

T.R.
GEBZE TECHNICAL UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES

HUMAN-ROBOT CO-WORKING AND ROBOETHICS

KADİR ALPASLAN DEMİR
A THESIS SUBMITTED FOR THE DEGREE OF
MASTER OF BUSINESS ADMINISTRATION
DEPARTMENT OF MANAGEMENT

GEBZE
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SUMMARY

The robotic technology is advancing at an incredible pace. Robots are already becoming a part of our lives. Soon, humans and robots will be co-workers. Human-robot co-working will create many changes in our organizational and business environments. One vision of Industry 5.0 is human-robot co-working.

The goal of this research is to identify factors affecting robot acceptance in human-robot co-working environments. To reach the research goal, we conducted a focus group study on human-robot co-working and collected data from working professionals.

In this thesis, first, we identify and briefly discuss current research questions in roboethics. Then, we discuss a wide range of issues related to human-robot co-working. In the following sections, we present our research and focus group study findings.

Based on the research data analysis, we acquired the following findings. Almost all participants believe that robots will be a part of our workplaces soon. The attitude toward robots vary. Some participants have strong positive, some have strong negative, and most participants have an attitude between positive and negative toward working with robots. Some of the participants strongly express that robots have to be useful – in other words, robots have to improve efficiency and work environment - to be accepted in workplaces. Participants have different opinions on the appearance and behavior of robots to be used in workplaces. Some prefer human-like while others prefer machine-like appearance and behavior. As a result, there are multiple factors influencing acceptance of human-robot co-working. Attitude toward robots and usefulness are among the main factors.

Key Words: Robots, Human-Robot Co-working, Industry 5.0, Roboethics, Management of Information Systems, Management and Organization, Robots in Organizations, Organizational Robotics.

ÖZET

Robot teknolojisi inanılmaz bir hızla ilerlemektedir. Robotlar artık günlük yaşamımızın bir parçası olmaya başladılar. Yakın bir gelecekte insanlar ve robotlar iş arkadaşı olacaklar. İnsanların ve robotların birlikte çalışması örgütlerde ve işletmelerde birçok değişikliğe yol açacaktır. Endüstri 5.0 vizyonlarından bir tanesi insanların ve robotların beraber çalışmasıdır.

Bu araştırmanın amacı, insanların ve robotların birlikte çalıştığı ortamlarda robotların kabulüne etki eden faktörleri tespit etmektir. Araştırmanın amacına ulaşmak için insanların ve robotların beraber çalışması üzerine bir odak grup çalışması gerçekleştirilmiş ve çalışanlardan veri toplanmıştır.

Bu tezde önce robot etiği ile ilgili güncel araştırma soruları tespit edilerek kısaca tartışılmıştır. Sonra, insanların ve robotların beraber çalışması ile ilgili geniş bir yelpazedeki hususlar tartışılmıştır. Sonraki bölümlerde, araştırmamızı ve odak grup çalışması bulgularımızı sunmaktayız.

Araştırma verilerinin analizi sonucu elde edilen bulgular kısaca şu şekildedir: Hemen hemen tüm araştırma katılımcıları robotların yakın bir zamanda iş yaşamımızın bir parçası olacağına inanmaktadırlar. Robotlara karşı tutum değişkenlik göstermektedir. Robotlarla beraber çalışmaya karşı bazı katılımcıların çok olumlu, bazılarının çok olumsuz ve diğerlerinin ise olumlu ve olumsuz arasında bir tutumları olduğu belirlenmiştir. Bazı katılımcılar robotların işyerlerinde kabul edilmesi için işe yaramalarının gerektiğini yani üretkenliği arttırmaları ve iş ortamını iyileştirmeleri gerektiğini özellikle vurguladılar. Katılımcıların işyerlerindeki robotların fiziki görünümüne ve sergilemesi gereken davranışlarına ait değişik fikirleri bulunmaktadır. Bazıları insansı özellikler beklerken, diğerleri makinemsi özellikleri tercih etmektedir. Sonuç olarak, insanlarla robotların beraber çalışmasının kabulüne birden çok faktör etki etmektedir. Robotlara karşı tutum ve işe yararlılık ana faktörler arasındadır.

Anahtar Kelimeler: Robotlar, İnsanların ve Robotların Beraber Çalışması, Endüstri 5.0, Robot Etiği, Yönetim Bilişim Sistemleri, Yönetim ve Organizasyon, Örgütlerde Robotlar, Örgütsel Robotlar.

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LIST of ABBREVIATIONS and ACRONYMS

<u>Abbreviations</u>	<u>Explanations</u>
<u>and Acronyms</u>	
GTÜ	: Gebze Teknik Üniversitesi
NARS	: Negative Attitude Toward Robots Scale
RAS	: Robot Anxiety Scale
TAM	: Technology Acceptance Model
TPB	: Theory of Planned Behavior
TRA	: Theory of Reasoned Action

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1. INTRODUCTION

In the past, the use of robots was mostly limited to factories. Therefore, industrial robots were at the core of the robotics market (Demir & Cicibas, 2017; Demir & Cicibaş, 2019). However, the use of robots is expanding (Ray, Mondada, & Siegwart, 2008). In recent years, both remotely operated and autonomous unmanned vehicles have found many civilian and military uses (Demir, Cicibas, & Arica, 2015). Autonomous cars are being tested on roads (Demir, 2017). Medical robots are being developed to assist surgeons in various surgical procedures (Lin, Abney, & Bekey, 2011b). Robots for educational and entertainment purposes are available for purchase (Web 1, 2018; Web 2, 2018). Robots are already in society (Lin et al., 2011b). They are used in labor and services (Ray et al., 2008), military and security (Demir et al., 2015), research and education, entertainment, medical and healthcare, and personal care (Lin et al., 2011b). Robots are beginning to take care of themselves and even replicate themselves (Graetz & Michaels, 2015; Zykov, Mytilinaios, Adams, & Lipson, 2005; Ellery, 2016).

The current trend in robotics is moving toward robots playing a part in human lives (Ray et al., 2008; Lin et al., 2011b; Coeckelbergh, 2009). Recently, Softbank Robotics, a Japan robotics company, introduced a humanoid robot named “Pepper” (Web 1, 2018). This humanoid robot is capable of recognizing and interpreting human emotions. Pepper responds to these emotions accordingly. Additionally, Pepper is able to learn and adapt itself according to the personality traits and habits of people interacting with it. According to the Softbank Robotics company website (Web 1, 2018), Pepper is being used in about 140 Softbank Mobile stores to welcome, interact, inform, and amuse customers. In a few years, the company will make the robot available for purchase worldwide. Moreover, the price of this humanoid robot is quite reasonable. Cozmo (Web 2, 2018), developed by Anki, is a remarkable toy robot with improved artificial intelligence (AI). It is marketed as “a robot with a personality”. Cozmo is self-aware. According to the developer, Cozmo is able to recognize its user, read the emotions of the user, and interpret its environment. Furthermore, Cozmo is able to show emotions based on the interactions with its user. Again, the price of the Cozmo is quite reasonable. There are also other robots available for purchase at affordable prices. In addition, there are many

research projects to increase the ability and capability of robots. These developments promise us a future with more robots around.

1.1. Contributions of this Research

The contributions of this research study are as follows:

- Identification of research questions in roboethics
- Identification of issues related to human-robot co-working in organizations
- Initial identification of factors influencing acceptance of human-robot co-working in organizations with office working environments

1.2. Statement of the Problem

The use of robots is expanding. Soon, robots will be a part of our lives. Robots will be in our homes, in our work, in stores, and in restaurants. Currently, work takes up approximately one-third of a daily routine for most professionals. Even if we choose not to have robots in our personal life, we will likely work with robots in our workplaces. As robots start to perform tasks in organizations, humans will start interacting and working with robots.

1.3. Significance of the Problem

The focus of Industry 4.0 is smart manufacturing and smart factories. Automation with robots will play a key role in Industry 4.0. Moreover, some researchers hypothesize that Industry 5.0 will be about human-robot collaboration in workplaces. As a result, an investigation of how robots and humans work together will be a major research topic for both roboticists and organizational researchers. This research is one of the first investigations into this topic.

1.4. Research Goal

The goal of this research is to investigate factors affecting the acceptance of robots in the workplaces. Due to the current state of the art in this research area, this research is exploratory in nature.

1.5. Research Questions

The basic research questions in this study are as follows:

1. What are the issues related to human-robot co-working?
2. What are the research questions for roboethics?
3. Will the people accept robots in their workplaces as co-workers?
4. What are the factors affecting the acceptance of robots in the workplaces?

While these are the main research questions for this study, we have detailed research questions. These questions are presented in the research design section.

1.6. Research Hypothesis

This research is exploratory in nature. As a result, the identification of various potential factors affecting robot acceptance is one of the primary goals of this study. Therefore, we do not have research hypotheses in this study. One of the future works of this study will be developing research hypotheses based on the findings of this research.

1.7. Research Strategy

Every research has its own strategy to reach the intended research output. Our research strategy is presented in Figure 1.7.1.

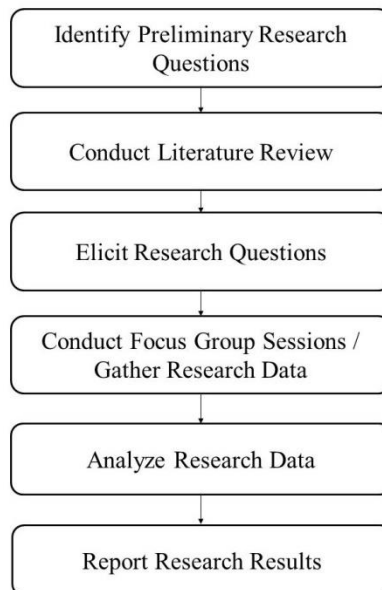


Figure 1.7.1: Research Strategy

1.8. Research Scope

In this research, we set our scope to include the following:

- The identification of factors affecting robot acceptance for organizational purposes
- Robots used in organizations having office-like environments

1.9. Research Assumptions

In this research, we assume that robots will be a part of our lives in many aspects. This assumption is supported by many research studies. There are also many funded research studies investigating how to benefit from robots in various parts of our lives from domestic use to industrial use. Following this assumption, we also assume that robots will be used in organizations having office type workplaces. Another assumption is that robots will be used not in one but in different roles.

1.10. Research Applicability

This research is applicable to organizations having mostly office type workplaces. The applicability to other types of workplaces is currently unknown.

1.11. Overview of the Thesis

This thesis consists of ten chapters. In the first chapter, we overview the research. We provide metadata related to this research.

The second chapter discusses the related research on the topic. We overview robotic research areas that will affect the management field. We specifically discuss robotics, artificial intelligence, human-robot interaction, social robotics, roboethics, and humanoid robots.

In the third chapter, we discuss the emerging roboethics discipline and identify the current essential research questions in roboethics.

In the fourth chapter, we identify the issues related to human-robot co-working. There are quite a number of issues from the organizational and human worker perspective in a human-robot co-working environment.

In the fifth chapter, we detail our research design and method. We list the research questions. We explain why we choose the focus group study as our main research methodology. We also provide other information related to our research design.

In the sixth chapter, we provide details related to our focus group sessions. We provide data for each session in detail.

The seventh chapter presents our findings based on the data gathered from focus group sessions. We further discuss our findings.

We provide the conclusions, the limitations of the study, and future work in the eighth, ninth, and the last chapter.

2. LITERATURE REVIEW

In this section, we review the related literature on the subject. First, we briefly discuss robotics subfields that are particularly related to organizational research since the focus of this thesis is human-robot co-working in organizations. Then, we provide a brief introduction to focus group studies. We conducted a focus group study to collect data for this research study. Then, we briefly explain two important theories relevant to this research. These are the theory of reasoned action, and the theory of planned behavior. The former theory is actually an extension of the first one. Then, we explain a widely used model known as the Technology Acceptance Model. A research study focusing on the adoption or acceptance of any technology will be incomplete without a reference to this model that is used in a wide range of studies in the management of information systems research. Finally, we discuss the robot acceptance. We particularly focus on two important studies that are closely related to this study. A literature review on human-robot co-working and roboethics may be quite long, however, in this thesis we provide brief introductions to the relevant subjects for the sake of readability. In addition, we also provide necessary references to relevant studies with adequate arguments in the sections titled roboethics and human-robot co-working.

2.1. Robotics

The term *robot* originates from a Czech word, “*robota*”. The meaning of *robota* is “forced labor”. This term was first used by Karel Čapek in a science fiction play titled *R.U.R.* (*Rossum's Universal Robots*, 1920). The meaning of the word is quite striking and it is as if robots were initially envisioned to be the slaves of the people. Note that this may create interesting discussions in the future.

Robotics is a discipline focusing on the design, manufacturing, operation, and use of robots (Demir, 2017). There are many research areas in robotics. Up until recent years, the focus of most robotics research was artificial intelligence and robot design. Naturally, studies on social aspects of robots were limited. However, as robotic technology advances and the production and availability of robots increase, the dream of robots and people living and working together is becoming a reality.

Experts began imagining these machines among people and researchers started to study the social aspects of robotics. There are some particular research areas within the overall robotics research that will especially help to integrate robots into our lives and into the workplaces. These research areas are artificial intelligence (AI), human-robot interaction (HRI), social robotics, roboethics, and humanoids.

