CoLLaboratE

Co-production CeLL performing Human-Robot Collaborative AssEmbly

D2.6 – Social Studies Analysis of the Implications Human-Robot Collaboration on Job Quality

Due date: M35

Abstract:

The present document presents the work that has been done for the T2.3: Social Studies Analysis of the Implications Human-Robot Collaboration on Job Quality. It is part of the framework design, requirements & social studies feedback. The report includes the findings of a literature review that was conducted to identify the relevant for the use cases factors that influence job quality. Furthermore, it includes the design of the study that will be conducted in order to assess the changes in job quality of the workers after the introduction of the use cases. The study will be deployed in two waves: a first wave before the introduction of the use cases and a second wave after the introduction of the use cases. Data from both waves will be compared to assess the influence of the use cases on job quality. In the present report, the descriptive analyses of the wave 1 data are reported. In a later version of the report, the comparison between wave 1 and wave 2 will be presented.

Dissemination Level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Document Status

Document Title	D2.6 – Social Studies Analysis of the Implications Human-Robot Collaboration on Job Quality
Version	0.5
Work Package	2
Deliverable	2.6
Prepared by	KUL
Contributors	ARCELIK, CRF, KOLEKTOR, ROMAERO
Checked by	ARCELIK, CRF, KOLEKTOR, ROMAERO
Approved by	AUTH
Due Date	31/08/2021
Completion Date	29/10/2021 (final version TBD)
Confidentiality	Public

Document Change Log

Each change or set of changes made to this document will result in an increment to the version number of the document. This change log records the process and identifies for each version number of the document the modification(s) which caused the version number to be incremented.

Change Log	Version	Date
First draft	0.1	October, 26 2021
Contributing partners' input	0.2	October 28, 2021
Internal reviewers' feedback	0.3	October 28, 2021
Final (first version)	0.5	October 29, 2021

EXECUTIVE SUMMARY

The goal of T2.3 is to assess the changes in job quality of the workers that will be brought by the introduction of the collaborative robots in the use cases. To achieve the goal of the task, we conducted a literature review to pin down the factors that are responsible for influencing job quality. The main factors are the following: : Job Satisfaction, Physical Factors, Physical Demands, Social Support at Work, Work Intensity, Emotional Demands, Task Autonomy, Task Clarity and Feedback Performance, Working Flexibility, Job Insecurity, Training and Learning Opportunities, Intrinsic rewards, Perceived Usefulness of Technology, Perceived ease of Use of Technology.

Next, we designed a questionnaire that will allow us to measure these factors. Last, we came up with the design of the study. The study will include two rounds of distributing the questionnaire measuring the factors influencing job quality in the workers that will participate in the use cases. The first round was conducted in the period of September-October 2021, expect for CRF and KOLLEKTOR, which will deploy the first round in a few weeks. The second round will be conducted one month after the end of the use cases. The data obtained from the two rounds will be compare to assess if there was a change in job quality of the workers by the introduction of the collaborative robots.

In the present version of D2.6, the descriptive results of the data of the first round, for ARCELIK and ROMAERO, are presented. In a later version of the report, the descriptive results of the first round will be extended to the data of all four partners and the comparison between the two rounds (influence of the use cases on job quality) will be presented.

Table of Contents

ABBREVIATIONS AND ACRONYMS

Partner's short name	Partner's full name
AUTH	ARISTOTLE UNIVERSITY OF THESSALONIKI
CERTH	CENTRE OF RESEARCH AND TECHNOLOGY HELLAS
ARMINES	ASSOCIATION POUR LA RECHERCHE ET LE DEVELOPMENT DES METHODES ET PROCESSUS INDUSTRIELS
JSI	INSTITUT JOZEF STEFAN
IDIAP	FONDATION DE L'INSTITUT DE RECHERCHE
UNIGE	UNIVERSITA DEGLI STUDI DI GENOVA
KU Leuven	KATHOLIEKE UNIVERSITEIT LEUVEN
LMS	UNIVERSITY OF PATRAS
CRF	CENTRO RICERCHE FIAT SOCIETA CONSORILE PER AZIONI
BOR	BLUE OCEAN ROBOTICS
ASTI	AUTOMATISMOS Y SISTEMAS DE TRANSPORTE INTERNO SA
KOL	KOLEKTOR ORODJARNA NACRTOVANJE IN IZDELAVA ORODIJ TER ORODJARSKE STORITVE D.O.O.S
ARCELIK	ARCELIK A.S.
ROMAERO	ROMAERO S.A.

Abbreviation	Definition
WP	Work Package
D	Deliverable
EC	European Commission
EU	European Union
OECD	Organisation for Economic Co-operation and Development

1 INTRODUCTION

The goal of T2.3 is to assess the changes in job quality of the workers that might be brought by the introduction of the collaborative robots in the use cases. To achieve the goal of the task, we conducted a literature review to identify the factors that are responsible for influencing job quality.

Next, we designed a questionnaire that will allow us to measure these factors. Last, we came up with the methodology and the design of the study. The study will consist of two parts. In every part we will distribute the questionnaire measuring the factors influencing job quality in the workers that will participate in the use cases. The first part will be placed one month before the start of the use cases. The second part will be placed one month after the end of the use cases. The results of the two rounds will be compare to assess if there was a change in job quality of the workers by the introduction of the collaborative robots.

1.1 JOB QUALITY FACTORS

According to the Organisation for Economic Co-operation and Development (OECD) framework on job quality, the working environment is defined by "a combination of job characteristics", which shape the place where people perform their jobs [1]. This includes a broad range of characteristics, which relate to the nature of the work tasks, the physical and social conditions under which these tasks are performed, the scheduling of working time, the prospects that the job provides to workers and the intrinsic rewards associated with the job. Among others, job quality is linked to the working environment and the workers' well-being [1]. The factors influencing job quality are various. Below, we present the most relevant factors for our case studies.

