which may be easily integrated without fearing high resistances. Two employees, additional to the core group members, stated that they would have liked to partake more in the process of developing the improvements. Moreover, all employees confirmed that their feedback was taken into consideration, which in return motivated them to realise the introduced processes in the interest of preserving and protecting the environment, being part of the change and the organisation's profitability. No new fears arose, probably, due to the fact that the majority was convinced about the implementation's feasibility. Only one employee mentioned a certain scepticism towards the long-term realisation due to individuals' laziness. This statement emphasized the need for monitoring and defining employees in charge. As the **sole provision of further material in form of links and presentation slides was not effective** - be it due to lack of time or interest - the relevance of actively presenting results became evident. Nonetheless, a tool (e.g. Microsoft OneNote), which is used on a daily basis, was chosen to provide all new

information, guidelines and processes of the final outcome in a structured, easily accessible and always available way. The final presentation in form of a common brunch, which was introduced by the management's affirmation of the result's relevance, its usefulness for the organisation and additional rejection of her initial scepticism, opened the floor for further discussion, feedback, doubts and critics. This overall **bottom-up approach of inducing use-time changes proved to be essential in order to live improvements one day, understand the possibilities and constraints**. Especially core group members became more motivated, started expressing personal ideas and emphasised longer discussions over time. As discussed in the analysis of the final presentation's interactive part, employees felt motivated to prolong a device's use-time, because of less change (e.g. convenience, stable and safe work environment, less potential for errors), environmental protection (e.g. organisation takes responsibility, good conscience), working in an environmentally conscious organisation (e.g. being part, long-lasting company as role model), cost saving and the possibility to change demand. However, influences on the employee's private life (e.g. becoming a role model themselves) and thoughts about future generations were not mentioned as motivating drivers. Moreover, the rise of a new identity as an 'environmental employee', as retrieved by Hargreaves, was not prevalent, most probably, because the implementation of the improvements was still ahead at the end of the cooperation. Nonetheless, the present thesis may confirm a different finding concluded by Hargreaves, namely that pro-environmental activities need not be preceded by "*pro-environmental attitudes, values or intentions*" as assumed by conventional approaches (Hargreaves 2011, p.95). Although, only the management and few employees rated themselves as environmental conscious persons, important (subtle and superficially observable) pro-environmental changes occurred. Overall, this **study gave evidence that the conducted approach is recommendable for small organisations in similar settings**, as employees considered as individuals with certain practices influence the organisation's daily business and their motivation is essential for the success of change processes. Nonetheless, the precise action research process shall be tailored to the respective organisation, as employees considered improvements more valuable and accurate, if they are directly related to their practices – findings, which are close to those of Muster, who studied general actions aiming at promoting sustainable consumption in companies with a practice theory approach (Muster 2011).

At the end of the cooperation, several open issues remained and next steps were planned: communicating efforts towards sustainable consumption to external stakeholders and/or customers by establishing a CSR strategy (e.g. via website, folder), integrating elaborated results in vision as well as goals, transferring responsibilities, monitoring and coordinating tasks from the core group members to the administrative assistants or those interested and organising a **reflection meeting after a certain period of time** (e.g. two months) **to encounter the fear of daily routines retreating new processes into the background**. The evaluation of these steps were out of the present thesis's scope, however, would be highly appealing for future work. This conclusion is emphasised by the CEO's open answer in the last post questionnaire with nearly two months delay, thus, giving an insight in the subsequent development after the cooperation. She mentioned, that all of a sudden, several employees expressed the desire of replacing their current, functional devices regardless their ages and conditions with smaller, more lightweight laptops fitting into much more beautiful protection sleeves. Although she rejected to replace functional devices, she was astonished about their unsustainable thinking. Therefore, one of the main findings, although unexpected as it would have originally been out of scope, showed that the **long-term change to sustainable practices may not be underestimated**. Even though the willingness to adapt and the promotion of awareness was confirmed, routinized practices need

time to be improved, most probable in combination with supervision and monitoring. The integration of employees' concerns and lifestyle problems into the mission statement, vision or CSR activities, as suggested by Muster (2011), may be highly supportive in the long run.