2.1.1. Artificial Intelligence

For most people, artificial intelligence is almost a synonym for robots. However, there are some robotics research areas that are not directly related to artificial intelligence. Areas such as electronics engineering, mechanical engineering, control systems engineering, and power engineering are also important areas supporting robotics engineering. Therefore, for most robotics engineers, artificial intelligence is about increasing the intelligence of robots. Currently, robots are not smart enough to work and live among people. Thus, we need more research on artificial intelligence before integrating these robots into organizations and society.

2.1.2. Human-Robot Interaction (HRI)

Human-robot interaction research is gaining attention in recent years. As the vision of robots and humans live and work together is becoming a reality, scholars and scientists got more interested in examining issues related to human-robot interaction. HRI 2018, the Annual ACM/IEEE International Conference on Human-Robot Interaction, is the 13th conference in the series. Each year, the conference highlights a theme in robotics. The *Journal of Human-Robot Interaction* is a good resource for the current state of the art. The human-robot interaction research is in early stages. For example, early research indicates that people prefer human-like behavior or communication in human-robot interaction (Ray et al., 2008). However, as we experiment with robots, we may invent new ways of communication and interaction with robots. We need more research, especially applied and experimental research, to help us in successfully integrating robots into organizations.

2.1.3. Social Robotics

Breazeal (2002) offered the term sociable robots: “A sociable robot is able to communicate and interact with us, understand and even relate to us, in a personal way. It is a robot that is socially intelligent in a human-like way. We interact with it as if it were a person, and ultimately as a friend.”. Social robotics deal with social issues surrounding robots. Humans are social creatures (Breazeal, 2003). Thus, a great deal of organizational behavior research revolves around social issues in the workplace. People in organizations will eventually expect a certain level of social behavior from robots if they become coworkers. Therefore, social robotics is a crucial research area for the integration of robots into organizations.

2.1.4. Roboethics

Roboethics is the study of ethical issues surrounding robotics. The term was first coined in the First International Symposium of Roboethics held at Sanremo, Italy in 2004. One of the main goals in roboethics is the design of ethical robotic behavior.

In addition to law and culture, ethics regulate a great deal of human behavior. Ethics is an indispensable part of human behavior. It exists almost in all aspects of our lives. Managers and employees are expected to have a certain level of work ethics in an organization. If people and robots are to work together, people will expect robots to follow certain ethical rules. Roboethics will help us to successfully integrate robots into society.

2.1.5. Humanoid Robots (Humanoids)

According to Euron Roboethics Roadmap, “humanoids are robots whose body structure resembles the human one” (Veruggio, 2006). Note that humanoid robots are also called humanoids. Humanoid robots do not only resemble humans in structure but people also expect human-like behavior from these types of robots (Veruggio, 2006; Lin et al., 2011b). First examples of robots interacting with customers are humanoid robots. For example, a humanoid robot, Pepper developed by Softbank Robotics, is now commercially available for businesses with affordable prices. According to the developers, Pepper is designed to be “the first humanoid robot

capable of recognizing the principal human emotions and adapting his behavior to the mood of his interlocutor”. This humanoid robot is used as a new way to welcome, inform, and amuse the customers. Again, the developers claim that Pepper also recently became the first humanoid robot to be adopted in Japanese homes. However, some studies found that people do not prefer a humanoid as a robot (Ray et al., 2008; Arras & Cerqui, 2005). They would like to see a machine-like look in a robot (Ray et al., 2008). However, they prefer human-like behavior or communication (Ray et al., 2008). One interesting study may investigate the question that whether the human body resemblance of humanoids increases the expectation of human-like behavior and morality from these machines or not.

2.2. Theory of Reasoned Action

Theory of Reasoned Action (TRA) is developed by Fishbein and Ajzen (1975) and further discussed in (Ajzen & Fishbein, 1980). TRA explains the relationship between attitudes and behaviors within reasoned human actions. This theory attempts to explain why humans show a particular behavior by linking three main cognitive components. These are the attitude toward an act or behavior, subjective norm, and behavioral intention. TRA is presented in Figure 2.2.1.

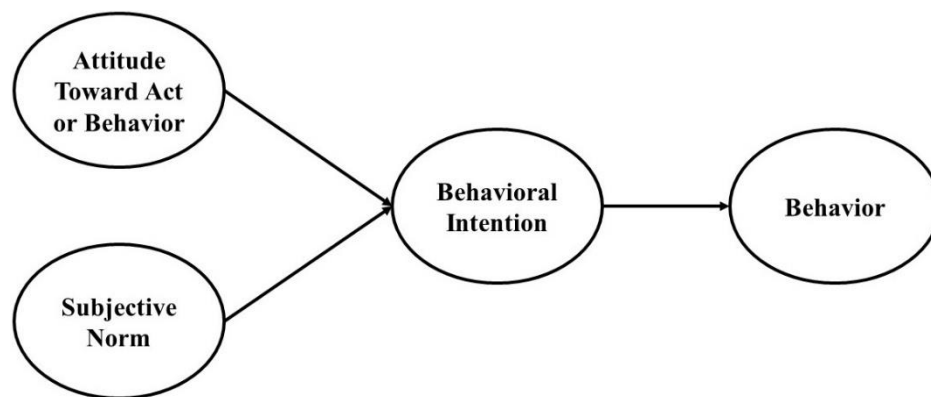


Figure 2.2.1: Theory of Reasoned Action

Personal attitude toward an act or behavior and subjective norm affect the behavioral intention of a human. The intention naturally leads a certain behavior. See a recent detailed discussion of TRA in (Montano & Kasprzyk, 2015).

This theory influenced the field of management information systems in investigating why information technology users accept or adopt particular information technology. Therefore, the theory provides a foundation for many research studies on technology acceptance (Taherdoost, 2018).

In the organizational context, the subjective norm is often affected by the social influences in the organization. Work ethics is a significant part of organizational social influences. Therefore, TRA has the potential to offer viable explanations for investigating the links between the concepts of human-robot co-working, work ethics, and roboethics.

2.3. Theory of Planned Behavior

In the area of psychology, the theory of planned behavior (TPB) (Ajzen, 1991) is a well-known theory explaining the links between individual beliefs and behavior. The theory of planned behavior extends the theory of reasoned action mainly by adding a new variable, namely perceived behavioral control. Figure 2.3.1 presents the theory.

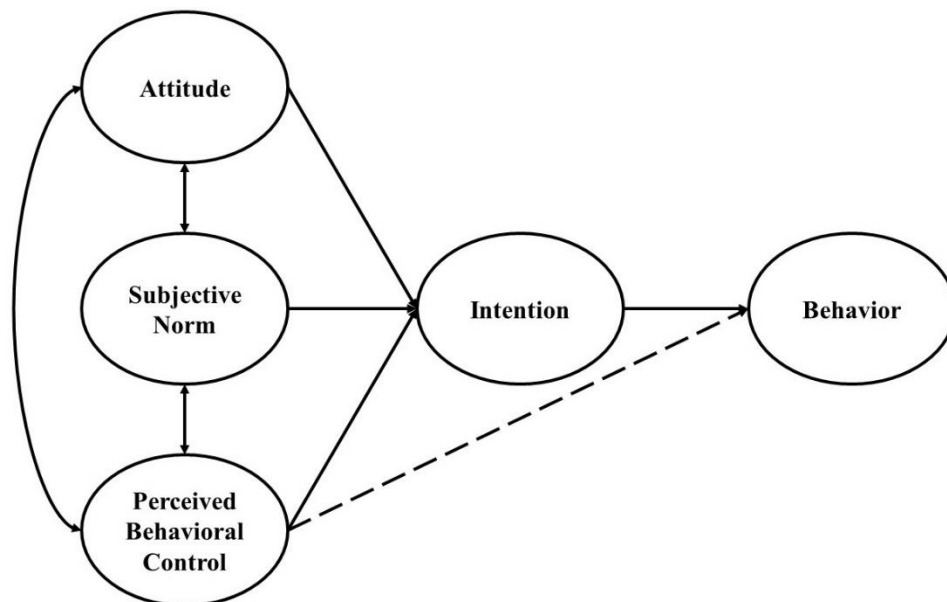


Figure 2.3.1: Theory of Planned Behavior

Like the theory of reasoned action, this theory also influenced the field of management information systems in investigating why people accept or adopt

particular information technology. TPB is used in a number of areas such as investigating health-related behavior (Godin & Kok, 1996). See a meta-analytic review of the efficacy of this theory in (Armitage & Conner, 2001). A comparison of the TPB and the TRA is provided in (Madden, Ellen, & Ajzen, 1992).

Just like the TRA, the TPB has the potential to offer viable explanations for investigating the links between the concepts of human-robot co-working, work ethics, and roboethics. Thus, we feel the need to briefly discuss these theories within this graduate thesis.

2.4. Technology Acceptance Model

Technology acceptance is one of the main research areas in the management of information systems (MIS) field. An eminent model in technology acceptance research is the Technology Acceptance Model (TAM). TAM basically states that if a technology is perceived as “useful” and “easy to use”, then it is likely to be accepted. Figure 2.4.1 provides the original technology acceptance model developed by Davis (1985). Davis (1985) also articulated that there may be various factors affecting the perceived usefulness and perceived ease of use. A lot of studies following the original technology acceptance model focused on the investigation of these factors. There are many technologies used in various areas. Therefore, the factors affecting the perceived usefulness and perceived ease of use vary by technology (Legris, Ingham, & Colletette, 2003), organization (Oliveira & Martins, 2011), or even the environment surrounding the technology (Amoako-Gyampah & Salam, 2004).

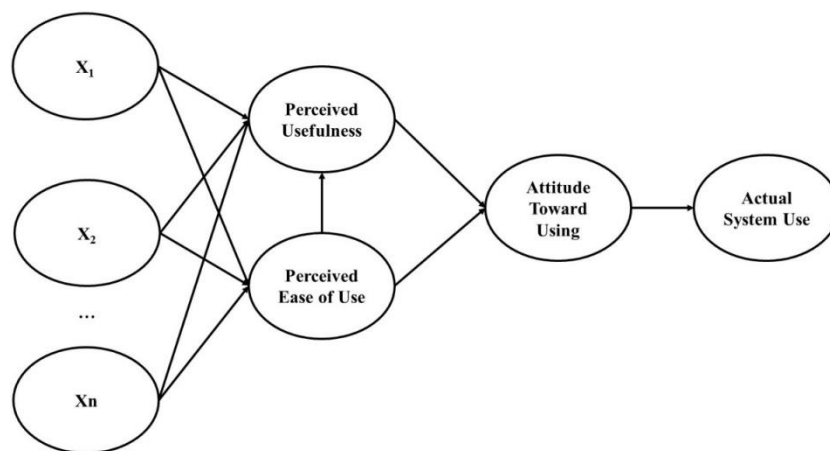


Figure 2.4.1: Original Technology Acceptance Model (TAM) (Davis, 1985)

There are many studies related to technology acceptance and adoption models model. See a review of these models and theories in various related studies (Dillon & Morris, 1996; Legris et al., 2003; Marangunić & Granić, 2015; Lai, 2017; Taherdoost, 2018).

2.5. Robot Acceptance

Since the use of robots in society is limited, the number of studies on robot acceptance is limited as well. Most research on the topic is conducted on the acceptance of social robots. However, these studies focus on domestic use, elderly care, and healthcare (De Graaf & Allouch, 2013; Broadbent, Stafford, & MacDonald, 2009). The research on the acceptance of robots in the early stages. There are studies that may be considered as precursor studies. Research on attitude toward robots is one of these precursor studies. One of the earlier works on attitude toward robots was conducted by Nomura and friends (Nomura, Kanda, Suzuki, and Kato, 2008). They developed a scale called Negative Attitude toward Robots Scale (NARS) and another scale called Robot Anxiety Scale (RAS) (Nomura, Suzuki, Kanda, & Kato, 2006a). NARS scale has an interaction, social, and emotional dimension. The scales are presented in Table 2.5.1 and Table 2.5.2. Note that one of the first scales developed to understand the attitude toward robots has a negative approach.

The NARS scale has been used in a number of studies (Bartneck, Nomura, Kanda, Suzuki, & Kennsuke, 2005; Syrdal, Dautenhahn, Koay, & Walters, 2009). Bartneck et al. (2005) conducted a cross-cultural study on attitudes toward robots. They surveyed participants from different nationalities to understand if there are any cultural aspect of attitudes toward robots. They used NARS scale. There were Dutch, Chinese living in the Netherlands, and Japanese participants in the study. Most participants were university students. They conducted a nationality and gender analysis on the results. Only one of the nationality had a significant influence on the social dimension. Japanese participants have a more negative attitude toward robots on the social dimension. They seem more concerned regarding the negative social influence of robots on society. The authors argued that this might be due to more exposure to robots in Japan compared to other countries. Thus, the Japanese may be more aware of the abilities and inabilities of robots. In addition, an important finding of this study is that gender has no influence on attitude toward robots. On the other

hand, gender may have an influence on various dimensions of NARS (Nomura, Suzuki, Kanda, & Kato, 2006b).