1.1.1 Job Satisfaction

Even though the concept of "job satisfaction" has been widely used in scientific research, there is no specific definition of what job satisfaction is, as many authors have different approaches to what it means [2]. Dating back to 1935, job satisfaction was defined in [3] as "any combination of psychological, physiological and environmental circumstances" which makes a worker satisfied with his job. Further, Vroom [4] linked job satisfaction with a person's role in a company, while according to another study [5], job satisfaction is defined by the peoples' feelings towards their jobs, whether they like or dislike their job. Besides these, job satisfaction has also been associated with the worker's behavior in a workplace, meeting of worker's expectations and needs rather than their values [6] [7], with a person's sense of achievement and success [8] or with the workers' satisfaction towards job-related rewards [9].

Results of a study [10] showed that the factor which less affects job satisfaction is the salary, while the ones that affect it most are job security and how interesting the work is.

1.1.2 Physical Factors

This job characteristic makes reference to the working conditions in a specified work-environment, assessing safety, dangerous and health-related conditions. It is specifically important as it speaks to the workers' well-being while performing their job, as they need to evaluate how dangerous their work is. Physical factors have a significant impact on job quality, as they can negatively affect the workers' health [1].

1.1.3 Physical Demands

Physical demands address work situations where workers are exposed to hard physical effort, such as lifting heavy objects, performing repetitive movements, etc. These affect the workers' quality of life and as a result the well-being in the long term [1].

1.1.4 Social Support At Work

This characteristic refers to the atmosphere at work, the relationship between the staff and management, and how easy and transparent communication is in relation to work problems [1]. In other words, the social support is related to collaborative problem solving and sharing information, receiving advice from various sources of social support (e.g. colleagues, supervisors and managers. Further, there has been shown that supervisor support has a positive impact on perceived job satisfaction, while there is a minimal influence caused by the social support offered by colleagues [11].

1.1.5 Work Intensity

Work intensity can also influence job quality, taking into account aspects such as working time, speed and effort and the tightness of deadlines. It is an essential component of the working environment. Work intensity can have positive effects such as higher pay and promotions, but also negative ramifications on the workers' well-being, thus influencing job quality and satisfaction [1].

1.1.6 Emotional Demands

The emotional demands related to work situations take into account the workers' predispositions to stress and being frustrated during their work. These can be a result of their interaction with other colleagues or work situations and can be observed by assessing the frequency of emotionally draining tasks, tasks that make workers hide their feelings or tasks that are in conflict with a worker's personal values. Therefore, emotional demands usually have a psychological cost, and can negatively influence job quality [1].

1.1.7 Task Autonomy

Task autonomy refers to the ability of the worker to decide on how to do his work in regards to methods, speed, working partners or effort [1]. This is closely related to job satisfaction and quality, as it increases creativity, physical and psychological well-being of the workers, supporting learning and gaining new skills [12]. Moreover, in [13] it was observed that an increased job satisfaction is also closely associated with the workers' perceived job control, in relation to task autonomy.

1.1.8 Task Clarity and Feedback Performance

These attributes refer to how well the work tasks are defined and communicated to the workers, but also whether the workers receive feedback on their performance. It is known that frequent feedback increases success among employees and can reduce the workers' stress at home in relation to work-related tasks. However, in order to correctly assess the influence of the feedback on job quality, it is important to differentiate between useful and unconstructive feedback, which can positively, respectively negatively affect the quality of a job [1].

1.1.9 Working Flexibility

In addition to tasks autonomy, this job characteristic refers to the employees being able to choose their working times, when to start and finish their working days, or when to take holidays. This has a big impact on the work-life balance and contributes to the workers' well-being by allowing people to work when it best suits them. On the other hand, a lack of flexible working hours can cause dissatisfaction, thus affecting job quality [1].

1.1.10   Job Insecurity

Job insecurity concerns the employees' fears of losing their jobs, which has an impact on their well-being and health conditions. As well, high job insecurity can diminish the workers' commitment and effort to their work-related tasks, which can negatively influence job quality [1].

1.1.11   Training And Learning Opportunities

Training and learning opportunities have an important role in the workers' well-being, being a driver of career advancement. The learning opportunities can be formal, which are structured and have a duration, incidence, and quality, while informal learning takes place throughout usual working activities. The training opportunities are increasing job satisfaction, motivation and career growth [1].

1.1.12   Intrinsic Rewards

Intrinsic rewards refer to the workers' ability to see their work in a bigger context than their work environment, such as acknowledging the purpose of their work in relation to society, without being influenced by their income. Thus, it relates to the employees' passion for their work, rather than their interest in the monetary reward. This has an impact on productivity and effort, implicitly on the job quality [1]

1.1.13   Perceived Usefulness of Technology

Nowadays, technologies such as cloud and mobile computing, machine learning or advanced robotics are changing the way we work, interact and communicate, but also how businesses create and capture value [14]. Thus, the workers' opinion towards new technologies represent an essential aspect when implementing new technologies in the workplace, as their fear can cause resistance to further use them [15]. [16] defines the perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance". So, if a person believes a system, in our case the collaborative robots, has high usefulness, then it is more likely that a positive relationship will be developed. This in turn can have an impact on the satisfaction user gets from the use of the robot and influence the perceived quality of job [21].

1.1.14   Perceived Ease of Use

On the other hand, the perceived ease of use is defined in [16] as "the degree to which a person believes that using a particular system would be free of effort". Ease of use can influence how fast a user will accept a system (collaborative robots) which is beneficial for the satisfaction a user gets from the use of the system [21]. Furthermore, ease of use can influence the perceived usefulness of the system which in turn increase job satisfaction and perceived quality [21].

