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DRIVERS OF WORKING TIME REGULATION AND CREATIVITY: *DESIGN, METHODOLOGY AND TECHNICAL SOLUTION OF THE SURVEY*

Master´s thesis

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TÖÖAJA REGULATSIOONI JA LOOVUSE MÕJUTEGURID: *KÜSITLUSUURINGU DISAIN, METODOLOOGIA JA TEHNILINE LAHENDUS*

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Author's declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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07.05.2016

Abstract

The main aim of this master thesis is to design and construct a survey for the research project on working time regulation and creativity of the R&D employees.

The main problems investigated in this study include general problems relating to designing surveys for research projects and also problems specific to research on working time regulation and creativity.

The main result of this thesis is a complete survey that has been set up on a platform which has been chosen in the course of this study and that can achieve all the goals that have been set in the context of the research project. Additionally, a large part of this study can serve as a guideline for anyone undertaking a modern web-based survey.

The thesis is written in English and contains 85 pages of text, nine chapters, three figures and 15 tables.

Annotatsioon

Tööaja regulatsiooni ja loovuse mõjutegurid: küsitlusuuringu disain, metodoloogia ja tehniline ülesehitus

Käesoleva töö eesmärk on disainida ja ehitada üles küsitlusuuring teadus- ja arendustöötajate tööajakorralduse ja loovuse mõjutegureid uuriva teadusprojekti läbiviimiseks.

Töös käsitletud probleemid sisaldavad nii traditsioonilisi küsitlusuuringu disaini ja ülesehitusega seonduvaid probleeme kui ka spetsiifilisi teadus- ja arendustöötajate tööajakorralduse uuringuga seonduvaid küsimusi ning lahendusi. Konkreetse teadusprojekti kontekstis käsitletakse nii uuringu aluseks oleks populatsiooni ja valimi määratlemist, küsimuste koostamist, küsitlusuuringu korraldamise viisi ja sobiva teenusepakkuja valikut, küsimustiku tehnilist ülesehitust kui ka küsitluse läbiviimise planeerimist. Probleemide lahendamiseks kasutatakse Saaty otsusmudelit ja varasemat teadustööd küsitlusuuringute metodoloogia valdkonnas, mida autor täiendab omapoolsete soovitustega arvestamaks veebipõhiste küsitlusuuringute eripäradega.

Käesoleva töö tulemiks on valmis küsitlusuuring töö käigus valitud platvormil, mis võimaldab täita teadusprojekti poolt seatud eesmärke. Samuti võib suurt osa käesolevast tööst käsitleda juhendmaterjalina, mis on kasulik tänapäevaste veebipõhiste küstlusuuringute ülesehitajatele.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 85 leheküljel, üheksat peatükki, kolme joonist ja 15 tabelit.

List of abbreviations and terms

R&D *Research and Development*

Teadus- ja arendustegevus

R&D survey *Survey used for the research on working time regulation and creativity of the R&D employees*

Küsimustik, mida kasutatakse teadus-ja arendustöötajate tööajakorralduse ja loovuse mõjutegurite uurimiseks.

This study *This master thesis*

Käesolev magistritöö

AHP *Analytical Hierarchy Process*

Analüütiliste hierarhiate meetod

CI *Consistency index*

Kooskõlaindeks

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1. Introduction

This study is part of a research project investigating the working time regulation and creativity of the research and development (**R&D**) employees, undertaken by a research group at the Department of Finance and Economics at Tallinn University of Technology, which is co-funded by the Estonian Research Council research grant PUT315 "Towards the Knowledge Economy: Incentives, Regulation and Capital Allocation". The purpose of the respective research is to investigate the working time arrangement of R&D employees and its potential impact on the results of their creative work in order to develop solutions for increasing efficiency and innovation. As explained in the information sheet of the survey (see Appendix 1), the main focus is on the differences between fixed and flexible work time arrangements for creative R&D employees (IT-developers, scientists, engineers, product-, service- and business development employees, etc.) with respect to their work results, job satisfaction, tiredness, sleepiness and other characteristics.

This master thesis focuses on the design, methodology and technical solution for the survey that would contribute to the research project described above (**R&D survey**). Development of the survey is one of the key parts of the respective research project and the design and technical build-up of the survey could be one of the key determinants of success for the whole project.

The main beneficiaries of this study are the members of the research group in the Tallinn School of Economics and Business Administration, who can use the results of this thesis to continue with their research project. In addition, everyone who is conducting or planning to conduct web-based surveys on research purposes can use the results of this thesis to design and develop high-quality surveys that would fill the needs of their work. This study was conducted entirely in Tallinn, Estonia. The study was started in autumn 2014 and was finished in spring 2016.

1.1 Background and the problem

Survey methodology nowadays combines many fields, for example mathematics, computer science, psychology and social sciences (Groves et al, 2009). This study seeks to take a

scientific and interdisciplinary approach by using the existing knowledge from all of those fields in order to fulfil the requirements of the research project and produce research with high quality that could later be published in reputable journals.

As mentioned by survey researchers (Couper, 2000; Dillman, 1991), the design and quality of the survey is often the main determinant of the quality of research projects that rely on questionnaires for data collection. As a result, **the main problem that this study is seeking to solve is how to design a survey that would fill the requirements of the research project (methodological correctness and high reliability of data) under the given financial constraints.**

Previous research in the field of survey methodology tends to be somewhat out-of-date and focus mainly on interviewer-based surveys, while nowadays web surveys are increasing becoming a norm in research due to cost and flexibility advantages (Millar & Dillman, 2011). However, web surveys have their own peculiarities and potential pitfalls that have to be analysed and addressed in order to ensure the quality of the survey. Most of the older survey methodology guidelines are not directly applicable in the context of the R&D study as they do not consider the rapid technological progress has been on-going in the past fifteen years and has had considerably impact on the design of web surveys. Additionally, the R&D survey is undertaken in an interdisciplinary environment and faces a complex two-step sample selection situation, while previous research focusing on those aspects of the survey design is clearly insufficient. This study seeks to fill these gaps in research.

1.2 The purpose of this study

The main purpose of this study is to develop a survey for the research on working time regulation and creativity of the R&D employees. The objective is twofold:

1. To design a high-quality survey that would minimise error in the survey results under the given cost constraints.

2. To serve as a guideline for other survey designers who are undertaking modern web-based surveys in an interdisciplinary environment and complex sampling situations.

The main problem and the resulting central research question of this study is:

1. How to develop a high-quality survey for the research on working time regulation and creativity of the R&D employees?

The main problem includes both the methodological and technical aspects of designing surveys and also partly the content of the survey as some of the survey questions are written by the author (others are employed from previous research). The main problem can be divided into more detailed problems (sub-questions) such as:

1. How to define an appropriate population and perform sampling for the survey?

2. Which requirements and methodological concerns have to be considered when formulating the survey questions?

3. How to choose the optimal survey platform for the survey?

4. How to technically construct the survey on the chosen platform in order to increase response rates and simplify data analysis?

Each of these problems will be discussed in a separate section of this study.

1.3 Methodology

In order to achieve the objectives of this study and answer the sub-questions and the central research question, a wide range of previous research is employed, mainly on survey methodology, but also from other relevant fields. The focus is on applying previous knowledge in the context of a particular research project in order to develop the most optimal survey and as a result also act as a guideline for other survey designers. The author defines optimal survey as maximised quality (minimised survey error) under the given cost constraints. In case the survey error is minimised in various parts of the survey design process, the survey can be considered to represent quality both in terms of methodological correctness and content (Couper, 2000).

For defining the population and undertaking the sampling process, traditional sampling methodology is used as described by Brick (2011), Groves et al (2009), Dillman (2011) and Couper (2000). For forming the questions, previous research in the field of working time regulation has been used (Kelliher, 2008; Stavrou & Kilianotis, 2010; de Menezes & Kelliher,

2011, Seo, Chae & Lee, 2014 and others), combined with previous work on the methodology of writing questions for surveys (Groves et al, 2009; Krosnich & Fabregas, 1997).

In the section on mode selection for the survey, previous studies by Sills & Song (2002) Andrews, Nonnecke & Preece (2003), Groves et al (2009) and many others have been employed. For choosing the optimal online platform for the survey, Saaty decision-making methodology has been used, described in detail by Saaty (1990) and Saaty (2008).

For constructing the questions on an online platform, pretesting and designing the distribution schedule for the survey, research on survey methodology has been applied. For example, ideas suggested by Dillman (1991), Peytchev et al (2006) and many other authors have been applied in the context of the R&D survey.

1.4 Overview of the study

As described above, this study is part of a larger research project. The total survey process that is undertaken is illustrated in the figure below (Figure 1), inspired by Groves et al (2009). Boxes in light blue colour cover the steps that are covered by this study and boxes in red colour are beyond the scope of this study, which will be discussed in separate upcoming papers.
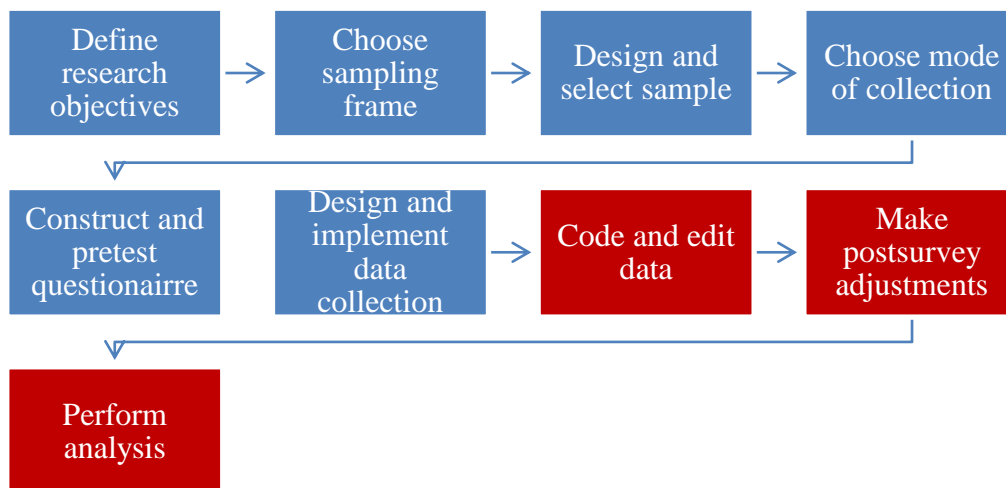

Figure 1. Scope of work

Every research project starts with defining the objectives. The objectives of this study and the R&D research project have been defined in the introduction of this thesis and are elaborated further in the following sections, which consider the framework of survey methodology in

more details. Next, the population, sampling frame and sample selection issues are considered in section 3. Sample selection has important implications for the whole research project and also for the development of the survey as sample peculiarities have to be considered in later stages of the survey process. After sampling, question formulation is undertaken in section 4 (considered exogenous in the graph above, but crucial in the case of the R&D survey). Question formulation has to consider the underlying constructs that are being measured in order to provide meaningful scientific contributions. Next, in section 5, an appropriate mode for undertaking the data collection process is selected and the platform for the survey is chosen by using Saaty´s decision-making framework. When the platform has been chosen, the study proceeds to technical construction of the survey on the chosen platform (section 6). The next step of the survey process is pretesting the survey and designing the data collection process, after which the actual data collection can be undertaken (section 7). Finally, results of the survey process (section 8) and conclusion (section 9) are presented.

It is important to note that many issues relevant to the survey process are excluded from the scope of this study in order to remain focused, most importantly:

1. The client-contractor relationship. The author could be considered as a contractor and the research team as the client, but in this case both parties were so interconnected (the author is also part of the research team), that no real client-contractor relationship concerns were anticipated (and none realised).

2. Detailed issues concerning the planned data analysis methods. However, the data examination had already started at the time of writing this thesis (spring 2016), where STATA statistical package (version 12) was used as the primary tool of analysis.

3. The general motivation for the R&D research project is considered only briefly in this study, but is discussed in more details in separate upcoming papers (Hazak et al, forthcoming).

2. General survey methodology

The field of survey methodology seeks to employ means that help to reduce error in survey results and thereby increase quality and reliability of data. The job of the survey designer is therefore to make design, estimation, platform choice and other decisions in order to minimise error in different parts of the survey process (Dillman, 2011).

Numerous survey researchers (Couper, 2000; Dillman, 1991; Groves et al, 2009) agree that the main sources of bias in survey-based research are the errors noted in the following table (Table 1).

Table 1. Sources of survey error

Error type	Explanation
1. **Sampling error**	Sampling error means that there are significant differences between the variables of interest in the population and the sample. The sampling process of the survey has to minimise sampling error and/or design methods for correcting the potential bias.
2. **Non-coverage error**	Non-coverage error refers to a situation where not all of the population is covered by the sampling frame. As a result, the sample might not be representative of the population. The sampling process has to minimise this threat and/or design methods for correcting the potential bias.
3. **Measurement error**	Measurement error means that are differences between the underlying variables that the survey is seeking to measure and the actual responses provided by the respondents (for example, when respondents do not understand the questions or deliberately provide invalid answers). Survey questions have to be designed in a way that the potential measurement error is minimised.
4. **Non-response error**	Non-response error means that some members of the population do not respond to the survey. Various design features (such as mode of the survey, platform selection, layout, distribution schedule, etc.) can affect response rates and have to be considered in order to reduce the potential bias and increase response rates.

Each of these errors can result in discrepancies between the characteristics of the population that is being investigated and the actual sample, which reduces the reliability of the data collected in the survey process. Dillman (1991) notes that all of those sources of bias should be evaluated and overcome by the survey researcher in the design process. As a result, all of those potential errors will be considered in detail and referred to in the following sections of this study.

In addition, as Couper (2000) has pointed out, survey quality can never be considered as an absolute measure and should be evaluated relative to other survey measures such as cost, timeliness, etc. Cost is a particularly relevant factor in the case of the R&D survey as the budget for undertaking the survey is limited and is considered explicitly when selecting the mode of data collection and platform for undertaking the survey (section 5 of this study).

The general problem with survey methodology is that survey design (and quality) lacks simple and objective metrics. Therefore the methods for evaluating survey design can only be indirect:

1. The most important objective of the R&D survey is to produce data that can be used for testing the hypotheses defined by the R&D research team. Therefore survey design can be considered a success in case enough data is collected for the subsequent econometric analysis. An estimate of the research team is that at least 100 responses is required in both stages of the survey data collection process in order to draw significant conclusions about the hypotheses.

2. The response rates achieved in data collection can be compared to other similar studies.

3. Another criterion for evaluating survey design has been manually added by the author. In the end of the survey, there is an open-box question asking the respondents to provide comments about the survey design and technical build-up. These comments can also be used for evaluating the success of the design.

3. Sample selection

Sample selection has been defined by survey researchers as methods for identifying a collection of observations from the population in order to make inferences about the population based on those observations (Brick, 2011). The main aim of the sample selection process is to reduce **sampling error** and **non-coverage error** (Dillman, 1991). Both of those potential errors are considered in this section of the study.

The general process for sampling is illustrated in the figure below (Figure 2), inspired by Groves et al (2009).
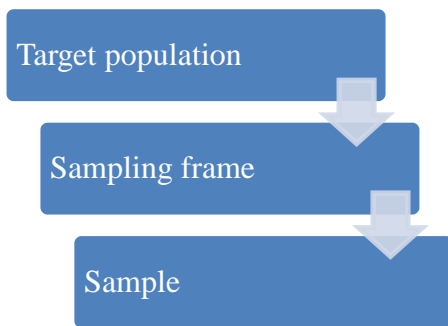
Figure 2. Sampling

The R&D survey seeks to investigate the R&D employees in Estonia. However, the target population is restricted to those companies and research institutions that employ more than 15 R&D employees (excluding universities and hospitals). Universities and hospitals were excluded as in these establishments adjustments in work time regulations are considered unrealistic due to the nature of work, which is largely determined by timetables and work shifts. The minimum boundary of 15 employees was set based on the following assumptions:

1. In companies and institutions where there are less than 15 R&D employees it is unlikely that these employees are considered as a distinct group by the human resource division and the management. Therefore work time regulations have probably been set with the rest of the employees (non - R&D) in mind.
2. Companies with a small workforce tend to have less formal working policies and work time regulations, which would make direct comparison with considerably larger companies difficult.

3. Considerable administrative tasks have to be undertaken by the research team with respect to every company and institution that is being targeted (contact establishment, initial meeting, provision of the list of employees, etc.). The minimum boundary contributes to reducing the cost of the research project.

Three data sources were used for collecting information about the population. The research institutions were identified based on the list of evaluated research institutions published by the Estonian Ministry of Education and Research. For identifying the companies, data from Statistics Estonia and Estonian Commercial Register was used.

Statistics Estonia collects information about the companies that employ R&D employees. The respective data is collected via regular obligatory business surveys that Estonian companies have to complete. According to the definition by Statistics Estonia, R&D employees are defined as employees who spend over 10% of their time on creative research and development activities.

A query was made to Statistics Estonia by the research team and general information about the companies employing R&D employees was received, which was used for providing descriptive statistics about the population. However, the query did not include the names of the specific companies. As the next step, the research team identified the companies employing R&D employees from the Estonian Commercial Register. Therefore the limitation of this study is that only companies that report being engaged in R&D activities are included in the population. Another limitation is that the data received from Statistics Estonia dates to 2012, which means that the data could include some companies that have gone out of business by now and exclude emerging R&D companies.

The total population amounts to 1 081 R&D employees, comprising of 764 employees from 18 companies and 317 employees from 6 research institutions. The main characteristics describing the population are the following:

1. 70% of the population consists of males, while 30% are female
2. The majority of the population (88%) consists of employees working for large companies/institutions (over 250 employees), whereas 10% work for mid-sized (between 50 and 150 employees) and 3% for small (up to 49 employees) establishments.
3. 71% of the population members work for private and 29% for public establishments

4. Out of the private sector R&D employees, 14% work in banking, 41% in IT, 15% in engineering/technology and 30% in narrow-focused R&D (such as R&D competence centres) sector.

The population can be considered technologically savvy (R&D employees, large part of whom are working in the IT sector), which has implications for the mode selection for the survey (see section 5).

3.1 Sampling Frame

Sampling frame is the proportion of the target population that has a theoretical chance of actually being included in the sample. The sampling frame in the case of the R&D survey sets limitations in two stages:

1. The frame does not cover those companies that were not included in the records of Statistics Estonia and/or Estonian commercial register at the time of the analysis.
2. The frame does not cover those companies that did not agree to participate in the study. In total 8 companies and research institutions agreed to participate in the study (Table 2).

Table 2. Participating companies

Company	Industry	Number of employees in the sampling frame
Elektrilevi	Energy	35
Swedbank	Banking	61
Playtech	IT	240
ELIKO	R&D	46
Institute of the Estonian language	R&D	67
National Institute of Chemical Physics and Biophysics	R&D	75

SEB	Banking	18
Danske Bank	Banking	26

To summarise, sampling frame covers 568 R&D employees, which forms 52% of the total population. The fact that sampling frame does not cover the entire population could cause non-coverage error in case the part of the population that is not covered by the frame is significantly different by its characteristics from the part of the population that is covered. In the R&D survey, this concern is mitigated by employing means in the analysis stage that counter this potential bias (see section 3.3.1 and 3.3.2).

3.2 Final Sample

Not all of the R&D employees in the sampling frame have the interest and time to complete the R&D survey. As a result, the final sample (from where the actual measurements for the research project are sought) consists of those R&D employees from the sampling frame that completed the survey.

The process of completing the survey was undertaken in two alternative paths, based on the preferences of the companies:

1. Companies participating in the research project provided the list of their R&D employees, who were then sent the survey link via the survey platform selected (see section 5 of this study for the platform selection process). These lists were first analysed by the research team (duplicates and employees who did not work full-time were removed, if information was available).
1. Companies sent the link to their employees by themselves.