Table 2.5.1: Negative Attitudes toward Robots Scale (NARS) (Nomura, Kanda, Suzuki, & Kato, 2008)

Subscale	Item
S1: Negative Attitude toward Interaction with Robots	I would feel uneasy if I was given a job where I had to use robots. The word "robot" means nothing to me. I would feel nervous operating a robot in front of other people. I would hate the idea that robots or artificial intelligences were making judgements about things. I would feel very nervous just standing in front of a robot. I would feel paranoid talking with a robot.
S2: Negative Attitude toward Social Influence of Robots	I would feel uneasy if robots really had emotions. Something bad might happen if robots developed into living beings. I feel that if I depend on robots too much, something bad might happen. I am concerned that robots would be a bad influence on children. I feel that in the future society will be dominated by robots.
S3: Negative Attitude toward Emotional Interactions with Robots	I would feel relaxed talking with robots* If robots had emotions I would be able to make friends with them.* I feel comforted being with robots that have emotions.*

* Reverse Coded Item

Table 2.5.2: Robot Anxiety Scale (RAS) (Nomura, Suzuki, Kanda, & Kato, 2006)

Subscale	Item
S1: Anxiety toward Communication Capability of Robots	Whether the robot might talk about irrelevant things in the middle of a conversation. Whether the robot might not be flexible in following the direction of our conversation. Whether the robot might not understand difficult conversation topics.
S2: Anxiety toward Behavioral Characteristics of Robots	What kind of movements the robot will make. What the robot is going to do. How strong the robot is. How fast the robot will move.
S3: Anxiety toward Discourse with Robots	How should I talk to the robot. How should I respond when the robot talks to me. Whether the robot will understand what I am talking about. Whether I will understand what the robot is talking about.

Bagdasarov and her colleagues investigated the organizational considerations of working with robots (Bagdasarov, Martin, & Buckley, 2018). They discussed the issue under three sets of factors: Individual, organizational, and robotic agent factors. Under each set, the authors discussed a number of factors. Employee's age, gender, level of education, experience with technology/technical background, expectations, and social perceptiveness/interpersonal sensitivity are the individual factors. The organization's workflow, physical environment, social/emotional context, training, and employee-robot goal alignment are the organizational factors. The robot's appearance, behavior, capabilities for interaction, and safety are the robotic agent factors. Figure 2.5.1 shows these factors.

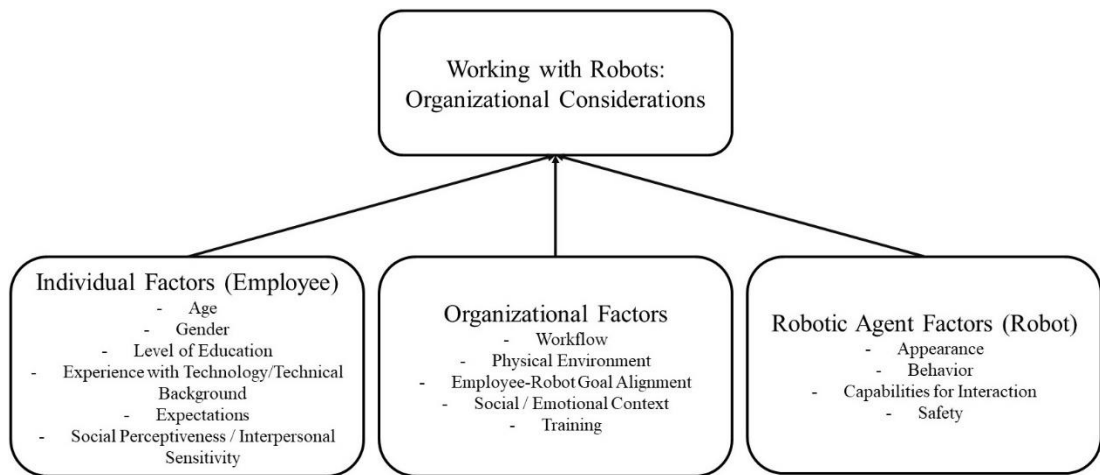


Figure 2.5.1: Organizational Considerations of Working with Robots
(Bagdasarov, Martin, & Buckley, 2018)

3. ROBOETHICS

Roboethics is an emerging research field (Demir, 2017). In this section, we explain roboethics and we highlight the most essential research questions. Some of the findings discussed in this chapter are detailed in one of our previous studies (Demir, 2017).

As robots become widespread and a part of our lives, they will have many unprecedented impacts on our lives and on society. These impacts will be the subject of many roboethics research studies. Gianmarco Veruggio proposed the term “roboethics” during the 1st International Symposium of Roboethics that was held at Sanremo, Italy in 2014. The research areas and related disciplines supporting roboethics are presented in Figure 3.1. (Veruggio, 2007). The figure shows the main disciplines supporting roboethics. However, there are also many other fields contributing to roboethics. As a result, roboethics is an interdisciplinary research field supported by many disciplines.

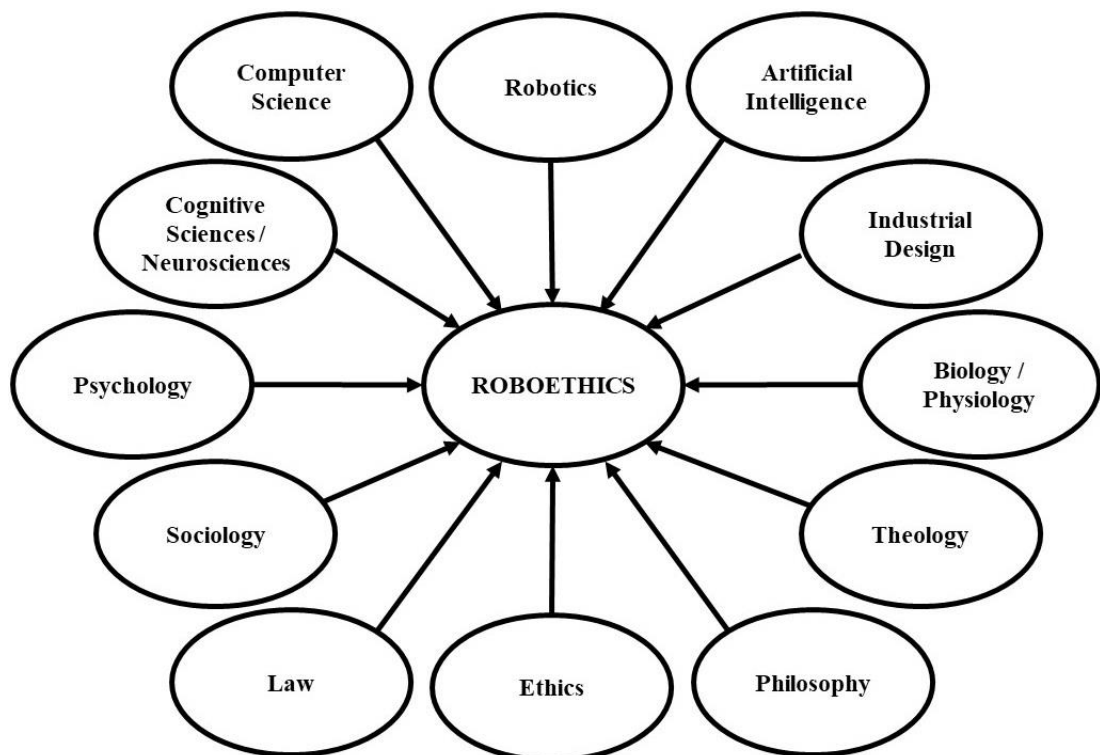


Figure 3.1. Research Areas Supporting Roboethics (Veruggio, 2007)

A science fiction novelist, Isaac Asimov, developed a set of rules known as Asimov's Three Laws of Robotics (Asimov, 1950; Anderson, 2008; Anderson, 2016). They are an ideal set of rules that robots should always abide. Table 3.1 shows the first three rules.

Table 3.1: Asimov's Three Laws of Robotics (Asimov, 1950)

- | |
|--|
| <ol style="list-style-type: none"> 1. <i>A robot may not injure a human being, or, through inaction, allow a human being to come to harm.</i> 2. <i>A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.</i> 3. <i>A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.</i> |
|--|

Later, Isaac Asimov extended the first three laws with an additional law. It is called the zeroth law. Table 3.2 presents this zeroth law. In terms of priority, this zeroth law comes before the other ones.

Table 3.2: Asimov's Zeroth Law of Robotics

- | |
|---|
| <ol style="list-style-type: none"> 0. <i>A robot may not harm humanity, or, by inaction, allow humanity to come to harm.</i> |
|---|

Eminent scholars in this field such as Arkin (2009) and Anderson (2008; 2016) stress that Isaac Asimov's Laws of Robotics are not adequate for establishing a basis for machine or robot ethics. On the other hand, these laws are significant in the sense that they started a discussion for an important topic among philosophers and scientists. Arkin (2009) even argue that a discussion on roboethics will be incomplete without referencing these laws on robotics. Asimov's Laws are too ambiguous to be used in developing a robot based on these laws. For instance, it is quite hard to identify the situations in which a robot, through inaction, allow a human being to come to harm. Furthermore, robots have to self-aware to successfully implement the third law that is protecting its own existence. Achieving self-awareness in robots is quite a challenge. Even though there are many problems with

these laws, Asimov's Laws of Robotics are actually a good source of interesting questions on robotics and roboethics. What kind of "harm" are we talking about in the first law? Does it include psychological harm in addition to physical harm? What kind of orders will the robots be required to obey? Are the robots supposed to take orders from any human? What is humanity in the context of robotics and roboethics? There are many other interesting and challenging questions. As a result, while Asimov's Laws of Robotics is simple in nature, they are extremely hard or even impossible to implement in real life, at least for the near future. (Murphy & Woods, 2009).

3.1. Research Questions in Roboethics

Currently, the field of roboethics is filled with many interesting and challenging open questions for research (Sullins, 2011). The studies discussing these questions are only early discussions scratching the surface of roboethics and leading to more interesting questions. At this point, asking the right questions and framing the questions in the correct way are the main contributions that we can make to the relevant literature.

Sullins (2011) provided a brief discussion on various open research questions related to the subfields of roboethics. These subfields are presented in Table 3.1.1. Sullins (2011) mostly focused on the subfields in his article. However, in this study, we focus on specific interesting research questions concerning roboethics. Naturally, as Sullins (2011) also pointed out that his and other studies including this one are not and could not be exhaustive at this stage.

Table 3.1.1: Fields of Studies for Roboethics (Sullins, 2011)

Military Applications
Privacy
Robotic Ethical Awareness
Affective Robotics
Sex Robots
Carebots
Medibots
Autonomous Vehicles
Attribution of Moral Blame
Environmental Robotics

3.2. The Definition of a Robot

According to one definition, a robot is *a machine that senses, thinks, and acts* (Bekey, 2005). Even though this is a simple definition, it has many problems. How does a machine think? What does thinking mean? What does acting mean for a robot? Oxford dictionary defines a robot as *a machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer*. Merriam Webster dictionary defines a robot as *a machine that looks like a human being and performs various complex acts (such as walking or talking) of a human being*. These definitions are problematic as well. One resorts to a vague concept such as a carrying out a complex series of actions automatically. The other one assumes that a robot looks like a human being. The ambiguity in these definitions indicates that the current definitions are far from being satisfactory.

Ambiguous definitions also create other important problems. A scientific or philosophical definition of a robot is important. However, there is another type of definition that will enable us to benefit from this technology in our homes, in our workplaces, and in our lives. That is the legal definition. We have to develop a legal definition of a robot that is satisfactory enough to be included in a robot law and other related regulations. In the robotic era, we will face many types of moral, ethical, and legal questions. Ethical issues coupled with moral issues will be the

source of many discussions. However, without resolving legal issues we will not be able to benefit from this technology without creating chaos.

3.3. The Definition of a Cyborg

The word cyborg is created by combining two words: Cyber and Organism. It refers to organisms enhanced with artificial cyber abilities. There are interesting questions about cyborgs. Where do the organism end and cyber begin? Who will be responsible when a prosthetic part of a human malfunctions and that human causes harm to another human? As a result, the legal definition of a cyborg will be a discussion for the future as well. Furthermore, how much artificial enhancement are we going to allow beyond normal prosthetics? In addition, what will be considered as normal prosthetics? As a result, there are many questions related to cyborgs as well.

3.4. Designing Ethical Behavior in Robots

While what should be the ethical rules surrounding robotics is a crucial question, another crucial question is transforming these rules into ethical robot behavior. Finding the right ethical rules is the first step. Then, we need to satisfactorily engineer these rules into robots. Anderson argues that before building an ethical robot, we need to be able to develop a computer program that acts as an ethical advisor to human beings (Anderson, 2008; Andeson, 2016). She focuses on machine metaethics that deals with the field of machine ethics. Machine metaethics talks about the field, rather than do actual work for machine ethics. The ultimate goal of machine ethics is the development of ethical autonomous machines (Anderson, 2008; Andeson, 2016). Arkin (2009) discusses how to embed ethics in a hybrid deliberative/reactive robot architecture. To sum up, to design ethical behavior in robots, we need advancements in the ethics of robotics, roboethics, and machine metaethics.

3.5. Integrating Robots into Society

In the future, while some robots will work in factories away from most people, some robots will be providing services directly to the people. The interactions between humans and robots will create many discussions and probably evolve over

time. The feelings and behaviors toward robots may be different in different cultures. Even roboethics may vary from culture to culture. Therefore, roboticists are faced with challenges such as designing robots that are culture-aware and easy to integrate into society. Integrating robots into society will be a big challenge for the robotics field (Demir, Caymaz, & Elçi, 2017). As the use of robots increases in society, there will be many research studies on the subject.