1.1.15   Individual Differences

Apart from the certain characteristics and factors of the job itself that can influence the perception of job quality, there are certain individual differences concerning certain personality and demographic characteristics that can potential have an influence on the perception about the quality of job.

Big Five

During the past years, an increased interest in researching the link between personality traits and job satisfaction and perceived quality can be observed [17]. The "Big Five" is a result of extensive research on personality traits, being able to represent distinct structures of personality traits into one common framework [18]. As described in [18], these five factors are usually the following:

- Extraversion - talkative, assertive, energetic
- Agreeableness - cooperative, trustful, good-natured
- Conscientiousness - responsible, dependable, orderly

- Neuroticism - neurotic, upset, not calm
- Intellect - intellectual, imaginative, independent-minded

The personality traits are important to consider, as personality differences among workers can make some job characteristics more important than others. For instance, Extraversion and Consciousness have been found to be positively correlated with job satisfaction. People that are being more extravert and more responsible have reported higher levels of job satisfaction. On the other hand, Neuroticism has been found to be negatively correlated with job satisfaction. Workers that are more vulnerable to negative emotions report lower levels of job satisfaction [22].

Gender, Age, Education

The differences in age groups reveal different perceptions of job quality. One aspect is related to the work intensity, which for young people (16-24) is not that high compared to older workers. Moreover, the people who entered the labor market in times with high unemployment, have higher job insecurities, which affect the quality of the working environment. Another aspect refers to the physical demands, which for people aged over 55, is higher compared to younger people. Furthermore, older people have less access to training and learning opportunities, thus having fewer chances for career advancement, which also affects their well-being. On the other hand, older people feel more secure when it comes to the future of their job than younger people.

When referring to gender differences, the research shows that women tend to be disadvantaged when it comes to wages and access to high-skilled jobs, often being considered as "secondary earners". However, gender inequalities do not directly influence job quality. In relation to task autonomy, the literature shows little evidence of differences between men and women, but men are most likely to have better control over wider aspects of their job. Moreover, when it comes to access to training and learning opportunities, it is believed that men and women both have good opportunities, thus not many differences have been proven from this point of view [1]. In relation to the overall quality of the working environment, studies show that it is better for women, as they tend to enjoy workplaces with lower health and safety risks [19]. Women also tend to report better job satisfaction than men, even when they have similar positions as they have lower expectations [20]. Moreover, when it comes to education, [20] discovered that higher education brings higher expectations, thus more educated persons have lower job satisfaction.

2 STUDY

2.1 WAVE 1

Wave 1 data were collected before the introduction of the use-cases in the companies of the four involved partners (CRF, KOLLEKTOR, ARCELIK, ROMAERO). The aim of this analysis was to get an overview of the baseline levels of job satisfaction and job quality in the different employees before exposing them to a HRC. Additionally and to gain as much insights as possible, the data from wave 1 will be used to compare the different partners' employees in their baseline levels of job satisfaction and job quality.

2.1.1 Method

Participants and design. In total, 32 individuals participated in wave 1. 12 participants were recruited by ROMERO, 20 participants by ARCELIK, whereas additional participants are planned to be recruited by CRF and KOL for the first wave of the corresponding use cases. The sample's age ranged from 19 to 60 years old (M= 33.94, SD= 10.61), with 23 men, and 9 women. The participants in each use case have been divided in two groups across two conditions: use-case condition (condition 1), i.e. the group will be exposed to a HRC using CoLLaboratE solution and a

no-use-case condition (condition 2), which the group will not be exposed to a HRC. 16 participants were in condition 1 and 16 participants in condition 2.

Procedure. The employees selected for participating in the study were approached (by e-mail or orally) by the partner for which they are working. Participants were asked to take time to answer the survey on Qualtrics or on paper. If the survey was filled-in on paper, the involved partner was responsible for transcribing the responses on Qualtrics. Before answering the questions, an informed consent (Appendix A) was presented and participants had to provide their agreement to participate. After agreeing, participants were asked to fill-in their ID's, determined by the partner. This ID will be used to link data from wave 1 to data from wave 2. In a next step, questionnaires from the different dependent variables (Appendix B) were presented. At the end of the survey, participants were asked to answer the Big-5 inventory and demographical questions about their gender, age, and education (Appendix B). A few weeks after responding to wave 1, participants in condition 1 will be exposing to a HRC. A few weeks after the HRC exposition, the same survey will be spread again to collect wave 2 data.

Analysis. The goal of this first data analysis was to gain insights in the baseline levels of the employees in the different dependent variables. To do so, means and standard deviations measures will be computed in R. To compare the baselines of the employees of the different partners, one-way ANOVA's will be computed in the same R program. The goal of ANOVA's analyses is to investigate whether two or multiple conditions significantly differ from each other on a specific dependent variable, with the use of a F-statistics. For the current ANOVA's analyses, 30 degrees of freedom will be used (total number of participants minus number of conditions), and a significance level of $p < .05$ will be used. Possible relations between the dependent variables and the control variables will be investigated by the help of a correlation plot.

2.1.2   Results

A short overview of the different results can be found in Table 1. The different dependent variables were calculated by adding the score of the different questions, and then by dividing the addition's result by the total number of questions (e.g.: physical factors = (Q1 + Q2 + Q3)/3).

Physical Factors. The physical factors scale was composed of three questions, from which one was scored on a 4-points Likert scale and two were scored on a 5-points Likert scale. A higher score meant low levels of risks, unhealthy and dangerous behaviors at the work place. The mean level of the total sample was 3.38 (sd = 1.26). Employees of ARCELIK reported a mean of 4.12 (sd = .80) and employees of ROMAERO reported a mean of 2.11 (sd = .76), resulting in a significant difference between both partners ($F(1,30) = 50.05$, $p < .001$). Employees from condition 1 (M= 3.48, sd = 1.27) and condition 2 (M= 3.27, sd = 1.28) did not differ from each other ($F(1,30) = .21$, $p = .65$).