6.3 Relevance and changes

The status-quo analysis revealed that, except the management, none of the employees have ever explicitly dealt with the topic 'use-time' and their practices of using PCs and laptops before. Thus, its relevance was rated as 'more or less important' on average and was subject to the present investigation, in how far it may develop through the action research process. One of the main findings within this section was constituted by the facts, that only five out of nine employees brought the topics 'use-time' and 'e-waste' into relation, and additionally, that only one employee was aware of the severe environmental impacts of the production even before the first use. Moreover, the majority of employees had the perception of not being able to improve their practices, as they have already been conscious of using their devices as long as possible and/or passing them on. From an ecological perspective, these behavioural patterns strongly contradicted the short use-times mentioned throughout the cooperation. Passing unwanted devices on to people with less requirements, who in return dispose their existing one, is a consequence which must not be underestimated. Thus, all these factors emphasised **the need for change and promoting awareness, as practices of premature replacement are not directly affected by their negative (environmental) impacts**. This is close to Cooper's conclusion, that marketing of longer-lasting devices on ecological grounds may be limited, until the consumers' lack of awareness regarding the environmental impact of short-lived appliances is addressed (Cooper 2004).

Previous discussion has shown, that the **action research process led to superficially observable, but also subtle changes**. The former is visible to all employees and shall contribute to the overall presence of the topic's relevance. In order to avoid a laptop's overheating and to demonstrate the importance of taking care of devices, the management agreed on the low investment of cooling pads with an additional elevating function, which comes with extra convenience for the employees. Thereby, it may be highlighted that **improvements considered more than just one side in their best-case scenario**: the individual is motivated to use a convenient supporting tool, the organisation may save costs in the long run by small investments (e.g. less repair expenses) and benefit from productive employees, and the environment gets protected by preventing e-waste and producing less highly electronical appliances. Likewise, participants of Hargreaves's study were not 'deep green environmentalists', but emphasized "*the cost-savings, efficiency improvements and additional convenience of pro-environmental alternatives*" (Hargreaves 2011, p.89). Although, the development and intermediate results were not explicitly communicated, they were visible to 75% of the employees through longer discussions regarding procurement, regularly held action meetings in open offices and the purchase of cooling pads. Besides, the existence of subtle changes may be substantiated by the following relevant examples. Within an informal conversation after one of the action meetings, one core group member stated that practices have started to change since my presence and highlighted that they themselves would not have interrupted daily business to improve the status-quo, and learned many useful aspects for future decisions. The CEO explicitly wanted to wait for the elaborated end-of-life possibilities before taking action on stored, but non-functional PCs and additionally, recognised essential changes in the employees' awareness and train of thoughts at the end of the cooperation. Due to time-critical reasons, a consumer laptop, based on the previous

models, was procured, however, one of the core group members underpinned to purchase a business model according to the developed criteria the next time. Last, throughout the process, core group members started to 'correct' themselves, when the appearance or mentioning of old, unsustainable practices was realised. Thus, the **action research process addressed not only the top of the iceberg, but underlying behavioural patterns through raising awareness, self-reflection and critical discussions**. This is similar to experiences made in a study applying social practice theory to induce pro-environmental behaviour change, which revealed that *"the manner in which practices were approached, understood and experienced by practitioners appeared to have changed significantly"*, however, changes and those subtle shifts in performing practices would not have been obvious to superficial examination (Hargreaves 2011, p.93).

It is rather important to mention the **evidence of certain indicators for spillover effects** (introduced in the previous chapter 6.2) as they may be of high relevance not only to the organisation, but, perhaps, for the employee as a customer, **although, they have not been in the focus of the present thesis and require future investigation**. After the presentation of the developed improvements, five employees have already changed and nine were still planning to change personal practices like better protecting the laptop's battery, purchasing greener, longer-lasting products, cleaning ventilation slots and the device's cases, frequently maintaining and performing system setups. More than half of the employees wanted to inform their family and friends about the environmental impacts of short use-times (e.g. e-waste), however, four, surprisingly including one of the core group members, will not – reasons remained unclear. Similar importance was concluded by Muster, who underpinned the consideration of employees as communicators. They may spread the word in their social environment about the company's activities supporting their private consumption behaviour and related concerns, leading to an improved organisation's image (Muster 2011).