Potential sampling and non-coverage errors can therefore derive from the employer´s lists not being up-to-date and any difficulties in defining the R&D employees by the companies. Such errors can cause both undercoverage and overcoverage issues (Groves, et al, 2009). Undercoverage in this case means that some of the employees, that are R&D employees, did not receive the link for the survey and overcoverage concerns situations where non-R&D employees mistakenly also received the link for the survey (there are foreign elements in the

frame that are not part of the population). The coverage bias was mitigated by the following activites:

1. The research team analysed the lists provided by the companies and assured the number of employees matches with the number provided by Statistics Estonia.

2. Some observations were removed from the final sample in order to reduce coverage bias concerns.

The following observations were later removed from the sample based on the reponses to some questions, which indicated that these respondents do not belong to the population that is being investigated:

1. Removal of observations where respondents answer the question "Do you consider your work a research and development activity, which requires creativity" with answers "Rather not" and "Not at all". This question was added to the survey with the purpose of controlling for individuals that managed to gain access to the survey even though they were not considered R&D employees by the data from Statistics Estonia.

2. Removal of observations where respondents answered that they also work in another workplace for more than 20 hours a week. These results would indicate that the research-and development work is not the main occupation of the respondent and the answers could therefore lead to misleading conclusions about the effects of work time regulation on the R&D employees.

As a result, the final sample consists of R&D employees, who perceive their work as being creative and whose main occupation is in the particular company or R&D institution.

3.3 Sample randomness

Traditional survey research relies on probabilistic random samples where every member of the population has an equal chance of being in the sample (Winship & Mare, 1992; Krosnick, 1999; Groves et al, 2009). However, in the case of R&D survey, the sample is clearly non-probabilistic and to a large extent based on self-selection. As a result, the sampling design does not guarantee the randomness of the sample and potential sampling error and non-coverage error could be present.

The naive remedy to these concerns would be simply to assume that the sample is still random as a relatively large proportion of the population is covered by the sampling frame, even though the sampling process was non-probabilistic. By assuming that the sample is random, the following assumptions would be made:

1. The companies that agreed to participate in the survey were random e.g. there are no significant differences in the main variables of interest between the companies that agreed to participate and those who did not. Therefore there is no sampling error.
2. The people that responded were random e.g. there are no significant differences in the main variables of interest between the people who decided to fill in the survey and those who did not. Therefore there is no non-response error.

As individuals only had a chance of being in the sample in case their employer agreed to participate in the survey, the assumption for randomness is likely to be invalid. It is relatively clear that not all of the members of the population had an equal chance of being included in the sample and there could be important differences in the characteristics of the R&D employees that are employed by the companies which decided to participate in the survey and those that did not (sampling error).

Additionally, potential bias in the survey results might also realise from the fact that the characteristics of those individuals that completed the survey and those that left the survey unfinished or did not start at all are significantly different (individual selectivity might result in non-response error).

As a result, it can be argued that the sample is not random and that in order to count for this potential bias and make inferences about the population, the sample that is obtained in the survey process has to be weighted with respect to the characteristics of the total population. Alternatively, analysis methods dealing with non-random samples could be employed.

3.3.1 Sample weighting

In order to make inferences about the population, sample characteristics have to be similar to the population characteristics. Sample weights have to be designed in order to compensate for unequal sampling rates that might lead to sampling error and non-coverage error.

The aim of sample weighting is to make the sample correspond better to the characteristics of the population. Unfortunately, little information about the population characteristics is known,

weights could potentially be assigned only for male/female ratio, field (sector) of the company, proportion of R&D employees in the total workforce of the company and company size. Sample weighting process is designed in two steps:

1. **Company-level weighting**, based on the sector of the company in order to assign more weight for those sectors that were underrepresented in the sample and less weight for those companies that were overrepresented in the sample.
2. **Population-level weighting**, which weighs the sample for the male/female ratio in population.

3.3.2 Other methods for dealing with non-random samples

Beside sample weigthing, there are also other methods for dealing with potential sampling and coverage errors. As noted by Winship & Mare (1992) the majority of the data collection projects involve some non-random elements, but manage to overcome the selectivity issues in the analysis stage by employing specific models that correct for non-probability aspects. For example, selection models can be used, which try to model the way in which the selection into the sample occurs. Therefore selection models do not require randomness of the sample in order to provide meaningful scientific contributions. The most widely used selection model is the Heckman model, developed by Heckman (1979) and recommended by Winship & Mare (1992). The autohor proposes to use the Heckman model also in the research on R&D employees.

The Heckman model assumes that the discrete decision of being in the sample and the actual dependent variable that is investigated have a bivariate distribution with correlation p. The aim is to use limited information to make inferences for the entire population. By its nature, the model includes two steps:

1. Probit model for the selection mechanism, which predicts the patterns that lead to higher probability of response.
2. Regression of the actual causality that is being investigated.

The model may or may not have the same variables in both steps. The steps are connected by the Inverse Mills ratio.

The use of the Heckman model is also often accompanied by the use of replicate weighting methods that are based on resampling. The main methods include bootstrapping and

jackknife, as suggested by Efron (1981) and Efron & Stein (1981). Both methods estimate the precision of sample statistics, while jackknife uses subsets of available data and bootstrap draws randomly with replacement from the original sample. These methods are often used in cases when inferences that are based on parametric assumptions are in doubt. Bootstrap tends to be considered a more advanced method and is widely used in applied research, therefore bootstrap has also been selected for the R&D research project.

4. Question formulation

After the population has been defined and the sample selection concerns investigated, the focus of the survey design turns to question formulation. The main aim of question formulation is to design survey questions, which would measure the true underlying constructs that the research project on R&D employees is seeking to measure. The main aim at this stage of the survey design is to reduce **measurement error**,

The general process that should be followed when constructing survey questions is illustrated in the figure below (Figure 3), inspired by Groves et al (2009).
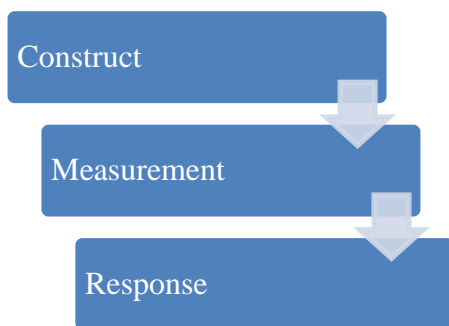

Figure 3. Question formulation

4.1 Constructs

The first step in forming the questions is defining the constructs, which are the elements of information that are being sought after in the research project. The constructs derive from the hypotheses that are being investigated (and subsequently tested). The hypotheses in the case of the R&D research project are derived from previous research on working time regulation and creativity. A brief background to the research on working time regulation is presented next, in order to explain the environment in which the hypotheses and constructs are defined.

4.1.1 Background of the R&D research project

As explained by Hazak et al (forthcoming), fixed work time regulation, including the duration and timing of a working day and working week, has remained the norm in most countries and industries even though the nature of work has changed substantially in the last decades. Fixed work time ignores the personal and profession specifics and as a result could result in

inefficient use of intellectual resources and have various negative implications on individual employees. It is assumed that the effects of work time regulation are more relevant for those employees who spend a considerable proportion of their time working on tasks that require creative thinking, for example, R&D employees.

However, the effect of work time regulation directly or indirectly contributing or disturbing the creative work of R&D employees has largely been disregarded in previous research. Understanding the relationship between creativity and work time regulation is a potential source for increasing innovation and productivity in companies all around the globe.

Previous research in the field has mainly looked into the direct and indirect factors that influence job performance, while working time arrangement has been one of those factors. For example, Kelliher (2008) has found that job satisfaction, organisational commitment and perceived stress level are factors that have an impact on job performance. Additionally, she claimed that these factors are greater when individuals have more flexible work options available. Kelliher (2008) also notes that flexible working encourages positive attitudes towards work and organisations, which translate into harder work effort and improved performance.

Focusing on jobs that require creativity, Amabile, Hadley & Kramer (2002) have found evidence that stress and constant time pressure are the main factors that are having a negative effect on work results. They also claim that fixed work time regulation amplifies the negative effect of the factors supressing creativity.

Previous research has also related work time flexibility to stress and health symptoms. Almeida & Davis (2010) have found evidence that higher flexibility is associated with fewer stress factors and less health symptoms. Additionally, stress level was also found to be related to the total number of working hours.

Overall, the research results of relationships between working time regulation, work performance, job satisfaction and health issues have been controversial. In a recent comprehensive review, de Menezes & Kelliher (2011) highlight that 31% of the studies to date have found support that flexible work time supports individual performance or productivity, whereas 69% of the studies did not identify an effect. Similarly, 57% of the studies find evidence that flexible work time supports job satisfaction, while 40% find no such

effect, and 32% of studies have noted that flexible work time supports health or well-being, while 69% find no such effect.

As an example of recent studies focusing on creative jobs, Seo, Chae & Lee (2014) have investigated the impact of absorptive capacity, exploration and exploitation on individual creativity. Based on a survey analysis, they found evidence that creative self-efficacy, which is a subjective belief that individual has personal creative ability, is positively related to actual creative abilities. Additionally, they discovered that subjective well-being moderates the relationship between creative self-efficacy and creativity. Generalising their results, work motivation and subjective well-being have expectedly a significant impact on creativity and innovativeness.

4.1.2 Hypotheses and constructs

Based on previous research, the research team and the author have defined hypotheses that need to be tested with the data collected by the R&D survey. The core hypotheses that have been agreed on are presented below (in reality, the research team has posed many more hypotheses, but as this is not the main scope of this study, only a selection is presented here for illustrative purposes):

> **H1:** Flexible work options have a positive effect on job satisfaction of the R&D employees.
>
> **H2:** Job satisfaction has a positive effect on the job performance of the R&D employees.
>
> **H3:** Flexible work options have a diminishing effect on the work stress of the R&D employees.
>
> **H4:** Work stress has a negative effect on the creativity of the R&D employees.
>
> **H5:** Flexible work options have a positive effect on the general health of the R&D employees.
>
> **H6**: Flexible work options have a positive effect on the subjective well-being of the R&D employees.

H7: Flexible work options have a positive effect on the creativity of the R&D employees.

H8: Flexible work options have a positive effect on the quality of sleep for the R&D employees.

Based on these hypotheses, the main constructs that have to be measured by the R&D survey can be outlined:

1. **Work time regulation**
2. **Job satisfaction**
3. **Job performance**
4. **Stress**
5. **Creativity**
6. **Health**
7. **Well-being**
8. **Sleepiness**

In addition to these main constructs, considerable additional information is collected in the R&D survey, mainly relating to other factors influencing the constructs that can later be used as control variables in the analysis phase of the research project. For example, when investigating the link between work time regulation and job satisfaction, information about all other factors besides work time regulation that have an effect on job satisfaction is needed in order to make meaningful conclusions about the relationship. Also, some personal information about the respondents is gathered that can be used for sample weighting (see section 3.4) and for providing descriptive statistics about the sample.

The information about the main constructs and the additional information are not available from any other source and as a result a customised data collection process needs to be undertaken.

4.2 Measurement

Measurements are the instruments that are used for gathering information about the constructs (Dillman, 1991; Groves et al, 2009). In the context of the current research project, survey questions are the information gathering instruments. As a result, a critical part of the survey

design is to define questions that reflect the constructs that are being investigated. In the field of survey methodology, this is often noted as instrument validity (Couper, 2000).

In practice, two options of estimating validity exist (Groves et al, 2009; Krosnick & Fabrigar, 1997):

1. Using data external to the survey.
2. Using more than one measurement for the same construct. In this case it can be cross-checked in the analysis stage whether the answers to questions that measure the same construct are correlated or not (correlation therefore implies validity).

In case of the R&D survey, option 1 is not applicable as there are no external records available with respect to most of the underlying constructs that are being measured (records exist for health-related data, but the research team has no access to those medical records). Therefore option 2 has been selected as a method for assessing validity in the survey at hand and multiple questions have been created for those constructs where validity is a concern.

For example, the fact whether an employee has fixed or flexible work time is asked both directly (Does your employer allow you to officially/unofficially use the following options?) and indirectly (To what extent do the following factors cause your workday not to start and end at the times you would prefer?), where aspects pointing to fixed work time arrangement are included in the answer options (such as "Conditions set in the job contract" and "Informal arrangements with the employer"). Also, the fact whether work time arrangement has an effect on creativity is asked both directly (To what extent is your current work time arrangement having a negative effect on your creativity?) and indirectly (To what extent do the following factors have negative effect on the results of your creative work?), where an answer option referring to work time is included ("Unsuitable work time"). Similar double-checking questions have also been designed for constructs of job satisfaction, job performance, stress and tiredness in order to assess the validity of self-written questions in the subsequent analysis stage.

In the R&D survey it can be considered controversial whether true values exist at all for many of the underlying constructs such as creativity, well-being, job satisfaction and stress. De Menezes & Kelliher (2011) have noted in the course of their systemic review of research concerning the effects of flexible working that a significant part of the research in this field is

by its nature based on perceptions. Similarly, the results of the R&D survey will also be largely based on perceptions.

Even though individual perceptions are largely subjective, previous research has identified that in case of personal creativity, the perceived value is highly related to the actual results (Seo, Chae, & Lee, 2014). In addition, many of the indicators used in this work lack an objective measurement (happiness, optimism, etc.) and therefore perceptive measures are the best proxies for these underlying concepts. The instruments used by Seo, Chae & Lee (2014) for measuring creativity and well-being have also been employed in the R&D survey (three questions in survey section "WORK TIME REGIME", two questions in survey section "WORK SATISFACTION" and one question in survey section "FATIGUE").

Validity is not a concern for those questions, which have been validated by previous research. For example, two widely used standardised questionnaires have been embedded in the R&D survey:

1. Sleepiness questionnaire (survey section "SLEEPINESS")
2. Sleep regime (Morningness-eveningness) questionnaire (survey section "SLEEP REGIME")

The validity of those questionnaires has been confirmed by previous studies; refer to Adan & Almirall (1991) and Johns (1991). As previous studies have found these questionnaires to measure the true underlying constructs, these instruments can also be used in the R&D survey.

The research team also has plans to measure some of the variables (mainly relating to stress and health) more objectively in a follow–up research, which would include a practical real-life experiment where employees switch from fixed to flexible work time (or vice versa) and the resulting effects are measured by various standardised real-time (physical) tests.

4.3 Response

Even in cases when all the measurements correspond perfectly to the underlying constructs, survey results could still be biased. This is due to the fact that respondents might provide values that are different from what the measurements and constructs are seeking for. In terms of survey methodology, measurement error incurs. For example, survey researchers have

identified that people tend to underreport socially unacceptable behaviour such as drug and alcohol abuse (Groves et al, 2009). As a result, the aim of the survey designer is to formulate questions that minimise potential measurement error.

The most common question formats used in scientific surveys are open-ended questions and closed-ended questions (Groves et al, 2009). In the R&D survey, both types of questions have been utilised. However, the main constructs are measured by closed-ended questions with ordered scales as this has also been the methodology used in large part of previous studies concerning the effects of work time regulation (de Menezes & Kelliher, 2011). More detailed discussion on the question types and the respective application in the R&D survey is provided in section 6 of this study.

The fact that the main constructs are measured by closed-ended questions with an ordinal scale raises the issue of which specific scales to use for these questions. As a result, scaling is discussed next.

4.3.1 Scaling

The response scales that are used for questions can have important implications on how the respondents answer to the closed-ended question. In addition, scaling choices determine which methods of analysis can be employed in the econometric analysis subsequent to the data collection process. Krosnick & Fabrigar (1997) claim that the length of the scales and whether or not to include a midpoint are one of the most important design choices that the survey designer has to make (in case midpoints are included, the response scales are called bipolar, while otherwise scales are noted as unipolar). In addition, Krosnick & Fabrigar (1997) note that it has to be decided if all scale points are labelled or only the start- and end values are labelled and others are numbered.

Response scales can affect the reporting of behaviours and attitudes (Groves et al, 2009). With too few response options, rating scales could discriminate between respondents with different underlying judgements. On the other hand, with too many response options, respondents may fail to reliably distinguish between the categories and in turn become overly confused about the questions.

Previous research (Almeida & Davis, 2010; Krosnick & Fabrigar, 1997) has suggested unipolar five-point or seven-point response options on a so-called "likert" scale. For example,

scales that measure effect relating to the construct defined in the question from no effect ("Not at all") to very strong effect ("Totally"). Alternatively, seven-point or nine-point bipolar scales could be used, ranging from "Totally disagree to "Completely agree". In the more recent study, Almeida & Davis (2010) prefer five-point scales measuring the impact of the proposed effect and therefore these have also been used as the primary scale in the R&D survey. In two questions concerning the effects of transferring from fixed work time to flexible work time (or vice versa), bipolar nine-point scales have been used in order to somewhat reduce the amount of questions.

Another aspect concerning the scales is how to label or number the scale points. Krosnick & Fabregar (1997) note that survey researchers often decide to label only the end points and use numbers for all the scale points in between. The reasoning for this is that numeric values could be more precise than verbal labels and that numeric values are more comprehendible to individual minds. This in turn could make responding to the questions less mentally demanding. On the other hand, a strong argument in favour of labelling all the options is that verbal labels could be more natural for respondents as individuals do not express opinions in numbers during everyday conversations. Additionally, numbered points do not have any inherent meaning and therefore labels could help to clarify the meaning of scale points. Krosnick & Fabregar (1997) conclude that fully-labelled scales are more reliable than partially labelled scales and therefore labelling is recommended.

In the R&D survey, scales have been fully labelled on questions that have been constructed by the author. With respect to the standardized questionnaires embedded in the survey and questions deriving directly from previous research, scaling is kept unchanged in the R&D survey in order to make the results comparable to previous studies. For example, in one question concerning evaluation of work ability on a 10-point scale, only end values have been labelled as this was directly employed from previous research. The scales are all unidirectional (from "Small" to "Large", from "Not at all" to "Totally") in order to reduce the potential errors and false conclusions in the analysis phase.

The scales determine which methods of analysis can be employed in subsequent stages of the research project. The likert scales can be analysed and the hypotheses tested by using the ordered logit and probit models (Hardin & Hilbe, 2007). The Heckman model described in section 2.6 can also be used with this type of data (Heckman, 1979).

4.3.2 Writing the questions

Some of the questions in the R&D survey were employed from previous studies (questions concerning sleepiness, sleep regime, creativity and well-being), while the rest were written by the author.

Groves et al (2009) has developed a guideline for writing good survey questions, which has also been followed for writing questions for the R&D survey. However, the guideline is somewhat out-dated and mainly designed for interviewer-based and mail-based surveys, therefore some suggestions are not applicable for modern web-based surveys. The author next discusses how the guideline is applied in the R&D survey and which points from the guideline should be removed for web-based surveys.

Groves et al (2009) provide separate guidelines for three types of questions:

1. **Non-Sensitive questions about behaviour** (Table 3)

2. **Sensitive questions about behaviour**

3. **Attitude questions** (Table 4)

The R&D survey mainly concerns attitude questions. However, some non-sensitive questions about behaviour are also included. The R&D survey does not include question about sensitive behaviour (for example, alcohol or drug abuse, sexual behaviour) and therefore the respective guideline has been excluded from this study.