Physical Demands. Physical demands of employees' work was composed of two questions, both scored on a 5-points Likert scale. A low score indicated a high level of physical demand at work. The mean level of the total sample was 2.83 (sd = 1.10). Employees of ARCELIK reported a mean of 3.08 (sd = 1.14) and employees of ROMAERO reported a mean of 2.42 (sd = .95), resulting in a similar level in both partners ($F(1,30) = 2.82$, $p = .10$). Employees from condition 1 (M= 2.78, sd = 1.15) and condition 2 (M= 2.88, sd = 1.09) did not differ from each other ($F(1,30) = .06$, $p = .82$).

Social Support at work. Level of social support was measured with the help of a single question, scored on a 4-points Likert scale. A low score indicating a low level of social support at work. The mean level of the total sample was 3.44 (sd = .72). Employees of ARCELIK reported a mean of 3.35 (sd = .75) and employees of ROMAERO reported a mean of 3.58 (sd = .67), resulting in a similar level in both partners ($F(1,30) = .79$, $p = .38$). Employees from condition 1 (M= 3.38, sd = .89) and condition 2 (M= 3.50, sd = .52) did not differ from each other ($F(1,30) = .24$, $p = .63$).

Work Intensity. Level of work intensity was measured with the help of three questions, from which two were scored on a 7-points Likert scale and the other one was scored on a 5-points Likert scale. A low score indicating a high level of work intensity. The mean level of the total sample was 3.38 (*sd* = 1.17). Employees of ARCELIK reported a mean of 3.47 (*sd* = 1.30) and employees of ROMAERO reported a mean of 3.22 (*sd* = .92), resulting in a similar level in both partners (F(1,30) = .32, p = .57). Employees from condition 1 (*M*= 3.38, *sd* = .97) and condition 2 (*M*= 3.38, *sd* = 1.37) did not differ from each other (F(1,30) = 0, p = 1). Additionally, participants were asked to indicates how many hours a week they work. The mean working hours a week of the sample was 42.94 (*sd* = 5.88).

Emotional Demands. Emotional demand level was measured with the help of five questions, scored on a 5-points Likert scale. A high score indicating a low level of emotional demands. The mean level of the total sample was 3.31 (*sd* = .91). Employees of ARCELIK reported a mean of 3.48 (*sd* = .87) and employees of ROMAERO reported a mean of 3.03 (*sd* = .94), resulting in a similar level in both partners (F(1,30) = 1.86, p = .18). Employees from condition 1 (*M*= 3.53, *sd* = 1.03) and condition 2 (*M*= 3.10, *sd* = .75) did not differ from each other (F(1,30) = 1.79, p = .19).

Task autonomy. Level of task autonomy was measured with the help of five questions, from which three were scored on a 4-points Likert scale, and two scored on a 5-points Likert scale. A low score indicating a low level of autonomy. The mean level of the total sample was 3.12 (*sd* = .89). Employees of ARCELIK reported a mean of 3.12 (*sd* = .90) and employees of ROMAERO reported a mean of 3.13 (*sd* = .91), resulting in a similar level in both partners (F(1,30) = 0, p = .99). Employees from condition 1 (*M*= 2.83, *sd* = .85) and condition 2 (*M*= 3.44, *sd* = .85) did not differ from each other (F(1,30) = 4.18, p = .05).

Task clarity and feedback performance. Task clarity and feedback performance was measured with the help of one question scored on a 5-points Likert scale, and three yes/no questions. A low score indicating a low level of task clarity and feedback performance. The mean level of the total sample was 1.63 (*sd* = .32). Employees of ARCELIK reported a mean of 1.56 (*sd* = .24) and employees of ROMAERO reported a mean of 1.73 (*sd* = .41), resulting in a similar level in both partners (F(1,30) = 2.14, p = .15). Employees from condition 1 (*M*= 1.55, *sd* = .38) and condition 2 (*M*= 1.70, *sd* = .23) did not differ from each other (F(1,30) = 2, p = .17).

Working flexibility. Working flexibility was measured with a single question, scored on a 4-points Likert scale. A higher score indicated a high level of flexibility. The mean level of the total sample was 1.91 (*sd* = 1.20). Employees of ARCELIK reported a mean of 1.80 (*sd* = 1.24) and employees of ROMAERO reported a mean of 2.08 (*sd* = 1.16), resulting in a similar level in both partners (F(1,30) = .41, p = .53). Employees from condition 1 (*M*= 1.88, *sd* = 1.20) and condition 2 (*M*= 1.94, *sd* = 1.24) did not differ from each other (F(1,30) = .02, p = .89).

Job insecurity. Job insecurity among employees was measured with one yes/no question, and two questions scored on a 7-points Likert scale. A higher score indicating lower levels of job insecurity. The mean level of the total sample was 3.43 (*sd* = .77). Employees of ARCELIK reported a mean of 3.43 (*sd* = .77) and employees of ROMAERO reported a mean of 3.42 (*sd* = .82), resulting in a similar level in both partners (F(1,30) = .003, p = .95). Employees from condition 1 (*M*= 3.13, *sd* = .62) and condition 2 (*M*= 3.73, *sd* = .81) differs from each other (F(1,30) = 5.62, p = .02).

Training and learning opportunities. Training and learning opportunities were measured with six yes/no question, and one questions scored on a 7-points Likert scale. A higher score indicating more opportunities. The mean level of the total sample was 1.18 (*sd* = .46). Employees of ARCELIK reported a mean of 1.01 (*sd* = .41) and employees of ROMAERO reported a mean of 1.45 (*sd* = .41), resulting in difference between both partners (F(1,30) = 8.48, p = .007). Employees from condition

1 (M= .99, sd = .44) and condition 2 (M= 1.37, sd = .41) differs from each other (F(1,30) = 6.24, p = .02).

