Fear of Robots: Evidence from Robotized Furniture Manufacturing Industry of Lithuania

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Abstract
In the past fifteen years the development of robots has been rapid, they became more flexible, autonomous, versatile, making them more appealing to the manufacturing industry that can benefit greatly in increased efficiency, added value, and competitiveness by adopting industrial robots. Additionally, the lack of a quality workforce could accelerate the manufacturing industry in refocusing towards robotic solutions, thus, being less dependent on the manual labor force. Accordingly, the main notion in the scientific literature is that robots will substitute a large proportion of the manual workforce, causing short-term technological unemployment, leading to the workers' fear of robots. However, robots are perceived positively by the general public in regard to supplementing routine activities, working alongside the employees. Therefore, this study aims at identifying whether manufacturing employees working in robotized production lines fear robots, raising the following research questions: do the workers of robotized production lines fear robots? How do the demographic characteristics of workers impact fear of robots? Research design and methodology include quantitative data collection via paper surveys from the operators (N=350) of robotized production lines in five furniture companies in Lithuania. The results revealed that the majority of respondents do not express fear of robots, with the older and longer working employees being less afraid of robots than their younger colleagues. Even though it was expected to detect the fear of robots in manufacturing employees, results could be explained with a phenomenon where employees working with robots express lower levels of fear towards them.

Keywords
Robotization; fear of robots; furniture industry; robotization in Lithuania; robots.

Introduction

The Fourth Industrial Revolution - Industry 4.0 - (Schwab, 2017) is introducing robotic solutions to monotonous everyday activities, redesigning the industrial landscape, delivering new technologies, and digitizing workplaces. The term "robot" has been adapted by the English language as of the early 1920s from the Czech „*robota*“ which means “compulsory labor” (Čapek, 1923; Takayama, Ju, & Nass, 2008) and refers to “machines that can navigate through and interact with the physical world of factories, warehouses, battlefields, and offices” (Brynjolfsson & McAfee, 2014, p. 27). The development of robots in the past 15 years has been challenging, though rapid, making them more flexible, autonomous, and versatile; performing tasks such as packaging, welding, painting, and increasing the stock of robots per million hours worked by more than 150% (Graetz & Michaels, 2018; Michaels & Graetz, 2015). Companies of various industries have been adopting robotics and other digital solutions for several decades now to make their activities more efficient by decreasing production times, lowering costs, maintaining consistent product quality, generating added value, improving competitiveness (Ivanov, 2017; Webster & Ivanov, 2020). The main motivation in creating and adapting industrial robots lies in eliminating people's participation in unappealing jobs, which can be described by the three Ds: dirty, dangerous, and dull (Takayama et al., 2008).

Analyzing data from IFR (International Federation of Robotics) from developed countries from 1993 to 2007, Graetz and Michaels (2018) confirmed that the rise of robotic solution practice can be linked with reductions in production prices and increases in both total factor productivity and salaries. Significantly, the installations of robots have been around 400000 units per year globally in 2018 and 2019, where the average robot density in the manufacturing sector was 113 robots per 10,000 employees in 2019 (International Federation of Robotics, 2019, 2020). China continues to lead the industrial robotics market, increasing Asia’s robot density to 118 units per 10,000 employees, Germany and Italy led strong growth in Europe of 114 units per 10,000 employees, while the United States became the third-largest industrial robot market globally with 103 units per 10,000 employees during 2019 (International Federation of Robotics, 2020; Müller, 2019). Sales of robots are expected to maintain a growth rate of 12% annually from 2020 to 2022 (Müller, 2019) with 23 to 37% of companies planning on investment in digitalization solutions, depending on industry (World Economic Forum, 2018). However, not all of the countries of developed region of Europe are able to maintain the same robotization speed.

The spurred growth of implementation of robotized solutions raises the question, whether employees can adapt quickly enough and what is their stance towards robots in their workplace. Therefore, this research is aimed at exploring if the workers of the furniture industry with robotized production lines express the fear of robots. The research questions thus are formulated as follows: do the workers of robotized production lines fear robots? How do the demographic characteristics of workers impact fear of robots? The following sections explore the context of an emerging economy of Lithuania and what are the robotization trends in it and what is the specificity of the furniture sector; followed by a scientific literature review on fear of robots.

