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ADVANCES IN GLOBAL SERVICES AND RETAIL MANAGEMENT

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The Impact of Industry 4.0 Strategy on the Work-Life Balance of Employees

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Abstract

The era of Industry 4.0 has been creating new opportunities for the employees, like having more flexible and spare time. It has changed their work-life balance, like spending more time for the need to learn new concepts and skills. This quantitatively designed research aimed to investigate the impact of firms' Industry 4.0 strategy on their work-life balance in manufacturing enterprises. The survey technique was used to collect 425 valid survey data from randomly selected employees working in the manufacturing enterprises operating in Konya in Turkey. Data were analyzed by using descriptive statistics, exploratory factor analysis, structural equation modeling path analysis technique. Results displayed that there was a negative and weak relationship between firms' Industry 4.0 strategy and work-life balance ($R^2 = -0.04$; $p < 0.05$). Findings suggested that firms' Industry 4.0 strategy is not fully recognized by the employees. It can be said that employees are mainly concerned with their personal lives and suppose that Industry 4.0 technologies will negatively affect their future at the workplace. Therefore, it is important to acknowledge employees about Industry 4.0 technologies. Management needs to empower employees by providing training to gain them new skills to cope with the requirements of the digital transformation.

Keywords: industry 4.0, work-life balance, manufacturing industry

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Introduction

Industry 4.0 refers to the latest era of the industrialization. Industry 4.0 includes various new technologies for the digitization and automation of the production environment like Big Data and data analysis, robotics, mobile computing, Internet of Things (IoT), cloud computing, simulation and modelling, cyber-physical systems, 3D printing, radio frequency identification (RFID), among others. These Industry 4.0 technologies bring new horizons to the industry to have more efficient processes and develop innovative products and services (Antunes, Pinto, Reis, & Henriques, 2018). These new technologies demand a change in the skills profile of the workforce. In this age, employees are expected to have data-driven skills to adapt to changes in the workplace where such technologies are used (Ras, Wild, Stahl, & Baudet, 2017).

Technological advances change both the structure of work and personal lives. For instance, digital devices and technologies including laptops and smartphones remove both the temporal and the physical boundary between work and home or other life activities (Berry & Hughes, 2020). In the

age of Industry 4.0, there is an intense use of digital technologies that operate interconnectedly and online.

Industry 4.0 technologies have substantial potential to relieve professionals from routine work and to facilitate more flexible work organization and better work life balance. However there is still a need to empirically investigate the impact of Industry 4.0 on the work-life balance of employees (Ras et al., 2017). Thus, this research aimed to determine the impact of firm's Industry 4.0 strategy on their work-life balance.

Literature Review

Industry 4.0

The introduction of smart technologies into the manufacturing environment has brought about the fourth industrial revolution. Industry 4.0 refers to the decentralization of business processes that was enabled by technological advances. It is characterized by the implementation and integration of a variety of simple to advanced Information, Digital, and Operation Technologies (IDOT) such as industrial sensors, industrial controllers, Machine to Machine communications, Internet of Things (IoT), Automated Guided Vehicles (AGV), CyberPhysical Systems (CPSs), robots, Augmented and Virtual Reality (AVR), artificial intelligence (AI), cloud computing, Internet of Services (IoS), and Big Data Analytics (BDA). Industry 4.0 represents a business environment where employees, machinery, devices, and enterprise systems are connected through CPSs and the Internet. This industrial revolution has enabled autonomous, dynamic, and smart manufacturing in businesses with the digitization and integration of the entire value chain of the lifecycle of products (Fatorachian & Kazemi, 2021; Ghobakhloo, 2020).

The technologies of Industry 4.0 have the integration and interoperability features. These technologies do not operate independently and rely on the implementation and integration of various combinations of IDOT across value networks (Ghobakhloo, 2020). Industrial automation systems help to create connections between the cyber and physical worlds. Moreover, interoperability facilitates production processes within and beyond the boundaries of a business to interconnect systems and exchange knowledge and skills (Büchi, Cugno, & Castagnoli, 2020).

Industry 4.0 enables firms to have the opportunity of production flexibility, the speed of serial prototypes, greater output capacity, reduced set-up costs and fewer errors and machine downtimes, higher product quality and less rejected production, and customers' improved opinion of products (Büchi et al., 2020). Industry 4.0 technologies leads to the production decentralization that enables machines, human resources, materials, and process controllers intercommunicate in real-time (Ghobakhloo, 2020).