4.3.3 Non-sensitive questions

Table 3. Non-sensitive questions

Groves et al (2009)	Application in the R&D survey and proposed amendments (if any)
1. *With closed questions, include all reasonable possibilities as explicit response options.*	Has been applied in the R&D survey. Previous research has been used in order to define all reasonable response options for the closed-ended questions.
2. *Make the wording as specific as possible.*	With respect to self-written questions, the population that is investigated has been considered and questions have been made as precise as possible with the help of expert review and pretesting (see section 7).
3. *Use the words that all respondents*	Questions have been worded to be understandable for the

will understand.	population under investigation (R&D employees). No jargon or undefined abbreviations have been used in the survey.
4. *Lengthen the questions by adding memory cues to improve recall.*	There are no self-written questions in the R&D survey that require recalling specific past events. However, this could remain relevant in many other web surveys.
5. *When forgetting is likely, use aided recall*	Not applicable as there are no questions in the R&D survey where forgetting is likely. However, this could remain relevant in many other web surveys.
6. *When the events of interest are frequent but not very involving, have respondents keep a diary.*	Author proposes exclusion for web surveys as web surveys in most cases include only one-time contact with the respondent. Also, diary keeping adds considerable burden for respondents and could therefore result in increased non-response.
7. *When long recall periods must be used, use a life event calendar to improve reporting.*	Author proposes exclusion for web surveys as life event calendars can only be used in interviewer-based surveys.
8. *To reduce telescoping errors, ask respondents to use household records or use bounded recall.*	Author proposes exclusion for web surveys as this can only be used in interviewer-based surveys.
9. *If cost is a factor, consider whether proxies might be able to provide accurate information.*	Author proposes exclusion for web surveys as web surveys are cost-effective and rely on proxies by their nature.

4.3.4 Attitude questions

Table 4. Attitude questions

Groves et al (2009)	Application in the R&D survey and proposed amendments (if any)
1. *Specify the attitude object clearly.*	The attitude objects are specified as clearly as possible in the R&D survey. The clearness is tested by expert review and survey pretesting (see section 7 of this study).
2. *Avoid double-barrelled questions.*	Double-barred questions concern situations where one question asks about two separate constructs. Separate questions have been made for those questions in the R&D survey where pretesting discovered this concern.
3. *Measure the strength of the attitude, if necessary using separate items for this purpose.*	With respect to the main constructs that are being investigated, the strength of attitudes has been measured.

4. *Use bipolar items except when they might miss key information.*	The main constructs of interest are measured on a unipolar scale as recommended by Almeida & Davis (2010) and Krosnick & Fabrigar (1997). Bipolar items have been used with respect to two questions in the R&D survey in order to somewhat reduce the amount of questions.
5. *The alternatives mentioned in the question have a big impact on the answers; carefully consider which alternatives to include.*	The alternatives that have been used for questions in the R&D survey are mostly based on previous research. All alternatives have been considered with care by the research team. A few changes in alternatives have been made based on the expert review (see section 7 of this study).
6. *In measuring change over time, ask the same question each time.*	The R&D survey does not include any questions measuring change over time. However, this could remain relevant in many other web surveys.
7. *When asking general and specific questions about a topic, ask the general question first.*	In every section of the R&D survey, general questions are presented first, followed by more specific questions.
8. *When asking questions about multiple items, start with the least popular one.*	Has been considered in "check all that apply" questions.
9. *Use closed questions for measuring attitudes.*	As described before, closed-ended questions have been used for measuring attitudes in the R&D survey.
10. *Use five-to seven-point scales and label every scale point.*	As described before, five-point scales have been used in most cases and all scale points have been labelled.
11. *Start with the end of the scale that is the least popular.*	Has not been applied in the R&D survey. Other research (Almeida & Davis, 2010) has suggested that scales should be as uniform as possible through the survey in order to reduce the burden of filling in the survey for the respondents. As the burden of R&D survey is relatively high, this recommendation has been followed where possible (self-written questions). Author proposes removal from the guideline for surveys that place a high burden on the respondents.
12. *Use analogue devices (such as thermometers) to collect more detailed scale information.*	Detailed scale information has been used in the R&D survey for questions which measure percentage on time spent on certain activities (scale from 0 to 100%) and hours spent on certain tasks (from 0 to 16 hours a day).
13. *Use ranking only if the respondents can see all the alternatives; otherwise; use paired comparisons.*	Ranking questions have not been used in the R&D survey. However, this could remain relevant is many other web surveys.
14. *Get rating for every items of interest; do not use check-all-that apply items.*	Check-all-that apply questions have been used in a few cases concerning attitude towards fixed and flexible work time.

Author sees this point of the guideline as controversial and proposes exclusion from the guideline. In the R&D survey, there are 86 questions, which already present a relatively large burden on the respondents. In case all the "check all that apply" questions would be turned into separate sub-questions, the total amount of questions would more than double. In the case of the R&D survey (and also other large surveys), this does not seem to be reasonable.

4.4 Reliability of responses

According to Groves et al (2009) and Krosnich & Fabregas (1997), reliability of the survey responses is best measured over repeated trials. This uncovers the fact whether respondents are consistent or not with their answers and as a result reduces measurement bias concerns. For this reason, the R&D has been designed to be undertaken in two stages.

The first stage of the R&D survey is undertaken in the light period of the year (April – July) and the second in the darkest time of the year (January-March) in order to control for the time period factors. Other survey conditions are set to remain the same in both stages.

5. Choice of platform

After sampling and question formulation, the focus of the survey design turns to the actual data collection process. Firstly, the mode of data collection has to be selected from various options that are available (personal interviews, telephone calls, mail, web, etc.). Secondly, an appropriate service provider has to be chosen, who could provide the technical capability for undertaking the survey in the selected mode. The main source of bias that has to be considered at this stage is **non-response error**. Dillman (1991) notes that the indicator of response rate is widely used for measuring non-response error. In cases where response rate is sufficiently high, non-response is not considered as a concern for survey results. However, it remains highly controversial what constitutes a sufficiently high response rates as it is strongly dependent on the specific research project and population that is being investigated.

5.1 Mode selection

The main modes that are used for survey data collection are the following (Couper, 2000):

1. **Personal interview**

2. **Telephone interview**

3. **Regular mail**

4. **Web survey**

In the past, personal interviews and mail-based surveys were the most widely used methods for survey data collection. However, since the 1990s, web surveys have become increasingly popular due to substantial time and cost advantages. Based on author´s personal experience, other survey modes can nowadays rarely be seen, at least in Estonia.

Previous work in survey methodology (Groves et al, 2009; Couper, 2000) has pointed out that the choice of the survey mode should be made in the context of the particular aims of the survey at hand and the resources available. As a result, the mode selection often poses a trade-off between costs and survey error.

Some early studies (Couper, 2000) have suggested that there are response rate benefits in offering the survey in more than one mode to the respondents. However, more recent studies (Millar & Dillman, 2011) note that offering a choice in mode does not encourage response and might in certain cases even discourage response (due to the fact that when choice is presented, respondents have to make a decision, which could be difficult and might result in a complete rejection of the survey). Millar & Dillman (2011) also point out that research costs often make it impractical or financially unfeasible to use more than one mode of data collection. As a result, the R&D survey is undertaken in one mode only.

The budget for the R&D survey is limited and therefore only web surveys satisfy the cost side of the equation. However, the potential survey error that might realise in web surveys still has to be investigated and compared to other modes before the final decision is concluded.

5.1.1 Disadvantages of web surveys

Early research in survey methodology with respect to web surveys expressed caution. Couper & Rowe (1996) noted that older and less-educated respondents may be less likely to respond via computers and therefore response rates could be lower for web surveys than for other types of surveys (such as personal interviews and mail). Couper (2000) and Groves et al (2009) also pointed out that the main concern regarding web surveys is the fact that not all of the population members might remain in the sampling frame as they do not have access to the web. However, the web penetration has been tremendous in the past 15 years and therefore the author does not see this as a concern for the R&D survey (it is assumed that all the R&D employees have access to internet, which seems reasonable considering the level of economic development in Estonia).

Sills & Song (2002) note that another potential problem with respect to web surveys is related to software and server crashes, which could have disastrous effects on the results of research projects. They also claimed that slow internet connections might lower response rates for web surveys as people are reluctant to wait for the survey pages to load. The author sees these problems also as relics of the past due to the fact that internet speeds have become high enough to handle any type of survey, at least in developed countries such as Estonia, where the R&D survey is undertaken. Additionally, there are numerous survey platforms with more than ten years of operating history, which should deem it unlikely that there are important software errors on those platforms.

5.1.2 Advantages of web surveys

As technology has progressed, many researchers have started to note the advantages that web surveys provide. Sills & Song (2002) point out that for studying populations that are technologically savvy, web surveys are preferred to other modes of data collection due to cost advantages, design flexibility, easy geographic reach, speed of delivery and ease of data cleaning. Similarly, Groves et al. (2009) note that there are numerous advantages to using web surveys such as reduced costs, increased timeliness and flexibility in designing measurements. Cost and timeliness have been noted as main advantages of web surveys also by Andrews, Nonnecke & Preece (2003).

Additionally, Groves et al (2009) point out that web surveys offer many benefits to the researchers that are not available in other modes. For example, in web surveys researchers can distinguish between people who have not started the survey at all, who have started but not answered to any questions, who have answered some questions, but not completed the survey and those that have completed the whole survey. These insights can offer clues on how to improve response rates in follow-up surveys or next research projects.

As described before, early research on web surveys noted that response rates for web surveys could be lower than for other modes of data collection. However, Kaplowich, Hadlock & Levine (2006) studied response rates under various modes of data collection and discovered that web surveys achieve comparable response rates to mail surveys in cases when relevant remainders are sent to respondents, at a substantially lower cost level. Personal interviews have higher response rates than web and mail surveys, but also at a cost per respondent that is substantially higher. Groves et al (2009) claim that response rates can be the highest of all modes in web surveys when questions relate to sensitive topics such as use of narcotics, alcohol abuse and health. People do not want to disclose these issues during personal interviews and telephone calls as they fear the negative reaction and misjudgement by the interviewer, but are often willing to answer in impersonal survey modes such as via the web.

5.1.3 Final choice of mode

After the advantages and disadvantages of web surveys compared to other data collection methods have been assessed, the final decision on the mode of the survey can be made.

Web survey has been chosen as the mode of data collection for the R&D survey, based on the following arguments:

1. The cost of a web survey is substantially lower than for other modes of data collection. As the budget for the R&D survey is tight, other data collection modes cannot be afforded in the current context.

2. R&D survey contains relatively sensitive questions about individual health (for example, weight, recent diseases, etc.) which respondents might not wish to disclose in the course of a personal interview or telephone call.

3. More recent studies on the effects of flexible work time (Kelliher, 2008) and on personal creativity (Seo, 2014) have also successfully relied on web surveys for data collection. Kelliher (2008) notes that web surveys delivered via an email link are increasingly becoming the norm in research.

5.2 Web platform selection

After web survey has been chosen as the sole mode of data collection for the R&D survey, the focus of the survey design turns to which service provider or platform to use for creating an online survey that could be distributed to the respondents.

As there are hundreds if not thousands of web survey platforms offered by various service providers, the choice of platform is considerably difficult. The platform selection can have important implications on how the data collection processes is carried out as all the platforms vary in functionality, software quality and operating history. As a result, a formal decision-making framework is required for making the decision of which platform to use. The widely used method proposed by Saaty (1990) has been used in this study and is described next.

5.3 Saaty method for decision-making

The method of Saaty (1990) relies on the Analytic Hierarchy Process (AHP), which divides the overall problem (that needs to be decided on) into criteria, subcriteria and alternatives in a structured manner. This hierarchical structure provides a clear overview of the problem and helps the decision-maker to assess the importance and magnitude of elements on each level. In the AHP process, the decision-maker has to make pairwise judgements concerning the impact of the elements on the lower level of the hierarchy to the elements on the level above.

Saaty was driven to develop this method as he discovered that only a minor proportion of elements required for decision-making could be expressed on an absolute scale (for example, temperature, cost), whereas most criteria require a relative evaluation. Even for items on an absolute scale, position on an absolute scale might have to be accompanied by relative evaluation as moves on an absolute scale might not always have an equal impact on the decision (for example, when choosing a job, the impact of salary is higher when an individual has a relatively low income and lower when individual has a relatively high income). However, the AHP process can include both relative and absolute measurements and combine them into a comprehensive decision-making model.

Saaty (1990) proposes the use of paired comparisons among criteria and subcriteria. This allows to focus and set priorities only on the two criteria or subcriteria than are being evaluated (and ignore all the other elements) at the time, which is considerably more comprehendible for a human mind than comparing three or more criteria at the same time. These pairwise comparisons are performed one at the time through the complete hierarchy, after which the AHP generates priority scales for all the measurements. Priority scale is AHP´s way on standardizing various (subjective/relative/absolute) scales into a single framework.

Scales are required in order to make the pairwise comparisons. Scales demonstrate how much one item dominates over another element (with respect to the criterion that is currently under measurement). The priorities in the AHP framework are set on the scale described in the following table (Table 5), as originally defined by Saaty (1990):

Table 5. Saaty scales

Intensity or importance on an absolute scale	Definition
1	Equal
3	Moderate importance of one over another
5	Essential or strong importance
7	Very strong importance

9	Extreme importance
2,4,6,8	Intermediate values between the two adjacent judgements (in case compromise is needed)

The comparisons that are based on expert judgement have to be consistent. Saaty (2008) has proposed a consistency index (CI) that should be used to evaluate whether the judgements and therefore the whole decision-making model is consistent. Saaty has suggested CI of less than 0.1 to be tolerable, otherwise the information in the model would become too chaotic.

The main advantage of the Saaty´s method is that it is based on logical reasoning and is analytical by its nature. Subjective opinions are successfully transferred into numbers, which can then be objectively tested. In addition, the hierarchical structure of the method makes it comprehendible to any ordinary individual. For these reasons, the Saaty method has also been chosen to solve the problem of platform selection for the R&D survey.

5.4 Application of Saaty´s method

The problem that has to be solved is the following:

1. How to choose an optimal platform for the R&D survey?

Platform choice is crucial as it can have important implications on the results of the whole research project. In case of a survey platform with lacking functionality and technical problems, the reputation of the research team can also be put at risk. On the other hand, the cost side of the process is critical as well due to the fact that the budget for the platform is rather limited.

Nowadays there are hundreds if not thousands of survey platforms offered on the web. All of them have their own peculiarities and differ in functionality. As a result, the platform selection is a complex problem and has to be solved by using a scientific method such as Saaty´s AHP.

The Web-Hipre program (http://hipre.aalto.fi/), developed by the researchers in Aalto University has been used as an analytical and computation tool for making the comparisons and building the hierarchy.

The goal of the decision-making process is to find an optimal platform for the survey, which fills all the requirements that have been defined by the research team. The main requirements that are used for pre-screening the platforms are as follows:

1. Well-established operating history with respectable client list. New, starting platforms are excluded due to higher operational risks.

2. Monthly cost under 100 euros. The project cannot afford more expensive solutions.

3. Capability of handling at least 1000 respondents. It is estimated that around 200-500 respondents participate in the survey, a higher bar is set in order to remain conservative.

Based on these requirements, the following alternatives were identified by the research team (Table 6).

Table 6. Alternative survey platforms

Alternative	Website	Description
QuestionPro	www.questionpro.com	An online survey platform with over two million customers. The platform was started in 2002 and therefore has a long operating history. Their clients include many world-famous organisations such as Microsoft, Toyota, Samsung and others.
SurveyMonkey	www.surveymonkey.com	SurveyMonkey is also a well-established platform with over 30 million customers. Most notable clients include Facebook, Samsung, Salesforce, etc. The company was established in 2004. The platform claims to having reached 99.5% customer satisfaction.
SurveyGizmo	www.surveygizmo.com	Another survey platform established back in 2006. No information about specific customers is provided, but it is noted that the client list includes well-known international companies.

| eFormular | www.eformular.ee | One of the most popular survey platforms in Estonia. Their clients include EMT, Sampo bank, University of Tartu, etc. Over 50 thousand surveys have been created on their platform. |
| Ankeet | www.ankeet.ee | Another Estonian survey platform, which started its operations in 2011. Their vision seems to be making the survey creation as simple as possible. No information about specific customers is provided, but the platform has been used for many large-scale surveys undertaken in Estonia. |

Before the alternatives can be evaluated, the criteria (and subcriteria) that are used for ranking the alternatives and eventually making the decision have to be defined. The research team has defined the following main criteria (Table 7):

Table 7. Saaty main criteria

Criterion	Description
Usability	The platform has to be simple and easy to use, both for the researchers and the respondents. This makes the whole data collection process considerably smoother. Usability is evaluated subjectively by the research team members (group decision is used).
Functionality	The alternatives differ in the functionality than is being offered. Some of the functions are especially important for the R&D survey (see the subcriteria below). The functionalities of the alternatives can be compared.
Price	Price has important implications as the budget for the R&D survey is limited. The monthly cost of the platform can be compared. The cost has to remain under 100 euros per month; otherwise the research team could not afford the platform.

Functionality in turn is divided into the following subcriteria (Table 8):

Table 8. Saaty subcriteria

Subcriterion	Description
Save and continue	Possibility to save the survey and continue later. This means that the respondents who are not able to complete the survey at one time, are not completely lost and can later start from where they left off. On the Saaty scale, the availability of this option gives a moderate importance (rating 3).
Individual survey links	Possibility of sending individual survey links to the respondents that are protected by a unique password. This is crucial for distributing the survey properly. On the Saaty scale, this option gives a very strong priority (rating 7). If individual links can be sent, but not with an unique password protection, strong priority is assigned (rating 5).
Ballot stuffing	Possibility of avoiding situations where respondents could fill in the survey more than once. On the Saaty scale, this option gives a strong priority (rating 5).
Extended user rights	Possibility to grant excess to the administrative area of the platform for a third party (for example, the HR person from the company being surveyed). On the Saaty scale, this option gives a moderate importance (rating 3).
Response tracking	Possibility to track which respondents have completed the survey and which have not. This is crucial for sending reminders. On the Saaty scale, this option gives a strong priority (rating 5). In case there is a possibility to send remainders only to those respondents who have not completed the survey, a very strong priority is assigned (rating 7).
Excel output	Possibility to extract data in Microsoft Excel format. Data in other formats could also be processed, but Excel is preferred by the research team and reduces the time that is later spent on data cleaning procedures. On the Saaty scale, this option gives a moderate importance (rating 3).
Second language	Possibility to add another language to the survey. The R&D survey is designed to be undertaken in both English and Estonian. On the Saaty scale, the availability of a second-language option gives a strong

priority (rating 5).

The next step in Saaty´s framework is to perform pairwise comparisons between the subcriteria. The scales that are used for making the comparisons are the standard AHP scales defined by Saaty (1990) and also described above. Pairwise comparisons are undertaken for all possible combinations of the subcriteria.

The main logic behind the judgements given in the following table (Table 9) is that those functionalities that can have a direct influence of the results of the R&D survey are given a higher priority and those that are more of a "nice-to-have" type are given a lower priority.

