

THE IMPLEMENTATION OF INDUSTRY 4.0 UNDER MANUFACTURING COMPANIES: A QUALITATIVE ANALYSIS

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Abstract

The concept of Industry 4.0, which is argued to not only contribute towards the improvement of firm performance but also aid in increasing value, is an important initiative that promises to generate competitive advantage among countries. In light of the current policies supportive of the implementation of Industry 4.0 within the European Union member states (such as 2014 “Communication for a European Industry Renaissance” and the 2012 “Industrial Policy”), large industry sectors have commenced their shift towards the development of “smart factories”. This movement is also mirrored under the manufacturing sector in Turkey. This creates a motivation to analyze current industry 4.0 application levels and the actual and expected benefits of the initiative from the perspectives of companies. As a result, we conducted a content analysis on the annual activity reports of the manufacturing sector companies listed on BIST (Borsa Istanbul). Findings show that Industry 4.0 applications are mostly beneficial for the operations function since they help firms to develop their operational process and ensure quality control and assurance.

Keywords: Industry 4.0, Manufacturing Companies, Benefits, Business Functions, BIST

İMALAT FİRMALARINDA ENDÜSTRİ 4.0 UYGULANMASI: KALİTATİF BİR ANALİZ

Özet

Firmaların performans gelişiminin yanı sıra değerlerinin artmasına da katkı sağlayan Endüstri 4.0 kavramı, ülkeler arasında da rekabet avantajı yaratan önemli bir girişimdir. Avrupa Birliği üye ülkeleri arasında hayata geçirilen Endüstri 4.0'ın uygulanmasını destekleyen mevcut politikalar (2014 Avrupa Endüstri Rönesansı için İletişim, 2012 Endüstriyel Politika, vb. ışığında, büyük endüstriler akıllı fabrikalara geçiş sürecini başlatmışlardır. Bu gelişmeler Türkiye'ye de yansımıştır ve Endüstri 4.0'ın uygulanma seviyesini ve bu girişimin mevcut ve beklenen faydalarını firmaların perspektifinden analiz etme konusunda motivasyon yaratmaktadır. Dolayısıyla, bu çalışmada BIST'de listelenen imalat endüstrisinde faaliyet gösteren firmaların yıllık faaliyet raporları üzerinde içerik analizi yapılmıştır. Çalışma bulguları göstermiştir ki Endüstri 4.0 uygulamaları firmaların operasyonel süreçlerinin gelişimi ile kalite kontrol ve teminine katkı sağladığından firmaların en fazla operasyon fonksiyonu açısından yararlıdır.

Anahtar Kelimeler: Endüstri 4.0, İmalat Firmaları, Yararlar, İşletme Fonksiyonları, BIST

1. Introduction and Literature Review

Fourth industrial revolution, referred to as “Industry 4.0” was firstly publicize in 2011 at Hannover Fair. (Kagermann et al., 2011). Main technological change of this revolution is cyber-physical systems. With this technological advancement the real and virtual world will be connected to each other synchronously (Kagermann 2015). These systems will bring about advantages, such as; accurate prediction of failures, an effective production process with increased planning and management activities (Rüßmann et al., 2015). Moreover, production process can become more visible by manager so that making decision will become more easier and managing the production systems will become flexible with this technology. (Kagermann et al., 2013). Furthermore productivity will increase in the Industry 4.0 era (Ganzarain & Errasti, 2016; Kagermann, 2015: 34; Rüßmann et al., 2015; Schmidt et al., 2015).

Systems integration will take on new shapes with the Industry 4.0, both within and between factories/factories systems (Varghese and Tandur, 2014: 636). So that, firms can more effectively plan and organize activities which from raw materials acquisition to marketing, logistic and customers. (Siemens, 2016). Different factories can exchange the information between each other such as product and service information of one firms can be observable by the others. (Wang et al., 2016: 2-3; Zhou et al., 2015). Moreover, this integration will not only affect the factories but also whole supply chain will be more integrated each other than now (Kagermann et al., 2013).

Additionally, energy and resources more efficiently used in the fourth industrial revolution era. Optimization of value chain, non-stop production (Kagermann, 2015: 34;) effectively allocation of resources (Stock and Seliger, 2016: 540) smart logistic and smart grid systems. (Kagermann et al., 2013; Kagermann, 2015) are the some examples to clarify how the factories will use resource and energy more efficiently.