Robotization tendencies in the world and Lithuania

Lithuania is an interesting context for exploring robotization tendencies since the country is advertised as tech-friendly to build businesses in. However, robotization is underdeveloped, compared to other European Union countries, especially in the western region. Lithuania is also surveyed by the IFR regarding robotization, but no or very few installations are reported, making it difficult to approximate the level of robotization in the country. It is testified by the experts that only 3% of companies established in Lithuania exploit robotic solutions for their advantage currently (Statybunaujienos.lt, 2019), however, the demand for such technologies exceeds the supply (Markevičienė, 2018; Rutkauskaitė, 2019). Nevertheless, there were merely 2 industrial robots per 10,000 inhabitants in Lithuania in 2017 (Mrazauskaitė, 2018), even though Lithuania is one of the 15 European Union member states that have a platform for cooperation regarding Industry 4.0 that is highly endorsed by the EU (European Commission, 2018; "Platform 'Pramonė 4.0' Structure", 2020).

One of the leading manufacturing industries in Lithuania is the furniture industry, which can be described as global, exporting 69,4% of its products to the EU or outside (Lietuvos statistikos departamentas, 2020), creating 2,4% of national GDP and 9,7% of manufacturing sector GDP (Versli Lietuva, 2017). Lack of quality workforce in the Lithuanian furniture sector (Lukšytė & Melnikas, 2018; Markevičienė, 2018; Rutkauskaitė, 2019; Vasauskaite & Streimikiene, 2015) has made the industry refocus in increasing the effectiveness - producing 50% more with 14% less workforce compared to the period of the economic crisis of 2008 (Markevičienė, 2018), associating this development with adoption of modern digital solutions, like robotization and automation of the processes (Lukšytė & Melnikas, 2018). There are several challenges Lithuanian furniture and overall manufacturing industry is facing. Firstly, the manufacturing industry is growing at the expense of contract manufacturing production of low-tech labor-intensive workforce that constitute 85% of Lithuanian industrial workers (Markevičienė, 2018), with a 60% high risk to be affected by automation (OECD, 2018). Additionally, furniture companies of four European countries distinguished lack of skills and knowledge among staff to be the main (60%) barrier when implementing key enabling technologies (CSM, 2017). The same study found that companies rate themselves at 2,1 out of 5,0 points in the level of automation and robotics technology in furniture industries, projecting disputes over the workforce in the manufacturing industry. Secondly, the Lithuanian furniture industry is highly dependent on IKEA, bringing both incentives and motivation for progress and a lack of diversification (Liuima, 2017). Thirdly, this industry is dominated by SMEs and micro-enterprises with limited resources to invest in highly needed innovations and digital solutions to maintain competitiveness (Mrazauskaitė, 2018; Vasauskaite & Streimikiene, 2015). However, the ongoing cauterization of Lithuanian furniture industry is believed to double the size of industry in the period of several years (Lietuvos pramonininkų konfederacija, 2019). Furthermore, employment expectations for furniture industry in Lithuania are projected positively, expecting increase in demand for employees in the short period (Lietuvos statistikos departamentas, 2020). These tendencies reveal that robotization of the furniture industry of Lithuania face inevitable robotization and will require a shift towards digital solutions and adoption of Industry 4.0 solutions.

Overall tendencies reveal that we will face a grand installation of both consumer and industrial robots over the next 15-20 years and the debate on how will this change the working environment is still unsettled with polarized opinions with a majority of researchers agreeing, that changes are going to be drastic, dismissing current and creating new jobs, shifting geographical landscapes of production, affecting competitive advantages of employees, companies, and countries (Ivanov, 2017). Estimating the ratio of human labor changed by robots, Acemoglu and Restrepo (2020) calculate that 1 robot will reduce employment of 5,6 human workers, lowering the wages by 0,5%. Stakeholders interested in robotization's effect on the workforce approximate that digitalization threatens 30-57% of jobs throughout the world (European Commission, 2020; Frey & Osborne, 2017; Graetz & Michaels, 2018; Pissarides, 2019). Nonetheless, the world stock of robots is expected to increase up to 25% by 2025 (Zinser, Rose, & Sirkin, 2015), lowering the employment and wages of the human workforce even more.