Table 9. Pairwise comparisons - subcriteria

Subcriterion 1	Subcriterion 2	Evaluation
Save and continue	Individual survey links	Individual survey links are more important (rating 5)
Save and continue	Ballot stuffing	Ballot stuffing is moderately more important (rating 3)
Save and continue	Extended user rights	Equal importance (rating 1)
Save and continue	Response tracking	Response tracking is more important (rating 5)
Save and continue	Excel output	Equal importance (rating 1)
Save and continue	Second language	Second language is moderately more important (rating 3)
Individual survey links	Ballot stuffing	Individual survey links are moderately more important (rating 3)
Individual survey links	Extended user rights	Individual survey links are more important (rating 5)
Individual survey links	Response tracking	Equal importance (rating 1)
Individual survey links	Excel output	Individual survey links are more important (rating 5)
Individual survey	Second language	Individual survey links are moderately more important (rating

links		3)
Ballot stuffing	Extended user rights	Ballot stuffing is moderately more important (rating 3)
Ballot stuffing	Response tracking	Response tracking is moderately more important (rating 3)
Ballot stuffing	Excel output	Ballot stuffing is moderately more important (rating 3)
Ballot stuffing	Second language	Equal importance (rating 1)
Extended user rights	Response tracking	Response tracking is more important (rating 5)
Extended user rights	Excel output	Equal importance (rating 1)
Extended user rights	Second language	Second language is moderately more important (rating 3)
Response tracking	Excel output	Response tracking is more important (rating 5)
Response tracking	Second language	Response tracking is moderately more important (rating 3)
Excel output	Second language	Second language is moderately more important (rating 5)

The judgements given and the resulting priorities can be seen in the following matrix produced by the Web-Hipre program. Priorities are derived from the matrix as its principal eigenvector (Saaty, 1990).
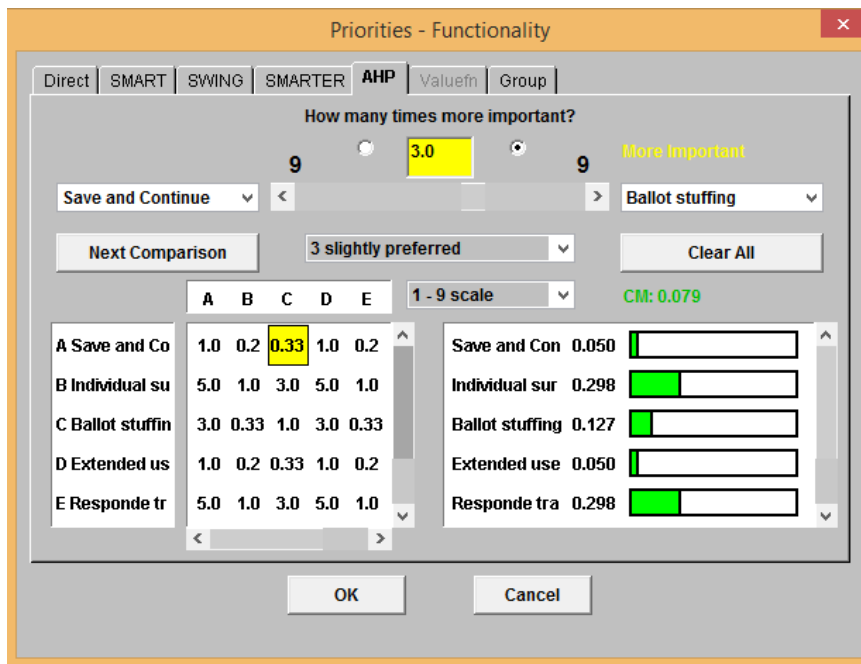
The consistency index is below 0.1, which means that the matrix is consistent and acceptable. The largest weight is on functionalities of individual survey links and response tracking.

Next, the main criteria of usability, functionality and price are evaluated. The main reasoning behind the pairwise comparisons below (Table 10) is that higher priority is assigned to those criteria that can have more direct effect on the results of the R&D survey.

Table 10. Pairwise comparsions - main criteria

Criterion 1	Criterion 2	Evaluation
Usability	Functionality	Functionality is moderately more important (rating 3)
Usability	Price	Equal importance (rating 1)
Price	Functionality	Functionality is moderately more important (rating 3)

The resulting Web-Hipre matrix is as follows:
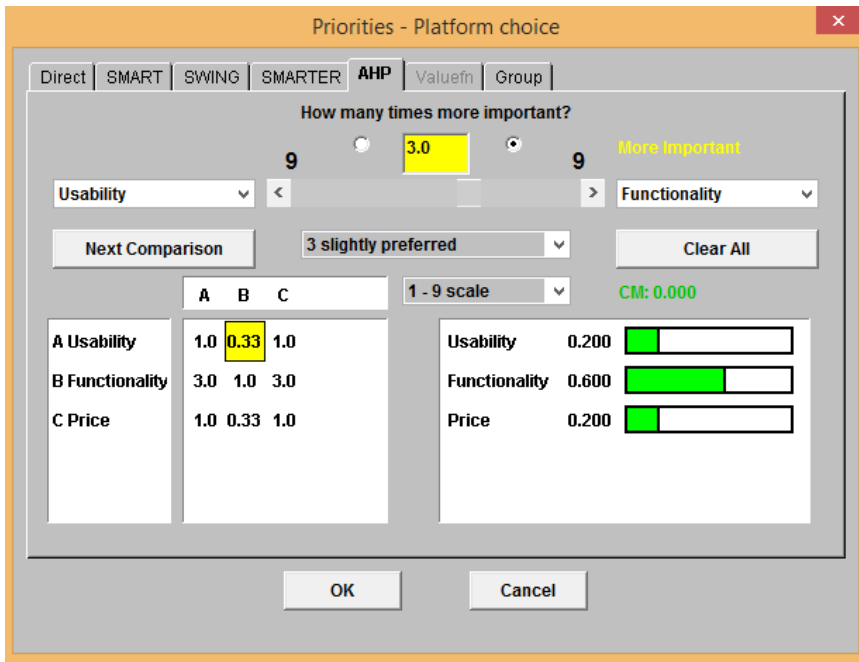
49

The consistency index is below 0.1, which means that the matrix is consistent and acceptable. The largest weight is on functionality, while usability and price have the same weight.

The whole decision tree (hierarchy) in Web-Hipre format turns out as follows:
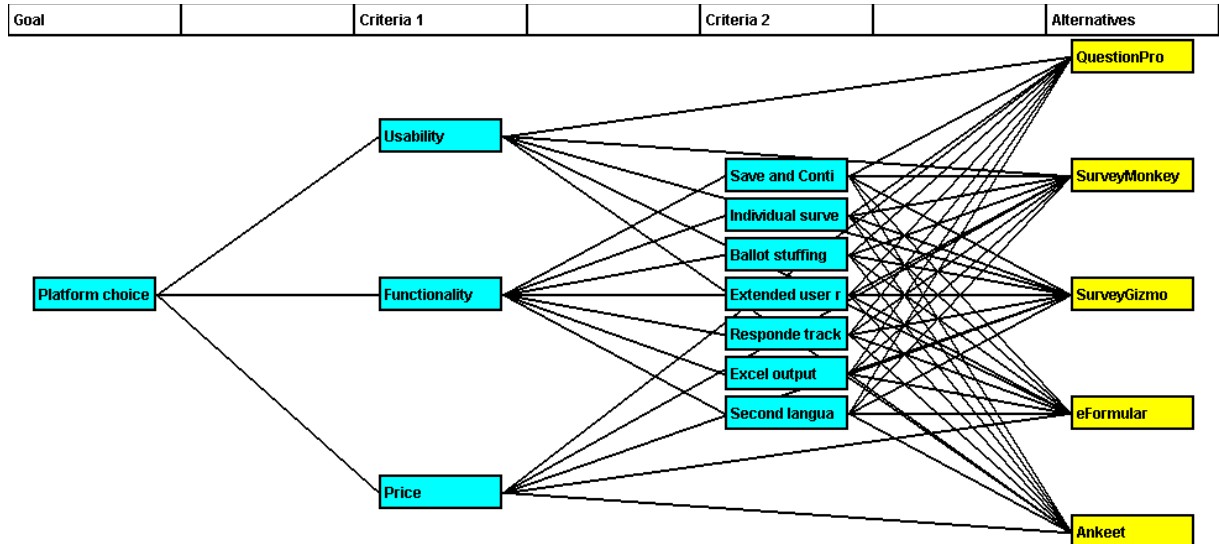
Now when the hierarchy has been built, the next step in the AHP process is to start comparing the alternatives with respect to the criteria (usability, functionality and price) and the subcriteria (save and continue, individual survey links, ballot stuffing, extended user rights, response tracking, excel output, second language). The comparisons that are then obtained are used to compute the overall priorities for each of the alternatives.

5.4.1 Usability

With respect to usability, group decision has been used as different people may have considerably different opinions on what usability is. After testing a sample survey in each of the platforms, three research team members have expressed their pairwise comparisons of the usability of alternative platforms on the Saaty scale. These judgements are later combined in order to arrive at the overall priority. The results can be seen in the tables below (Table 11, Table 12 and Table 13):

Table 11. Group decision - expert 1

Expert 1	QuestionPro	SurveyMonkey	SurveyGizmo	eFormular	Ankeet	Weight
QuestionPro	1	3	5	5	5	**0.48**
SurveyMonkey	0.33	1	3	3	3	**0.26**
SurveyGizmo	0.2	0.33	1	1	1	**0.09**
eFormular	0.2	0.33	1	1	1	**0.09**
Ankeet	0.2	0.33	1	1	1	**0.09**

Table 12. Group decision - expert 2

Expert 2	QuestionPro	SurveyMonkey	SurveyGizmo	eFormular	Ankeet	Weight
QuestionPro	1	3	3	5	1	**0.33**
SurveyMonkey	0.33	1	3	3	3	**0.26**
SurveyGizmo	0.33	0.33	1	3	1	**0.14**
eFormular	0.2	0.33	0.33	1	0.2	**0.05**
Ankeet	1	0.33	1	5	1	**0.21**

Table 13. Group decision - expert 3

Expert 3	QuestionPro	SurveyMonkey	SurveyGizmo	eFormular	Ankeet	Weight
QuestionPro	1	0.33	1	3	0.33	**0.14**
SurveyMonkey	3	1	3	5	1	**0.33**
SurveyGizmo	1	0.33	1	3	0.33	**0.14**
eFormular	0.33	0.20	0.33	1	0.2	**0.05**
Ankeet	3	1	3	5	1	**0.33**

After individual judgements have been revealed, they can be combined into a combined judgement and final weights can be calculated (Table 14). Geometric mean has been used for calculating the combined judgements, as originally suggested by Saaty (1990).

Table 14. Group decision - summary

Total	Question Pro	SurveyMonkey	SurveyGizmo	eFormular	Ankeet	Geo-mean	Weight
QuestionPro	1	1.44	2.47	4.22	1.18	**1.78**	**0.31**
SurveyMonkey	0.69	1	3	3.56	2.08	**1.73**	**0.30**
SurveyGizmo	0.41	0.33	1	2.08	0.69	**0.72**	**0.13**
eFormular	0.24	0.28	0.48	1	0.34	**0.41**	**0.07**
Ankeet	0.84	0.48	1.44	2.92	1	**1.11**	**0.19**

The resulting weights have been entered directly into the Wen-Hipre program. In the next phase, all the subcriteria of functionality are going to be compared among the alternatives.

5.4.2 Save and continue

From the alternatives under consideration, QuestionPro, SurveyMonkey and SurveyGizmo have the option of adding the "Save and continue later" button to the survey. In case the

respondent clicks on the respective button, a new window appears where email address can be entered. The system then automatically sends the link for continuing with the survey to the email address. Unfortunately, eFormular and Ankeet do not have this feature.
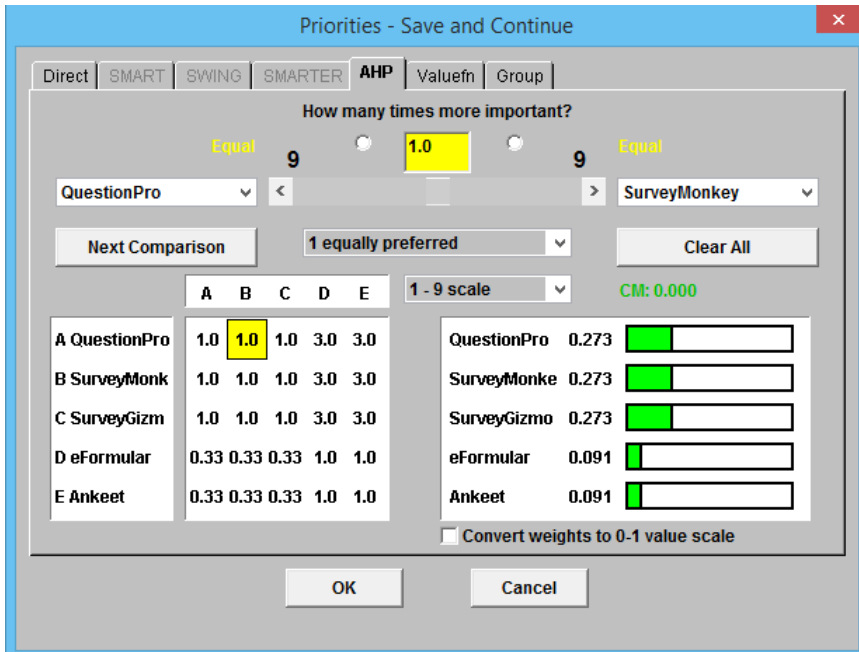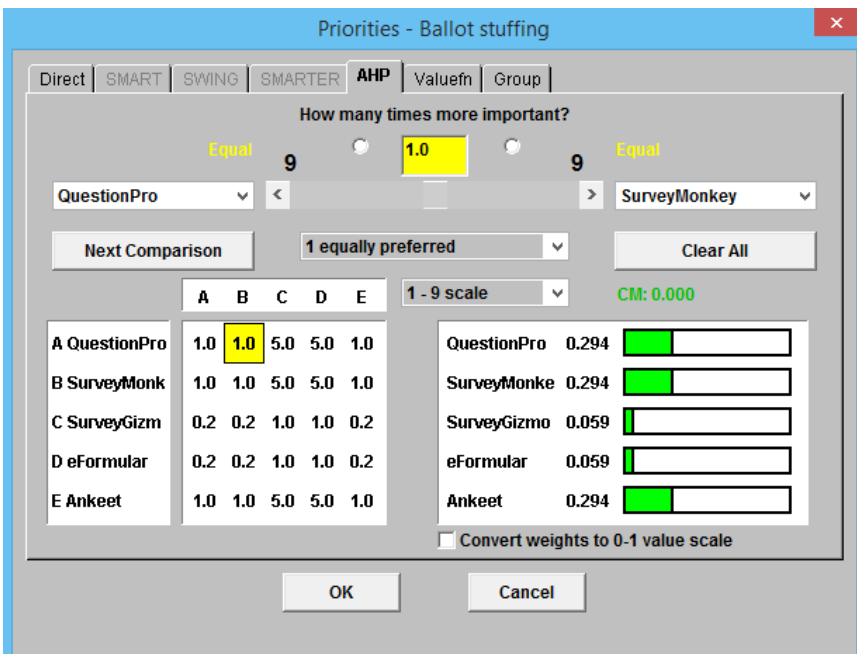

5.4.3 Individual survey links

In QuestionPro, there is a possibility to send each respondent a personal survey link, which is protected by a unique password. In SurveyMonkey, SurveyGizmo and Ankeet, personalised links can be sent, but only a general (not personal) password can be set for the survey. eFormular does not have the possibility of sending individual personalised links.

Priorities - Individual survey links

Direct | SMART | SWING | SMARTER | **AHP** | Valuefn | Group

How many times more important?

Equal 9 1.0 9 Equal

SurveyGizmo | Ankeet

Next Comparison | 1 equally preferred | Clear All

1 - 9 scale | CM: 0.033

	A	B	C	D	E
A QuestionPro	1.0	3.0	7.0	3.0	3.0
B SurveyMonk	0.33	1.0	3.0	1.0	1.0
C eFormular	0.14	0.33	1.0	0.33	0.33
D SurveyGizm	0.33	1.0	3.0	1.0	1.0
E Ankeet	0.33	1.0	3.0	1.0	1.0

QuestionPro 0.460
SurveyMonke 0.161
eFormular 0.057
SurveyGizmo 0.161
Ankeet 0.161

☐ Convert weights to 0-1 value scale

OK | Cancel

5.4.4 Ballot stuffing

QuestionPro, SurveyMonkey and Ankeet have developed a functionality which makes it impossible for one respondent to complete the survey more than once from the same IP address. SurveyGizmo and eFormular do not discuss this potential vulnerability in their service descriptions.

Priorities - Ballot stuffing

Direct | SMART | SWING | SMARTER | **AHP** | Valuefn | Group

How many times more important?

Equal 9 1.0 9 Equal

QuestionPro | SurveyMonkey

Next Comparison | 1 equally preferred | Clear All

1 - 9 scale | CM: 0.000

	A	B	C	D	E
A QuestionPro	1.0	1.0	5.0	5.0	1.0
B SurveyMonk	1.0	1.0	5.0	5.0	1.0
C SurveyGizm	0.2	0.2	1.0	1.0	0.2
D eFormular	0.2	0.2	1.0	1.0	0.2
E Ankeet	1.0	1.0	5.0	5.0	1.0

QuestionPro 0.294
SurveyMonke 0.294
SurveyGizmo 0.059
eFormular 0.059
Ankeet 0.294

☐ Convert weights to 0-1 value scale

OK | Cancel

5.4.5 Extended user rights

QuestionPro and SurveyMonkey have the possibility to grant access to the administrative area of the platform for a third party (however, only in case the most expensive subscription type is selected), who could then send out survey links and review results (exact limitations can be set). Other platforms do not have this functionality.

5.4.6 Response tracking

QuestionPro, SurveyGizmo, eFormular and SurveyMonkey all have the functionality to track which of those respondents, who were sent the survey link, have responded. In addition, QuestionPro, SurveyGizmo and eFormular have the functionality to send remainder emails only to those respondents who have not yet completed the survey, while SurveyMonkey lacks this functionality. Ankeet lacks the (individual) response tracking possibility completely.
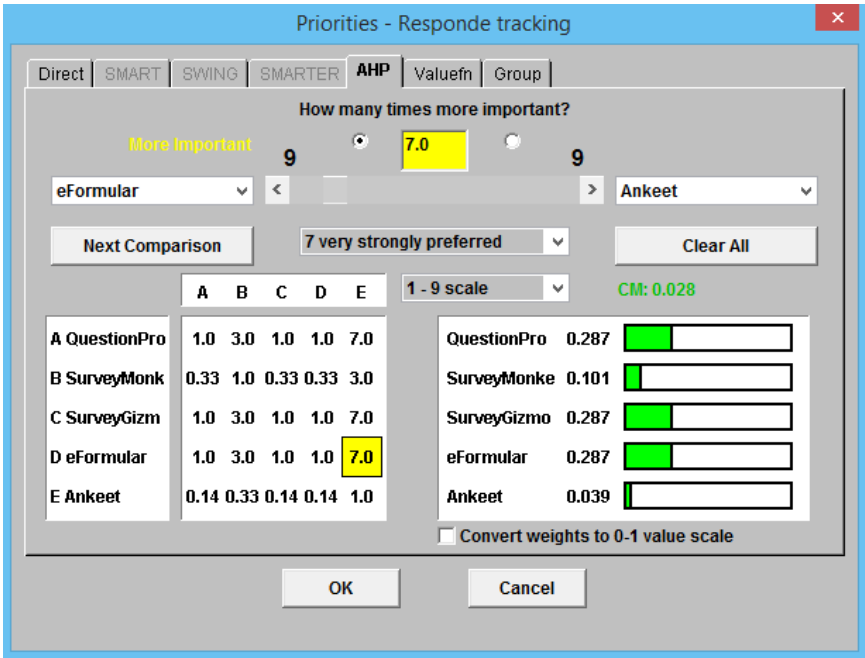
5.4.7 Excel output

QuestionPro, SurveyMonkey, SurveyGizmo and Ankeet all have to option to extract data in a Microsoft Excel format, beside many other formats available. Ankeet lacks the Excel output possibility.
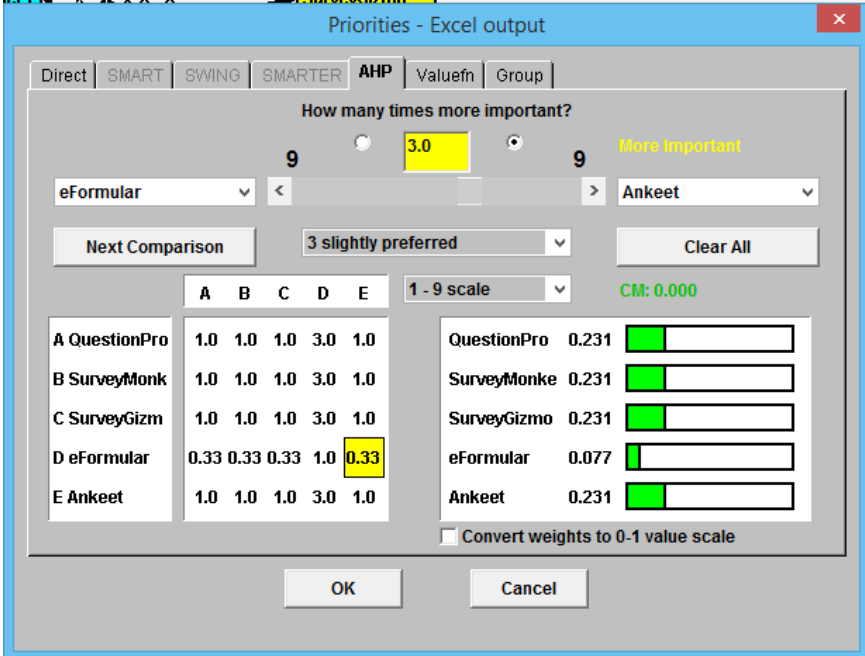
5.4.8 Second language