Intrinsic Rewards. Levels of intrinsic rewards resulting from the job was measured with three 7-points Likert scale questions. A higher score indicating a high level of intrinsic rewards. The mean level of the total sample was 5.45 (sd = 1.41). Employees of ARCELIK reported a mean of 4.70 (sd = 1.20) and employees of ROMAERO reported a mean of 6.69 (sd = .61), resulting in a difference between the partners (F(1,30) = 28.29, p < .001). Employees from condition 1 (M= 5.52, sd = 1.12) and condition 2 (M= 5.38, sd = 1.68) did not differ from each other (F(1,30) = .08, p = .78).

Job satisfaction. Job satisfaction was measured with the help of five 7-points Likert scale questions. A higher score indicated higher levels of job satisfaction. The mean level of the total sample was 5.43 (sd = 1.52). Employees of ARCELIK reported a mean of 5.32 (sd = 1.82) and employees of ROMAERO reported a mean of 5.62 (sd = .87), resulting in a similar level in both partners (F(1,30) = .28, p = .60). Employees from condition 1 (M= 5.28, sd = 1.50) and condition 2 (M= 5.59, sd = 1.58) did not differ from each other (F(1,30) = .33, p = .57).

Perceived usefulness of the technology. Perceived usefulness of technology was measured with six 7-points Likert scale questions, with a higher score indicating higher levels of perceived usefulness. The mean level of the total sample was 5.38 (sd = 1.97). Employees of ARCELIK reported a mean of 4.63 (sd = 2.13) and employees of ROMAERO reported a mean of 6.63 (sd = .61), resulting in difference between both partners (F(1,30) = 9.90, p = .004). Employees from condition 1 (M= 5.42, sd = 2.00) and condition 2 (M= 5.35, sd = 1.99) did not differ from each other (F(1,30) = .01, p = .92).

Perceived ease of use. Perceived ease of use was also measured with six 7-points Likert scale questions, with a higher score indicating higher levels of perceived ease of use. The mean level of the total sample was 5.53 (sd = 1.66). Employees of ARCELIK reported a mean of 5.17 (sd = 1.82) and employees of ROMAERO reported a mean of 6.13 (sd = 1.20), resulting in similar levels in both partners (F(1,30) = 2.62, p = .12). Employees from condition 1 (M= 5.25, sd = 2.07) and condition 2 (M= 5.80, sd = 1.12) did not differ from each other (F(1,30) = .88, p = .36).

Table 1

Mean and standard deviations for the different dependent variables for the general sample, the different partners, and the two conditions. The differences between partners is highlighted in the last column. In the second column the range of the dependent variables are presented.

	Range [Min- Max]	General		ARCELIK		ROMAERO		Diff	Condition 1 (UC)		Condition 2		Diff
		M	sd	M	sd	M	sd	F(p)	M	sd	M	sd	F(p)
Physical factors	1.00 – 4.67	3.38	1.26	4.13	0.80	2.11	0.76	50.05 (p< .001) *	3.48	1.27	3.27	1.28	.21 (p = .65)
Physical demands	1.00 – 5.00	2.83	1.10	3.08	1.14	2.42	0.95	2.82 (p = .10)	2.78	1.15	2.88	1.09	.06 (p = .82)
Social support at work	1.00 – 4.00	3.44	.72	3.35	.75	3.58	.67	.79 (p = .38)	3.38	.89	3.5	.52	.24 (p = .63)
Work intensity	1.00 – 6.33	3.38	1.167	3.47	1.30	3.22	.92	.32 (p = .57)	3.38	.97	3.38	1.37	0 (p = 1)
Emotional demands	1.00 – 5.00	3.31	.91	3.48	.87	3.03	.94	1.86 (p = .18)	3.53	1.03	3.1	.75	1.79 (p = .19)
Task autonomy	1.00 – 4.40	3.12	.89	3.12	.90	3.13	.91	0 (p = .99)	2.83	.85	3.44	.85	4.18 (p = .05)
Task clarity and feedback performance	0.25 – 2.00	1.63	.32	1.56	.24	1.73	.41	2.14 (p = .15)	1.55	.38	1.70	.23	2 (p = .17)
Working flexibility	1.00 – 4.00	1.91	1.20	1.8	1.24	2.08	1.16	.41 (p = .53)	1.88	1.20	1.94	1.24	.02 (p = .89)
Job insecurity	.67 – 5.00	3.43	.77	3.43	.77	3.42	.82	.003 (p = .95)	3.13	.62	3.73	.81	5.62 (p = .02) *
Training and learning opportunities	.14 – 1.86	1.18	.46	1.01	.41	1.45	.41	8.48 (p = .007) *	.99	.44	1.37	.41	6.24 (p = .02) *
Intrinsic rewards	1.00 – 7.00	5.45	1.41	4.7	1.20	6.69	.61	28.29 (p < .001) *	5.52	1.12	5.38	1.68	.08 (p = .78)
Job satisfaction	1.00 – 7.00	5.43	1.52	5.32	1.82	5.62	.87	.28 (p = .60)	5.28	1.50	5.59	1.58	.33 (p = .57)
Perceived usefulness of the technology	1.00 – 7.00	5.38	1.97	4.63	2.13	6.63	.61	9.90 (p = .004) *	5.42	2.00	5.35	1.99	.01 (p = .92)
Perceived ease of use	1.00 – 7.00	5.53	1.66	5.17	1.82	6.13	1.20	2.62 (p = .12)	5.25	2.07	5.80	1.12	.88 (p = .36)