For increasing the relevance of and raising awareness for use-time related practices in small organisations, the following combination of actions may be recommended due to its evidence in the gathered data. **Through introducing the topic with moving / non-moving images, facts and statistics, demonstrating its relation to environmental impacts like 'e-waste' and establishing a common collaboration to develop feasible and accurate improvements, the topic 'use-time' became more important**. As shown in the analysed results of the last post questionnaire, two major shifts towards increased importance and raised awareness (e.g. repair services' price-performance ratio better than initially expected, topic surprisingly interesting) were prevalent at the end of the cooperation. The majority of employees started to reflect on their practices' impacts or felt confirmed to continue taking care of their belongings. Moreover, several participants mentioned the importance of having consistent guidelines, defined criteria and coherent documentation in an organisation, which may be interpreted as an answer to the discovered missing processes during the status-quo analysis. In addition, the management perceived the action research process as an essential impulse to make the organisation more structured and to develop in the direction of providing a standardised work environment, without losing the focus on the single device's condition. The latter is a considerably important aspect from an ecological perspective, especially feasible in the setting of a small organisation.

In contrast, the **analysis didn't reveal many considerable changes with regard to the expected and desired use-time after the cooperation**. The use-time expected by the interview partners increased, probably, through their higher involvement. Five employees didn't differentiate between the expected and the desired use-time, representing a rather unexpected

result. Only one participant desired more than five years of use-time. The remaining answers uncovered a general expected / desired use-time between three and five years. Whether this is due to their scepticism towards the device's performance after longer use-times, their fear of an individual's laziness or simply, because of the defined target values stays an unsolved question. Moreover, reasons for replacement have not considerably changed compared to the data gathered in the interviews at the beginning of the cooperation. Quite the contrary, one employee mentioned the desire for a smaller display to be sufficient for replacing the existing laptop. These findings are strongly related to the already mentioned challenge of changing practices sustainably (see previous chapter 6.2).

Among the uncovered advantages of saving resources and sustainable use of resources (e.g. sharing or passing on, fewer replacements), higher employee motivation (e.g. device is in better condition due to upgrades / maintenances, personalised device is treated with more care), many equal devices, an improved organisation's image, time saving and the support of repair services, **the aspect of cost saving was critically reflected**. Employees argued, that purchasing business models with better reparability implies a fixed cost degression and less overhead costs due a decreased amount of new purchases. However, the management was not yet convinced due to the higher acquisition costs, a typical depreciation period of three years and a prevalent economic system, which systematically contradicts environmental consciousness as depreciation rates are annually deducted from revenues, leading to a decreased profit and thus, less taxes. After the full depreciation, devices become worthless from an economic point of view and consequently, the CEO highlighted the need for public incentives, subsidies, governmental policies or certificates honouring the financial effort taken to protect the environment. Cooper has already suggested required changes regarding the government, which shall, according to his findings, *"introduce economic incentives to good practice such as 'pay as you throw' waste strategies"* (Cooper 2004, p.423), reform taxes to emphasise repair services, increase product standards through tighter regulations, and develop measures to establish the availability and access to information on the product's life span for customers (Cooper 2004). One employee even underpinned the importance of organisations to improve today's system, by paying more attention to use-times regardless the end of depreciation and triggering powerful change for our 'throw-away society'. Although, the present study may confirm that the wide-spread belief in 'planned obsolescence' or a 'throw-away mentality' was not prevalent, similar to Wieser and Tröger (2015), the latter terminology was occasionally used by the participants. To my understanding, it was exceptionally important that one of the younger employees highlighted the relevance of integrating environmental aspects into the nature of organisations, as the statement represented the voice of the upcoming generation. Apart from that, financial aspects were always highlighted throughout the process, constituting a high priority in an organisational setting. This only slightly reminds of the findings made by Cox et al. (2013), who discovered that environmental concerns were no drivers for improvement, as employees at Omega Ltd, and especially the management, mentioned ecological aspects being motivating and important. Again, these findings may be addressed by applying a lifecycle model in future work (comparable to results discussed in the previous chapter 6.2).

Problems, fears and disadvantages of prolonging a device's use-time (e.g. costs, organisational effort, decrease in device's performance, inactive individuals), which were mentioned during the cooperation, were extensively discussed in the previous chapters, taken into account and directly addressed within the final presentation of results. This may be one of the reasons for the high acceptance and motivation rate among the employees.