QuestionPro, SurveyMonkey and SurveyGizmo have developed a functionality that allows making the survey multi-lingual relatively easily (an Excel table is used for providing translations to every object in the survey), eFormular and Ankeet seem to lack this.
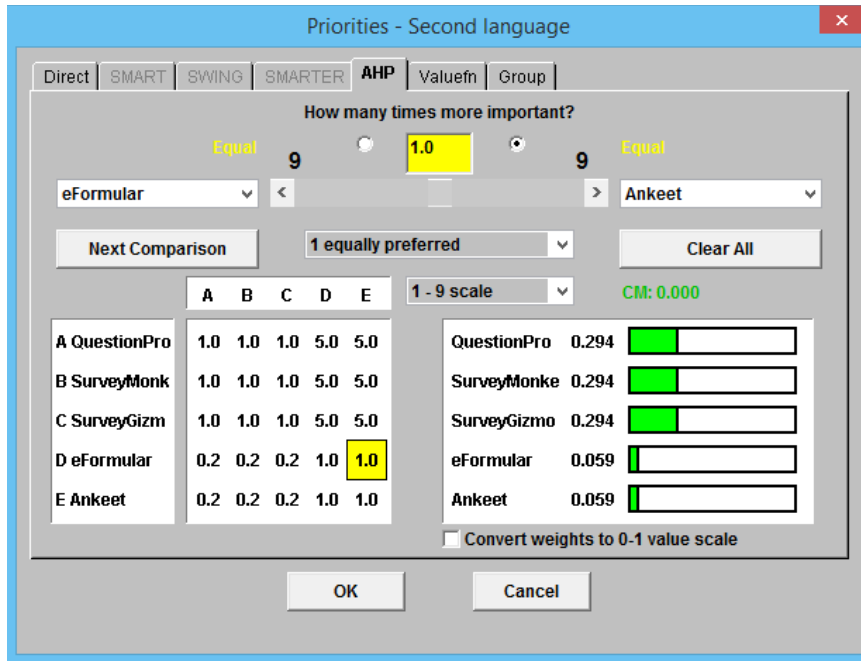
5.4.9 Price

Price has to be treated differently from other criteria in the AHP framework. Price has to be first transformed to the reciprocal of price in order to calculate weights that are comparable to the weights of other criteria and subcriteria. The monthly price for services has been used in the calculations (Table 15).

Table 15. Saaty main criteria - price

Alternative	Price (monthly)	Reciprocal of price	Weight
QuestionPro	99	1/99	0,10117
SurveyMonkey	35	1/35	0.286167
SurveyGizmo	85	1/85	0.117833
eFormular	35	1/35	0.286167
Ankeet	48	1/48	0.208863

5.4.10 Final result

After all the criteria and subcriteria have been evaluated, the results of the AHP can be presented. The final result of the AHP on the functionality level (ignoring usability and price) is displayed below.
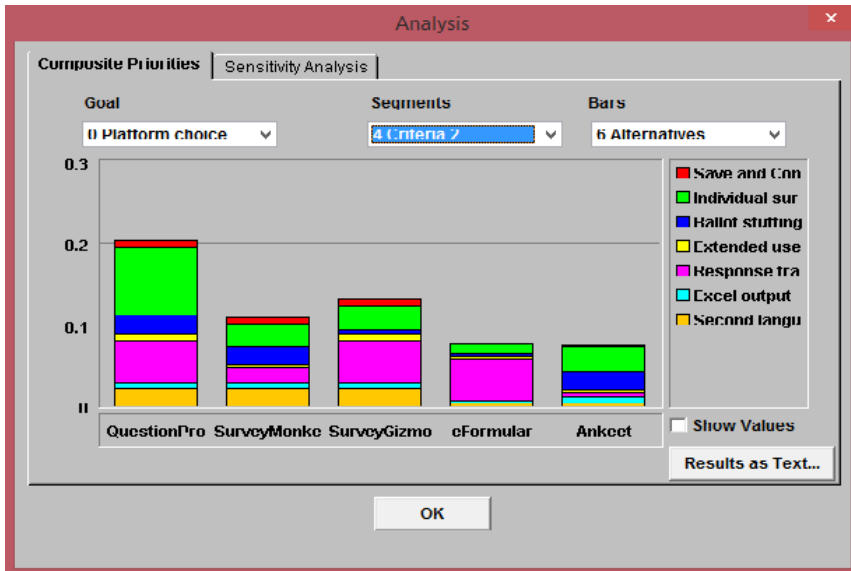
In terms of functionality, QuestionPro is clearly the best, followed by SurveyGizmo and SurveyMonkey, respectively. eFormular and Ankeet are clearly lacking some important functions that are relevant for the R&D survey.

The final result of the AHP on the level of the main criteria is displayed below.
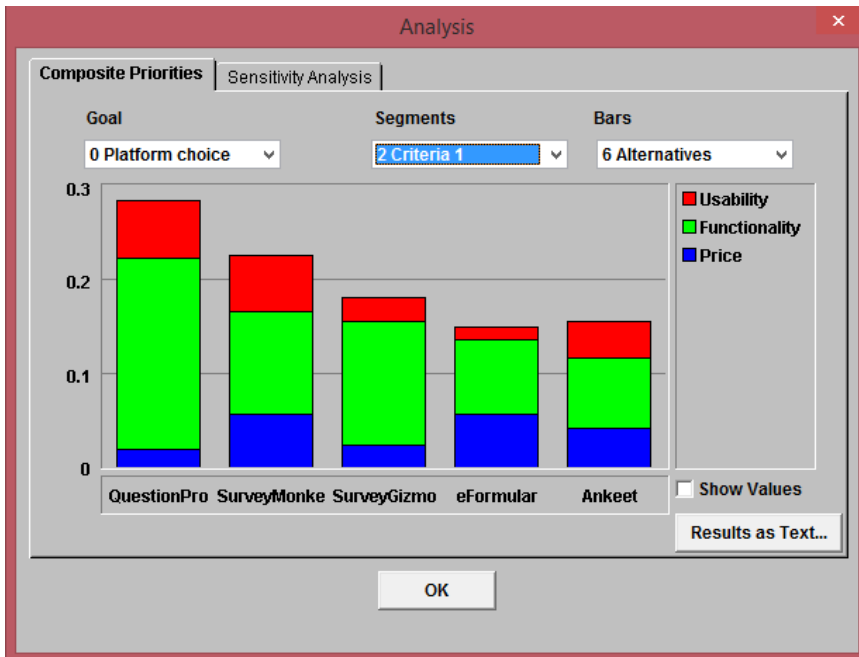
QuestionPro is ranking first, mainly due to functionality advantages. SurveyMonkey ranks second with comparable usability and cost advantages, but considerably lower functionality. SurveyGizmo is third with similar cost as QuestionPro, but with lower usability and functionality. Ankeet and eFormular differ in terms of the particular criteria, but overall are on the same level and clearly behind the first three alternatives.

5.4.11 Sensitivity analysis

Next, sensitivity analysis is performed with respect to the weights on the main criteria. Sensitivity analysis is important for understanding how changes in the main variables of interest (weights) may affect the final outcome.

5.4.11.1 Usability

In case the weight on usability would be changed, the main result (QuestionPro ranking first) would stay the same no matter how the weights would be changed.
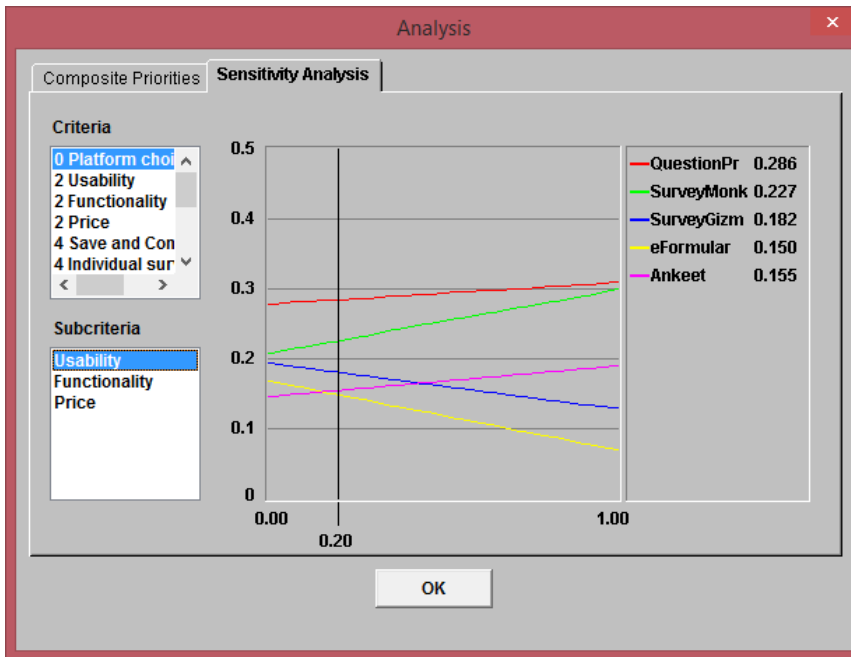
5.4.11.2 Functionality

With respect to functionality, the final choice would change in case the weight on functionality criteria would be reduced from 0.6 to 0.36. Before the change, the relation of the functionality weight to other weights remains at 0.6 / (1- 0.6) = 1.5. After the change, the relation of the weight to other weights would be 0.36/ (1-0.36) = 0.56. This means that the priority of functionality compared to other criteria should be reduced by 0.56*(1/1.5) = 0.37 times in order that the final weight would change. In the latter case SurveyMonkey would be ranking first.
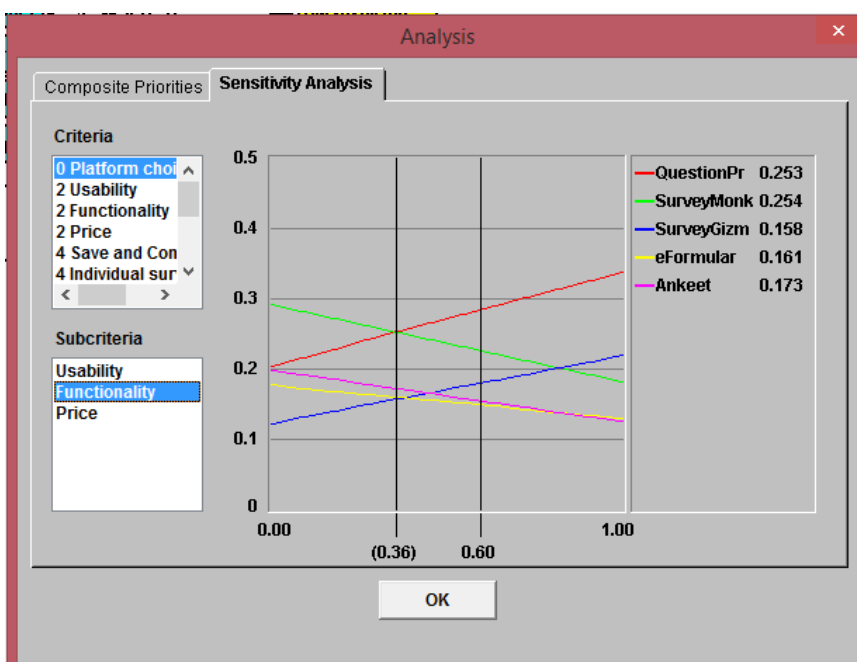
5.4.11.3 Price

The final choice would change in case the weight on price criteria would be increased from 0.2 to 0.39. Before the change, the relation of the price weight to other weights remains at 0.2 / (1- 0.2) = 0.25. After the change, the relation of the weight to other weights would be 0.39/ (1-0.39) = 0.64. This means that the priority of functionality compared to other criteria should be increased by 0.64*(1/0.25) = 2.56 times in order that the final weight would change. In that case SurveyMonkey would be ranking first.
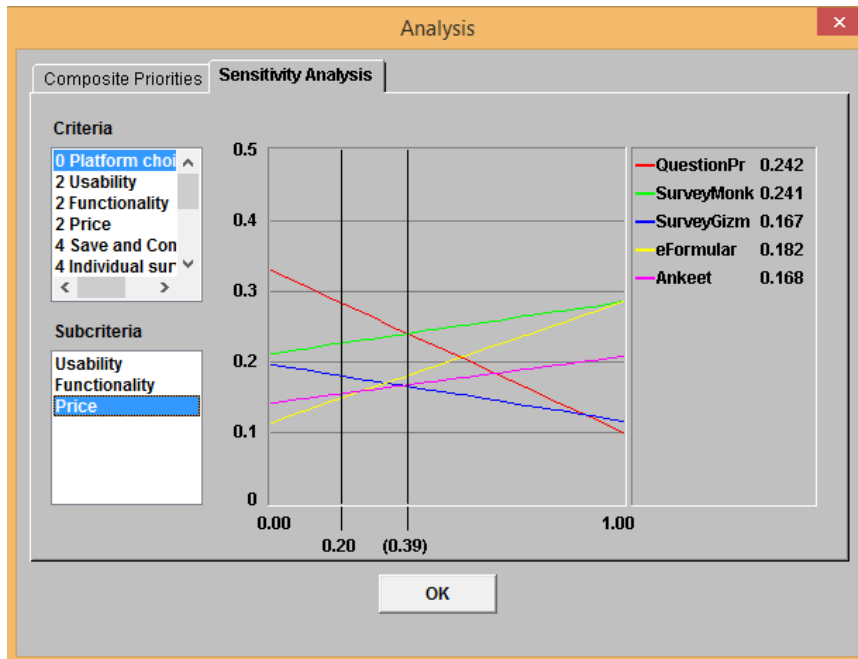
5.4.12 Decision

Based on the Saaty´s AHP framework, QuestionPro has been chosen as the platform for undertaking the R&D survey.

6. Creation of the survey

After the survey platform has been chosen, the focus turns to the construction of the survey on the online environment of QuestionPro. The main aim at this stage is similar to the previous section – to reduce **non-response error**. As defined by Dillman (2011), non-response error refers to situations where some members of the population do not respond to the survey. Dillman also notes that the presence and extent of non-response error is often evaluated by investigating the response rates. In case response rates are high and do not differ significantly between various groups of respondents, non-response should not cause bias in the results of the survey.

Previous research (Couper, 2000; Peytchev et al, 2006; Groves et al, 2009) has discovered that the visual layout and design elements used in web and mail surveys can have an effect on the survey answers provided. It has been noted that design elements such as placement of questions, flow of instruments, typographical features, etc. can have an important effect on the response rates for surveys. Couper (2000) claims that these type of design features are even more critical in web surveys than in other types of surveys due to the design flexibility that most web platforms offer. Therefore care has to be taken in choosing the right elements to be used in the online survey environment for the R&D survey in order to increase response rates and thereby reduce non-response error.

The following design features that could potentially have an effect on survey error are considered in this section:

1. **General features** (section 6.1)
2. **Question types** (section 6.2)
3. **Scrolling versus paging** (section 6.3)
4. **Progress indicator** (section 6.4)
5. **Question validation** (section 6.5)
6. **Automated skip logic** (section 6.6)

6.1 General features

Survey methodology researchers (Crawford, McCabe & Pope, 2005; Groves et al, 2009) often claim that the design features used for web surveys should be as simplistic and plain as possible. This means that no background colour or images should be included in the survey as these could make the questions texts unreadable, increase page loading times and magnify the number of technical (software) errors. It is also claimed that question texts and answers should be clearly separated in web surveys. In addition, Crawford, McCabe & Pope (2005) suggest that no question numbers should be added in web surveys as these do not serve the purpose they commonly do in paper surveys (help respondents to navigate) and could distract respondents.

Another important aspect of the design is the overall structure and the order in which the questions are presented. Moreover, the placement of sensitive questions that concern health-related information and personal questions about family, profession, pay, etc. is especially important. Andrews, Nonnecke & Preece (2003) note that drop-out rates tend to increase when sensitive and confidential personal information is required in the beginning of the survey. As a result, they suggest leaving these types of questions in the end. Similarly, Dillman (1991) suggests that interesting and easy-to-answer questions should be placed in the beginning of the survey in order to stimulate participation and establish the legitimacy and importance of the survey, whereas more difficult and sensitive questions should be left in the end of the questionnaire. He also notes that open-ended questions tend to produce more non-response and should also be left in the second half of the survey.

Findings of previous research have been applied in the R&D survey. The survey is designed without a background colour and any additional images. Additionally, question and answer texts are clearly separated and no question numbers are visible to be respondents (question numbers are present when the survey data is downloaded, in order to simplify data analysis of the results). The overall structure of the R&D survey is discussed next.

6.1.1 Overall structure of the R&D survey

The overall structure of the R&D survey starts with an information page, where the main aims of the survey and the general organisation of the research project are explained. Also, the treatment of personal information is explained and the approval for the survey from the

Tallinn Medical Research Ethics Committee is presented. Respondents have to agree with the terms and conditions in order to proceed to the questions.

The survey questions are divided into eight sections:

1. **WORK ORGANISATION** – includes questions about work time regulation, time expenditure on certain work tasks, relationship between work time regulation and pay, satisfaction with work time, etc.

2. **WORK SATISFACTION** – includes questions about job satisfaction and factors influencing it.

3. **WORK PRODUCTIVITY** – includes questions about various factors influencing productivity and the impact of work time regulation on productivity.

4. **SLEEPINESS** – includes a standardised sleepiness questionnaire, accompanied by a question linking sleep regime to work time regulation.

5. **SLEEP CYCLE** – includes a standardised morningness-eveningness questionnaire, accompanied by two questions linking sleep cycle to working habits.

6. **FATIGUE** – includes questions about emotional and physical fatigue and questions linking fatigue to work time regulation.

7. **HEATLT CONDITION** – includes questions about work ability and general health condition.

8. **ADDITIONAL INFORMATION** – questions about age, profession, education family information, pay. In the end, comments about the survey are being asked for.

As suggested by Dillman (1991), the R&D survey starts with more interesting questions about work-time regulation, work satisfaction and work results, which should emphasise the importance of the survey and potentially be more interesting for the respondents to answer. Questions concerning health-related and personal information are left in the last two sections of the survey. Where possible, open-ended questions have been moved to the later stages of the survey. In the last section, participants can also provide comments in three categories:

1. Comments about the relationship between work time regulation and sleepiness and tiredness

2. Comments about the relationship between work time regulation and creativity.

3. General comments about the design of the survey.

Especially the comments provided in the last box could be critical for evaluating the design of the survey. In the end, after all the questions have been answered, a new page appears where respondents are being thanked for their participation in the survey.

In total, the R&D survey consists of 86 questions. Based on the trials by the author, the approximated response time is under 50 minutes. Survey research (Groves et al, 2009) suggests that response rates are only marginally associated with questionnaire length, but surveys taking over an hour to complete could suffer from lower data quality as respondents reduce the amount of mental efforts dedicated to each question.