3.6. Integrating Robots into Organizations

According to the website (Web 1, 2018), the robot Pepper owned by Softbank Robotics from Japan, is used to welcome, inform, and amuse the customers in more than 140 Softbank Mobile stores. The robot Pepper is a humanoid – a human-shaped robot. Pepper is able to recognize human emotions and react to these emotions accordingly. Moreover, Pepper is able to evolve based on the interactions with its users. Pepper is commercially available for businesses at affordable prices. When the technology becomes available to the public at affordable prices, its diffusion is fast. This promises a future with robots in organizations and workplaces.

We discuss the issues related to integrating robots into organizations in detail under the section human-robot co-working.

3.7. Moral Responsibility

Who will take moral responsibility when a robot intentionally or unintentionally harm a human being, an animal, or the environment? What is the responsibility of the designer or the manufacturer of the robot? Will the robots be accountable for their actions? If the actions of a robot are completely deterministic, then we can easily attribute the responsibility to the designer. However, when the robot software has machine learning capabilities and the actions of the robot are nondeterministic, then the issue becomes problematic. We can still hold the designers accountable. Then, the designers will be reluctant to incorporate enhanced machine learning capabilities into robots.

The military is one of the first customers of robotic technology. We are already expanding the use of robots for military purposes including eliminating enemies – mostly by killing. Proponents of using robots to kill enemies argue that they save the

lives of allied warriors by doing so. While the word enemy is the central point for the proponents, from a humanistic viewpoint, an enemy is still a human. Therefore, the crucial question still remains under debate. Are we going to allow robots to kill humans?

3.8. Roboethics Taxonomy

Taxonomies help a lot in framing a research area. We will eventually develop taxonomies and frameworks for robotics and roboethics. Table 3.8.1 presents a roboethics taxonomy developed by (Veruggio & Operto, 2008). See an updated and detailed discussion on the taxonomy and related ethical concerns in (Veruggio, Operto, & Bekey, 2016). Each type of robot in the taxonomy is a subject of interesting and different ethical concerns. While we need to address these concerns, we also need to identify common concerns. This taxonomy is based on the use of robots for a particular purpose. We also need other taxonomies such as based on robot decision-making capabilities.

Table 3.8.1: A Taxonomy of Roboethics (Veruggio & Operto, 2008)

Humanoids
Outdoor Robotics
Military Robotics
Artificial Body
Surgical Robotics
Educational Robot Kits
Industrial Robotics
Biorobotics
Robot Toys
Adaptive Robot Servants
Biomechatronics
Entertainment Robotics
Distributed Robotic Systems
Health Care & Quality of Life
Robotic Art

3.9. Ensuring Privacy with Robotic Agents

As information technology and systems develop, privacy concerns increase. Social media is already a serious threat to privacy as many users are unaware of the exposure social media creates. However, the importance and awareness of privacy are on the rise. Robots will have a lot of information technology in them. Privacy concerns combined with a range of ethical concerns related to robotic technology will create a lot of discussion among the public. Robots will collect intentional or unintentional private data while living among us. There will be an inevitable need to regulate the collection, storage, and dissemination of private data by robots.

3.10. Ensuring Information Security in Robotic Agents

Ensuring information security is challenging in the digital age or in other words, in the information age. The threats to digital assets are increasing as more data and information get digitized. The number of attacks to information systems is increasing. Today, an automobile has more than 20 computers in it. Hackers even attack automobiles with digital systems. As robotic agents become widespread in society, they sure will be a target for hackers and other types of attackers. Moreover, hackers taking over robots may create problems at levels we cannot predict today. Ensuring information security in robotic agents will be an integral part of roboethics. When robots take over more and more important roles in society, ensuring information security in robots will be indispensable.

3.11. Ensuring Safety in Robotic Agents

Ensuring safety is a crucial aspect of the development of any machine. There are many types of machines that are quite powerful compared to humans. When they break down, they create hazards. A system malfunction in an airplane or a train may result in the loss of many lives. Even the maintenance of elevators in buildings are heavily regulated in many countries. The development of these and other similar types of systems are heavily regulated and the products are tested rigorously. However, today, many robotic systems come with an application programming interface (API) enabling robotic programming. There are even robot toys that can be programmed by novice computer programmers. Even in preschool education, robotic

programming is becoming a part of the curriculum. Using these application programming interfaces, people are able to write custom software and upload it onto a robot. As robots enter our lives and homes, the ability to program these robots may create safety problems. Soon, we will need laws and regulations to ban or limit robotic programming that may create safety concerns.

3.12. Robot Automation Levels

A widely accepted automation level for robotics is important for the advancement of the field. Such levels provide a common language among robotics researchers. Furthermore, they may be used for the legal classification of robots. Table 3.12.1 provides automation levels for machines (Sheridan & Verplank, 1978). However, we need to extend this and other proposals for automation levels to incorporate ethical capabilities. Only after a universally accepted automation classification incorporated with ethical considerations, we will be able to integrate robots into our society.

Table 3.12.1: Automation Levels (Sheridan & Verplank, 1978)

Automation Level	Automation Description
1	No computer assistance: the human must make all decisions and take actions.
2	Computer offers a complete set of decision/action alternatives.
3	Computer narrows the selection down to a few.
4	Computer suggests one alternative.
5	Computer executes a suggestion if the human approves.
6	Computer allows the human a restricted time to veto before the automatic execution.
7	Computer executes automatically, then informs humans when necessary.
8	Computer informs the human only if asked.
9	Computer informs the human only if it decides to.
10	Computer decides everything and acts autonomously, ignoring the human.

3.13. Code of Ethics for Robotics Engineers

A code of ethics provides a set of ethical guidelines for professionals. Therefore, a code of ethics is crucial for many types of professions, such as doctors,

lawyers, engineers, etc. A number of codes of ethics have been proposed for robotic engineering (Ingram, Jones, Lewis, Richards, Rich, & Schachterle, 2010; Riek & Howard, 2014). Ingram and his friends developed one of the first code of ethics for robotic engineers. It is known as the Worcester Polytechnic Institute (WPI) Code of Ethics (Ingram, Jones, Lewis, & Richards, 2010). In the development of the code, they use various codes of ethics, such as IEEE and ACM code of ethics for engineers, as a baseline. This code of ethics was even accepted by various academic institutions such as the Illinois Institute of Technology (2010). Table 3.13.1 presents the WPI code of ethics for robotic engineers.

Table 3.13.1: A Code of Ethics for Robotic Engineers (Ingram, Jones, Lewis, & Richards, 2010)

Preamble <i>As an ethical robotics engineer, I understand that I have the responsibility to keep in mind at all times the well-being of the following communities:</i> <i>Global - the good of people and the environment</i> <i>National - the good of the people and government of my nation and its allies</i> <i>Local - the good of the people and environment of affected communities</i> <i>Robotics Engineers - the reputation of the profession and colleagues</i> <i>Customers and End-Users - the expectations of the customer and end-users</i> <i>Employers - the financial and reputational well-being of the company</i> Principles <i>1. Act in such a manner that I would be willing to accept responsibility for the actions and uses of anything in which I have a part in creating.</i> <i>2. Consider and respect peoples' physical well-being and rights.</i> <i>3. Not knowingly misinform, and if misinformation is spread do my best to correct it.</i> <i>4. Respect and follow local, national and international laws wherever applicable.</i> <i>5. Recognize and disclose any conflicts of interest.</i> <i>6. Accept and offer constructive criticism.</i> <i>7. Help and assist colleagues in their professional development and in following this code.</i>
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Riek and Howard developed a set of guiding principles for a human-robot interaction profession code of ethics (Riek & Howard, 2014). There are four main considerations: Human dignity, design, social, and legal considerations. Their code of ethics is clear and concrete compared to Ingram and his friends'. These codes of ethics provide a foundation for further development of an advanced and widely acceptable code of ethics.

3.14. Killer Robots

Asimov's Laws of Robotics state that robots should not harm humans. Furthermore, they should not even let harm come to humans through inaction. However, one of the first uses of robotic technology is the military. Currently, unmanned aerial vehicles (UAVs) and other types of drones are used in killing humans. Since drones are operated by humans, it is currently seen as humans killing humans by means of technology. One step further is to allow this killing determined by a machine, which is possible with the current robotic technology. Then we face the ultimate question: *Are we going to allow robots to kill humans?* This question is the subject of controversial debate among artificial intelligence and robotics researchers (Demir & Caymaz, 2017). Today, there are a number of UAVs equipped with lethal weapons (Demir et al., 2015). These UAVs are frequently used in military operations. There are many other types of lethal autonomous weapon systems (LAWS). The increasing and spreading use of LAWS raises significant concerns among researchers, scientists, and other people (Quintana, 2008; Cole, Dobbins, & Hailwood, 2010; Sharkey, 2012; Tonkens, 2012). Moreover, there are attempts to attract public attention to the issue (Demir & Caymaz, 2017). Recently, in 2013, a campaign to stop killer robots was launched by a group of scientists and owners of AI companies (*The Campaign to Stop Killer Robots*) (Web 3, 2019). The campaign is attracting quite an attention. In 2015, an open letter (2015) titled "*Autonomous Weapons: An Open Letter from AI & Robotics Researchers*", was delivered at the opening of the well-recognized International Joint Conferences on Artificial Intelligence conference (IJCAI 2015). Over twenty thousand people including eminent artificial intelligence and robotics researchers signed this open letter. The letter calls for a ban on lethal autonomous weapons beyond meaningful human control. In 2017, another open letter (2017), signed by founders and directors of over

one hundred artificial intelligence and robotics companies, was presented at the same annual conference (IJCAI 2017). The title of this important letter is “*An Open Letter to the United Nations Convention on Certain Conventional Weapons*”. The letter is addressed to the United Nations. This open letter was a part of *The Campaign to Stop Killer Robots*. In the letter, using autonomous weapon systems was called Pandora’s Box. As known from the famous mythical story, Pandora’s Box is devastating for humanity once opened. The writers of this letter wanted to draw the attention of the United Nations by using the concept of Pandora’s Box, something that should be avoided at all cost. However, the use of Lethal Autonomous Weapons Systems was already a concern for the United Nations. Therefore, since *2013 United Nations Convention on Certain Conventional Weapons (CCW) Meeting of States Parties*, the increasing use of Lethal Autonomous Weapons Systems is under debate among experts in CCW Review conferences (Demir & Caymaz, 2017).

The use of Lethal Autonomous Weapons Systems including killer robots will be the focus of many discussions in various international and national conferences, symposiums, workshops, and meetings. There are two options. We may completely ban the use of any Lethal Autonomous Weapons Systems. This is what the campaign to stop killer robots intends to. The second option is the regulation of Lethal Autonomous Weapons Systems use and development. Which option will prevail is hard to tell at this point. Note that the countries that have the advantage of technology prefer to use this military technology as long as possible. Other underdeveloped countries that do not have the technology advantage want to ban or limit this deadly technology.

3.15. Summary of Roboethics Research Questions

While there are many questions in roboethics, we identified the most essential ones at this state of the art in the current literature. A selected summary of interesting questions discussed is presented in Table 3.15.1.

Table 3.15.1: Summary of Roboethics Research Questions (Demir, 2017)

- 1. What is the definition of a robot?*
- 2. What is the definition of a cyborg?*
- 3. What should the robot law include?*
- 4. What are the rights of robots?*
- 5. What are the ethical rules of human-robot interaction?*
- 6. How do we classify robots based on an automation level incorporating ethical considerations?*
- 7. How do we integrate robots into the society?*
- 8. How do we integrate robots into the organizations and workplaces?*
- 9. What is the code of ethics for the robotics engineering?*
- 10. Are we going to allow robots to kill humans?*

3.16. Discussions on Roboethics Research Questions

Currently, the roboethics field is subject to many open research questions (Sullins, 2011). Furthermore, we need much to do in developing an acceptable robot law that satisfactorily regulates various uses of robots both in workplaces and society (Mehlman, Berg, & Ray, 2017; Petit, 2017). Some researchers stress the need for a new branch of law for robotics and roboethics (Petit, 2017). Environmental protection laws are crucial in sustaining our environment. Since the environment has its own law, we may naturally develop a law for robots. As a result, we believe that in due time there will be a robotic law just like there is an environmental law (Petit, 2017).

Currently, the adoption of various critical technologies is slowed down by the ethical and regulatory issues rather than technological issues. For instance, the well-recognized company, Amazon, wanted to use aerial drones for delivering purchased products (Sullins, 2015). The regulatory agency of civilian airspace in the USA, US Federal Aerospace Administration (FAA), has not yet approved the use of aerial drones in the airspace. Again, the use of autonomous or robotic cars on roads are not regulated yet. The advancement of robotic technology will inadvertently be limited as the necessary regulations regarding the use of these technologies are not in place. As a result, we should also focus on roboethics and robot law as we focused on the development of this crucial technology.

Sullins (2015) pointed out that roboticists have to eventually focus on ethical issues in their robot development projects. Hence, roboticists should learn about roboethics. Therefore, roboethics will be a part of many robotics related curriculums at the undergraduate and graduate level, maybe even sooner than many scholars foresee.

4. HUMAN-ROBOT CO-WORKING

Since the early days of organizational research, increasing the effectiveness and efficiency of organizations is one of the main goals in management and organization research. The use of machinery and product lines in production was innovative. It boosted the economies and created many changes in society. The introduction of robots to society will be innovative. Organizations will try to benefit from robotic technology to the maximum extent. Naturally, many issues will arise during integrating robots into organizations. In this section, we highlight certain research areas and issues that will be the focus of many organizational research studies in the future.