6.4 Reflection on a meta-level

In order to achieve a holistic perspective on the entire action research process conducted (see Figure 13), I performed three levels of reflection:

1. **Reflection on the outcome:** The developed improvements, were continuously reflected by the core group members and myself during the action meetings (see chapter 4.6). Moreover, I personally reflected the course of each action meeting directly afterwards. In addition, the outcome was presented to all employees within a final presentation, offering participants the opportunity to reflect upon the introduced changes (see chapter 4.7).
2. **Reflection on the process:** At the end of the cooperation, the core group members and I met for a final reflection meeting in order to commonly discuss and evaluate the performed process (see chapter 4.8).
3. **Reflection on a meta-level:** Based on my action process log and all data gathered, I performed a reflection on a meta-level with regard to effort, communication, difficulties, resistances, and my role as a researcher during the entire process, and how these parts were addressed.

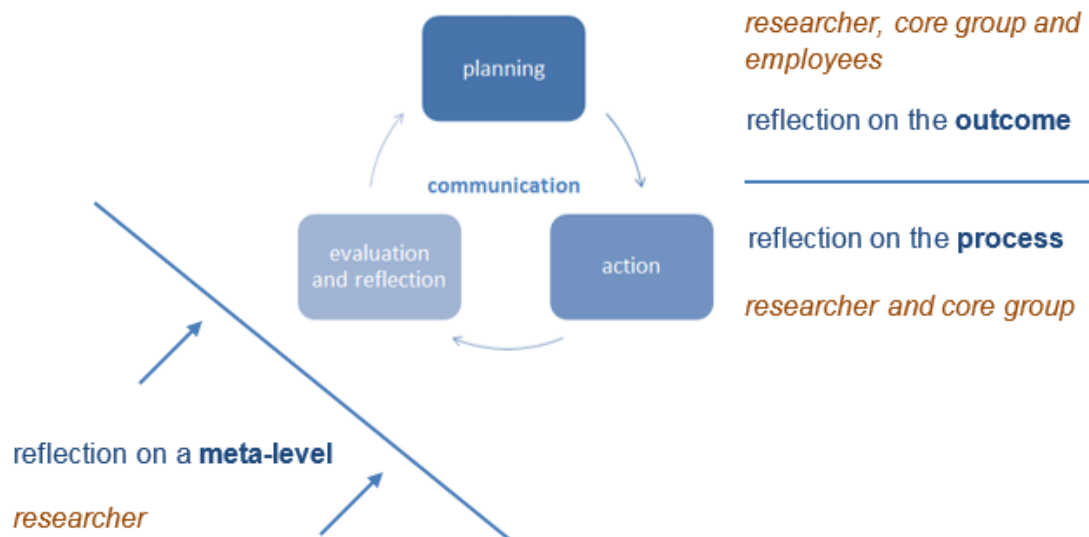


Figure 13 - Reflection levels in action research

The overall time and resource **effort** of performing an action research process was essentially higher than a solely qualitative study conducting interviews. As I had no prior experience, all stages were indeed prepared to the best of my knowledge and belief, nonetheless, I have experienced several lessons learned. As the effort for the cooperation partner, especially for the core group, was not clear from the beginning, effort estimations were rather difficult. Consequently, integrating the action meetings and their implied development of improvements and actions into the core group members' daily business, which was generally characterised with high workload, was challenging. Unexpected technical issues and the fulfilment of customers' projects always had priority. To address the challenge of high efforts, research work on the Internet was internally delegated to the administrative assistants. Additionally, I carried out several intensive research tasks like ecological aspects of procurement to support the core group with profound information. Due to all these factors, the original end of the cooperation had to be postponed by one month. However, the study may confirm that by extending the time period, insights into the organisation's practices, culture, management and aims were noticeably more

valuable, because the more one knows about the local behavioural patterns, the better he/she can understand the motivation and intentions behind.

Due to this overall positive development and prevalent motivation, I may conclude, that the effort of these regular meetings in person were essential to achieve a continuous development. Extraordinarily long pauses between the sessions (e.g. more than two weeks) were not efficiently used to do more, but were tempting to postpone work and in fact counterproductive. Thus, we mostly achieved to organise the action meetings within an acceptable time range, but were clearly dependent on summer holidays, internal deadlines and daily business. Apart from that, extra effort like the final development of the organisation's vision and goals, which was not desired to be supported by me, was not performed until the end of the cooperation due to time constraints. Consequently, the interruption of daily business and my presence were vital for making progress and achieving improvements. For future work, I would recommend at least one or two more months of cooperation time in order to be part and support the first implementation steps and a second common evaluation.