Correlation with control variables. As can be seen in Figure 1, the dependent variables measured in wave 1 (and wave 2) are slightly correlated with some of the control variables, such as extraversion, conscientiousness, education and age. The influence of those control variables on the differences between condition 1 and condition 2 will be explored in more details in the second version of this report, to make sure that those correlations don't influence the differences between condition 1 and condition 2 after introducing the use-cases in employees.
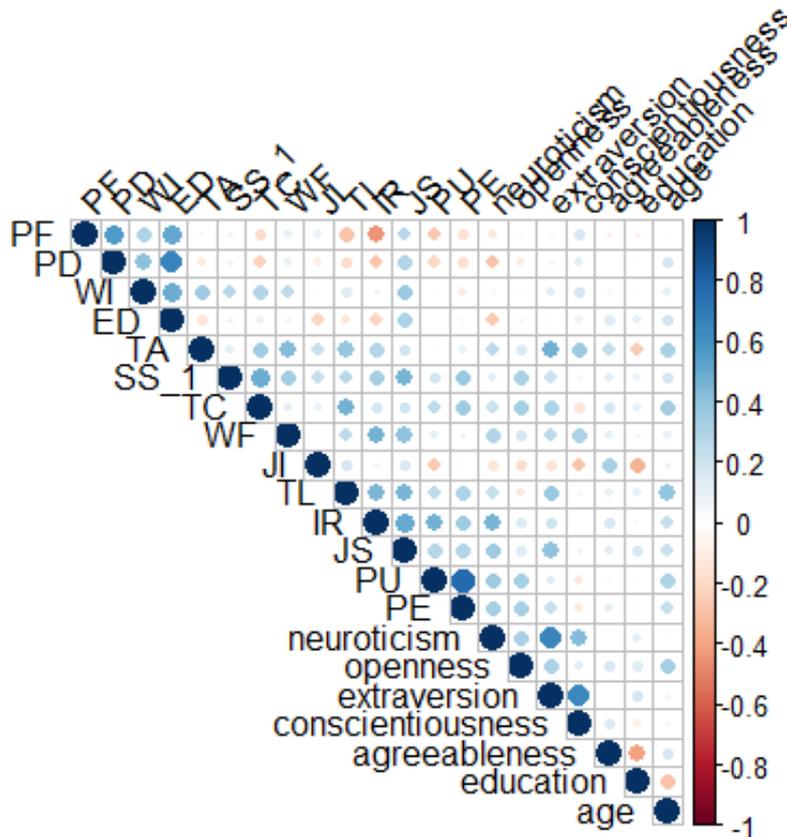

Figure 1. Correlation plot between the different dependent variables and the control variables (neuroticism, openness, extraversion, conscientiousness, agreeableness, education, and age). The direction of the relation is indicated by a blue (positive) or a red (negative) color. The strength of the relation is indicated by the size of the circle.

2.1.3 Conclusion

The goal of the current analysis was to gain insight in the baseline levels of job quality in the employees of ARCELIK and ROMAERO (baseline data from CRF and KOLLEKTOR will follow later). As could be seen in Table 1, the general sample scored close to the maximum for most of the job quality's factors, with the exception of physical demands, work intensity and working flexibility. This suggests that employees from the analyzed sample experiences their job as high in physical demands, high in intensity and low in flexibility. The experience of physical demands was the highest in ROMAERO's employees than in ARCELIK's employees. Employees from ARCELIK and ROMAERO differ in their scores on training and learning opportunities and intrinsic rewards. The results suggested that ROMAERO's employees reported having more training and learning opportunities and a higher intrinsic reward resulting from their job than ARCELIK's employees. Additionally, ROMEARO's employees reported higher levels of Perceived usefulness of the technology than ARCELIK's employees.

When comparing employees who will be exposed to a use case in the next weeks (condition 1) and employees who will not be exposed to a use case (condition 2), two significant differences

were found. Firstly, employees who will be exposed to a use case reported higher levels of job insecurity than employees who will not be exposed to a use case. However, at this point we are unable to assess if this higher feeling of job insecurity is due to the future exposure to the use case or if it is a coincidence. When conducting the analyze of wave 2 data, we will be able to investigate whether this difference remains after the introduction of the use case. If this difference remains significant, we will be able to suggest that employees exposed to a use case feel less secure about their current job due to the introduction of the robot. Secondly, employees who will be exposed to a use case reported lower training and learning opportunities than employees who will not be exposed to a use case. Again, the analysis of wave 2 data will allow us to know if this difference is due to the introduction of the robot or not.

3 REFERENCES

[1] OECD. (2017). OECD Guidelines on Measuring the Quality of the Working Environment.

[2] Aziri, B. (2011). JOB SATISFACTION: A LITERATURE REVIEW. Management Research & Practice, 3(4).

[3] Hoppock, R. (1935). Job Satisfaction, Harper and Brothers, New York, p. 47

[4] Vroom, V.H. (1964). Work and motivation, John Wiley and Sons, New York, p.99

[5] Spector, P.E. (1997). Job satisfaction: Application, assessment, causes and consequences,Thousand Oaks, CA,Sage Publications, Inc

[6] Davis, K. and Nestrom, J.W. (1985). Human Behavior at work: Organizational Behavior, 7 edition,McGraw Hill, New York, p.109

[7] Clark, A.E. (1997), "Job satisfaction and gender: Why are women so happy at work?", Labour Economics, Vol. 4, pp. 341-372.

[8] Kaliski, B.S. (2007). Encyclopedia of Business and Finance, Second edition, Thompson Gale, Detroit, p. 446

[9] Statt, D. (2004). The Routledge Dictionary of Business Management, Third edition, Routledge Publishing, Detroit, p. 78

[10] Clark, A.E. (1998), "Measures of job satisfaction: What makes a good job? Evidence from OECD

countries", OECD Labour Market and Social Policy Occasional Papers, No. 34, OECD Publishing, Paris,

http://dx.doi.org/10.1787/670570634774.