In a previous study (Demir, Caymaz, & Elçi, 2017), we identified the issues related to human-robot co-working from an organizational perspective. In Table 4.1, we list these issues. In this study, we extend these issues. In Table 4.2, we list additional human-robot co-working issues.

Table 4.1: Human-Robot Co-working Issues (Demir, Caymaz, & Elçi, 2017)

Evolution in Organizational Behavior
Acceptance of Robots in the Workplace
Evolution in Organizational Structures and Workflows
Evolution in Work Ethics
Discrimination against Robots or People
Privacy and Trust in a Human-Robot Collaborative Work Environment
Education and Training
Redesign of Workplaces for Robots

Table 4.2: Additional Human-Robot Co-working Issues

Legal and Regulatory Issues
Personal Preference toward Working with Robots
Psychological Issues Resulting from Human-Robot Co-working
Social Implications of Human-Robot Co-working
The Changing Role of Human Resources Departments
The Changing Role of Information Technology Departments and Emerging of Robotics Departments
Ethical Issues Resulting from Human-Robot Co-working – Ethical Status of Robots
Preference toward Types of Robots to Work with (Learning or Rule-based Robots)
Learning to Work with Robots
Negative Attitude Toward Robots due to Shrinking Human Workforce
Humans Competing with Robots or Robots Complementing Humans

4.1. Evolution in Organizational Behavior

Naturally, the focus of current organizational behavior research is human relations. However, as the number of robots in the workplace increases, the focus of organizational behavior research will shift toward human-robot interactions. This line of research will be different from the current human-robot interaction research, which currently investigates the interaction between one human and one robot. Organizational behavior research will mostly focus on human-robot interactions as a group behavior. We will need many new theories and research models with scales such as negative attitudes toward robots (NARS) scale (Syrdal et al., 2009; Nomura, Kanda, & Suzuki, 2006).

Over the years, we learned that organizational behavior must be studied and applied in a contingency framework. Currently, the most popular topics in this field are connected with theories of motivation and leadership, work design and/or satisfaction (Robbins, & Judge, 2012). The results of some of this work will be limited in applicability in a human-robot co-working environment. As a result, organizational behavior research will evolve – may be drastically - over time due to robots in the workplace.

4.2. Acceptance of Robots in the Workplace

The use of robots is expanding (Ray et al., 2008). There are various studies investigating the attitudes toward robots in various application areas (Ray et al., 2008; Syrdal et al., 2009; Nomura et al., 2006; Sanders, Schafer, Volante, Reardon, & Hancock, 2016). For example, one study found a very positive attitude toward robots for service and personal use (Ray et al., 2008). Yet, it is too early to tell that robots will be easily accepted in society. People tend to accept robots and treat them as social entities (Bartneck, Verbunt, Mubin, & Al Mahmud, 2007; Chidambaram, Chiang, & Mutlu, 2012; Young, Sung, Voids, Sharlin, Igarashi, Christensen, & Grinter, 2011) and even sometimes attribute them with moral responsibilities and rights (Liu, Helfenstein, & Wahlstedt, 2008). Some studies suggest that robotic interfaces can be intentionally designed to be persuasive (Chidambaram et al., 2012; Siegel, Breazeal, & Norton, 2009). An interesting study shows that people may accept commands from a robot (Cormier, Newman, Nakane, Young, & Durocher, 2013; Geiskkovitch, Cormier, Seo, & Young, 2016). However, currently, we do not know exactly to what level robots will be accepted in the workplace.

4.3. Evolution in Organizational Structures and Workflows

The introduction of new technology into an organization creates changes in the organizational structure and workflows. In fact, the main argument for investment in technology is the premise of increased effectiveness and efficiency. In some cases, the new technology necessitates structural changes and in many cases, the technology changes the organizational workflows. The existing organizational theories such as Mintzberg's organizational structures (Mintzberg, 1993) may evolve over time to explain how humans and robots efficiently and effectively work together – if they will.

Workflows separate work activities into well-defined tasks, roles, rules, and procedures. Workflows regulate the work in any type of organization. In the past, humans were the sole responsible for carrying out almost all tasks. With the introduction of information technology, processes in the workplace are partially or

totally automated by information systems, i.e., computer programs carrying out tasks and enforcing rules that are originally the responsibility of humans (Kobayashi, Fussell, Xiao, & Seagull, 2005; Bahlman & Johnson, 2005).

4.4. Evolution in Work Ethics

The work ethic is a cultural norm that advocates being personally accountable and responsible for the work that one does and is based on a belief that work has intrinsic value. The concept of work ethic has evolved from the writings of the early 20th-century scholar, Max Weber (1905), who has been credited with contributing to the success of capitalism in western society with the Protestant work ethic (Hill & Petty, 1995; Hirschfeld & Feild, 2000). Weber emphasized the value of work commitment and raised questions as to why some people place greater importance on work and appear more conscientious than others.

Work ethics seem to be a multidimensional set of values. An individual with a high work ethic would place great value on hard work, autonomy, fairness, wise and efficient use of time, and the intrinsic value of work (Dubin, 1956; Cherrington, 1980; Furnham, 1984). As robots become co-workers in our workplaces, work ethics will evolve. There will be interesting discussions related to work ethics. Robots are machines and they have inherent characteristics. They do not get tired. They can be programmed to be hard working, committed, precise, loyal, etc. So, how employees with high work ethics feel in an environment in which competing with robots is almost impossible. We may need a new set of work ethics with robots in the workplace. Furthermore, it is not hard to predict that there will be a close interaction between work ethics and roboethics research.

4.5. Discrimination against Robots or People

Even though there are many laws and regulations against discrimination, it is a reality in the workplace. Members of an organization may discriminate against other members of the organization due to race, color, religion, sex, or national origin. In the future, we may add one dimension to this list. That is being organic or mechanic. We currently do not know what the status of robots will be in society and in organizations. Whether robots will have rights or not will be an interesting

discussion. Moreover, the status of robots may likely to evolve over time. Robots may be viewed as properties to be owned or beings with certain rights. Depending on the discussion, discrimination may not be an issue but the discussion may only revolve around preference of robots over people or people over robots. Bosses or managers may prefer one over another. It is hard to predict how the arguments will shape at this state of the art in robotics and roboethics.

4.6. Privacy and Trust in a Human-Robot Collaborative Work Environment

A systematic study of the notion of privacy began with Warren and Brandeis' famous essay titled "The Right to Privacy" (Warren & Brandeis, 1890), in which privacy is defined as "the right to be left alone". Since then, privacy is the focus of many studies. Depending on the environment, people expect different levels of privacy. For example, people expect a high level of privacy at homes but the expectation is low in public places. Even though the workplace is a type of public place, employees still expect a certain level of privacy in the workplace (Brey, 2005).

Trust can be defined as an individual's belief or an expectation of other's ethical behaviors under various influential factors such as risk and security (Mayer, Davis, & Schoorman, 1995). Researchers use these influential factors to determine the tendency of trust (Riegelsberger, Sasse, & McCarthy, 2005) and construct trust as a fundamental aspect in all types of relationships (Gefen, Karahanna, & Straub, 2003).

Robots are machines and they are capable of recording everything. Unlike humans, robots do not forget. In addition, robots can be equipped with sensors that humans do not have. For example, in the future, robots may be able to read minds using electroencephalogram (EEG). People may not be ready for some of these capabilities and qualities of robots. We will see how the concepts of privacy and trust will evolve as robots become a part of our lives.

4.7. Education and Training

The introduction of new technology creates changes in organizations. Managing an organizational change is inherently challenging (Demir & Ozkan, 2015; Cicibas, & Demir, 2016; Demir, Turan, Onel, Ekin, & Demir, 2019). Bringing robots into the work environment will be a big technological change for many organizations. In many cases, employees resist changes. Education and training help us to overcome the resistance to the new technology, therefore, they are crucial for technology transformation (Cicibas & Demir, 2016; Demir et al., 2019).

Working with robots will not be easy for many employees especially if some of their coworkers lost their jobs due to utilizing robots in the workplace. However, note that we experienced such challenges in earlier industrial revolutions. We overcome these challenges and new types of jobs emerge as technology advances.

4.8. Redesign of Workplaces for Robots

Naturally, our work environments are designed for humans. In most offices, we have office rooms, desks, a coffee room, a kitchen, restrooms, etc. These are all infrastructure for humans. Robots do not need many of these and in fact, they may need others. For example, robots may need a recharging room, a cleaning room, a repair room, etc. Currently, robots are not as skillful as humans in terms of movement. Therefore, maybe not in the future but in the early days of utilizing robots in the workplace, we may need to redesign our workplace to accommodate robots.

4.9. Legal and Regulatory Issues

Without the necessary regulations, human-robot co-working will create many problems. First of all, we need to legally define what a robot is. While there are scientific and other types of definitions for the robot, what will be really binding for businesses and organizations is a legal definition of a robot. There are many types of automated machines. A robot is an automated machine as well. There are automation levels defined for machines (Sheridan & Verplank, 1978). The distinction between an automated machine and a robot should be clear in a law regulating the human-

robot co-working. There are also closely related entities such as drones and cyborgs. The regulations should also include the distinctions of robots from drones and cyborgs.

In addition to a clear definition, the law and other relevant regulations should at least include the types of robots that can be used in workplaces, the roles, and responsibilities of robots, the extent and the types of decisions robots are allowed to make regarding humans, the types of robot malfunctions, who is responsible in a robot malfunction, the division of responsibilities in robot malfunctions, whether the robot software follows certain hard-coded rules or is allowed to learn and evolve, the certifications robots require, the certification authorities and their responsibilities.

There will be also many discussions regarding the regulations for robot development, manufacturing, and certifications. Are we going to allow anybody, any company, or any organization to develop a robot and put the robot into our homes, our workplaces, and our lives? Currently, it is hard to say that many countries are successful in regulating air space for drone use. We need to be ahead of such rapid deployment of various autonomous machines.

The legal and regulatory issues surrounding the use of artificial intelligence, robots, drones, and cyborgs will be the focus of many research studies.

4.10. Personal Preference toward Working with Robots

The personal preference of using or not using a type of technology varies from human to human. There will be people who will be eager to work with robots and who will strongly oppose to the idea of working with robots. Organizations willing to benefit from human-robot co-working in their workplaces should be aware of these personal preferences. If organizations mostly consist of employees with a negative attitude toward robots, then their transition to human-robot co-working environments will not be easy or even possible. Since, human-robot co-working is not a reality yet, the personal preference toward working with robots is mostly shaped by the media rather than the first-hand experiences. There are many famous movies or TV shows depicting the fantasy of robots taking over the world or fighting the human race. This negative media has an effect on personal preference toward working with robots.

4.11. Psychological Issues Resulting from Human-Robot Co-working

Advanced technology has a certain psychological effect on humans. Addiction to video games is considered a psychological disorder that is gaining attention. There are people who have strong attachments to their smartphones. There is even a phobia called “nomophobia” meaning no mobile phobia. According to the Collins dictionary, nomophobia is defined as *a state of stress caused by having no access to or being unable to use one's mobile phone*. We do not currently know whether there will be a “robophobia” or “norobophobia”. However, it is quite likely that advanced technology such as a robot will have a certain unprecedented psychological effect on many employees. Psychological issues related to working with robots and their effect on organizational climates will be a research topic for organizational robotics.

4.12. Social Implications of Human-Robot Co-working

Humans are social creatures. They interact with their kind in various aspects of their lives including work. Having social events at work to increase work performance is a common practice in many organizations (Demir, 2008). When the number of robots in human workplaces increase, the number of humans may likely decrease. This may limit the social interactions between humans. Even if the number of human employees stays the same, the introduction of robots into workplaces may have unprecedented effects on social interactions in the workplace. Some humans may prefer robots that show social behavior. A study reports that empathy influences human-robot interaction and robots showing emphatic reactions are found friendlier by human users (Leite, Pereira, Mascarenhas, Martinho, Prada, & Paiva, 2013). Some will think social behavior shown by robots is unreal. Some will think that this kind of social robot behavior is just computer programming that is actually fake. Employees will have different views on how to interact with robots socially. The issue gets complicated when there are robots in a management or superior position. Employees tend to show respect for their superiors or managers. Respect is a social behavior. Humans may get confused about whether they should respect a robot manager or not. Since, in fact, respect will mean nothing to a robot. These kinds of issues will be new, confusing, and even frustrating to many. There are studies

showing that children treat robots as they treat their living pets (Bartlett, Estivill-Castro, & Seymon, 2004). Just like today's new generation having inevitably more interaction with smartphones and they see the smartphones as a part of their life, the future of robot-human interaction may be similar to this human-smartphone interaction. It is too early to predict what the social implications of human-robot co-working will be. However, social studies will be an integral part of human-robot co-working research.

4.13. The Changing Role of Human Resources

Departments

Conducting work analysis, developing job descriptions, and filling the jobs with the people having the right qualifications are among the important responsibilities of human resources departments. Except for industries utilizing industrial robots, a vast majority of organizations currently employ humans for work. As robots become a part of organizations, human resources departments will face new challenges. In addition to their current responsibilities, they will also need to identify the jobs to be handled by robots. They will basically decide the jobs to give to robots. The importance and responsibilities of human resources departments will increase. Eventually, human resources departments will evolve and they may even be named differently in the future.