Regarding the **communication** between the cooperation partner and myself, quick responses via e-mail from the administrative assistants and the core group members were extraordinarily positive and simultaneously essential to continuously stay in contact. Internal communication concerning the cooperation and its development was not made obvious, but certain reactions gave evidence that it was sometimes non-existent, or additionally not demanded. For instance, when one of the core group members asked his colleagues whether they wanted to be regularly informed about the on-going process or solely at the end of the cooperation, they selected the second alternative. Offering more diverse possibilities to interact and actively design the process, would have been a possibility to address the colleagues' interest, but was unfortunately not feasible due to a master thesis's time constraints. Moreover, a new employee, who attended the final presentation, was not aware of the cooperation's aim and process, which he understandably criticised in the last post-questionnaire. Besides, it was not apparent in which way employees, who were not able to participate in the common sessions like the workshop or final presentation, were informed or updated. In contrast, the planned external communication (e.g. changes on the website, in information material) to demonstrate the environmental perspective of the organisation, was dependent on an employee, who was not available during the entire cooperation and on top of that, left shortly before the end of our collaboration. Thus, it was unclear, whether and especially when the organisation will start communicating its extra efforts on sustainable consumption to the customers, which may go hand in hand with an improved image. This would have been an essential step to additionally record and demonstrate the topic's importance to the employees.

Although, the overall outcome and process was mostly positive and noticeably valuable for both, the organisation and myself, certain **resistances** as well as **difficulties** emerged during the cooperation. According to Maurer, *"resistance is the most important factor in change, and the most neglected"* (Maurer 2006, p.121). Helping the organisation to *"see that resistance is protective and not necessarily a negative thing, it gives people more options for engaging others. If the client can understand this, sometimes resistance is the message they should hear. It can be the voice of reason warning them of danger. So instead of attempting to overcome resistance, they choose to engage it"* (Maurer 2006, p.124). Changes, especially in a small and familiar organisation, may be quickly perceived as criticism or restrictions of the used and well-known practices. Thus, highlighting the drivers and beneficial aspects of changes was of vital importance to address initial resistances.

Regarding the employees, except the core group members, discussion and interaction possibilities within common sessions were on the one hand welcomed and desired following the feedback from the post-questionnaires, but on the other hand were either not used or perceived as an exam. Several employees seemed to be afraid of saying something wrong or embarrassing themselves in front of their colleagues and/or me. In general, the majority were interested listeners during the workshop, who partly resisted to actively participate. Thus, I decided to intervene and make use of a creativity method in the final presentation, gently forcing all participants to get involved. Experimenting with new methods seemed interesting for the employees and led to valuable, multi-faceted results in the end.

Moreover, many staff members claimed that due to time constraints, they didn't have enough time to have a closer look at the slides (e.g. take action, further material). As all participants stated that they are still planning to do so, I was uncertain about the real reasons and how they could have been addressed better. Most certainly, it was not the intention of the study to test employees, whether they had considered the information or not, but to motivate them. Consequently, the importance of actively presenting relevant results to the colleagues was strengthened. Besides, investing leisure time for engaging in the topic was apparently resisted by several. For instance, the participation in a repair café was found interesting and useful by the core group members, but lacked of real motivation to organise a common attendance in their leisure time. In contrast, the majority stated in the last post-questionnaire that they plan to inform family and/or friends about the topic and its environmental impacts and change personal behaviours. Considering these ambiguous aspects, it is not possible to make a clear statement about in how far individuals were motivated to actively engage during their private life (see previous chapters for discussions on spillover effects). Nonetheless, the results gave evidence that employees are willing to change their practices at the workplace, if the management and a certain monitoring of the new tasks gets implemented as a next step. In addition, certain resistances against the suggested use guideline (e.g. unclear recommendations for the battery use, unplugging the receiver of the wireless mouse) and maintenance (e.g. fixed annual system setups), which emerged during the discussions in the final presentation, need to be addressed during the implementation in daily business by developing details and adapting processes accordingly.

The circumstance, that the CEO was not able to attend the first three action meetings due to time constraints, initially lowered the time and work efficiency of the core group. For instance, their developed concepts and ideas were only developed in note form, waiting for the management's consultation and making them more responsive to her desired changes. It seemed to be the typical practice regarding conceptualisation tasks, which they rather subtly resisted to change. Retrospective, the CEO's presence already during the meetings would have supported efficiency and the topic's relevance right from the start. Nonetheless, the core group members discovered more and more possibilities to improve the status-quo throughout the action meetings, started to actively suggest actions and reflect upon my inputs, thus, leading to longer discussions from one session to the subsequent. Contradicting their predominant motivation during the development, they strongly resisted to be responsible for future implementation, monitoring or controlling – be it due to their high workload or their predominant interest in different, more technical areas.