Autonomous systems and robotics technology is the other technology that Industry 4.0 brings benefits to companies. Taking decision based on the situation without need of an authority (Redfield and Seto, 2017:103) and adapting themselves to different situation (Blanchet et al., 2014: 8; Rüßmann, et al., 2015: 3) which are the some skills of the new autonomous systems and robotics. So that this systems will be more practical than employees (Pfeiffer, 2016: 1), and controlled remotely. (Blanchet et al., 2014: 8)

Moreover, companies can increase profitability with using big data (McAfee et al., 2012: 5-6). Different types of data such as video, text data will be collected through the smart systems. So that it brings that advantages more accurately decision making with using detailed information about customers preferences, production systems, supply chain. (Manyika et al., 2011: 5), detection of faulty easier (Rüßmann et al., 2015: 2-3). The addressed Industry 4.0 benefits under the literature highlights the importance of the transition towards a more proficient business. This study aims to contribute towards creating an understanding of the usage and effect of the Industry 4.0 transition overtaking the business world.

2. Methodology

In order to a systematic review was conducted on the 2017 activity reports of manufacturing firms listed on the BIST. Following the steps outlined by Tranfield, Denyer and Smart (2003) we attempt to map and assess “available evidence” to provide “insights and guidance” for analyzing our research question.

As the Industry 4.0 developments is largely expected to affect the manufacturing industry (Strandhagen et al., 2017) they were selected for the analysis. The annual reports were selected as the annual reports are routinely audited, allows for comparability and are easily accessible for everyone.

The 2017 annual reports were only included under the analysis as they reflect a transition period after the announcement of a new government funded Industry 4.0 project (Sanayi Gazetesi. 2018:1).

The full-text of the 2017 annual reports for the manufacturing firms listed under the Istanbul Stock Exchange were searched in order to retrieve information relating to firm Industry 4.0 activities. The source documents were downloaded from the investor relations section under the official website of the firm. This stage of the study was conducted by two researchers in order to ensure no annual report addressing Industry 4.0 was left out of the analysis. After individually searching through the 178 documents, the identified firms were double checked and text concerning the transition towards Industry 4.0 were recorded under an Excel sheet. Out of the 178 listed manufacturing firms under BIST, only 20 were identified as transitioning towards Industry 4.0.

Table 1: Transitioning Firms Identified under the Manufacturing Industry

Industry	Count	Percentage
Textile, Wearing Apparel and Leather	1	5%
Food, Beverage and Tobacco	3	15%
Chemicals, Petroleum Rubber and Plastic Products	5	25%
Fabricated Metal Products, Machinery and Equipment	8	4%
Wood Products and Furniture	1	5%
Non-Metallic Mineral Products	2	10%
Total	20	100%

The highest percentage of firms transitioning towards Industry 4.0 within the year 2017 are firms operating within the “Chemicals, Petroleum Rubber and Plastic Products” sector at 25%. While the second and third highest sectors are the “Food, Beverage and Tobacco” (15%) and “Non-Metallic Mineral Products” (10%), respectively.

Following the identification of firm activities relating to Industry 4.0, the recorded text was subject to an inductive analysis and the categories/themes were drawn from the data (Strauss and Corbin, 1990).

3. Findings

2017 annual activity reports of 20 firms from six different manufacturing sub-sectors were analyzed to examine the benefits of Industry 4.0 applications in terms of business functions. The total number of the inscriptions expressing benefits in the activity reports of 20 (Table 2) manufacturing firms is 236. The firms which mention about benefits of Industry 4.0 in their reports mostly are Vestel, Türk Traktör, Anadolu Isuzu and Tüpraş, respectively.

Table 2. Firms and Dispersion of the Inscriptions Expressing Benefits

Firms	Count of Inscriptions
Anadolu Cam Sanayii A.Ş.	4
Arcelik A.Ş.	2
Anadolu Isuzu Otomotiv Sanayi ve Ticaret A.Ş.	40
Aygaz A.Ş.	2
Brisa Bridgestone Sabancı Lastik Sanayi ve Ticaret A.Ş.	1
Ditaş Doğan Yedek Parça İmalat Ve Teknik A.Ş.	2
Ford Otomotiv Sanayi A.Ş.	3
Kordsa Teknik Tekstil A.Ş.	6
Orma Orman Mahsulleri İntegre Sanayi ve Ticaret A.Ş.	1
Otokar Otomotiv Ve Savunma Sanayi A.Ş.	2
Petkim Petrokimya Holding A.Ş.	16
Pınar Su Sanayi ve Ticaret A.Ş.	5
Pınar Süt Mamulleri Sanayii A.Ş.	2
Türk Prysmian Kablo ve Sistemleri A.Ş.	1
Soda Sanayii A.Ş.	6
Tat Gıda Sanayi A.Ş.	4
Trakya Cam Sanayii A.Ş.	1
Türk Traktör ve Ziraat Makineleri A.Ş.	40
Tüpras-Türkiye Petrol Rafinerileri A.Ş.	28
Vestel Beviz Esya ve Elektronik Sanayi ve Ticaret A.Ş.	70
Grand Total	236