Today, there are companies and businesses advertising themselves as "green". They claim to be sensitive to the environment. The "green" businesses and organizations try to act responsibly toward the environment even though these initiatives drive up costs. In the future, there may be even businesses claiming to be "human". These organizations will only employ humans even though being a "human" organization drives up costs assuming employing robots is a cheaper alternative. These "human" organizations will claim that they act socially responsible toward humans and they create jobs for humans.

4.14. The Changing Role of Information Technology Departments and Emerging of Robotics Departments

The importance of information technology (IT) departments increases as the use of technology become inevitable for organizations. To realize the vision of human-robot co-working, organizations will need to find a way to acquire and maintain the robots. At first, this task will be likely assigned to IT departments. Later on, organizations may create robotics departments responsible for acquiring and maintaining the robots in the organization.

As robots take important responsibilities, robot maintenances and upgrades should be done in a safe and secure manner. Information assurance of robots will be important. Securing information acquired by robots will be a challenge and even complicated than securing current organizational IT infrastructures. Human-robot co-working will likely complicate assuring information and ensuring privacy at work. This will likely be an important research topic for information security researchers.

4.15. Ethical Issues Resulting from Human-Robot Co-working – Ethical Status of Robots

Being honest, hard-working, and helpful are among the expected ethical behavior from human employees. Robots that are selfless, have no ambition, do not know laziness, and cannot lie will certainly have an effect on how we perceive current work ethic values. Humans may not be able to compete with robots in achieving a good ethical norm in this aspect. It is hard to predict how work ethics will evolve in a human-robot co-working environment. Furthermore, there will likely be an ethical norm defining the interactions between humans and robots. In a study, it is reported that humans may feel sorry even to events such as one robot behaving badly toward another (Briggs & Scheutz, 2014). We will have to determine the ethical status of robots in workplaces.

4.16. Preference toward Types of Robots to Work with (Learning or Rule-based Robots)

A great deal of research goes into machine learning and developing robots that can learn. However, machine learning may have consequences. Robots with machine learning capabilities may show unpredictable behavior. If this unpredictable behavior is frequent, then humans will be reluctant to assign important tasks to robots. Depending on the behavior, some people may even refuse to work with robots. On the other hand, rule-based robots are predictable. However, they will be limited in their capabilities. As a result, we will probably face a tradeoff in the types of robots that will be used in human-robot co-working environments. We may need to choose between a learning robot with the possibility of showing unpredictable behaviors and a predictable rule-based robot that is incapable of or limited in learning.

4.17. Getting Used to Working with Robots

Humans know robots as a concept from books and movies. However, human-robot co-working will be new to almost all employees in offices. While interacting with robots is expected to be easy, the actual experience may be different from the expectation. We may have to learn how to behave toward the robot to get what we really want. Non-verbal communication is an important part of human interaction. Robots may or may not understand these non-verbal communications. Humans will need time to learn and get used to working with robots. Furthermore, there will be robots with different capabilities. Some will be advanced and some are not. It will be hard and confusing for humans to distinguish robots with different capabilities. Robot manufacturers will need to find a way to develop robots that can inform about their capability without confusion. Humans may need to learn to work with different kinds of robots.

4.18. Negative Attitude Toward Robots due to Shrinking Human Workforce

According to a study, what humans most fear about robots at both personal and societal level is the loss of jobs (Ray et al., 2008). As robots start taking over jobs

from humans, there will likely be a negative attitude toward robots. Some will argue that the use of robots will increase unemployment. The counter-argument to this view is that new jobs will be created. History shows that this counter-argument has validity. While robots take over mundane jobs, humans will focus on jobs requiring creativity, artistry, research, and development. However, there is a dilemma in this view. The people losing jobs will unlikely to possess the education, training, and skills to assume the responsibility of jobs requiring creativity. Consider a middle age female housekeeper at a hotel. When she loses her job to a robot, it is unlikely that she will possess the necessary qualifications for a position as a marketing campaign manager that will likely be a job for humans in the robotic age. The worker unions will strongly oppose to robots if they cause unemployment. The constituents having this negative attitude will reach out to their politicians making robotic laws and regulations or voting for them. As a result, at least in the early years of the robotic age, people may have a negative attitude toward robots as they cause unemployment.

4.19. Humans Competing with Robots or Robots

Complementing Humans

The positions and roles robots assume will be a source of discussion among scientists and practitioners. The easy way is to place robots in roles complementing what humans do. Humans will not lose jobs and consequently, they will not feel threatened by robots. Most humans may even prefer obedient robot assistants. The robots in these positions will help humans complete tasks without the burden of managing a human assistant. Furthermore, as robots take over mundane and cumbersome tasks, humans will have more time for tasks requiring creativity and higher intelligence. Robots complementing humans is an easier, straightforward, and less problematic solution for creating human-robot co-working environments. On the other hand, some people may advocate that robots may or even shall take positions that humans compete for. They will argue that this will improve the performance of human employees. Naturally, humans compete with each other for positions in organizations. Adding robots into this competition will complicate management and organizational behavior. There are even studies investigating the reactions of humans to a commanding robot (Cormier et al., 2013).

4.20. Discussions on Issues Related to Human-Robot Co-working

Artificial intelligence (AI) and robotic technology are advancing at an enormous speed. Robots are already becoming a part of our society (Lin, Abney, & Bekey, 2011a; Lin et al., 2011b). Various scholars began investigating how humans and robots collaborate (Breazeal, Hoffman, & Lockerd, 2004; Hoffman & Breazeal, 2004; Lin et al., 2011b; Cormier et al., 2013; Geiskkovitch et al., 2016; Piçarra, Giger, Pochwatko, & Możaryn, 2016). In one of the studies, the researchers investigated how a human teach a task to a robot (Breazeal et al., 2004). There are even studies in which robots are commanding people (Cormier et al., 2013; Geiskkovitch, Cormier, Seo, & Young, 2016). Preliminary research shows that people are inclined to accept robots and treat them as social entities (Bartneck et al., 2007; Chidambaram et al., 2012; Young et al., 2011). Moreover, they even attribute robots with moral responsibilities and rights (Liu et al., 2008). These studies indicate that the effect of robotic technology on our lives will be significant. There will be many studies dealing with the integration of robots into various aspects of our lives. One important line of studies will focus on the integration of robots into organizations.

We identified five robotics research areas that are likely to influence organizational research in the future. These are artificial intelligence, human-robot interaction, social robotics, roboethics, and humanoid robots. In addition to these areas, robotic law will also be a significant research area not just for organizational research but for also regulating robot use in society. Some of the studies in these areas will be shaped by the need to integrate robots into our work environments. On the organizational research side, the use of robots in the workplace may result in an evolution in the organizational behavior, in the organizational structures and workflows, and in work ethics. Moreover, acceptance of robots in the workplace, discrimination against robots or people, achieving privacy and trust in a human-robot collaborative work environment will be important research questions. The current workplaces are designed for humans in mind. As robots enter our workplaces, we need to redesign the workplaces to accommodate this new type of coworkers. Naturally, training and education of employees will be an indispensable step in

adapting to robots in the work. We discussed each of these areas and issues briefly. Finally, we believe that how people actually react to robots in the workplace and how organizational structures and behaviors will evolve when working with robots will be the subject of many research studies to come.

5. RESEARCH DESIGN AND METHOD

In this section, we detail our research design and method.

5.1. Research Design

5.1.1. Research Questions

After the literature search, we identified the following dimensions that will likely to affect robot acceptance in organizations. These main dimensions and related sub-dimensions are as follows:

1. Attitude toward living and working with robots
 - a. Attitude toward living with robots
 - b. Attitude toward working with robots
2. Robot
 - a. Appearance (Humanoid/Mechanical)
 - b. Gender (Having a gender/without a gender)
3. Human Employee
 - a. Intention to work with robots
 - b. Fear of unemployment or fear of robots taking over jobs
 - c. Behavior toward robots
4. Interaction with robots
 - a. Interaction methods (Natural human interaction / Via computer like interfaces)
 - b. Expected Behavior (Mechanical / Social)
 - c. The expectation of ethical behavior
5. Work
 - a. Role / Position (Subordinate / Assistant, Coworker / Colleague, Manager / Superior)
 - b. Types of jobs / works / tasks
6. Work Environment
 - a. Discrimination
 - b. Devaluation of humans

Based on the identified dimensions, we intend to gather the following research data from research participants:

- Attitude toward living and working with robots
- The expected timeframe for robots becoming part of organizations
- Expected robot bodily features
- Expected work performance from robots
- Expected social behavior from robots
- Expected possibility of discrimination toward humans or robots
- Level of privacy expectation while working with robots
- Expected interaction levels, types, and methods between humans and robots
- The roles of robots in the organizational hierarchy
- The role of humans and robots in a human-robot collaborative environment

Based on the identified dimensions, we developed a set of preliminary questions. Note that we did not use all these questions. There are only a limited number of discussion questions that can be asked in a focus group study. Related literature suggests that asking 10 to 15 questions is suitable for a focus group study session. However, we list all the research questions we developed. These questions may be used for further research.

1. Do you think that robots will be a part of our lives?
2. Do you expect significant changes when robots become a part of our lives?
3. When do you think robots will be a part of our lives?
4. When do you think robots will be a part of organizations?
5. What is your attitude toward the idea of working with robots?
6. Do you think that the expectation from a robot will be similar to what managers expect from the human worker?
7. What do you expect from a robot worker?
8. If you know more about robots, do you think that your attitude toward robots may change?
9. What should be the physical appearance of a robot in offices (humanoid or machine-like)?

10. Do you agree with the warnings/dangers of artificial intelligence (AI) commonly discussed in the news and TV shows?
11. When people lose jobs due to increased use of robots, do you consider this an expected result of technology?
12. Do you want to work with a robot assistant in your workplace?
13. Do you want to work with a robot colleague in your workplace?
14. Do you want to work with a robot manager in your workplace?
15. Do you expect human-like behavior from the robots in your workplace?
16. What kind of human-like behavior do you expect from the robots in your workplace?
17. What kind of machine-like behavior do you expect from the robots in your workplace?
18. Do you expect emotional responses from the robots in your workplace such as showing sadness (imitating feeling sorry) for an employee leaving work?
19. Do you expect conscience from the robots in your workplace?
20. Do you expect high intelligence from the robots in your workplace?
21. Do you expect learning or just programmed behavior from the robots in your workplace?
22. Do you want the robots working during off hours in your workplace? Note. This question is intended to understand how research participants feel toward an obvious advantage of robots such as being able to work for 24 hours.
23. Do you think that working with robots will lead to discrimination in your workplace both toward robots or humans?
24. Do you think that robots having the ability to record everything will lead to privacy problems? Note. This question is intended to understand how research participants feel toward an inherent ability of robots such as being able to record every conversation etc.
25. Do you prefer a genderless robot or a robot having a gender such as male/female body feature or male/female voice?

5.1.2. Research Population

Professionals working in an office-like environment are the main population for this study.

5.1.3. Population Sampling Method

There are two types of population sampling methods. These are probability sampling and non-probability sampling methods. In probability sampling methods, every population member has an equal chance of being selected as a research participant. If the selection process is unable to satisfy this requirement, then the method becomes a non-probability population sampling method. This type of method is used in pilot studies, case studies, qualitative research, and hypothesis development. We choose convenience sampling as our population sampling method. Convenience sampling is one of the non-probability sampling methods. In convenience sampling, the researchers choose research participants that are easily accessible. This type of sampling is cheaper and less time-consuming compared to many other sampling methods. As a result, convenience sampling is used in many types of research studies including focus group studies. Even though it is a common method, we must be careful when generalizing research outputs.

5.1.4. Population Sampling

We employ graduate students that meet the characteristics of the research population from Gebze Technical University in Istanbul, Turkey.

5.2. Research Method

We used a qualitative research method in this study. We identified our research method as a focus group study. First, we briefly introduce focus group studies. Then we provide details of our focus group study.

5.2.1. Introduction to Focus Group Studies

There are two main types of research methodologies in social sciences. These are quantitative and qualitative research studies. A focus group study is a qualitative

research method to gather data using a discussion focus group guided by a set of research questions. It is a powerful research data collection method since it provides deep insight into the issues under research.

Focus group studies are not only used for scientific purposes but also for various data gathering purposes. It is commonly used in other areas such as marketing, education, management, and politics. Market researchers use focus groups to get opinions on whether a product will be successful in a particular market or not. It is used in politics to investigate the effectiveness of a particular campaign message. Campaign managers frequently use this research method to shape their campaigns and their political messages. In management, focus group studies are used for investigating and solving management and organizational problems. Managers seek solutions to complicated organizational problems with the help of their employees.

Surveys are commonly structured or semi-structured. Therefore, participants are limited in expressing their views on the research questions. However, focus group studies are conducted in the form of discussions. Furthermore, the group moderator has the opportunity to guide the group discussions and ask further detailed questions depending on how the discussion is shaping. The discussion group moderator also has the opportunity to investigate the underlying reasons regarding the response a participant provides.

Focus group studies are commonly used as an exploratory research tool and particularly useful in the early stages of research studies (Çokluk, Yılmaz, & Oğuz, 2011). It is used for developing research hypotheses and related research models in social sciences. The data collected from focus groups can be used as a baseline to develop interviews or surveys (Kitzinger, 1995).