With regard to the actions discussed during the action meetings, the implementation of second-hand and leasing concepts at Omega Ltd were highly resisted, although, in general, perceived as 'good that they exist'. The topic was researched internally, but resulted in a rather superficial outcome, leading to an even confirmed resistance. One may argue, that both concepts are hardly

applicable for a small organisation, which passes devices internally on (e.g. from the developer to the administrative assistant), however, the analysis made apparent that these rather new concepts require an essential shift in the way we think and value. Possessing PCs and laptops is still perceived 'better', than just using or sharing them. In contrast, it became normal to lease central servers without any financial, performance- or security-related drawbacks. It would have been interesting to investigate the reasons for the perceived differences between internal and external IT-equipment. Apart from that, initial resistances existed against repair possibilities, which was dissolved by integrating economic aspects and example calculations, and against adding ecological aspects to the procurement criteria due to limiting the variety of possible devices, which was dispersed by highlighting the benefits of reparability, energy efficiency, longer guarantee and the CEO's support. Concluding the section of predominant resistances, the previous discussion showed, that all actions had to be also financially worthwhile to be considered as a real improvement.

When reflecting on my **role as a researcher** of this action research project, a twofold role became apparent: I was neither a real external, nor a full member of the organisation. On the one hand, initial barriers between myself and those, with whom I was in closer contact (e.g. core group, management, administrative assistants) were quickly eliminated. By underpinning my aim of developing feasible and useful improvements for and with the organisation, the core group members quickly accepted as well as realised my support and goodwill. The focus was always on a participatory approach, which welcomed ideas, suggestions, critics, evaluations and discussions. It was an essential experience for all involved to commonly discover possibilities of integrating environmental aspects into the employee's practices without discriminating one side. Moreover, I was invited twice for lunch and finally to the office Christmas party, which may be interpreted as a positive sign of integration and being part of the staff members. In the personal feedback section of the last post-questionnaire, one employee explicitly highlighted my effort of creating a friendly and open atmosphere, which in turn motivated to participate. On the other hand, one employee slightly criticised the time management of the final presentation in the subsequent post-questionnaire, but argued that an external obviously has difficulties reprimanding employees and generating a certain time pressure: *"Präsentation hätte bisschen strukturierter sein können, wobei es sicherlich schwierig ist als Externe die Mitarbeiter 'zurechtzuweisen' bzw. einen gewissen Zeitdruck zu schaffen"*. Thus, employees with whom I worked less and consequently, had a less close relationship, perceived me more as an external. These reasons strengthened my decision of integrating the core group members in the final presentation, supporting the colleagues' acceptance of the outcome.

Besides, I additionally represented some kind of expert role, as core group members waited for my inputs and ideas on a new area of improvement during the first action meetings. It was rather challenging to communicate, that I had no primarily predetermined solution. However, as the core group members had troubles of generating ideas for a new topic, especially procurement, I prepared rough suggestions in order to work more time efficiently and encourage the team to develop them. Due to time constraints, this was a feasible, but additionally valuable way of triggering their train of thoughts.

7 Conclusion and future work

The gathered data, which has been extensively analysed and discussed in the previous chapters, gave evidence that an action research approach is appropriate to promote feasible pro-environmental changes (i.e. improving the use-time of PCs and laptops) in the setting of a small organisation. However, due to its participatory style and close collaboration with all individuals involved, the performed process cannot be directly applied to the setting of bigger organisations and conclusions should be drawn with care. The outcome of the conducted cooperation may be classified as a trigger and first impulse towards sustainable consumption practices concerning the use of PCs and laptops in an organisational environment. By applying this methodological approach, not only superficially observable, but additionally relevant subtle changes in the employees' and manager's awareness as well as self-reflection have been achieved, which in return encouraged the transformation of certain behavioural patterns. An obvious benefit was the extensive engagement with emerged resistances, which have been closely taken into account through the support of the management and critical discussions from various perspectives, including the consideration of facts as well as available information. Moreover, it became prevalent, that by interrupting daily business and commonly elaborating on improvements, important interdependencies of practices as well as missing processes were uncovered.