Compatibly, the acceleration of digital solution adoption in the industry will stop only by reaching a point where all or the vast majority of products and services will be produced by robots, AI, automatized production lines, progressing into a system – robonomics – where only a limited human involvement will be required in these processes (DeCanio, 2016; Ivanov, 2017; McClure, 2018). Correspondingly, the development of technologies is also rapid, making robots and AI persevere human labor cognitive as well as physical performance (Berg, Buffie, & Zanna, 2018), bringing economic disruption and leaving less tech-savvy people behind (Autor, 2015). However, authors see the possibilities in this transition, where it is conceivable that human activities will not be substituted, but complemented by robots (DeCanio, 2016; Webster & Ivanov, 2020). The workforce is expected to change, re-skill, up-skill, even de-skill (Webster & Ivanov, 2020), adapt to the new normal, mixing the tasks between human and robot (Autor, 2015). Society should be able to appreciate the benefits of robonomics in the long term, even though facing some concerns in the short- and mid-term (Ivanov, 2017). Overall, the two sides of the same coin show that pessimists of technological development fear that humanity is taking the trajectory towards dystopic economics, creating extreme class conflicts and inequalities, while technology optimists believe that economic disruption will only be short-termed, as it has been throughout the history of technological disruption, bringing a positive impact in the long run (Berg et al., 2018). However, the current COVID-19 pandemic is affecting global robot sales and a decrease is expected in the short period, but the IFR forecasts long-run perspectives to be excellent, raising and speeding up the robot and general digital solution sales (International Federation of Robotics, 2020). Additionally, rising effectiveness and production rates offer stimuli for companies to adopt robots, leaving the workforce at somewhat precarious position of uncertainty.

Perception of robots

Not so long ago, robots were merely the figment of writers' imaginations, but now people have to adapt to the new environment where many activities are or can be robotized, automatized, or digitalized. Some authors suggest, that people may have no prior preconceptions of robots since it is a novelty (Fussell, Kiesler, Setlock, & Yew, 2008), however, other studies suggest that people have assumptions about digitalization in their environments. People tend to attribute anthropomorphic characteristics to robots (Epley, Waytz, & Cacioppo, 2007), treating them as human beings (Nass & Moon, 2000), even helping them, or being rude towards them and calling names (Broadbent, 2017; Rehm & Krogsager, 2013). Robots are preferred for tasks where service orientation, noncognitive abilities, or memorization is required (Takayama et al., 2008). In an industrial setting, people favor robots to be adjusted to their work speed and that they maintain physical distance, otherwise resulting in people feeling uncomfortable and suppressed (Kato, Fujita, & Arai, 2010; Weistroffer et al., 2014). Accordingly, the introduction of digital technologies in companies are expected to change the working environment, sets of skills needed, and the wages (Dekker, Salomons, & van der Waal, 2017), making the human workforce less crucial than at any time in the history (Webster & Ivanov, 2020).

However, as mentioned previously, the low-skilled workforce will be most affected by the robotization of industry, and their hours-worked have already declined (Graetz & Michaels, 2018). This is not surprising, since the robots can work 24/7, perform the routine task without complaints, and “learn” by simply being upgraded (Ivanov, 2017). Nevertheless, employees show a tendency to resist new technologies, outdating their abilities and diminishing their expected earnings. (Nica, 2016). Even though, 2 million new jobs were created applying digitalization in the EU over the last decade (European Commission, 2020). However, research carried out by Digybite in accordance with European Commission found that 42% of respondents could transfer some of their job activities to robots; 72% suppose that “robots steal peoples’ jobs;” 74% presume that AI will eliminate more jobs than it will create; (Digybite, 2017), thus making the situation pernicious for employees (Nica, 2016) and stimulating justifiable fear of robots.

Fear of robots is a multifaceted phenomenon, that can be understood as a cultural, institutional arrangement, or biological response (McClure, 2018). The author suggests that fear also has the attribute of being contagious. Having alarming news in the media, proposing drastic numbers extrapolated by scientists can induce fear of robots in certain groups of people since the data is easily manipulated and still polarized opinions remain among the researchers of the field. Technological unemployment is not something new; it has been stirring peoples’ imaginations and can be traced back to the great depression; John Maynard Keynes (1930) called it a disease; thus, no wonder, it is striking fear into humankind. Mostly, this fear is a fear of being left behind (McClure, 2018), not being able to adapt to new emerging technologies, not being quick enough to learn to operate these new machines. The manual labor force is highly susceptible to technological unemployment because technological advancement does directly refer to the more technologically skilled workers that will have the advantage and adapt easier to the change (Acemoglu & Autor, 2011; McClure, 2018). Nonetheless, fear of losing a job in general or over technologies might result in deterioration of health, in particular, psychological health, increasing anxiety, depression (McClure, 2018), creating social tensions, or even a shift in values (Ivanov, 2017). These fears can be visualized by numbers, where 37% of the sample population in the study carried out by McClure (2018) expressed that they are afraid or very afraid of certain technologies.

In the same study of McClure (2018), the portrait of average technophobes was drawn, who are “around 52 years old, female, and have less than a college degree <…>, are married, live in a metropolitan area, and identify as politically conservative” (p. 150).