While there are many advantages of focus group studies, there are also disadvantages. Focus group studies are a costly research method compared to some other research methods. It requires careful planning and execution. Managing focus group sessions requires experience. It is not suitable for many statistical analyses. Some of the advantages of focus group studies may be listed as follows (Çokluk et al., 2011):

- In focus group studies, research participants and researchers are in close contact.
- Focus group studies help benefit from qualitative data.

- Focus group studies provide in-depth data on research subjects.
- In focus group studies, participants interact with each other. This interaction enables quality and in-depth data gathering.
- In focus group studies, an idea offered or an argument presented by one of the participants may be further developed by others.
- Focus group studies help us to get a broad view of the research subject.
- The researcher has the ability to dynamically shape the discussion to collect valuable research data.

Some of the disadvantages of focus group studies may be listed as follows (Çokluk et al., 2011):

- Focus group studies are costly compared to some other research methods. A study may require multiple sessions. Each session has to be carefully planned and executed.
- There is a potential for conflict among participants.
- An idea or an argument of a participant may inadvertently affect or disturb others.
- One of the participants or a group of participants may dominate the discussion.
- Researchers have less control over the research data collected compared to interviews or surveys.
- Focus group studies are open-ended and sometimes it is hard to moderate the group discussion.
- Research data collection and analysis takes a considerable amount of time compared to some other research methods.
- Focus group studies are not suitable for all types of research studies. Sensitive subjects are hard or impossible to discuss in a group discussion.

A detailed discussion of focus group studies may be found in (Kitzinger, 1995; Çokluk et al., 2011; Krueger, 2014).

5.2.2. Focus Group Study Session Duration and Place

The sessions are designed to take between 1-1.5 hours. The sessions will take place in a meeting room. The meeting room is a small and cozy room to ensure a

comfortable setting for a focus group session. The meeting room has a round table. Round tables are considered good for discussions.

5.2.3. Focus Group Study Session Roles

The roles of the sessions are as follows:

Session Moderator: Manages the focus group session.

Session Recorder: Records the session.

Study Participants: Participates in the discussion session with their views.

5.2.4. Focus Group Study Session Procedure

The procedure for the focus group study sessions are as follows:

1. Session moderator explains the research goal and session procedure. The moderator also answers the questions from the participants regarding the session and their roles.
2. The moderator asks the participants about their willingness to participate in this study. At this point, the moderator reminds the participants that they are free to participate in the study or leave at any time. The moderator also reminds the participants that their anonymity will be ensured.
3. The participants sign the consent form and fill out a preliminary survey regarding the study.
4. The moderator starts the session and asks the research questions.
5. The participants answer the research question in turn. Sometimes, the participants comment on another participant's response.
6. During the session, the recorder records the responses of the participants.
7. The session ends. The moderator thanks the participants and explains how the participants may receive research results.
8. The session records are analyzed and coded.

The sessions are also recorded via two audio recording devices. One of the devices is a backup in case the other malfunctions.

6. RESEARCH DATA COLLECTION - FOCUS GROUP STUDY SESSIONS

In this section, we provide the details of our focus group study sessions. We conducted three focus group study sessions. Each session had a different number of participants. The sessions are conducted in Turkish. There were 10 females and 8 males. The age of participants varies between 25 and 43. The demographic data related to all sessions are presented in Table 6.1.

Table 6.1: Focus Group Study Demographics

Study Demographics	
Total Number of Participants	18
Gender	10 Females – 8 Males
Minimum Age	25
Maximum Age	43
Mean Age	31.7
Mode Age	27
Level of Education	Graduate
Occupations	Education, Public Management, Information Technology, Human Resources Management, Interior Design, Production Planning, Service Industry
Minimum Years of Work Experience	<1
Maximum Years of Work Experience	24
Mean Years of Work Experience	7.3

6.1. Focus Group Study Session 1

The information regarding this session is presented in Table 6.1.1 and Table 6.1.2.

Table 6.1.1: Focus Group Study Session 1 Data

Focus Group Study Session Information	
Identification	1
Date and Time	18 December 2018 – 20.00-21.30
Place	Gebze Technical University / Business School / Meeting Room
Total Session Length	90 Minutes
Discussion Length	69 Minutes
Number of Participants	5
Population	Working professionals studying for an MBA

Table 6.1.2: Focus Group Study Session 1 Participants

	Age	Gender	Occupation	Degree	Work Experience (Years)
Participant 1	40	F	Public Administration	Business Administration	24
Participant 2	25	M	Information Technology	Electronics Engineering	1,5
Participant 3	27	F	Production Planning	Economics	3
Participant 4	27	F	Information Technology	Mathematical Engineering	5
Participant 5	30	M	Information Technology	Mathematical Engineering	6

6.2. Focus Group Study Session 2

The information regarding this session is presented in Table 6.2.1 and Table 6.2.2.

Table 6.2.1: Focus Group Study Session 2

Focus Group Study Session Information	
Identification	2
Date and Time	19 December 2018 – 13.00-15.45
Place	Gebze Technical University / Business School / Meeting Room
Total Session Length	165 Minutes
Discussion Length	136 Minutes
Number of Participants	8
Population	Working professionals studying for an MBA or a doctoral degree

Table 6.2.2: Focus Group Study Session 2 Participants

	Age	Gender	Occupation	Degree	Work Experience (Years)
Participant 1	38	M	Education	Industrial Design	9
Participant 2	27	M	Education	-	1,5
Participant 3	27	F	Education	Economics	3
Participant 4	40	F	Public Administration	Business Administration	11
Participant 5	43	M	Service Industry	Electronics and Communications Engineering	14
Participant 6	33	F	Human Resources Management	Mining Engineering	8
Participant 7	34	M	Education	Business Administration	12
Participant 8	31	F	Education	Business Administration - Strategy	5

6.3. Focus Group Study Session 3

The information regarding this session is presented in Table 6.3.1 and Table 6.3.2.

Table 6.3.1: Focus Group Study Session 3

Focus Group Study Session Information	
Identification	3
Date and Time	8 January 2019 – 13.00-14.40
Place	Gebze Technical University / Business School / Meeting Room
Total Session Length	100 Minutes
Discussion Length	71 Minutes
Number of Participants	5
Population	Working professionals studying for an MBA or a doctoral degree

Table 6.3.2: Focus Group Study Session 3 Participants

	Age	Gender	Occupation	Degree	Work Experience (Years)
Participant 1	25	M	Education	Business Administration	1
Participant 2	30	F	Accounting	Business Administration	10
Participant 3	32	F	Public Administration	Public Administration	8
Participant 4	29	F	Graduate Student	Business Administration	<1
Participant 5	34	M	Interior Designer	interior design	10

7. RESEARCH FINDINGS AND ANALYSIS

In this section, we list the findings and analysis of this research.

Almost all our participants are either working professionals or have worked in the past in an office environment. Therefore, the participants are familiar with the requirements and dynamics of working in an office. Before the sessions, we presented a short survey to the participants. The survey consisted of questions regarding their background. We also asked the participants what kind of environment they work in. All participants indicated that they work in office environments. Their views on human-robot co-working are based on working in these environments.

Almost all participants indicated that they believe robots will be in our lives soon. According to the participants, the timeframe robots will be in our workplaces is about 5-15 years. This is also stated by the participants who indicated their negative attitude toward robots.

While some participants have a strong positive attitude toward robots, some participants have a strong negative attitude toward robots. There were some participants who see robots as a threat to humanity as we know it. Most participants have an attitude in the middle. Most indicated that they will be willing to work when the time comes.

We mostly recruited research participants from a graduate program at a respectable university. Due to our research participant recruitment method, all participants are between 25-43 years of age. All of the participants have at least a master's degree or studying toward a master's degree. Our participants are educated, middle age professionals. Therefore, it is not possible to draw a conclusion based on the participant's age or education.

Among the participants who have extensive experience with information systems, or have worked as IT specialists, or have an engineering background has a positive attitude toward robots. Some active IT specialists indicate that artificial intelligence has already become a part of their working environment. Therefore, the transition to human-robot co-working environments is already becoming a reality. This transition will be a smooth transition rather than an abrupt event.

Our analysis indicates that gender does not have a significant influence on the attitude toward robots and the willingness to work with robots. This finding is similar

to the findings of a previous study (Bartneck et al., 2005). There are both male and female participants who have a strong positive attitude toward robots. There are female participants who had a strong negative attitude toward robots. On the other hand, these female participants do believe that they may have to work with robots. However, there are no male participants who had a strong negative attitude toward robots. Note that the number of research participants is limited. Therefore, we believe we will also encounter males with a strong negative attitude toward robots even though we have not one in our sessions.

Participants had different opinions regarding the physical look of robots. Some indicate their preference toward humanoids, while others prefer a mechanic appearance in a robot. The opinions on how robots should behave also vary. Some expect a certain level of social behavior or emotional intelligence. Other participants see robots as machines. Thus, they do not expect any social interaction from a robot.

Our analysis of the various responses provided by the participants indicates that the robot appearance or even the social behavior of the robot does not have a significant effect on the willingness to work with robots.

We asked participants whether robots should have a gender or not. Some of the participants indicated that robots may have a gender suitable for the working environment. Some others indicated robots should be without a gender. These participants are the ones that think robots should stay as a machine and machines can not have a gender. We also asked whether robots should have gender-specific properties. The answers provided to this question are in line with their previous responses regarding gender. Overall, the participant responses regarding gender-related questions vary. Therefore, at this point, it is hard to provide guidance to robot developers regarding gender. It seems the answers to these questions require experimentation.

Most participants think that we need proper regulations regulating human-robot co-working environments.

When participants asked about how they would feel when they see a human mobbing or behaving badly toward a robot, some of the participants responded that they would feel uncomfortable toward such as act. Some mentioned that they would not like to see mobbing behavior of any kind in the workplace. Some others mentioned that they would feel just like how they feel when they see someone behaving badly toward a piece of machinery.

We also asked the participants whether robots should have rights or not. Some of the participants think that rights are associated with living organisms. Therefore robots should not have rights. Regulations will be enough to regulate the human-robot co-working. Most participants did not have a response to this question. It seems robot rights are such a new concept that participants have not formed an opinion on this topic.

The analysis of the research data shows that participants are generally more concerned about what the human-robot co-working provides for their working environments. They think robots should be useful. They were also eager to provide their opinions regarding their attitude toward robots. However, when they were asked about robot appearance, behavior, and other related properties, they were not decisive. As a result, our suggestion to robot developers is that they should focus on making robots useful.

8. CONCLUSIONS

Human-robot co-working will be a reality in due time. Businesses and organizations should prepare for human-robot co-working environments. Organizations who understand and prepare for this new working environment may achieve a competitive advantage over others.

Our research findings indicate that there are two main factors that may influence the intention to work with robots. This intention will support the actual behavior that is working with robots. Understanding these factors will in turn help achieve effective human-robot co-working environments. The first factor affecting the intention to work with robots is the attitude toward robots. Some of the participants had a strong negative attitude toward robots. On the other hand, some participants had a strong positive attitude toward robots. The rest of the participants were in between. Even though the number of participants is low, it seems the attitude toward robots follows the commonly known innovation distribution curve. The other one is perceived usefulness. Perceived usefulness is one of the two main factors of the well-tested original technology acceptance model (TAM). Some of the participants strongly indicate that the usefulness of robots is important. They are willing to work with robots if human-robot co-working environment leads to a better work environment. Some participants even indicate that they can work with a robot if the robot is fair in its decisions. The other factor of the technology acceptance model is the perceived ease of use. This factor was not discussed in the focus group sessions. We believe there is an inherent expectation that interacting with robots will be natural and easy. One of the important advantages of robots compared to prior technology will be their inherent ease of use. In fact, we will not use robots but we will communicate and interact with them.

Among the participants who have extensive experience with information systems, or have worked as IT specialists, or have an engineering background has a positive attitude toward robots. Therefore, we can assume that people familiar with technology has a positive attitude toward robots.

Participants had different opinions on the roles that a robot shall assume. While most participants want to work with a robot assistant, some participants indicate their willingness to work with a robot manager if it leads to a better working environment. Some of the participants want to work with robots as peers. The participants also indicate that they can work with robots in multiple roles. Participants who have a positive attitude toward robots are the ones who are willing to work with a robot in a managing position.

As a result, the robot acceptance model will be based on two main factors. These are the attitude toward robots and perceived usefulness.

9. LIMITATIONS OF THE STUDY

The main limitation of this study is the sample size. We conducted 3 focus group study sessions. The number of participants was 18. Conducting more sessions may increase the confidence in the study results. However, we have no reason to suspect the validity of the results.

All our research participants have at least an undergraduate degree. They are also graduate students at a master's or Ph.D. level. Therefore, all of our research participants are well-educated professionals. The focus of our research is human-robot co-working in office-like working environments. In this kind of work environments, there are professionals with a university education, a college education, and a high school education. At this point, we do not have data on whether education level has an influence on the acceptance of robots in workplaces or not. Therefore, currently, the findings of this study are only applicable to the work environments with people who have higher education degrees.

We did not have a high-level executive or a manager among our participants. While some of our participants are entrepreneurs, they do not manage a large number of people. The views of upper- or middle-level managers may add more depth to the discussions. Currently, we do not have data on managers' view regarding human-robot co-working.