6.2 Question types

One of the most important decisions that a survey designer has to make is which question types to use for which questions. The main question types that are regularly used in surveys and that are available on the platform of QuestionPro are the following:

1. **Closed-ended questions**. These questions fix the possible answers that can be provided by the respondents. The main concern is that those questions often bear positive bias and respondents often try to avoid extreme values (Dillman, 1991). Also, closed questions lose information compared to open-ended questions. These questions are further divided into:

   a. **Radio buttons** – respondents choose one answer from the list of provided answers. These can be further divided into two-option responses (yes/no) and rating ("likert") scales (for example, from "not at all" to "totally").

   b. **Checkboxes** – respondents choose one or more answers from the provided list of answers. Checkboxes are fast and easy way to obtain information and save space.

c. **Scales** – respondents choose where they lie on a given scale (for example from 0-100% of time spent on particular activities).

2. **Open-ended questions**. These questions provide simply an empty box where respondents provide a number/word/sentence that answers the question. The main concern with those questions is that respondents have trouble translating underlying value judgements into a specific word or number. On the other hand, open-ended questions provide considerably more information for the analysis in the later stages than closed items (Dillman, 2011; Groves et al, 2009)

Combinations of closed-ended and open-ended questions are also possible. For example, in many cases where checkboxes are used, there is one answer called "other", which is accompanied by an empty box for elaborating the answer.

Previous research has investigated which question types should be used under which circumstances. Crawford, McCage & Pope (2005) suggest that closed-ended questions should be used when a relatively complete list of possible answers can be produced by the researchers. For open-ended questions, they suggest that the text box should be no longer than the expected answer, otherwise people are encouraged to produce long vague answers and also non-response tends to increase. Couper, Traugott & Lamias (2000) and Groves et al (2009) provide similar suggestions for survey researchers and note that with open-ended questions respondents are less likely to answer and more likely to produce invalid information. They have found support that radio buttons produce less missing data than checkboxes and open-ended questions due to the fact that clicking on a radio button requires considerably less effort than manually typing a response in a box and that respondents often tend to think that they do not have a precise enough answer for the open box. Another suggestion that is provided is to put the open-ended questions in the later stages of the survey.

Many surveys combine closed-ended questions into a grid-format in order to make the survey more compact and decrease the number of questions. Crawford, McCage & Pope (2005) claim that grid format should only be used when there is one answer for a single question or row. Therefore questions with multiple answers should not be put in a grid format as these tend to increase confusion by the respondents.

As described in section 3 and suggested by previous research considered above, the main constructs that are investigated by the R&D survey are measured by closed-ended questions

on an ordinal ("likert") scale. On the platform of QuestionPro, radio buttons have been employed for all these questions that are measured on an ordinal scale. Also, radio buttons have been used for questions concerning the specifics about one´s job and part of the personal information in the last section of the survey. In many cases, questions with radio buttons have been combined into a grid format in order to visually shorten the questionnaire. Closed questions with checkboxes are used mainly for questions measuring the work time regulation at individual's workplace and estimating the impact of transferring from a fixed work time to a flexible work time (or vice versa). Questions with specific scales are used to measure percentage on time spent on certain activities (scale from 0 to 100%) and hours spent on certain tasks (from 0 to 16 hours a day).

Open-ended questions have also been used in the R&D survey, mainly as part of closed-ended questions (the "other "option), where the research team has not been able to provide a complete list of all possible options or where the respective list would be unreasonably long. Secondly, open-ended questions have been used for collecting part of the personal information (weight, height, experience) and for providing comments about the survey.

6.3 Scrolling versus paging

As described before, survey layout choices can have an effect on both responses and responses rates and therefore have important implications on the results of the survey. One of those choices concerns how respondents move from one question to the next. Two principal design options have been developed for this: **scrolling design** and **paging design**.

By its nature, scrolling design means that all questions are displayed on a single page and respondents continuously scroll down the page for answering the next questions. In this case the submit button is in the bottom of the page after all the questions. Paging design, on the other hand, means that every question is presented on a separate page accompanied by a separate submit button. As a result, the next question can only be seen after the previous question has been answered and submitted.

Peytchev et al (2006) studied the implications of applying scrolling versus paging design in web surveys. They note that scrolling design reveals the length of the survey at the outset and may therefore result in more people breaking off from filling in the survey (higher nonresponse) as people consider the burden of responding to all the questions too high. In the

paging design, however, more respondents would initially start with answering the questions, but nonresponse could be higher in the later stages of the survey as people get bored of the topic. Survey researchers have discovered that paging design reduces the time of taking the survey compared to scrolling design (Peytchev et al, 2006; Couper 2000; McCabe & Crawford, 2006). Another advantage of paging design is that it allows adding features such as question validation and automated skip logic (remove some questions based on the responses to previous questions).

In practice, most of the modern surveys are so-called hybrids of the scrolling and paging designs, where questions are divided between a certain number of pages and within the page scrolling is used for answering the subsequent questions. These hybrids aim to employ the advantages of both designs (Peytchev et al, 2006).

In the R&D survey, also a hybrid solution of scrolling and paging design has been applied. The survey questions have been divided between six pages and within these pages scrolling design is employed.

6.4 Progress indicator

Another survey design feature that has been considered in previous research on survey methodology is the implementation of a progress indicator. Progress indicator demonstrates to respondents how far they have progressed with the survey questions.

Previous research that has been investigating this issue is generally in favour of implementing progress indicators. Couper, Traugott, & Lamias (2000) claim that in web surveys without progress indicators respondents do not know how far they have progressed with the survey at hand and it is possible that many surveys are abandoned close to an end as people lose motivation. Therefore progress indicators benefit the survey as they inform the respondents on their progress and motivate them to finish what they have started. Similarly, Healey, Macpherson & Kuijten (2005) and Couper, Traugott & Lamias (2000) find some support that progress indicators reduce drop-out rates, especially in the later stages of the survey. It is also speculated that the effect could be larger for more time-consuming surveys.

Progress indicator has been implemented for the R&D survey based on the recommendations from previous research findings. In addition, as the R&D survey poses a relatively high

burden on the respondents, progress indicator is envisaged to motivate completion of the survey, especially for those respondents who have reached the second half of the survey.

6.5 Question validation

In modern web surveys, automatic question validation is a widely used feature. By its nature, this means that the system (survey platform) automatically validates the answers to the questions after they have been submitted. In case an answer fails the validation test, an error message is displayed to the respondent saying that the answer has to be modified before it is allowed to proceed to the next question. In the most basic form, question validation simply checks whether an answer to the question has been provided or not. In a slightly more advanced form, question validation checks whether the answer fits in a predefined range of acceptable answers. For example, in case respondents have to enter their height, the system automatically checks whether the response is between 140 – 220 centimetres; if not, an error message is displayed. Crawford, McCage & Pope (2005) recommend using validation for all closed—ended questions. It is claimed that validation makes the data that is collected more trustworthy and automatically removes those respondents who answer the survey questions in a random manner.

In the R&D survey, most of the closed-ended questions have been marked mandatory, thereby requiring validation for continuing. For open-ended questions that require numerical input (weight, height, experience in years), predefined validation ranges have been set.

6.6 Automated skip logic

One of the often-noted benefits of modern web surveys is the fact that survey "logic" can easily be introduced. Automated skip logic means that some of the questions are automatically skipped (hidden) based on answers to some previous questions. Previous research has noted positive effects of automated skip due to the fact that the burden of filling in the survey is reduced (Peytchev et al, 2006).

Automated skip logic has been added to the R&D survey. Some questions are displayed depending on whether the respondents currently have fixed or flexible work time options. These questions relate to the reasons why respondents use, do not use or would like to use flexible work time options.

7. Pretesting and running

Previous sections of this study have considered the survey design process from sampling to the actual construction of the survey on the platform of QuestionPro. However, before the survey can be sent to the members of the population that is being investigated, detailed pretesting is required in order to discover the potential errors and other pitfalls that could endanger the results of the survey. In addition, the distribution of the survey has to be carefully planned in order to maximise response rates and procedures for treating sensitive data have to be designed.

7.1 Pretesting

According to Groves et al (2009), pretesting has been a norm in survey research since the starting days of the field. A number of other researchers (Andrews, Nonnecke & Preece, 2003; Couper, 2000; Krosnick, 1999) concur that pretesting of the survey is essential for developing high-quality surveys and reducing survey error. The following three methods for pretesting have been noted:

1. **Expert reviews**

2. **Focus groups**

3. **Field pretest**

Groves et al (2009) claim that expert reviews tend to identify most problems in surveys. However, in case of web surveys, field pretesting is also critical in order to identify concerns that relate to various devices and internet browsers that are used for accessing the survey.

The pretesting of the R&D survey was undertaken in two stages. First an expert review was conducted, where an external researcher critically went through the whole survey. Based on the expert´s feedback, various issues were amended, mainly relating to:

1. **Question wording**. The language of the questions was changed in cases where the expert noted that some terms were too vague. A few grammar mistakes were also pointed out by the expert and corrected by the author.

2. **Question ordering**. The expert pointed to some questions that should be brought forward as these are interesting for the respondents and some questions that should be moved to the end as they could be considered intrusive (personal questions). Additionally, questions asking about the current situation were moved before the questions concerning the wishes and forecasts of the respondents.

3. **Scaling.** The expert recommended transforming the scaling as uniform as possible in order to reduce the burden of filling in the survey. A few scales were homogenised, but no changes were made to the questions that were part of standardised questionnaires or derived directly from previous research (in order to remain comparable to previous studies). "Hard to say" options were removed from the scales where they were present.

Next, the R&D survey was sent for a small field pretest, consisting of a sample size of five respondents. This identified some further issues relating to:

1. **Question wording**. The respondents pointed to a few more cases where wording was unclear and the language of these questions was changed respectively.

2. **Repeating questions**. The respondents noted that there were some questions that essentially measure the same thing. However, none of these were deleted. As was described before, there are some questions in the R&D survey measuring the same underlying construct as this is a common method for measuring validity of questions.

3. **Survey length**. The amount of time required for completing the survey was noted as a concern. The format of some questions was changed in order to reduce the amount of questions (questions were combined into a "grid" format).

7.2 Survey delivery

After the pretesting of the survey has been completed, the survey is essentially ready to be sent to the actual respondents. The distribution has to be planned carefully in order to increase response rates.

Survey researchers (Millar & Dillman, 2011; Groves et al, 2009) have noted that one of the main distribution-related concerns with web-based surveys is that email invitations can be easily ignored and forgotten. The underlying problem concerns the fact that it is difficult to

establish the legitimacy of the survey solely via email correspondence. To counter this issue, two measures have been implemented in the R&D survey process:

1. **Physical meetings** are held with the representatives of every company (general manager and/or HR manager) participating in the research project. The aim of these meetings is to establish legitimacy of the project and gain support from the management. In these meetings, also the process of how and when the surveys will be distributed is explained.

2. Prior to sending the individual email links from the QuestionPro´s platform, **pre-notification emails** are sent to the respondents by the company representatives, which emphasise the importance of the project and the relating survey. This approach was suggested by Andrews, Nonnencke & Preece (2003).

There are two alternative paths offered to the companies for distributing the survey links. The preferred approach is that individual links are sent to the respondents by the research team (via the QuestionPro platform). However, for this companies have to disclose the list of their R&D employees to the research team (including the email addresses). Two participating companies refused that option and for them an alternative solution was designed, which in principle means that these companies send the survey links out by themselves, without any intervention from the R&D research team. The disadvantage of the secondary solution is that automatic reminders cannot be sent from the system and therefore remainders have to be sent manually (also by the company representatives themselves).

Previous research (Andrews, Nonnencke & Preece, 2003; Groves et al, 2009) has noted the importance of designing a multistep schedule for distributing the survey, which makes the whole process more structured and can have positive implications on the response rates. Dillman (1991), Groves et al (2009) and Couper (2002) have all emphasised the importance of sending remainders, which can significantly increase response rates for web surveys.

The R&D survey distribution has been designed to follow the following steps:

1. **Day 0** – pre-notification email sent to the respondents by the representatives of the participating companies.

2. **Day 1** – emails containing links to the survey are sent to the respondents (either by the research team or company representatives).

3. **Day 15** – first remainder email is sent to the respondents (either by the research team or company representatives).

4. **Day 22** – second remainder email is sent to the respondents (either by the research team or company representatives).

5. **Day 29** – in case the response rate of a particular company is still low, an additional reminder is sent, expressing gratitude to those that have already completed the survey and encouraging those who have not. 10% is considered as a threshold for defining low response rate for a particular company.

Before sending out the survey links, ballot stuffing feature of QuestionPro (one of the criteria previously used in Saaty framework) has been enabled in order to make it impossible for any respondent to fill in the survey more than once.

7.3 Treatment of sensitive private information

The R&D survey includes questions that concern sensitive private information. For example, questions concerning the domestic sphere of the respondent (number of persons living together with the respondent and number of children), pay and profession are formulated. In addition, one section of the survey („HEALTH CONDITION) concerns the health of the respondents. Health information is considered sensitive information in Estonia and additional regulations apply when individuals are surveyed about health-related questions. As a result, the R&D survey was sent to Tallinn Medical Research Committee for review and the respective approval was received on 9 February 2015 (decision number 894).

As the survey includes sensitive information, additional safeguards have been designed to protect information confidentiality:

1. The access to the results of the survey is strictly limited to the research team members. Results are stored in a Dropbox account, which is password protected.

2. No data is stored in private computers, emails, etc.

3. After the results are downloaded from QuestionPro, the data that can connect the responses to the particular individual, is immediately separated (Name, surname, email

address) and stored in a separate Dropbox folder protected by a separate password. All the analysis is performed with anonomysed data.

8. Results

The R&D survey was undertaken in two stages, the first round was conducted from April 2015 to August 2015 and the second round from January 2016 to March 2016. The reason for undertaking the survey in two rounds was twofold. Firstly, it was necessary to remove the effects of season (and weather) that could influence the results. For example, it was assumed that people are in general more negative during the darkest and coldest time of the year (January-February) and more positive during summer months. Secondly, having two observation points makes the results of the whole research more prudent as it is possible to separate fixed effects and random effects in econometric modelling.

The results of the **first round** were as follows:

1. In total 365 individuals started the survey, of which 175 completed the survey. This represents a 47% completion rate. 16 responses were later removed from the sample due to answers to some questions which indicated that the individuals are not R&D employees.

2. The average time for completing the survey was 40 minutes.

3. 97% of respondents used a desktop computer or laptop for answering the questions, 2% used a smartphone and 1% used a tablet.

4. The response rates between companies ranged from 11% to 63%. Total response rate was 28%.

The results of the **second round** were as follows:

1. In total 170 individuals started the survey, of which 102 completed the survey. This represents a 58% completion rate. 8 responses were later removed from the sample due to answers to some questions which indicated that the individuals are not R&D employees.

2. The average time for completing the survey was 34 minutes.

3. 98% of respondents used a desktop computer or laptop for answering the questions and 2% used a smartphone.

5. The response rates between companies ranged from 15% to 68%. Total response rate was 31%.

The aim of the data collection process was to obtain responses from over 100 employees in both stages as this if often considered the level where relationships in variables of interest become statistically significant. In total for the two rounds, 279 responses were collected, out of which 41 overlapped.

Comparing the results to previous studies can reveal whether the design of the survey can be considered successful or not. In a comprehensive research project, Stavrou & Kilaniotis (2010) investigated the relationship between flexible working and company turnover. They undertook large-scale surveys in eight countries (UK, Australia, Canada, New Zealand, the USA, Finland, Sweden, Norway and Denmark) and reached response rates between 20-35%. The response rate achieved in the R&D survey is in the upper end of this range.

Beside the response rates, there is another method for assessing the success of the survey design. As mentioned before, respondents could leave comments about the survey in the end of the questionnaire. The analysis of those comments revealed that:

1. There were some concerns about response options of a few questions. Respondents pointed out that some questions should have included more response options. For example, it was noted that between options "rarely" and "often" they missed an option "sometimes" or in some questions the "other" option was absent. However, as these questions were based on standardised questionnaires or derived directly from previous research, the author does not see this as a problem caused by the survey design.

2. No concerns about the length of the questionnaire were expressed.

3. A few participants pointed out that some questions were asking about the same underlying feature. As described before, this was a deliberate feature of the survey design in order to assess the validity of responses measuring the main constructs of interest.

4. No major technical issues were identified. In the second stage of the survey, a few respondents pointed out that the validation errors were not clearly visible between the questions. This was due to the fact that QuestionPro updated its platform between the first and second round of distribution and in the new version validation errors were not marked in red colour as in the previous version. However, as this is purely technical issue relating to the survey platform, the author does not see this as a problem caused by the survey design.

To sum up, the author and other research team members consider the survey design and the relating process as a success due to the fact that a sufficient number of responses were obtained, response rate was relatively high and no major design-related problems were noted by the respondents. The survey filled the needs of the research project, which at the time of writing this thesis was continuing with the econometric analysis of the survey results and preparations for the upcoming papers on the subject.

The results of this study can be used by other survey designers who need to develop modern web-based surveys that involve an interdisciplinary approach and/or complex sampling situations. However, the author notes that when generalising the result of this thesis to other research projects, careful analysis concerning planned analysis methods, scaling issues and population peculiarities need to be undertaken, in order to consider the specifics and aims of the respective project.

9. Conclusion

The purpose of this study was to develop a survey for the research on working time regulation and creativity of the R&D employees. The objective of the study was twofold:

1. To design a high-quality survey that would minimise error in the survey results under the given cost constraints.

2. To serve as a guideline for anyone who is undertaking modern web-based surveys in an interdisciplinary environment and complex sampling situations.

It is obvious that the most important result of this study is the complete R&D survey that was used for undertaking the data collection process for the research project. Additionally, this study in its complete form and step-by-step approach can clearly act as a useful tool for anyone designing surveys, especially web-based surveys. The results on the sub-question level (defined in section 1 of this study) are as follows:

1. The population was defined as R&D employees working in Estonian companies and research institutions that employ more than 15 R&D employees (excluding universities and hospitals). The sampling frame was limited to those companies and institutions that agreed to participate in the project and by the reliability of the records of Statistics Estonia and Estonian Commercial Register. The final sample consists of those R&D employees, who decided to complete the survey and who perceive their work as being creative.

2. Previous research was used for formulating the survey questions. Some of the questions were employed from previous research projects, while others were written by the author. With respect to self-written questions, guidelines proposed by Groves et al (2009) were used as a starting point, whereas some amendments were proposed by the author.

3. Web-based survey was selected as the sole mode of data collection after considering the advantages and disadvantages of various modes and the context of the R&D research project. Saaty decision-making framework was used for selecting the service

provider (platform) for the survey. Based on the model constructed, QuestionPro was chosen as the platform for the R&D survey.

4. Results from previous research were used for constructing the survey on the platform of QuestionPro. The design choices included: general ordering of the survey sections and questions, question type choices, implementation of the hybrid of paging and scrolling design, implementation of progress indicator, elements of question validation and automated skip logic, etc. Additionally, the survey was pretested, distribution schedule was designed and procedures for treating sensitive information were set up, deeming the survey set for data collection.

To conclude, the author considers the objectives that were defined in the beginning of this study to be achieved. The results of this study are considered a success based on the following:

1. The design of the R&D survey satisfied the needs of the research project on working time regulation and creativity of the R&D employees. A sufficient number of respondents were obtained allowing the project to continue into a subsequent stage focusing on econometric modelling. This demonstrates the quality of the survey.

2. The R&D survey exhibited similar response rates to previous surveys relating to flexible working, which also supports the fact that the design was successful and no major sources of error were present in the R&D survey.

3. The comments left by the respondents of the R&D survey did not reveal any major concerns about the design and the relating survey process.

The research project that the R&D survey is part of is far from over. The next major step is a complete analysis of the data collected and testing of the hypotheses that were posed, after which the results can be published in separate papers.

Similarly, research is the field of survey methodology is far from being complete. Future studies could explore in more detail the new innovative elements that many web-based survey platforms offer, for example graphical rating scales, conjoint models and complex grids, and their effects on survey error.