[11] Brough, P., & Pears, J. (2004). Evaluating the influence of the type of social support on job satisfaction and work related psychological well-being. International Journal of Organisational Behaviour, 8(2), 472-485.

[12] Karasek, R. and T. Theorell (1990), Healthy Work. Stress, Productivity and the Reconstruction of Work Life, Basic Books, New York.

[13] Spector, P. E. (1986). Perceived control by employees: A meta-analysis of studies concerning autonomy and participation at work. Human relations, 39(11), 1005-1016.

[14] Cascio, W. F., & Montealegre, R. (2016). How technology is changing work and organizations. Annual Review of Organizational Psychology and Organizational Behavior, 3, 349-375.

[15] Gattiker, U. E., & Howg, L. (1990). Information technology and quality of work life: comparing users with non-users. Journal of Business and Psychology, 5(2), 237-260.

[16] Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS quarterly, 319-340.

[17] Williamson, J. M., Pemberton, A. E., & Lounsbury, J. W. (2005). An investigation of career and job satisfaction in relation to personality traits of information professionals. The Library Quarterly, 75(2), 122-141.

[18] John, O. P., & Srivastava, S. (1999). The Big Five trait taxonomy: History, measurement, and theoretical perspectives. Handbook of personality: Theory and research, 2(1999), 102-138.

[19] Fagan, C. and B. Burchell (2002), Gender, Jobs and Working Conditions in the European Union, Publications Office of the European Communities, Luxembourg.

[20] Clark, A.E. and A. Oswald (1996), "Satisfaction and comparison income", Journal of Public Economics, Vol. 61, No. 3, pp. 359-381, http://dx.doi.org/10.1016/0047-2727(95)01564-7.

[21] Calisir, F. and Calisir, F. (2004), "The relation of interface usability characteristics, perceived usefulness, and perceived ease of use to end‐user satisfaction with enterprise resource planning (ERP) systems", Computers in Human Behavior, Vol. 20, pp. 505‐15.

[22] Judge, T. A., Heller, D., & Mount, M. K. (2002). Five-factor model of personality and job satisfaction: A meta-analysis. Journal of Applied Psychology, 87, 530–541.

[23] Judge, T. A., Bono, J. E., & Locke, E. A. (2000). Personality and job satisfaction: The mediating role of job characteristics. Journal of Applied Psychology, 85, 751-765.

[24] Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Qutart. 13, 319-339.

[25] John, O. P., & Srivastava, S. (1999). The big five trait taxonomy: History, measurement, and theoretical perspectives. In L. A. Pervin, & O. P. John (Eds.), Handbook of personality: Theory and research (pp. 102-138). New York: Guilford Press

4 APPENDIX

4.1 APPENDIX A

Informed Consent

Dear Participant,

You are being invited to take part in a research study. Please take the time to read the following information carefully and decide if you want to take part in this study. Please feel free to ask questions if there is anything that is not clear or if you would like more information.

You will be asked to answer questions with regard to your levels of job satisfaction as well as some personality questions.

Participation in this study is totally voluntary, you are under no obligation to take part in this study. The data that you provide will be very useful for our study. You have the right to withdraw from the study at any time and without giving a reason.

The information you provide will be confidential. No one apart from the experimenter and principal investigator (names given below) will have access to the information you provide. Your consent form will be kept separate from the observations collected during the course of the study. Data will be stored for a maximum of seven years in accordance with the University data storage policy. Once the data is analyzed a report of the findings may be submitted for publication. Only broad trends will be reported and it will not be possible to identify any individuals. A summary of the results will be available from the experimenter on request once the study is complete.

If you have any questions or require any further information, please contact the experimenter(s) or the SOCIAAL-MAATSCHAPPELIJKE ETHISCHE COMMISSIE (SMEC). SMEC can be contacted for ethical issues and complaints.

Name of experimenters: Yunxin Liu - Sarah Delcourt
E-mail: yunxin.liu@kuleuven.be - sarah.delcourt@kuleuven.be

SMEC E-mail: smec@kuleuven.be

If you have read the information above and would like to participate in the study, please click "I consent."
Alternatively, if you do not want to complete the study, please click "I do not consent" and you will be redirected to the end of the study.:

- I agree
- I don't agree

4.2 APPENDIX B

Survey presented to participants

Physical Factors [1]

- My health or safety is at risk because of my work: 1-4 (Not at all true – Very true)
- How often do you work in dangerous conditions?: 1-5 (Never – Always)
- How often do you work in unhealthy conditions?: 1-5 (Never – Always)

Physical Demands [1]

- How often applies: do hard physical work?: 1-5 (Never ‑ Always)
- How often: come home from work exhausted?: 1-5 (Never ‑ Always)

Social Support at work [1]

- I can get support and help from my co-workers when needed: 1-4 (Not at all true ‑ Very true)

Work Intensity [1]

- Does your job involve working at very high speed?: 1-7 (All of the time ‑ Never)
- Does your job involve working to tight deadlines?: 1-7 (All of the time ‑ Never)
- How many hours do you usually work per week in your main paid job?: [Numeric]
- You have enough time to get the job done?: 1-5 (Almost always ‑ Almost never)
- And how many times a month do you work more than 10 hours a day?: [Numeric]

Emotional Demands [1]

- You find your job emotionally demanding: 1-5 (Almost always ‑ Almost never)
- Your job involves tasks that are in conflict with your personal values: 1-5 (Almost always ‑ Almost never)
- You get emotionally involved in your work: 1-5 (Almost always ‑ Almost never)
- You experience stress in your work: 1-5 (Almost always ‑ Almost never)
- Your job requires that you hide your feelings: 1-5 (Almost always ‑ Almost never)