Our studies are conducted in a respectful university in Istanbul, Turkey. Earlier studies show that culture has no or limited influence on attitude toward robots. At this point, we do not know whether culture has an effect on human-robot co-working. We need cross-cultural studies to investigate the effects of culture.

The age of research participants varies between 25 and 43. We believe the participants belong to the same age group. Therefore, different age groups may have different views on human-robot co-working. However, our participants' age group is the dominant group among working professionals.

10. FUTURE WORK

There are quite a number of future work opportunities in this research area. Developing a research model based on the findings of this study is one of the promising and exciting research opportunities. While there are scales that may be used with a research model for this line of research, new or modified scales may be required. The negative attitude toward robots (NARS) scale is a good candidate for the attitude toward robots factor. The negative approach used in the scale should be carefully investigated and tested before the use for robot acceptance model. A positive or mixed approach may be considered as well. The perceived ease of use scale developed for the well-known technology acceptance model may be used. Whether it requires adjustment is the subject of a research question.

One interesting study may investigate the question that whether the human body resemblance of humanoids increases the expectation of human-like behavior and morality from these machines or not. At this point, we do not know whether the bodily structure of a robot affects robot acceptance in workplaces.

Another research question may be related to the preference for human-robot interaction (HRI) methods. Identifying the preferred HRI method is an active research area. As robots become a part of our lives, the research in this area will gain more attention.

Identifying and optimizing the tasks robots will be assigned to is another research area. Whether robots shall complement tasks performed by humans or compete in these tasks will generate many discussions.

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BIOGRAPHY

Dr. Kadir Alpaslan Demir graduated from Turkish Naval Academy with a Bachelor of Science in Computer Engineering in 1999. Between 1999 and 2003, Dr. Demir worked as an officer in the Turkish Navy Submarines. In 2003, he started his graduate studies in Naval Postgraduate School, Monterey, CA, USA. Between 2003 and 2005, he completed one M.S. in Software Engineering and another M.S. in Computer Science with a focus in Computer Forensics. Between 2005 and 2008, Dr. Demir completed his doctoral research titled “Measurement of Software Project Management Effectiveness” and awarded a Ph.D. degree in Software Engineering. Dr. Demir received the title of Associate Professor in Management of Information Systems in 2017. Dr. Demir worked as a faculty member in the Turkish Naval Academy between 2009 and 2011. Since 2011, he is working as a software developer, software team leader, software program manager in Turkish Naval Research Center Command, Istanbul, Turkey. He served on the development of various Turkish Navy Combat Management System projects. He also published more than 50 academic papers. He is a regular reviewer for various scientific journals and conferences. His research interest includes software project management, unmanned systems, large-scale system and software development, human-robot co-working, strategic human resource management of defense research and development agencies.

APPENDICES

Appendix A: CONSENT FORM IN TURKISH

ARAŞTIRMAYA KATILIM ONAY FORMU

- Giriş.** Değerli Katılımcı, robotların organizasyonlarda kullanımı ile ilgili bir araştırmaya davetlisiniz. Bu araştırma ile “**Robotların organizasyonlarda kullanımları ile ilgili çalışanların düşünce ve beklentileri**”ne dair çeşitli bilgilere ulaşmayı hedefliyoruz. Bu form ile çalışmaya gönüllü katılımınıza dair onay almak istiyoruz. Bu araştırmaya katılarak katkıda bulunmak istediğinize dair onayı bu formu okuyup, imzalamak suretiyle vermiş bulunacaksınız. Formu imzalamadan evvel araştırma ile ilgili her türlü sorunuzu lütfen çekinmeden yöneltiniz.
- Araştırma Amacı.** Bu araştırma Gebze Teknik Üniversitesi Sosyal Bilimler Enstitüsü İşletme Anabilim dalında yapılan bir yüksek lisans tez araştırması kapsamında yapılmaktadır.
- Katılım Yöntemi.** Araştırmaya katılmaya karar vermeniz durumunda, sizden bir odak grup çalışmasına iştirak etmenizi isteyeceğiz. Bu odak grup çalışmasında, araştırma kapsamında belirlenmiş çeşitli araştırma soruları doğrultusunda arzu ettiğiniz takdirde fikirlerinizi sunacaksınız. Değerli fikirlerinizi sonradan bilimsel olarak analiz edebilmek için grup çalışması esnasında sesli ve/veya görüntülü kayıt alınabilir. Bu kayıtlar sadece bilimsel maksatlarla toplanmaktadır.
- Riskler ve Faydalar.** Bu araştırma kapsamında sizin için herhangi bir risk oluşmasını öngörmemekteyiz. Odak grup çalışmasının mümkün olduğunca rahat ve konforlu bir ortamda geçeceğini beklemekteyiz. Sizin için en önemli katkının bir odak grup çalışmasının icrasını şahsen tecrübe etmek ve geleceğimizde hayatımızda önemli bir yer edineceğini düşündüğümüz robotlar ile ilgili çeşitli bilgilere ve fikirlere sahip olacağınızı değerlendirmekteyiz.
- Kazanç.** Arzu ettiğiniz takdirde araştırma sonuçları sizinle paylaşılacaktır.
- Gizlilik.** Araştırma kayıtları sadece araştırma sorumluları tarafından toplanacak ve tutulacaktır. Kimliğiniz araştırma kapsamında gizli tutulacaktır.
- Gönüllülük.** Katılmaya karar vermeniz durumunda, araştırmanın herhangi bir aşamasında araştırmadan geri çekilme hakkına sahipsiniz. Arzu ettiğiniz takdirde bu formun bir örneğini alabilirsiniz.
- Araştırma İletişim Bilgileri.** Araştırma ile ilgili her türlü sorunuzu araştırma sorumlularına (Doç.Dr. Kadir Alpaslan Demir, kadiralpaslandemir@gmail.com, Doç.Dr. Meral Elçi, emeral@gtu.edu.tr) iletebilirsiniz.

9. **Katılım Onay Beyanı.** Araştırmaya katılım ile ilgili yukarıdaki bilgileri okudum. Araştırmaya katılım ile ilgili sorularımı yönelttim. Bilimsel analiz maksatları için grup çalışması esnasında sesli ve/veya görüntülü kayıt alınabileceğini anladım. Araştırmanın herhangi bir aşamasında çalışmadan geri çekileceğimi anladım. Bu araştırmaya gönüllü olarak katılmak istiyorum.

Katılımcı İmzası

Tarih

Araştırmacı İmzası

Tarih

Appendix B: CONSENT FORM IN ENGLISH

PARTICIPANT CONSENT FORM

1. **Introduction.** You are invited to participate in a study of working with robots in organizations. With the information gathered from you and other participants, we hope to discover insight into the **perspectives and expectations of employees on working with robots in organizations**. With this form, we ask for your voluntary participation in this study. We ask you to read and sign this form indicating that you are voluntarily agreeing to be in the study. Please ask any questions you may have related to this study and procedures before signing.
2. **Background Information.** This study is conducted as a part of a master's thesis in Business Administration at Gebze Technical University.
3. **Procedures.** If you agree to participate in this study, you will be asked to be a part of a focus group study. In this study, you will be directed a set of research questions and we will ask you to discuss these questions within the group if you are willing to do so. During these studies, we will be collecting data via audio and/or video recording for scientific research purposes. This data will only be collected for scientific research purposes.
4. **Risks and Benefits.** We do not anticipate any kind of risk to you during this study. The group discussions will be conducted in a comfortable and relaxed environment. This research involves no risks or discomforts. The benefits include an increase in the body of knowledge regarding human-robot co-working.
5. **Compensation.** A copy of the results will be available to you at the conclusion of the experiment.
6. **Confidentiality.** The records of this study will be kept confidential. No information will be publicly accessible which could identify you as a participant.
7. **Voluntary Nature of the Study.** If you agree to participate, you are free to withdraw from the study at any time without prejudice. You will be provided a copy of this form if requested.
8. **Points of Contact.** If you have any further questions or comments after the completion of the study, you may contact the research supervisors, (Assoc.Prof. Kadir Alpaslan Demir, kadiralpaslandemir@gmail.com, Assoc.Prof. Meral Elçi, emeral@gtu.edu.tr
9. **Statement of Consent.** I have read the information above. I have asked all the questions and have had my questions answered. I understand that during the focus

group study session there will be voice/video recordings for scientific research purposes. I understand that I may withdraw from the study at any time. I voluntarily participate in this study.

Participant's Signature

Date

Researcher's Signature

Date

Appendix C: PARTICIPANT BACKGROUND FORM IN TURKISH

KATILIMCI ÖZGEÇMİŞ FORMU

Ad Soyad: _____

İletişim: _____ (Tel) _____ (e-posta)

(Arzu edilirse) Araştırma sonuçlarının paylaşımı maksadı ile.

Yaş: _____ Eğitim Durumu: _____ (Lisans, Önlisans, Yüksek Lisans, Doktora vb.)

Mezuniyet Bölümü: _____

Meslek: _____ Gelir: _____

Çalışma Hayatı (Yıl): _____

Çalışma Sektörü: _____

Çalışılan Kurum Ortamı: _____ (Ofis) _____ (Fabrika)
_____ (Diğer)

Robotlar ile ilgili bilgi seviyeniz:

___ (Yok) ___ (Az) ___ (Orta) ___ (Yüksek) ___ (Çok Yüksek)

Gelecekte robotların yaşamımızın hangi alanlarında bulunacağını öngörmektesiniz?
(Lütfen, aşağıda alanların yanına X atınız. Aşağıda yer almayan diğer alanları boşluklara yazabilirsiniz.)

Çalışma Hayatı		Mağazalar		Güvenlik	
Sağlık/Hastaneler		Restoran/Kafe vb.		Bankacılık	
Eğitim		Ulaşım/Trafik		Ev Kullanımı	
Fabrikalar		Bakımevleri			

Robotların geleceğimiz için faydalı olduğunu düşünüyor musunuz?

_____ (Hiç) _____ (Az) _____ (Orta) _____ (Yüksek) _____ (Çok Yüksek)

Robotların geleceğimiz için bir tehlike oluşturduğunu düşünüyor musunuz?

_____ (Hiç) _____ (Az) _____ (Orta) _____ (Yüksek) _____ (Çok Yüksek)

Daha Önce Robotlarla Beraber Çalıştınız mı?: _____ (Hayır) _____ (Evet)

Robotlarla beraber çalışmak ister misiniz?

_____ (Evet) _____ (Hayır) _____ (Farketmez) _____ (Mecbur Kalırsam)

Robotlar kaç yıl içerisinde insanlarla beraber organizasyonlarda çalışmaya başlayacaktır? ____ (Yıl)

Çalıştığınız ortamdaki robotların görünüşünün ne olması gerektiğini düşünüyorsunuz?

_____ (İnsansı) _____ (Makinemsi) _____ (Farketmez) _____
(Diğer)

Çalıştığınız ortamdaki robotların cinsiyeti konusunda ne düşünüyorsunuz?

_____ (Cinsiyeti olsun) _____ (Cinsiyeti olmasın)
_____ (Farketmez)

Çalıştığınız ortamdaki robotların cinsiyeti olursa ne olsun?

_____ (Erkek) _____ (Kadın) _____ (Farketmez) _____ (Ortama hangisi uygunsa)

Robotların organizasyonlarda insanlarla beraber hangi rolde çalışacağını düşünmektesiniz?

_____ (Ast) _____ (Eş seviyede çalışan/İş arkadaşı) _____ (Yönetici)

Diğer _____

Belirtmek/Ekleme istediğiniz herhangi bir husus var mıdır?

Appendix D: PARTICIPANT BACKGROUND FORM IN ENGLISH

PARTICIPANT BACKGROUND FORM

Name : _____

Contact: _____(Tel) _____(e-mail)
(Optional) To receive research results.

Age: _____ Degree: _____ (College, Undergraduate, Graduate, Ph.D.
etc.)

Degree in: _____

Occupation: _____ Income: _____

Work Experience (Years): _____

Industry: _____

Workplace Environment: _____ (Office) _____ (Factory)
_____(Other)

Knowledge about robots: ____ (None) ____ (Little) ____ (Informed) ____ (Quite)
____ (Deep)

Please check the areas below that you think robots will play a part in. (Please mark with X. You may also add areas other than the areas indicated below.)

Work		Stores		Security	
Medical Care Hospitals		Restaurants / Cafe etc.		Banking	

Education / Training		Transportation Logistics		Home Use	
Factories		Elderly Care			

Do you think that robots will be useful in our future?

_____ (None) _____ (Little) _____ (Somewhat) _____ (Highly) _____ (Very Much)

Do you think that robots will be a danger for our future?

_____ (No) _____ (Not So Much) _____ (Moderate) _____ (High) _____ (Very High)

Have you worked with robots before?: _____ (No) _____ (Yes)

Do you want to work with robots? _____ (Yes) _____ (No) _____ (Indifferent) _____ (If I have to)

When do you think robots and people will work together?

____ (Years)

What should the robots look like in your office?

_____ (Humanoid) _____ (Mechanic) _____ (Does not Matter)
_____ (Other)

Do you think the robots in your office should have a gender?

_____ (With a gender) _____ (Without a gender) _____ (Does not Matter)

What should be the gender of robots in your office if they have a gender?

_____ (Male) _____ (Female) _____ (Does not Matter) _____ (Suitable with the environment)

What kind of roles/positions the robots should assume in your office?

_____ (Assistant) _____ (Same roles/positions with humans) _____ (Manager) Other

Anything to add and/or clarify?