Deconstructing this portrait, other studies also found similar results, where females are expected to fear technologies and robots alike, more than their male counterparts (Chua, Chen, & Wong, 1999; Dekker et al., 2017; Durndell & Haag, 2002). Though this factor might be influenced by education since females often choose less technology-related fields. However, education plays a crucial role regarding technophobia; the fewer years people spend in education, the more likely they are to be afraid of technologies (Dekker et al., 2017; McClure, 2018). Though, this might be highly related to personality traits, such as having more logical and mathematical skills and being computer-literate results in lower levels of anxiety towards technologies (Beckers & Schmidt, 2001; Korukonda, 2005). Most of the cases are true disregarding the regions or countries where they were conducted. Interestingly, technophobia correlates positively with neuroticism (Anthony, Clarke, & Anderson, 2000), unemployment, and anxiety (McClure, 2018); adverse labor market conditions are linked with crime, racism, and extremism (Dekker et al., 2017). Therefore, maintaining a steady, educated workforce is vital for any enterprise regarding the adoption of disruptive technologies; utilizing higher educated, managerial, or white-collared co-workers who tend to be less afraid of new technologies (Dekker et al., 2017) for the benefits of introducing robots and digital solutions to their less technology-aware colleagues.

Methodology

Sample and data collection

The responses to gather data were collected from the operators of robotized furniture production lines in Lithuania. Five furniture companies were surveyed in 2020. The research was based on the principle of convenience to obtain the data from the respondents who were easier to reach; however, certain inclusion criteria were applied: (1) working on robotized production lines; (2) working in the furniture manufacturing sector. Paper questionnaires were distributed to the employees. Data collection took approximately 1 month. At the end of the research, 350 questionnaires were collected. Data about gender, age, education, and time worked for the organization were collected regarding the respondent profile. The socio-demographic characteristics of the sample are illustrated in Table 1.

Table 1. Profile of the respondents

	%
Furniture industry	100
Working on a robotized production line	100
Gender	
Male	61
Female	39
Age	
Generation Z (date of birth 2002 and later)	5
Generation Y (date of birth 1981-2001)	50
Generation X (born in 1965-1980)	35
Baby boom generation (born in 1946 -1964)	10
Education	
Higher education	41
Non-degree	59

Time worked for the organization (job tenure)	
0-3 years	25
3-5 years	38
5 and more	37

Measures and data analysis

Fear of robots was measured using a six-item scale adapted from Dekker et al. (2017). Sample items are: "Robots steal people's jobs" and "Widespread use of robots can boost job opportunities". Cronbach's alpha was 0.789. Response options ranged from 1, "strongly disagree", to 5, "strongly agree".

Statistical analysis was performed using the statistical package IBM SPSS Statistics Standard v.23. Respondents' demographics were summarized using descriptive statistics. As the data had a skewed distribution, Spearman's coefficient was used as a measure of bivariate correlations between the main variables of the study. Multiple logistic regression analyses using an enter method were conducted. The model of fear of robots was adjusted for personal factors (gender, age, level of education, and years worked for the organization). Results were considered statistically significant at a 5% ($p<0.05$) significance level. Scores for all scales used were calculated.

Results

The means, standard deviations, and correlation matrix are provided in Table 2. As it is in the table, the mean ratings of fear of robots perceived by the respondents were 3.74. A negative correlation between fear of robots and time worked for the organization was revealed (-0.157, $p<0.01$). A positive correlation was observed for age (0.158, $p<0.01$).

Table 2. Mean, standard deviation, and Spearman correlations

	Mean	SD	1	2	3	4
1. Gender	1.39	0.49				
2. Age	2.50	0.74	0.057			
3. Education	1.59	0.49	0.035	-0.111*		
4. Time worked for the organization	2.11	0.78	-0.043	-0.365**	-0.084	
5. Fear of robots	3.74	0.67	-0.027	0.158**	-0.098	-0.157**

*Notes: n=350; * p < 0.05; ** p < 0.01; SPSS 23 was used to calculate the means and standard deviations; reported means of latent variables were zero in cross-sectional analyses.*

Previous research has suggested that employees according to their demographic variables such as gender, age, work tenure, and education differed regarding their fear of robots (Chua et al., 1999; Dekker et al., 2017; Durndell & Haag, 2002; McClure, 2018). Turning to current research, the Mann-Whitney U test (Table 3) did not show a statistically significant difference between the fear of robots ($U = 14083.500$, $p >0.05$) of males and females.

Table 3. Gender differences in fear of robots (Mann – Whitney test).