Task autonomy [1]

- How much choice do you have over the way in which you do your job?: 1-4 (A great deal of choice ‑ No choice at all)
- How much influence do you personally have on how hard you work?: 1-4 (Very true ‑ Not at all true)
- How much influence do you personally have on deciding what tasks you are to do?: 1-4 (A great deal ‑ Not at all)
- How much influence do you personally have on deciding how you are to do the task?: 1-4 (A great deal ‑ Not at all)
- How much influence do you personally have on deciding the quality standards to which you work?: 1-4 (A great deal ‑ Not at all)

Task clarity and feedback performance [1]

- You know what is expected of you at work: 1-5 (Almost always ‑ Almost never)

- In general, your immediate manager/supervisor: Provides you with feedback on your work: 1-2 (Yes – No)
- Had a frank discussion with your boss about your work performance?: 1-2 (Yes – No)
- Have been subject to regular formal assessment of your work performance?: 1-2 (Yes – No)

Working flexibility [1]

- I can decide the time I start and finish work: 1-4 (Not at all true – Very true)

Job insecurity [1]

- You have a secure job: 1-2 (Yes – No)
- I might lose my job in the next 6 months: 1-5 (Strongly agree – Strongly disagree)
- If I were to lose or quit my current job, it would be easy for me to find a job with similar salary: 1-5 (Strongly agree – Strongly disagree)

Training and learning opportunities [European Working Conditions Survey]

- Does your main paid job involve: learning new things?: 1-2 (Yes – No)
- The training has helped me improve the way I work: 1-2 (Agree – Disagree)
- I feel that my job is more secure because of my training: 1-2 (Agree – Disagree)
- I feel my prospects for future employment are better [because of training]: 1-2 (Agree – Disagree)
- At work, I have opportunities to learn and grow: 1-5 (Strongly agree – Strongly disagree)
- Does your main paid job involve: complex tasks?: 1-2 (Yes – No)
- Does your main paid job involve: solving unforeseen problems on your own?: 1-2 (Yes – No)

Intrinsic Rewards [1]

- My job is interesting: 1-5 (Strongly agree – Strongly disagree)
- In my job I can help other people: 1-5 (Strongly agree – Strongly disagree)
- My job is useful to society: 1-5 (Strongly agree – Strongly disagree)

Job satisfaction [23]

- I feel fairly satisfied with my present job: 1-7 (Strongly agree – Strongly disagree)
- Most days I am enthusiastic about my work: 1-7 (Strongly agree – Strongly disagree)
- Each day at work seems like it will never end" (reverse scored): 1-7 (Strongly agree – Strongly disagree)
- I find real enjoyment in my work: 1-7 (Strongly agree – Strongly disagree)
- I consider my job to be rather unpleasant (reverse scored): 1-7 (Strongly agree – Strongly disagree)

Perceived usefulness of the technology [24]

(Adapted for the technology will be tested in the pilots)

- Using "technology" in my job would enable me to accomplish task: 1-7 (extremely likely – extremely unlikely)
- Using "technology" would improve my job perf: 1-7 (extremely likely – extremely unlikely)
- Using "technology" in my job would increase my productivity: 1-7 (extremely likely – extremely unlikely)
- Using "technology" would enhance my effectiveness on the job: 1-7 (extremely likely – extremely unlikely)
- Using "technology" would make it easier to do my job: 1-7 (extremely likely – extremely unlikely)
- I would find "technology" useful in my job: 1-7 (extremely likely – extremely unlikely)

Perceived ease of use [24]

(Adapted for the technology will be tested in the pilots)

- Learning to operate "technology" would be: 1-7 (extremely likely – extremely unlikely)
- I would find it easy to get "technology" to do what I want to do: 1-7 (extremely likely – extremely unlikely)
- My interaction with "technology" would be clear and understandable: 1-7 (extremely likely – extremely unlikely)
- I would find "technology" to be flexible to interact with: 1-7 (extremely likely – extremely unlikely)
- It would be easy for me to become skillful at using "technology": 1-7 (extremely likely – extremely unlikely)
- I would find "technology" easy: 1-7 (extremely likely – extremely unlikely)

Big Five Inventory [25]

I see Myself as Someone Who...: 1-5 (Strongly disagree – Strongly agree)

- Is talkative
- Tends to be lazy
- Tends to find fault with others
- Is emotionally stable, not easily upset
- Does a thorough job
- Is inventive
- Is depressed, blue
- Has an assertive personality
- Is original, comes up with new ideas
- Can be cold and aloof
- Is reserved
- Perseveres until the task is finished
- Is helpful and unselfish with others

- Can be moody
- Can be somewhat careless
- Values artistic, aesthetic experiences
- Is relaxed, handles stress well
- Is sometimes shy, inhibited
- Is curious about many different things
- Is considerate and kind to almost everyone
- Is full of energy
- Does things efficiently
- Starts quarrels with others
- Remains calm in tense situations
- Is a reliable worker
- Prefers work that is routine
- Can be tense
- Is outgoing, sociable
- Is ingenious, a deep thinker
- Is sometimes rude to others
- Generates a lot of enthusiasm
- Makes plans and follows through with them
- Has a forgiving nature
- Gets nervous easily
- Tends to be disorganized
- Likes to reflect, play with ideas
- Worries a lot
- Has few artistic interests
- Has an active imagination
- Likes to cooperate with others
- Tends to be quiet
- Is easily distracted
- Is generally trusting
- Is sophisticated in art, music, or literature

Gender

- What is you gender (1-Female, 2-Male, 3-I do not wish to answer)

Age

- What is your age (Numeric)

Education

- What is the highest level of education you have completed?