9. Kokkuvõte

Käesoleva magistritöö eesmärk oli ehitatada üles küsitlusuuring teadus-ja arendustöötajate tööajakorralduse ja loovuse mõjutegureid uuriva teadusprojekti läbiviimiseks. Tööl oli kaks alameesmärki:

1. Disainida kõrge kvaliteediga küsitlusuuring, mis vähendaks miinimumuni hälvet uuringu tulemustes, arvestades samas ka projekti poolt seatud finantsiliste piirangutega.

2. Koostada juhendmaterjal igaühele kes viib läbi modernset veebipõhist küsitlusuuringut interdistsiplinaarses keskkonnas ja keerulistes valimi määratlemise situatsioonides.

Selgelt kõige olulisem töö tulemus on valmis küsimustik, mida on juba edukalt kasutatud teadusprojekti jaoks andmete kogumiseks. Lisaks on käesolev töö oma kompaktses vormis ja etapiviisilises lähenemises hea tööriist kõigile küsitlusuuringute koostajatele, eriti just veebipõhiste küsitlusuuringute puhul. Töö tulemused alaküsimuste tasemel (defineeritud käesoleva töö esimeses peatükis) on järgnevad:

1. Uuringu aluseks olev populatsioon defineeritud kui teadus- ja arendustöötajad, kes töötavad Eesti ettevõtetes ja insitutsioonides, kus on rohkem kui 15 teadus- ja arendustöötajat (v.a. ülikoolid ja haiglad). Valimi raamistiku määratles ära ettevõtete ja insitutsioonide nõusolek uuringus osaleda ning Statistikaameti ja Äriregistri andmete usalduväärsus. Lõplik valim koosneb nendest teadus- ja arendustöötajatest, kes täitsid küsitlusuuringu lõpuni ja kes ka ise peavad oma tööd teadus- ja arendustegevuseks.

2. Küsimuste formuleerimiseks kasutati varasema teadustöö tulemusi. Mõned küsimused võeti varasematest teadusprojektidest võrreldavuse tagamiseks, kuid ülejäänud konstrueeriti autori enda poolt. Ise formuleeritud küsimuste puhul kasutati lähtekohana Groves et al (2009) poolt loodud juhendit, millele autor pakkus välja omapoolseid parandusi.

3. Erinevate andmekogumise viiside eelised ja puudused hinnati varasema teadustöö põhjal, arvestades samas ka teadus-ja arendustöötajate uurimisprojekti konteksti, mille tulemusel valiti ainsaks andmekogumise viisiks veebipõhine küsimustik. Sobiva teenusepakkuja (platvormi) valimiseks kasutati Saaty otsusmudelit, mille põhjal valiti uuringu läbiviimiseks QuestionPro platvorm.

4. Küsimustiku ülesehitamiseks QuestionPro platvormil kasutati samuti varasema teadustöö tulemusi. Olulisemad otsustuskohad olid järgnevad: üldine sektsioonide ja küsimuste järjestus, küsimuste tüüpide valik, küsimuste vahel liikumise moodus, vastatud ja vastamata küsimuste suhte osakaalu näidiku kuvamine, küsimuste automaatne valideerimine, automaatsed küsimustest ülehüppe valikud, jt. Lisaks viidi läbi küsitlusuuringu eeltestimine, planeeriti laialisaatmise ja andmekogumise protsess ning seati paika protseduurid sensitiivsete isikuandmete töötlemiseks.

Kokkuvõtvalt loeb autor töö alguses sätestatud eesmärgid täidetuks. Töö tulemusi võib pidada edukaks järgmiste argumentide põhjal:

1. Küsitlusuuring täitis teadusprojekti poolt seatud eesmärke. Andmekogumise protsessis koguti piisav arv vastanuid, mille tulemusel saab kogu projekt liikuda edasi ökonomeetrilise modelleerimise faasi. See demostreerib küsitlusuuringu kvaliteeti.

2. Küsitlusuuringu käigus saavutatud vastanute osakaalud on võrreldavad teiste sarnaste uuringutega samas valdkonnas, mis samuti toetab fakti, et küsitlusuuringu disain oli edukas ja tulemused ei sisalda olulist hälvet.

3. Küsitlusuuringu vastajate poolt jäetud kommentaaride analüüs ei tuvastatud, et ankeet oleks sisaldanud olulisi vigu.

Teadus- ja arendustöötajate teadusprojekt ei ole veel kaugeltki lõppenud. Järgmine samm on kogutud andmete põhjalik analüüs ja püstitatud hüpoteeside testimine, mille järel saab tulemusi publitseerida rahvusvahelistes teadusajakirjades.

Samuti ei ole küsitlusuuringute metodoloogia valdkond veel kaugeltki valmis. Tulevased projektid peaksid uurima innovaatilisemate elementide (mida paljud veebiplatvormid pakuvad) rakendamist (näiteks graafilised skaalad, ühendatud küsimuste mudelid, kompleksed küsimustike võrgustikud) ja nende mõju tulemuste hälbele.

Summary

This master thesis focused on the design, methodology and technical solution for the survey that contributed to the research project investigating the working time regulation and creativity of the R&D employees. The main aim was to take a scientific and interdisciplinary approach in order to design a high-quality survey that would fill the requirements of the research project. In addition, the secondary objective was to act as a guideline for other survey designers undertaking modern web-based surveys. The central problem that this study was seeking to solve was how to develop a high-quality survey for the research on working time regulation and creativity of the R&D employees.

The main result of this study was the complete R&D survey, which was successfully used for undertaking the data collection process for the R&D research project. The design of the survey was considered a success as a sufficient number of responses were obtained, response rate was relatively high and no major design-related problems were noted by the respondents.

References

Adan, A., & Almirall, H. (1991). Horne and Östberg Morningness-Eveningness Questionairre: a reduced scale. *Personality and Individual Differences*.

Almeida, D. M., & Davis, K. D. (2010). Workplace Flexibility and Daily Stress Processes in Hotel Employees and their Children. *Alfred P. Sloan Foundation*.

Amabile, T. M., Hadley, C. N., & Kramer, S. J. (202). Creativity under the Gun. *Harvard Business Review*.

Andrews, D., Nonnecke, B., & Preece, J. (2003). Electronic survey methodology: A case study in reaching hard-to-involve internet users. *International Journal of Human-Computer Interaction*.

Brick, M. J. (2011). The future of survey sampling. *Public Opinion Quarterly*.

Christian, L. M., & Dillman, D. A. (2004). The influence of symbolic and graphical language manipulations on answers to self-administered questionairres: results from 14 experimental comparisons. *Public Opinion Quarterly*.

Couper, M. P. (2000). Web Surveys: A review of issues and approaches. *Public Opinion Quarterly*.

Couper, M. P., Traugott, M. W., & Lamias, M. J. (2000). Web Survey Design and Administration. *Public Opinion Quarterly*.

Crawford, S., McCabe, S. E., & Pope, D. (2005). Applying web-based survey design standards. *Technology Applications in Prevention*.

de Menezes, L. M., & Kelliher, C. (2011). Flexible Working and Performance: A Systematic Review of the Evidence for a Business Case. *International Joournal of Management Reviews*.

Dillman, D. A. (1991). The design and administration of mail surveys. *Annual Review of Sociology*.

Efron, B. (1981). Nonparametric estimates of standard error: The jacknife, the bootstrap and other methods. *Biometrika*.

Efron, B., & Stein, C. (1981). The Jacknife Estimate of Variance. *The Annals of Statistics*.

Groves, R. M., Fowler, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2009). *Survey Methodology.* New Jersey: Wiley Series in Survey Methodology.

Hardin, J., & Hilbe, J. (2007). Generalized Linear Models and Extensions. *Stata Press*.

Hazak, A., Virkebau, M., Tuulik, V., Tint, P., Pille, V., & Sõõru, E. (Forthcoming). Employee Performance, Working Time and Tiredness in Creative R&D Jobs: Employee Survey from Estonia. *7th International Conference, The Economies of Balkan and Eastern Europe Countries in thechanged world, EBEEC 2015, May 8-10, 2016*.

Healey, B., Macpherson, T., & Kuijten, B. (2005). An empirical evaluation of three web survey design principles. *Marketing Bulletin*.

Heckman, J. (1979). Sample selection bias as a specification error. *Econometrica*.

Johns, M. W. (1991). A new method for measuring daytime sleepiness: The Epworth sleepiness scale. *Sleep*.

Kaplowitz, M. D., Hadlock, T. D., & Levine, R. (2004). A comparison of web and mail survey response rates. *Public Opinion Quarterly*.

Kelliher, C. (2008). Flexible Working and Performance: Summary of Research. *Working families publication*.

Krosnick, J. A. (1999). Survey research. *Annual Review of Psychology*.

Krosnick, J. A., & Fabrigar, L. R. (1997). *Designing rating scales for effective measurement in surveys.* New York: John Wiley.

Millar, M. M., & Dillman, D. A. (2011). Improving response to web and mixed-mode surveys. *Public Opinion Quarterly*.

Peytchev, A., Couper, M. P., McCabe, S. E., & Crawford, S. D. (2006). Web Survey Design: Paging Versus Scrolling. *Public Opinion Quarterly*, 596-607.

Saaty, T. L. (1990). How to make a decision: The Analytic Hierarchy Process. *European Journal of Operational Research*.

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *Int. J. Services Sciences*.

Seo, Y. W., Chae, S. W., & Lee, K. C. (2014). The impact of absorptive capacity, exploration, and exploitation on individual creativity: Moderating effect of subjective well-being . *Computers in Human Behavior*.

Shih, T.-H., & Fan, X. (2007). Response rates and mode preferences in web-mail mixed-mode surveys: A meta analysis. *International Journal of Internet Science*.

Sills, S. J., & Song, C. (2002). Innovations in survey research: an application of web-based surveys. *Social Science Computer Review*.

Stavrou, E., & Kilaniotis, C. (2010). Flexible Work and Turnover: An Empirical Investigation across Cultures. *British Journal of Management*.

Winship, C., & Mare, R. D. (1992). Models for Sample Selection Bias. *Annual Review of Sociology*.

Appendix 1: the R&D survey

TEADUS- JA ARENDUSTÖÖTAJATE TÖÖAJAKORRALDUSE JA LOOVUSE MÕJUTEGURITE UURING

Dear participant

We are asking you to participate in a research project undertaken by Tallinn University of Technology and co-funded by Estonian Research Council research grant PUT315 „Towards the Knowledge Economy: Incentives, Regulation and Capital Allocation". Before you decide on your participation, please read carefully the following information, which explains the purpose of this research and the potential effects of your participation. This research project has been approved by the Tallinn Medical Research Ethics Committee on 9 February 2015 by decision No. 894.

<u>**The purpose of this research**</u>
The purpose of this research is to investigate working time arrangement of research and development (R&D) employees and its potential impact on the results of their creative work. The main focus is on the differences between fixed and flexible work time arrangements for creative R&D employees (scientists; IT-developers; engineers; product, service or business developers; etc.) with respect to their work results, job satisfaction, tiredness, sleepiness and other characteristics.

<u>**The duration of the research**</u>
Your involvement in the research begins on the day when you start filling in the survey and ends on the day when you complete the survey. We are asking you to fill in the survey during a two-week period, on the start and end day of which we will inform you separately. Even though we recommend completing the survey at once, it is possible to complete the survey in parts by saving the completed parts and continuing with the outstanding parts later.

<u>**What does your participation mean?**</u>
Your participation in the research project is at this stage limited to filling in the survey. For potential follow-up research, we will provide a separate information sheet and ask for a separate consent in case you turn out to be an appropriate candidate for the follow-up research.

<u>**Taking back your consent**</u>
Even if you have given your consent for participating in the research project, you can forego your participation at any point of time without having to explain your decision.

<u>**Privacy and the use of medical information**</u>
The survey that you are asked to fill in as part of the research collects some sensitive personal data as it includes to a limited extent questions concerning your health and medical history. These questions are general and concern the effects of your health conditions on your work, while the survey does not ask you to name the diseases that are or have been afflicting you. The answers from the survey will be retained in a digital database, which can be accessed only by a limited number of the research team members. Your personal answers will not be publicised in any form.

In the end of the questionnaire we will ask your name and email address. Filling in your name is not compulsory. We need your email address for the purposes of sending you a personal and confidential feedback on the survey, as well as for contacting you on a potential follow-up study. When summarising the survey results, your name and email address will in no case be connected to the responses that you have given.

<u>**The results of the research**</u>
The results of the survey will be concluded at an aggregate level. The results might be publicised in scientific journals and other publications. In the output of the research, the names of the companies that participated could be revealed, but the names of the persons that participated will not be revealed.

If you have any questions concerning the research project please turn to:

Principal investigator: Aaro Hazak, PhD, Professor at Tallinn University of Technology
E-mail: aaro.hazak@ttu.ee
Phone: +372 6204050 / 6204066

☐ **I have read the information sheet at hand and received sufficient information about the research. I am giving a voluntary consent for participating in this research and for processing personal data, including sensitive personal data.**
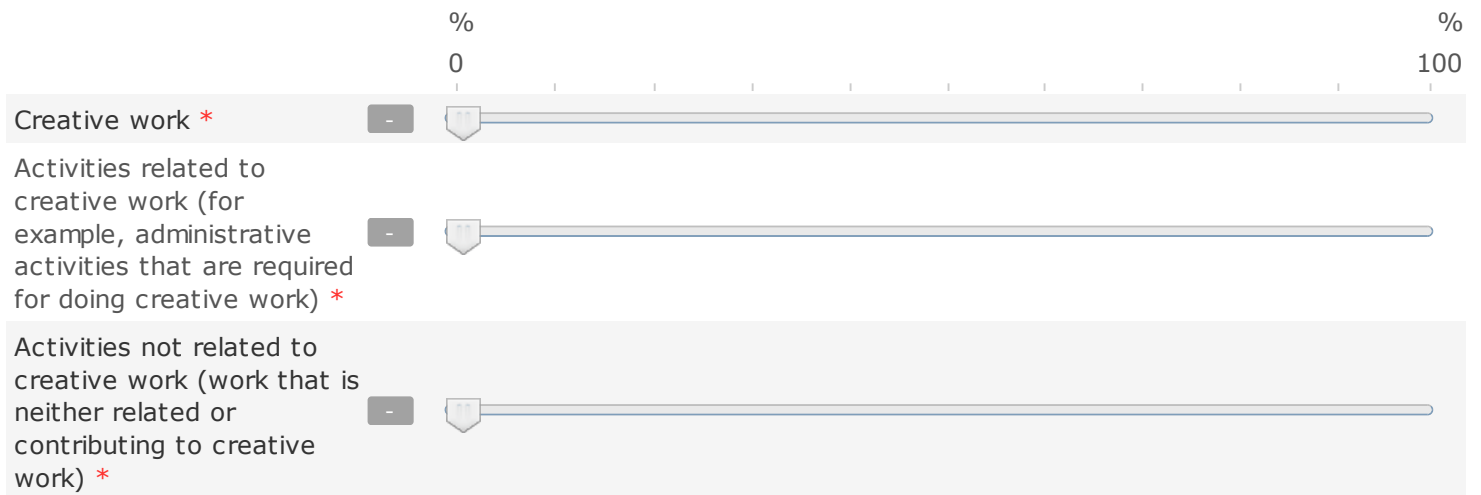
Do you consider your work a research and/or development activity requiring creativity?

What we have in mind is work where most of the time is spent on creative research and/or development (from now on „creative work"). *

- ○ Very much
- ○ Somewhat
- ○ Hard to say
- ○ Slightly
- ○ Not at all

Please mark approximately how much of your total working time (in percentages) is spent on the following activities

	% 0		% 100
Creative work *	-		
Activities related to creative work (for example, administrative activities that are required for doing creative work) *	-		
Activities not related to creative work (work that is neither related or contributing to creative work) *	-		

To what extent are you able to affect the division of your work time between the activities mentioned in the previous question (creative work, activities related to creative work, activities not related to creative work)? *

- ○ Not at all
- ○ To a small extent
- ○ Somewhat
- ○ To a large extent
- ○ Totally

Which of the following elements are defined in your job contract (or other document relating to your work arrangements)? Please indicate the agreed number of hours/days. *

- ☐ A fixed amount of work-hours per day
- ☐ Other fixed time frame of work (a fixed number of hours/days in a week or month)
- ☐ A fixed start time of the workday
- ☐ A fixed end time of the workday
- ☐ A fixed timeframe of the day, when you are required to be present at the workplace
- ☐ A fixed place, where your work has to be done (e.g. office, factory, etc)
- ☐ The work has to be completed by a specific time (a fixed goal that should be achieved)

☐ Flexible work time (i.e. there is no fixed start and end time of the workday and the amount of work-hours and work-days is not fixed)

☐ I do not know, work time set by the job contract or other regulations is not important

---

Are you obliged to report on the usage of your work time? *

○ Yes, a formal time usage report has to be submitted on a regular basis

○ Yes, formal time usage reports have to be submitted from time to time (for example, for specific projects)

○ Yes, time usage has to be explained in an informal format (for example, at meetings)

○ No obligation to report on the time usage

To what extent does the time usage reporting affect your pay? *

○ Not at all

○ To a small extent

○ Somewhat

○ To a large extent

○ Totally

When does your regular workday start and end? *

○ Workday usually starts and ends at a fixed time

○ Workday usually starts at a fixed time, but ends irregularly

○ Workday usually starts irregularly, but ends at a fixed time

○ There is a regular part of the workday, which starts and ends at a fixed time and an irregular part of the workday which differs from day to day

○ Regular workday cannot be defined as the start- and end times of a workday differ considerably from day to day

---

How long is your average workday at the given employer (please indicate average total hours of doing the work as well as being at the workplace for other reasons, assuming five working days per week)?

Hours   Hours
0   16

*
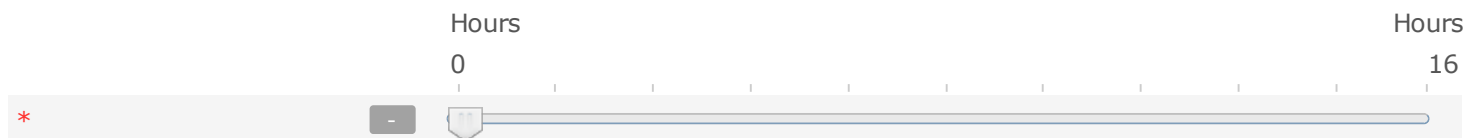
Do you work somewhere else as well? *

○ No

○ Yes

Approximately how many hours do you actually spend on doing the following on average per workday (in total for all your employers)?

Hours   Hours
0   16

Work at the workplace *

Work away from the workplace *

Being at the workplace (both for work and for other reasons) *

[-] [slider]

Does your employer allow you to officially (based on a written agreement or prior given consent) use the following options. You can choose multiple answers. *

- ☐ Flexible work time (an option to choose when to start and end a workday)
- ☐ Part-time work time (an option to temporarily or permanently work with less than a full-time workload)
- ☐ It is possible to work from a location suitable for me (e.g. home) as often as I like
- ☐ It is sometimes possible to work form a location suitable for me
- ☐ There are no such possibilities

Does your employer allow you to unofficially (without a written agreement or prior consent) use the following options? You can choose multiple answers. *

- ☐ Flexible work time (an option to choose when to start and end a workday)
- ☐ Part-time work time (an option to temporarily or permanently work with less than a full-time workload)
- ☐ It is possible to work from a location suitable for me (e.g. home) as often as I like
- ☐ It is sometimes possible to work form a location suitable for me
- ☐ There are no such possibilities

To what extent can you decide yourself about the speed of work and the time for breaks while executing your work tasks? *

- ○ Not at all
- ○ To a small extent
- ○ Somewhat
- ○ To a large extent
- ○ Totally

To what extent are you satisfied with your current work time arrangement? *

- ○ Not at all
- ○ To a small extent
- ○ Somewhat
- ○ To a large extent
- ○ Totally

To what extent is your current work time arrangement having a negative effect on your creativity? *

- ○ Not at all
- ○ To a small extent
- ○ Somewhat
- ○ To a large extent
- ○ Totally

To what extent do the following factors cause your workday not to start and end at the times that you would prefer?