	Female mean rank	Male mean rank	Mann - Whitney U test	Z	Sig.
Fear of robots	172.32	177.50	14083.500	-0.467	0.641

The Mann-Whitney test did not reveal any statistically significant differences concerning fear of robots depending on the education level (Table 4). This leads to the idea that when working in robotized production lines in the furniture sector, education level does not matter for feeling fear towards robots.

Table 4. Education differences in fear of robots (Mann – Whitney test)

	University degree mean rank	Non-university degree mean rank	Mann - Whitney U test	Z	Sig.
Fear of robots	187.01	167.36	13193.000	-1.796	0.073

The Kruskal-Wallis test (Table 5) showed a statistically significant difference in various age groups of respondents as regards their fear of robots (H = 11.730, p<0.05). It seems that respondents born in 1965-1980 (Gen X) felt less fearful towards robots (mean rank – 155.88) than respondents born after 2002 (Gen Y) (mean rank – 230.18).

Table 5. Age differences in fear of robots (Kruskal-Wallis H test)

	Baby boom mean rank	Gen X mean rank	Gen Y mean rank	Gen Y mean rank	Kruskal-Wallis H test	df	Sig.
Fear of robots	166.29	155.88	185.72	230.18	11.730	3	0.008

The Kruskal-Wallis test (Table 6) revealed statistically significant differences regarding fear of robots across employees with different job tenures. This proposes the idea that the longer people work in robotized production lines, the less fearful of robots they become.

Table 6. Working years' differences in fear of robots (Kruskal-Wallis H test)

	0-3 years mean rank	3-5 years mean rank	5 or more years mean rank	Kruskal-Wallis H test	df	Sig.
Fear of robots	186.90	192.93	149.12	13.823	2	0.001

To test the study model, multiple regression analyses were conducted (Table 7). The results are discussed further.

Table 7. Multiple regression results

	Dependent variable: (Standardized β)	P
Independent variables	**Fear of robots**	
Control variables		
Gender	-0.037	0.485
Age	-0.092	0.108
Education	-0.098	0.066
Time worked for the organization	-0.156	0.006

*Notes: R^2 = 0.053; Total F = 4.872; Adjusted R^2 = 0.042; *p<0.05; **p<0.01; *** p<0.001.*

It is visible from Table 7 that the time worked for the organization has the biggest not significant (β = -0.156, p = 0.006) impact of fear of robots, meaning, that when more time is spent working in the organization, it reduces the fear of robots.

Discussion and conclusions

This research aimed to explore whether employees experience fear of robots. A survey was conducted among line operators of robotized production lines of the furniture industry in Lithuania which revealed that there is no significant fear expressed by the respondents. Even though the furniture industry is in the scope of the sectors to be robotized and automated, workers with repetitive tasks being under a higher risk of being replaced by robots (Ivanov, 2017), the older workers with longer work tenure do not experience fear of robots and are likely to be less fearful of them than their younger colleagues. Moreover, strong markets that have lower uncertainty avoidance should be able to adapt to technological transformation more efficiently, because better GDP growth relates negatively to the perception of fear of robots, people are more willing to accept risks such as job change or enter unknown situations, especially if there is a dense network of trade unions in the country (Dekker et al., 2017). Correspondingly, digital solutions are expected to be perceived with greater caution or as a threat in the regions of lower economic growth and less stable workforce which can be disturbed by introducing disruptive technologies, such as robots (Jaimovich & Siu, 2020). Accordingly, Lithuania has been in the 1st place in the EU for GDP per capital growth since 2000 (Invest Lithuania, 2019), meaning that the environment is more friendly in adapting new technologies and employees accepting them, facing lower risks of becoming unemployed, thus, fearing the robots less. Moreover, being both business and robot friendly, Lithuania and its furniture industry should keep in mind the numbers provided by the IFR (International Federation of Robotics, 2019, 2020) and try to rise from 2 robotized units per 10,000 inhabitants and meet the 103-118 units of the developed countries. This could be reached by exploiting the benefits of the Industry 4.0 networks that the country is already a part of, increasing the reach and depth of communication of good practice and examples of success. Introducing robots at work can benefit greatly, since using robots lessens the fear of them (Dekker et al., 2017), though maintaining the notion that the future we are facing is where silicon replaces carbon (Ivanov, 2017). Being less fearful of robots, Lithuanian robotized production line operators of the furniture industry express their willingness to adapt, be more open-minded, and acceptance of innovations.

The paper has several limitations, which open avenues for future research. Firstly, the paper uses self-reported measures. Secondly, the paper uses a sample from a single country; hence, it has a limitation due to its restrictive generalizability. To overcome this factor, future research could be extended to a whole region.

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