Work-Life Balance

Work-life balance is the perception that work and nonwork activities are compatible and promote growth in accordance with an individual's current life priorities (Gragnano, Simbula, & Miglioretti, 2020). It is defined as equal time, satisfaction and participation in each of the work and family spheres. Work-life balance is two interactive worlds that can interchange and cannot be completely separated (Roy, 2016).

Work–life balance can be achieved if work and home demands are relatively low and resources at work and home are plentiful (Bardoel & Drago, 2016). Education, health, leisure, friendships, family, household management, and community involvement are the nonwork domains. Work-life balance can occur in the form of family-to-work conflict (negative), work-to-family conflict (negative), family-to-work enrichment (positive), and work-to-family enrichment (positive) (Gragnano et al., 2020). The outcome of work–life balance is associated with stress, burnout, job satisfaction, job performance, organizational commitment, and life and family satisfaction (Gragnano et al., 2020; Roy, 2016).

Industry 4.0 technologies provided by the employer raise expectations of availability and ability of employees to respond. These technologies facilitate flexibility and free people from restricted hours and physical locations; however, they also blur boundaries of work and personal time. Technology enabled flexibility drives to more complicated coordination among co-workers, which in turn leads to further stretching of work-life boundaries. Industry 4.0 technologies seem to contribute to the work-life conflict of workers, increasing their stress levels as well as negatively influencing their family and social lives (Sarker, Sarker, Xiao, & Ahuja, 2012).

Past research mainly focused on the impact of Industry 4.0 on firm level outcomes like efficiency and productivity. However, its effect on employee has often been neglected. Therefore, it is worth to investigate the impact of Industry 4.0 on work-life balance. Thus, this research focused on employee perception of the firm's Industry 4.0 strategy and its impact on their work-life balance.

- **H₁:** Employee perception of firms' Industry 4.0 strategy has an impact on their work-life balance.

Methods

This research was designed empirically to investigate the impact of employee perception of firm's Industry 4.0 strategy on their work-life balance. Surveyed data was collected by using a questionnaire form having three parts. The first part was the employee perception of the firm's Industry 4.0 strategy measure, the second part was the perception of work-life balance, and the third part was the demographic characteristics of the participants. Both measures, Industry 4.0 and work-life balance, were 5-point Likert scales ranged from "1 = strongly disagree " to "5 = strongly agree".

The measures for the employee perception of firm's Industry 4.0 strategy was adapted from the research of Atak (2018). The work-life balance perception measure was adapted from the research of Apaydın (2011). The measure of firm's Industry 4.0 strategy consisted of 21 items, and work-life balance consisted of 30 items. A reliability analysis was performed to the measures. The Cronbach's Alpha reliability coefficients for the "firm's Industry 4.0 strategy" and "work-life balance" were $\alpha = 0.90$ (20 items) and $\alpha = 0.82$ (19 items) respectively. Results of the reliability tests suggested that the internal consistency of the items of the measures were good.

Population of the research was the manufacturing enterprises operating in Konya, in Turkey. Konya is one of the top 5 developed big cities having intense industrial zones in Turkey. Sampling framework of the research was employees working in manufacturing companies (mainly machine manufacturing and automotive spare parts manufacturing). A total of 500 questionnaires were

delivered to randomly selected employees and 425 of them were scrutinized valid for analysis. This amount of data was assessed adequate to make generalization based on the given limitations (Hox & Bechger, 2006).

Expert feedbacks were taken from six experts actively working in the target industry and two academicians from the field to increase the surface validity of the questionnaire. A pilot study was conducted to test the preliminary construct validity of the measures. By analyzing 40 valid pilot data, some measure items were rephrased to clarify the meaning of items.

Findings

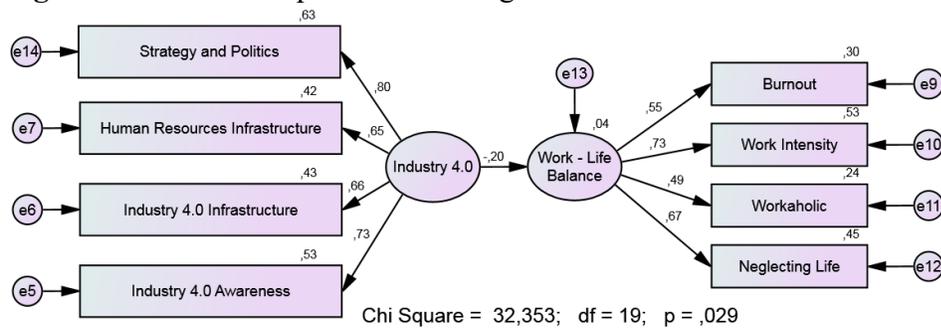
Data was analyzed by employing exploratory factor analysis, confirmatory factor analysis and Structural Equation Modelling path analysis techniques.