	Not at all	To a small extent	Somewhat	To a large extent	Totally
Conditions set in the job contract *	○	○	○	○	○
Informal arrangements with the employer *	○	○	○	○	○
Discontent and potential jealousy from colleagues *	○	○	○	○	○
Restrictions due to teamwork *	○	○	○	○	○
Disapproval of management *	○	○	○	○	○
Pay is related to the time spent at work *	○	○	○	○	○
Obligation to report on the time usage *	○	○	○	○	○
Nature of work *	○	○	○	○	○
Obligations relating to my close ones *	○	○	○	○	○

How much of your work time (in percentages) would you like to dedicate on creative work (in case you could choose freely)?

%
0

%
100

* 　　　　　 -
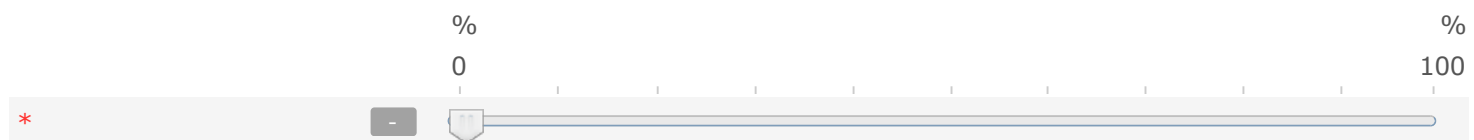
When would your workday start and end if you could choose it freely by yourself? *

○ Workday would start and end at a fixed time

○ Workday would start at a fixed time, but end irregularly

○ Workday would start irregularly, but end at a fixed time

○ There would be a regular part of the workday, which would start and end at a fixed time and an irregular part of the workday which would differ from day to day

○ Regular workday cannot be defined as my workload would differ considerably from day to day (for example, working 4 hours on one day and 12 hours on the other)

How would you prefer to work in case you could freely divide your workload within a week?

○ With high concentration on 1-2 days a week

○ With high concentration on 3-4 days a week

○ By a common standard of 5 days a week

○ With a dispersed workload on 6-7 days a week

To what extent would the nature of your work allow the usage of the following options?

	Not at all	To a small extent	Somewhat	To a large extent	Totally
With respect to creative work, flexible work time could be used *	○	○	○	○	○
With respect to creative work, part-time work could be used *	○	○	○	○	○

With respect to creative work, working at a distance from the workplace of the employer could be used *	○	○	○	○	○
With respect to other work activities, flexible work time could be used *	○	○	○	○	○
With respect to other work activities, part-time work could be used *	○	○	○	○	○
With respect to other work activities, working at a distance from the workplace of the employer could be used *	○	○	○	○	○

Why do you use flexible work time options? Answer in case you have such options and you are using them. You can choose multiple answers.

☐ I enforce flexible work time due to the needs of my employer

☐ Flexible work time has a positive effect on my health

☐ Flexible work time has a positive effect on my ability to work (efficient time usage)

☐ Flexible work time has a positive effect on my work productivity (work will be done)

☐ Flexible work time has a positive effect on the quality of my work

☐ Flexible work time improves my work and life balance

☐ Flexible work time allows me to spend time on other things beside work (hobbies, etc.)

☐ Flexible work time allows me to shorten my commute to work

☐ Flexible work time allows me to fulfill my obligations relating to my close ones (for example, driving family members or taking care of them according to their needs)

☐ Flexible work time allows me to take care of pets

Why would you like to use the flexible work time options? Answer in case you do not have those options. You can choose multiple answers.

☐ I believe that flexible work time would better fulfill the needs of my employer

☐ I believe that flexible work time would have a positive effect on my health

☐ I believe that flexible work time would have a positive effect on my ability to work (efficient time usage)

☐ I believe that flexible work time would have a positive effect on the productivity of my work (work gets done)

☐ I believe that flexible work time would have a positive effect on the quality of my work

☐ I believe that flexible work time would improve my work and life balance

☐ I believe that flexible work time would allow me to spend time on other things beside work (hobbies, etc.)

☐ I believe that flexible work time would shorten my commute to work

☐ I believe that flexible work time would allow me to fulfill my obligations relating to my close ones (for example, driving family members or taking care of them according to their needs)

☐ I believe that flexible work time would allow me to take care of pets

Why do you not use flexible work time options? Answer in case you have those options, but you are not using them. You can choose multiple answers.

☐ I have asked and my employer does not allow me to use these options

☐ I believe that my employer would not allow me to use such options

- ☐ The transition to flexible work time would be uncomfortable
- ☐ I have not had time to deal with that
- ☐ I am afraid that transition to flexible work time would have a negative effect on my career prospects
- ☐ I am afraid that transition to flexible work time would have a negative effect on my pay
- ☐ I believe that the productivity of teamwork would suffer
- ☐ Fixed work time corresponds better to the needs of my employer
- ☐ Fixed work time has a positive effect on my health
- ☐ Fixed work time has a positive effect on my ability to work
- ☐ Fixed work time has a positive effect on my work productivity
- ☐ Fixed work time has a positive effect on the quality of my work
- ☐ Fixed work time improves my work and life balance
- ☐ Fixed work time allows me to spend time on other things beside work (hobbies, etc.)
- ☐ Fixed work time allows me to fulfill my obligations relating to close ones (for example, driving family members or taking care of them according to their needs)

WORK SATISFACTION

To what extent are you satisfied with your work? *

- ○ Not at all
- ○ To a small extent
- ○ Somewhat
- ○ To a large extent
- ○ Totally

To what extent do you feel that you are fit to solve work tasks creatively? *

- ○ Not at all
- ○ To a small extent
- ○ Somewhat
- ○ To a large extent
- ○ Totally

To what extent do the following factors have a NEGATIVE effect on your WORK SATISFACTION?

	Not at all	To a small extent	Somewhat	To a large extent	Totally
Mental fatigue *	○	○	○	○	○
Physical fatigue *	○	○	○	○	○
Sleepiness *	○	○	○	○	○
Working environment at the workplace *	○	○	○	○	○
Working environment at home *	○	○	○	○	○
Colleagues *	○	○	○	○	○
Management *	○	○	○	○	○
Teamwork *	○	○	○	○	○

Routine *	○	○	○	○	○
Low salary *	○	○	○	○	○
Unsuitable work time *	○	○	○	○	○
Time usage reporting obligation *	○	○	○	○	○
Work tasks that are unclear *	○	○	○	○	○
Work tasks that are too hard *	○	○	○	○	○
Work tasks that are too simple *	○	○	○	○	○
Inefficient time usage *	○	○	○	○	○

With respect to your creative work, have you often come across the following points of stress? You can choose multiple answers. *

☐ Work tasks that are impossible to be completed within the agreed time

☐ Work tasks that that are impossible to be completed with an appropriate quality within the agreed time

☐ The unsuitable timing of work makes it impossible to finish work within the agreed time

☐ The unsuitable timing of work makes it impossible to finish work with an appropriate quality within the agreed time

☐ The unsuitable timing of work harms my desirable work and life balance

☐ The duration of the workday/workweek harms my desirable work and life balance

☐ Mental fatigue forces me to end work earlier than preferred/ required or slows me down

☐ Physical fatigue forces me to end work earlier than preferred/ required or slows me down

☐ Sleepiness forces me to end work earlier than preferred/ required or slows me down

WORK PRODUCTIVITY

How often do you feel that you are satisfied with the results of your creative work? *

○ Never

○ Rarely

○ Sometimes

○ Rather often

○ Often

To what extent do the following factors have a NEGATIVE effect on the RESULTS of your creative work?

	Not at all	To a small extent	Somewhat	To a large extent	Totally
Mental fatigue *	○	○	○	○	○
Sleepiness *	○	○	○	○	○
Work conditions at the workplace *	○	○	○	○	○
Work conditions at home *	○	○	○	○	○
Colleagues *	○	○	○	○	○
Management *	○	○	○	○	○
Teamwork *	○	○	○	○	○
Routine *	○	○	○	○	○

Low salary *	○	○	○	○	○
Unsuitable work time *	○	○	○	○	○
Time usage reporting obligation *	○	○	○	○	○
Work tasks that are unclear *	○	○	○	○	○
Work tasks that are too hard *	○	○	○	○	○
Work tasks that are too easy *	○	○	○	○	○
Inefficient time usage *	○	○	○	○	○

Please mark to what extent the following statements are true with respect to your creative work.

	Not at all	To a small extent	Somewhat	To a large extent	Totally
My creative work creates new knowledge or other reusable value *	○	○	○	○	○
I am offering new solutions for achieving work-related goals *	○	○	○	○	○
I am offering practical solutions for increasing work productivity *	○	○	○	○	○
I am offering possibilities for increasing work quality *	○	○	○	○	○
My creative work often receives positive feedback *	○	○	○	○	○

In case you would have to transfer to fixed work time, how would you evaluate the effect on the following? Please answer the question only if you currently have flexible work time.

	Very strong positive effect	Strong positive effect	Small positive effect	Very small positive effect	No effect	Very small negative effect	Small negative effect	Strong negative effect	Very strong negative effect
Your work satisfaction *	○	○	○	○	○	○	○	○	○
The productivity of your creative work *	○	○	○	○	○	○	○	○	○
The quality of your creative work *	○	○	○	○	○	○	○	○	○

In case you would be able to use the possibilities of flexible work time, how would you evaluate the effect on the following? Please answer the question only if you currently have fixed work time.

	Very strong positive effect	Strong positive effect	Small positive effect	Very small positive effect	No effect	Very small negative effect	Small negative effect	Strong negative effect	Very strong negative effect
Your work satisfaction *	○	○	○	○	○	○	○	○	○
The productivity of your creative work *	○	○	○	○	○	○	○	○	○
The quality of your creative work *	○	○	○	○	○	○	○	○	○

SLEEPINESS

How much do you sleep on average per day? *

○ Less than 6 hours
○ 6-7 hours
○ 7-8 hours
○ 8-9 hours
○ Over 9 hours

How often do you feel sleepy while sitting and reading? *

○ Never
○ Sometimes
○ Often
○ Always

How often do you feel sleepy while working with a computer? *

○ Never
○ Sometimes
○ Often
○ Always

How often do you feel sleepy while watching TV? *

○ Never
○ Sometimes
○ Often
○ Always

How often do you feel sleepy while sitting inactively in a public place (e.g. theatre or meeting)? *

○ Never
○ Sometimes
○ Often
○ Always

How often do you feel sleepy while being a passenger in a car during a one-hour-drive without a break? *

○ Never
○ Sometimes
○ Often
○ Always

How often do you feel sleepy while sitting and talking to someone? *

○ Never
○ Sometimes

- ○ Often
- ○ Always

How often do you feel sleepy after lunch (without alcohol)? *
- ○ Never
- ○ Sometimes
- ○ Often
- ○ Always

How often do you feel sleepy while sitting in a car that has stopped in traffic for a couple of minutes? *
- ○ Never
- ○ Sometimes
- ○ Often
- ○ Always

Do you snore loudly (louder than regular speech or your snoring is heard in the other room even if the door is closed)? *
- ○ Yes
- ○ No

Do you often feel not really well-rested, tired or sleepy during daytime? *
- ○ Yes
- ○ No

Have you been noticed to have breathing problems while sleeping? *
- ○ Yes
- ○ No

To what extent to the following factors have an effect on your sleepiness?

	Not at all	To a small extent	Somewhat	To a large extent	Totally
High workload (long workdays and not much sleep time)	○	○	○	○	○
Fixed work time that does not fit with my sleep cycle	○	○	○	○	○
Flexible work time that causes irregular sleep cycle	○	○	○	○	○
Time schedules of family members	○	○	○	○	○
External factors disturbing sleep (noise, light, etc.)	○	○	○	○	○
Chronical diseases	○	○	○	○	○
Other diseases	○	○	○	○	○

Anxiety ○ ○ ○ ○ ○

SLEEP CYCLE

Approximately what time would you get up if you were entirely free to plan your day? *
○ 5.00 – 6.30
○ 6.30 – 7.45
○ 7.45 – 9.45
○ 9.45 – 11.00
○ 11.00 – 12.00

During the first half hour after you wake up in the morning, how do you feel? *
○ Very tired
○ Fairly tired
○ Fairly refreshed
○ Very refreshed

At approximately what time in the evening do you feel tired, and, as a result, in need of sleep? *
○ 20.00 – 21.00
○ 21.00 – 22.15
○ 22.15 – 00.45
○ 00.45 – 2.00
○ 2.00 – 3.00

At approximately what time of the day do you usually feel your best? *
○ 5.00 – 8.00
○ 8.00 – 10.00
○ 10.00 – 17.00
○ 17.00 – 22.00
○ 22.00 – 5.00

One hears about "morning types" and "evening types". Which one of these types do you consider yourself to be? *
○ Definitely a morning type
○ Rather more a morning type than an evening type
○ Rather more an evening type than a morning type
○ Definitely an evening type

To what extent do you feel that your sleep cycle is limiting or has limited your work options? *

- Not at all
- To a small extent
- Somewhat
- To a large extent
- Totally

To what extent do you feel that your work is limiting or has limited your sleep cycle? *

- Not at all
- To a small extent
- Somewhat
- To a large extent
- Totally

FATIGUE

Have you recently felt joy over your daily activities? *

- Never
- Rarely
- Sometimes
- Rather often
- Often

Have you recently been active and energetic? *

- Never
- Rarely
- Sometimes
- Rather often
- Often

Have you recently been optimistic about the future? *

- Never
- Rarely
- Sometimes
- Rather often
- Often

To what extent do you consider yourself happy? *

- Not at all
- To a small extent

- Somewhat
- To a large extent
- Totally

To what extent are the following statements true about you?

	Not at all	To a small extent	Somewhat	To a large extent	Totally
When I am tired, my work motivation is lower *	○	○	○	○	○
Physical effort makes me tired *	○	○	○	○	○
I get tired easily *	○	○	○	○	○
Fatigue harms my physical capability *	○	○	○	○	○
Fatigue causes problems for me all the time *	○	○	○	○	○
Fatigue harms the development of my physical capability *	○	○	○	○	○
Fatigue disturbs me at fulfilling some obligations *	○	○	○	○	○
Fatigue is among the three most disturbing aspects in my life *	○	○	○	○	○
Fatigue harms my work-, family- or social life *	○	○	○	○	○

How often do you feel emotionally drained from your work? *
- Never
- Rarely
- Sometimes
- Rather often
- Often

What do you see as the underlying reasons for your mental fatigue? You can choose multiple answers *
- ☐ Sleepiness
- ☐ High workload (long workdays)
- ☐ Fixed work time , which does not fit to my lifestyle/rhythm
- ☐ Flexible work time, which causes irregular lifestyle/rhythm
- ☐ Chronical diseases
- ☐ Other diseases
- ☐ Anxiety
- ☐ Other

HEALTH CONDITION

What is your current ability to work compared to the best level of your life? Assuming that your best level

amounted to 10 points, please assess your current ability to work (0 shows that you are currently unable to work)

	Incapable to work								Best working condition		
	0	1	2	3	4	5	6	7	8	9	10
*	○	○	○	○	○	○	○	○	○	○	○

With respect to the load of mental work, how do you evaluate your ability to work creatively? *
- ○ Very low
- ○ Somewhat low
- ○ Average
- ○ Rather good
- ○ Very good

What is your: Height (cm) *
Weight (kg) *

Neck measurement *
- ○ over 40 cm
- ○ below 40 cm

Do you have high blood pressure or have you ever used medicine for high blood pressure? *
- ○ Yes
- ○ No

Do you suffer or have you suffered from diseases that significantly affect your sleepiness? *
- ○ Never
- ○ Rarely
- ○ Sometimes
- ○ Rather often
- ○ Often

Do you suffer or have you suffered from diseases that significantly affect your mental fatigue? *
- ○ Never
- ○ Rarely
- ○ Sometimes
- ○ Rather often
- ○ Often

Do you suffer or have you suffered from diseases that significantly affect your physical fatigue? *

- Never
- Rarely
- Sometimes
- Rather often
- Often

To what extent do you feel that the current work time arrangement is causing any of your current diseases or has caused your diseases in the past? *

- Not at all
- To a small extent
- Somewhat
- To a large extent
- Totally

Does your disease or injury interrupt you while doing your daily job? *

- No obstacles to work, I do not suffer from any disease or injury
- I am able to fulfill my work tasks, but I have some symptoms
- I sometimes have to reduce my speed of work or change work methods
- I often have to reduce my speed of work or change work methods
- Due to my disease I feel that I am only capable of working part of the scheduled work time
- I find than I am not able to work

How many workdays have you been absent from work due to disease or medical examination in the past year (12 months)? *

- None
- Not more than 9 days
- 10 – 24 days
- 25 – 99 days
- 100 – 365 days

Has your doctor related your diseases (if any) to the following reasons? You can choose multiple answers

- ☐ Sleepiness
- ☐ Mental fatigue
- ☐ Physical fatigue
- ☐ Fixed work time arrangement

Have you yourself related your diseases (if any) to the following reasons? You can choose multiple answers

- ☐ Sleepiness
- ☐ Mental fatigue
- ☐ Physical fatigue
- ☐ Fixed work time arrangement

Determination of creative work ability for the next two years

Do you believe that your medical conditions allow you to be able to do your current creative work in 2 years time?

Firstly, please answer assuming that your work time arrangement would stay the same: *

○ Not at all

○ To a small extent

○ Somewhat

○ To a large extent

○ Totally

Secondly, please answer assuming that you could choose your work time arrangement according to your preferences *

○ Not at all

○ To a small extent

○ Somewhat

○ To a large extent

○ Totally

ADDITIONAL INFORMATION

To sum up, we would like to ask for some personal information about you and your work - we reassure that this information will not be published and access to this information will be limited to selected members of the research team

Name:

Surname:

Please mark your email address, so that we could send you your personal and confidential feedback of the survey results and if necessary contact your with respect to the potential follow-up research

Email address * :

☐ I would like a personal feedback on my survey results to be sent on my email address

What is your year of birth? *

GENDER *
- ○ Female
- ○ Male

How many people live with you (if you live alone, please mark 0)? * [ ]

incl. school-age children (if none, please mark 0) * [ ]

incl. younger than school-aeg children (if none, please mark 0) * [ ]

EDUCATION *
- ○ Primary education
- ○ Secondary education
- ○ Vocational education
- ○ Undergraduate degree (bachelor´s degree, diploma, etc)
- ○ Master´s degree
- ○ PhD

POSITION (at your current employer) *
- ○ Top Manager (Head of a company, institute, etc)
- ○ Middle manager (Head of a department, subunit, etc)
- ○ Top specialist
- ○ Technician; middle-level specialist
- ○ Other

EXPERIENCE AS A R&D EMPLOYEE (years): * [ ]

EXPERIENCE AT THE CURRENT EMPLOYER (years): * [ ]

CONTEXT OF THE WORK (at the current employer) *
- ○ Work as part of a research and/or development team
- ○ Work as part of a team, which comprises mostly of non-R&D employees
- ○ Individual employee in the R&D area

How large is your monthly salary (gross)?
- ○ Below 1000 euros
- ○ 1000 - 2000 euros
- ○ 2000 - 3000 euros

○ 3000- 5000 euros

○ above 5000 euros

Is your work of a permanent or non-permanent nature (e.g. project-based)? *

○ Non- permanent, with a duration of less than 1 year

○ Non-permanent, with a duration of more than 1 year

○ Permanent

Name of your employer: *

In case you have comments on the linkages between your work time arrangement and sleepiness and fatigue, please mark them here:

In case you have comments on the linkages between your work time arrangement and creativity, please mark them here:

In case you have general comments about the survey, please mark them here: