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A Bibliometric Analysis of Industry 4.0-Focused Turkish E-Accounting Applications

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Abstract

In recent years, Industry 4.0-focused approaches have gained importance. Together with electronic trade, a modernist and innovative form of entrepreneurship has started, and automation has become widespread with the use of information technology. During the e-transformation phase, according to TÜİK (Turkish Statistical Institute) data in Turkey, the "Household Information Technology Usage Report" indicated that, as of 2018, 72.9% of individuals use computers and the Internet, and "The Research on the Usage of Information Technologies at Enterprises" indicated that 95.3% of enterprises have Internet access. Using the information and communication technologies, in the digital age in 2010 and onwards, the Revenue Administration of the Turkish Ministry of Treasury and Finance initiated the transition to electronic documents (e-Document) and electronic ledgers (e-Ledger) in the electronic environment to deal with the unregistered economy. In April 2019, to replace the 19 General Communiques issued as secondary legislation relating to e-applications implemented in Turkey until today, one "Draft General Communique on Tax Compliance Law" was prepared and submitted for public opinion in order to define taxpayer groups that will be newly included, to include new electronic document applications in the legislation, and to simplify legislation into one communique. This study provides general information on industry-oriented information and communication technologies in Turkey and addresses Industry 4.0-focused electronic accounting (e-Accounting) applications, providing web-based research outcomes to reflect Turkey as an example. "E-Accounting" literature retrieved from the Web of Science (WOS) database was subjected to a bibliometric analysis using BibExcel software.

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1. Introduction

Today, there has been a worldwide increase in the tendencies toward Industry 1.0-, Industry 2.0-, Industry 3.0-, and recently Industry 4.0-focused applications. Japan society has even moved to Community 5.0 instead of Industry 5.0. A focus on Industry 4.0 focus is essential for sustainability. First, Industry 4.0 and the situation in Turkey will be analyzed, and then the use of information and communication technologies will be reviewed. The main focus of this study is reviewing Turkish Industry 4.0-focused Electronic Accounting (e-Accounting) Applications. Finally, the research and analysis outcomes and further evaluations regarding the subject will be provided.

2. Industry 4.0 and Turkey

Industry 4.0 is a collective term that consists of numerous contemporary organizational concepts involving the use of information technology in industrial operations. Industry 4.0 is a set of values that consists of the internet of things, the Internet of services, and cyber-physical systems. Big data and analytics, autonomous robots, simulation, system integration, the internet of things (IoT), horizontal and vertical cyber security, cloud computing, additive manufacturing, and augmented reality are the nine technological elements that constitute the building blocks of Industry 4.0. At the end of the 18th century, steam-powered machines started to be used in factories, which were defined as the first industrial revolution (1.0). The second industrial revolution (2.0) started at the beginning of the 20th century with mass production powered by electricity, whilst in the third industrial revolution (3.0) electronic and information technology and automation in the industry became widespread from the 1970s. Today, we are in the fourth era of the industrial revolution, Industry 4.0, where value chains are connected end-to-end to cyber-physical systems and dynamic data processing (1)(2).

KPMG International classified the principles of the Framework of the Fourth Industrial Revolution (i4.0) (2017) into six dimensions of strategy and work model, finance and risk management, employees and their qualifications, systems and processes, services, and communication networks (3). To analyze the digital transformations of companies and how they are investing in Industry 4.0, Deloitte carried out global research on the manufacturing, energy, oil, gas, and mining sectors, which covered 11 countries and 361 executives. Deloitte studied how companies invest in digital transformation, their investment plans, basic difficulties encountered, and technical and organizational strategies relating to digital transformation (4). The Turkish Industrialists' and Businessmen's Association (TÜSİAD) and BCG jointly analyzed 25 Turkish manufacturing companies operating in six different sectors (automotive, machinery, white goods, food and beverages, textiles, and chemistry) and identified information and material flow, integration with suppliers, simulation of product and production processes during the design phase, smart products and smart production lines to increase flexibility and predictability in production as areas of opportunity for these sectors (5).