Regarding the use-time of PCs and laptops and the related premature replacements in an organisational setting, several main findings were retrieved. Overall, economic reasons were predominant throughout the research. First, the price-performance ratio, not only during procurement processes, but also before repair as well as upgrade decisions, was considered as the most important criterion. Second, the typical three years depreciation period for PCs and laptops was found counterproductive for environmentally conscious behaviour. Although, repair services became more attractive from a financial perspective, they were still perceived to require more effort than simply placing an online order. In addition, participants explicitly highlighted to be sceptical about the remaining life span after repair. Besides, users are not directly affected by the negative (environmental) impacts of their premature replacement practices. As IT equipment was considered as absolutely essential for daily business, the employees tended to accept a certain extend of unfairness (e.g. working conditions at production sites) as well as severe environmental impacts for the benefit of their convenience and needs. Technical innovations, increased mobility demand and performance requirements grounded their generally low expectations and desires regarding use-time. It has therefore been an important aim of this action research to promote awareness and elaborate improvement possibilities to make change feasible as well as to minimize the overhead effort.

Thus, four elaborated actions to prolong the use-time of PCs and laptops, which were considered as noticeably important for small organisations, are highlighted. First, the development of an accurate documentation (e.g. central tool) including the history as well as all use-time relevant information, checklists and maintenance tasks is essential to raise internal awareness for actual use-times and the device's conditions. Next, the purchase of (greener) business models enables increased durability, reparability and comes with an extended guarantee. Third, important contact details of serious and trustworthy repair as well as refurbishment services must be easily available to minimize overhead effort when needed. Last, but not least, the support of the management, the implementation of an adequate monitoring and the inclusion of environmental

aspects in the internal (e.g. vision, goals) and external (CSR strategy, website) communication is of vital importance.

To broaden the results of this study, future work in the field of improving the use-time of IT devices in organisations by applying action research ought to be done. It would be highly interesting, to investigate in how far spillover effects may occur and if small organisations may become a role model for the employees' individual behavioural patterns. Overall, it is recommendable to extend the cooperation in order to be able to evaluate the integration of new processes as well as concepts in daily business and to ensure sustainable change. Environmental aspects were evidently a motivating driver for change, however, the gap between knowing, being aware and eventually changing practices requires a longer time frame to be investigated. Addressing the manager's scepticism regarding the existence of financial benefits through a prolonged use-time, the additional application of a life cycle assessment model appears absolutely vital.

Finally, to my personal conviction and following my findings, we don't have the option to decide, whether the prevention of e-waste is useful or not. It is more the question, **how** we may prevent it in order to protect our environment, workers affected and future generations. In the long run, it is not disputable, that we all will be affected by its severe impacts – be it due to increased resource prices, natural catastrophes, degraded land or refugees. This study gave further evidence that the improvement of use-time and the avoidance of premature replacement is **one** of the possible options we have.

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List of abbreviations

BIOS	Basic input output system
CEO	Chief Executive Officer
CPU	Central processing unit
CSR	Corporate social responsibility
EEE	Electrical and electronic equipment
EPEAT	Electronic Product Environmental Assessment Tool
E-waste	Electronic waste
GHG	Greenhouse gas
GWP	Global warming potential
HDD	Hard disk drive
HDMI	High definition multimedia interface
HTL	Höhere Technische Lehranstalt
ICT / IT	Information (and communications) technology
ISO	International Organization for Standardization
kWh	Kilowatt hour
LCA	Lifecycle assessment
LCD	Liquid-crystal display
Ltd	Limited (GmbH)
MA	Magistratsabteilung (Municipal Department)
MWh	Megawatt hour
NGO	Non-governmental organization
OECD	Organisation for Economic Cooperation and Development
PC	Personal computer
PCI	Problem-centred interview
RAM	Random access memory
SME	Small to medium-sized enterprises
SSD	Solid state disk
StEP	Solving the E-Waste Problem
TCO	Tjänstemännens Centralorganisation (Standard)
VGA	Video graphics array
WEEE	Waste Electrical and Electronic Equipment (Directive)
WLAN	Wireless local area network
WKO	Wirtschaftskammer Österreich

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Appendix

As this thesis's amount of pages has already gone beyond scope, the appendix was transferred to the enclosed CD.