The analysis of the demographic characteristics revealed that majority of the respondents were male (99.06%); single (53.41%); at the age groups of 18-24 (30.59%), 25-34 (33.88%), and 35-49 (31.76%); having experience at the current workplace less than 1 year (19.29%), 1-3 years (28.47%), and 4-6 years (24.71); working at the production department (84.24%) as an employee (62.12) in small and medium sized enterprises.

An exploratory factor analysis was conducted for the measure of employee perception of firm's Industry 4.0 strategy. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy suggested that the sample was factorable (KMO = 0.875). The Bartlett's Test of Sphericity test had a significant result ($\chi^2 = 2971.186$, $df = 136$, $p < 000$), indicating that the factor analysis can be applied for this measure. Exploratory Factor Analysis was performed by using "Direct Oblimin" rotation with Principal Component Analysis method. Due to dual or low loading reasons three items of the measure were eliminated from the analysis. Exploratory factor analysis generated four components explaining 62.27% of total variance. Further analysis was conducted with the compound variables named strategy and policy, human resource infrastructure, Industry 4.0 infrastructure, Industry 4.0 awareness.

Another exploratory factor analysis was conducted for the measure of work-life balance. The KMO measure of sampling adequacy for this measure also suggested that the sample was factorable (KMO = 0.816). The Bartlett's Test of Sphericity test had a significant result ($\chi^2 = 1380.903$, $df = 120$, $p < 000$), indicating that the factor analysis can be applied for this measure. Exploratory Factor Analysis was performed by using "Varimax" rotation with Principal Component Analysis method. Three items of the measure were eliminated from the analysis because of dual or low loading reasons. Exploratory factor analysis generated six components explaining 63.58% of total variance. Two components had been loaded with two items. Thus, these components moved to the other components having nearest similar meanings. Further analysis was conducted with four compound variables named burnout, work intensity, workaholic, and neglecting life.

A confirmatory factor analysis (CFA) was executed for both constructs. Results of CFA analysis indicated that both constructs satisfied the construct validity thresholds. Then, a Structural Equation Modelling (SEM) path analysis was used to test the proposed hypothesis. Figure 1 displays SEM results with standardized values.

Figure 1. Structural Equation Modeling for the Theoretical Model

SEM model yielded statistically fit indices [$\chi^2 = 32.353 (19)$, $p = 0.029$; GFI = 0.981; AGFI; 0.965; NFI; 0.961; CFI; 0.983; RMSEA = 0.041] and found a weak and negative relationship between the variables employee perception of firm's Industry 4.0 strategy and work-life balance ($R^2 = -0.04$, $p < 0.001$). The proposed hypothesis ($H_1: \beta = 0.20$, $p < 0.001$) was supported.

Conclusions

This research was investigated the relationship between employee perception of business Industry 4.0 strategy and work-life balance. It was observed that both concepts were examined by scholars separately, however, there was scarce research exploring this relationship empirically.

The findings of this research proved that there is a weak and negative relationship between the employee perception of firm's Industry 4.0 strategy and work-life balance. The results revealed that the determinants of work-life balance can be explained by other variables. The results can also be interpreted that employees don't have a clear idea about the concept of Industry 4.0 and the firm's strategy on Industry 4.0.

It is obvious that Industry 4.0 technologies require new skills and knowledge. Thus, findings can be interpreted that Industry 4.0 will bring employees new challenges, such as learning new skills or replacing manpower with self-driving machine power. For this reason, management in organizations should provide training that explains Industry 4.0 awareness and its impact on both business processes and employee life. Management can also organize training for employees to acquire new skills to deal with Industry 4.0 technologies. In this way, companies can retain valuable human resources and eliminate their hesitation against these technologies.

This research has some limitations that suggest future research opportunities. This research was quantitatively designed and future researches can be designed qualitatively to get in-depth knowledge of the concept. This research was carried out in Konya in Turkey. Similar research can be conducted in other regions or other countries to determine the effect of cultural differences.

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