According to the literature review, business functions are classified into six main categories: operations, strategic management, human resources, marketing, procurement and distribution and technology and process development. These six categories were used as the analytical framework of the study. The unit of analysis was inscriptions expressing a benefit brought by the Industry 4.0 applications. In the reports, there were 95 inscriptions related to operations function, 52 inscriptions related to strategic management function, 36 inscriptions related to technology and process development function, 27 inscriptions related to procurement and distribution function, 18 inscriptions related to human resources management function, only four inscriptions related to marketing function. Four manufacturing firms did not mention any benefit under their activity reports and they were coded as not available (N/A). The percentage distribution of the total inscriptions according to business function categories (theme 1) are shown in Figure 1.

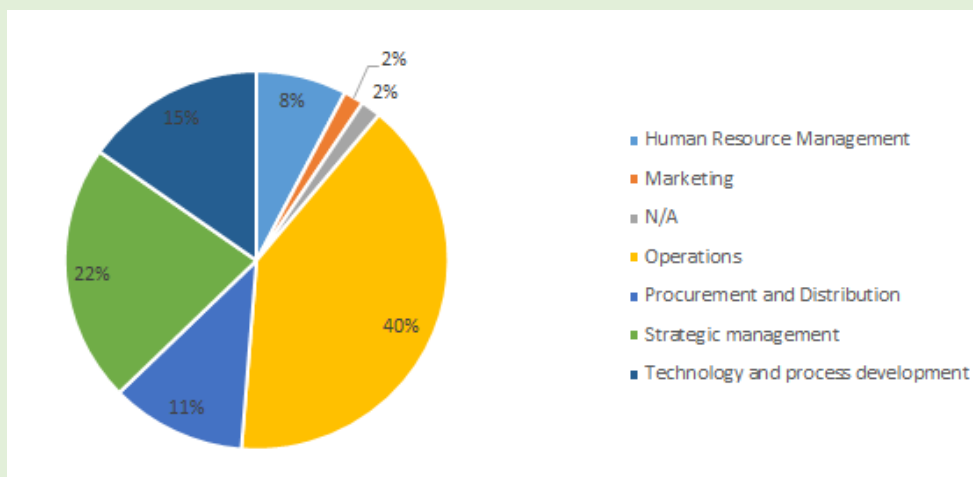


Figure 1. Dispersion of Business Function Categories Benefited from Industry 4.0

After classifying the inscriptions according to the business functions (theme 1), the researchers categorized the inscriptions into sub-categories (theme 2) and then further gathered them into a third theme according to the common actual benefit brought by Industry 4.0 applications. The processes or activities conducted under the business functions are handled as sub-categories. Inscriptions related to operations function were further categorized into four sub-categories: developing operation process, managing production, producing goods and quality control and assurance. Inscriptions related to strategic management function were categorized into four sub-categories: coordinating activities, corporate strategy development, gaining competitive advantage (differentiation) and gaining competitive advantage (cost). Inscriptions related to technology and process development function were categorized into five sub-categories: collecting and processing data, cyber security improvements, developing process, developing software and products or service designing. Inscriptions related to procurement and distribution function were categorized into two sub-categories: distribution and procurement. Inscriptions related to human resources management function were categorized into three sub-categories: managing human resources, managing working conditions and training. Inscriptions related to marketing function were categorized into two sub-categories: managing corporate image and providing customer relations. Figure 2 shows the number of inscriptions under sub-categories of business functions. The most frequently emphasized process or activity conducted is developing operation process and the least emphasized activity is managing corporate image. The firms view Industry 4.0 applications as more beneficial for the activities such as developing operation process, quality control and assurance, managing production and production goods, respectively. However, they think that Industry 4.0 has little role on their activities such as providing customer relations, managing human resources and managing corporate image.

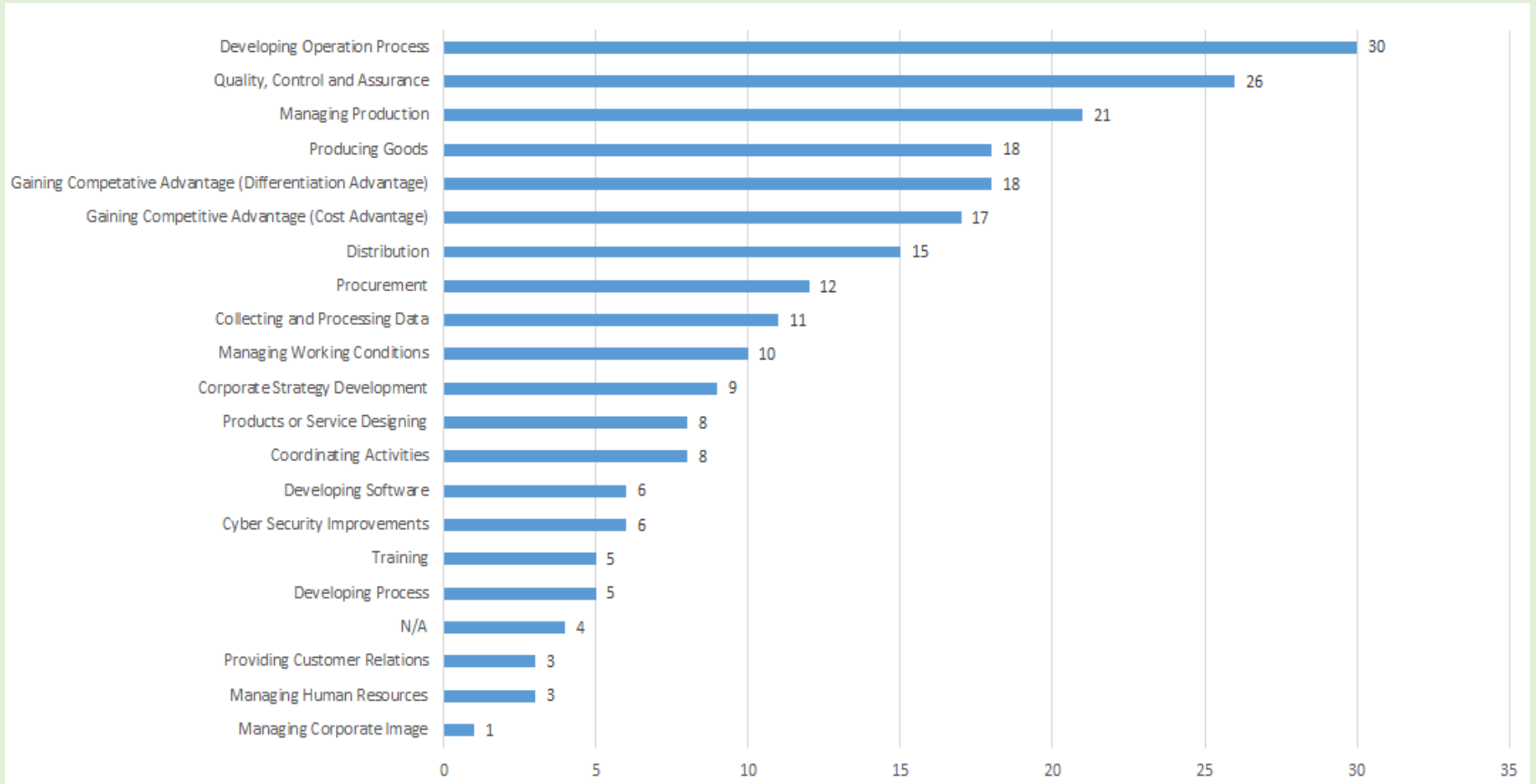


Figure 2. Number of Inscriptions under Sub-categories of Business Functions

4. Conclusion

This research used a content analysis on annual activity reports to reveal perceived benefits brought by Industry 4.0 applications in manufacturing firms. Based on a content analysis of activity reports, this study represents the views of 20 manufacturing firms on benefits of Industry 4.0 in terms six main business functions. The findings extracted from 20 different sub-categories and 76 detailed listed benefit under sub-categories revealed that the manufacturing firms benefited from Industry 4.0 for their business functions mostly operations, strategic management, technology and process development, human resources management and marketing respectively.

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