3. Information and Communication Technologies in Turkey

According to the "Information and Communication Technologies Sector" prepared by TÜBİSAD, the market grew by 15% and reached 131.7 billion TL. It contributed 10.2 billion TL in an exchange rate effect and 7.9 billion TL to the growth of the communication sector in 2018, respectively. In the last five years, the sector has almost doubled in size, the sector components are now aligned with the distributions of developed countries, and the share of value-added operations such as software and services continued to increase. The sector's exports have continued to increase since 2014 and reached 1.1 billion US dollars; however, this year it was only around 1 billion US dollars the cloud computing product or service rate was 8% in the 2018 revenue (6). According to the report of "The Digital Economic Transformation of Turkey" prepared by TÜBİSAD; it was seen that the GDP rate of R&D and innovation spending in Turkey was around 0.1%, and the patent application rate in information sector in terms of innovation output had a low rate with 3%, and suggestions were provided to extend the scope of the e-State service and for industry 4.0 (7).

According to the TUIK data for Turkey, as of 2018, the "Household Information Technology Usage Report" indicated that 72.9% of individuals use computers and the Internet. These rates are respectively 59.6% and 72.9% for the individuals aged 16-74; it was 68.6% and 80.4% for men, and 50.6% and 65.5% for women. Eight of ten households (83.8%) have access to the Internet. 45.6% of individuals used e-State services. 29.3%people do online

shopping, with 33.6% for men and 25% for women. It was determined that clothing and sports goods are most commonly purchased online and accounting for 65.2% of online sales. This rate is 55.9% for men and 77.3% for women (8). According to the TÜİK data, "The Research on the Usage of Information Technologies at Enterprises-2018" indicated that 95.3% of enterprises have Internet access. Accounting for employee numbers, 94.7% of enterprises with 10-49 employees, 97.8% of enterprises with 50–249 employees, and 99.2% of enterprises with more than 250 employees have Internet access. Furthermore, 66.1% of companies have websites, 93.7% use broadband, 9.8% make online sales, and 11.6% employ software experts (9). In the early years of computers, men were responsible for the hardware and women were responsible for the software. However, with the digital revolution, there was an increase in inequality between men and women in the use of information and communication technologies. In the report titled "Women in the Technology Sector", jointly prepared by Deloitte Turkey and TÜBİSAD, it was found that 19% of 486 white-collar women were engaged in research work in information technology departments, and 12% of them were information technology graduates (10).

4. Industry 4.0-Focused Turkish E-Accounting Applications

Together with the digital transformation within the context of Industry 4.0, e-State Applications came into prominence in Turkey. From 2010 and onwards, e-Accounting Applications were launched through being required by legal regulations. In the era of digital information production, the Revenue Administration of the Turkish Ministry of Treasury and Finance has been the only authorized institution responsible for dictating the regulations governing the electronic environment. During the electronic transformation process in Turkey, the Revenue Administration (RA) initiated the transition to an electronic applications environment in order to deal with the unregistered economy, follow, analyze, and evaluate tax activities with artificial intelligence and big data solutions, and transition to the use of electronic document (e-Document) and electronic ledger (e-Ledger) systems in the electronic environment. Within the scope of Industry 4.0 were transferred to electronic accounting (e-Accounting) applications throughout the world, including Turkey. The transition to e-Document and e-Ledger applications was initiated by the RA. As e-Accounting Applications; e-Invoices and e-Ledger accessible on the main web page of the RA under electronic transactions (e-Transactions) include all of them. The e-Documents include the Electronic Invoice (e-Invoice), e-Archive (e-Archive) Invoices, Electronic Dispatch (e-Dispatch), Electronic Self-Employment Voucher (e-Self-Employment Voucher/e-SEV), Electronic Producer Receipt (e-Producer Receipt/e-PR), Electronic Ticket (e-Ticket) and Electronic Passenger List (e-Passenger List). Maybe, ıt will be including ın current year for example draft Electronic Bank Receipt (e- Bank Receipt) with draft other new document. The e-Ledger includes e-Ledger & e-Journal applications and Ledger-Declaration System.

All of them in accordance with the standards determined by the RA; an *"e-Document"* is a document which features all electronic records, including information on the documents that must be organized in accordance with the Tax Procedure Law (TPL); an *"e-Invoice"* refers to an invoice subject to the conditions specified in the Communique and designed as an e-Document; *"e-Archive"* refers to the electronic storage and submission of invoices prepared in the electronic environment; *"e-Dispatch"* refers to dispatch of an e-Document form in a manner compliant; *"e-SEV"* refers to a self-employment voucher generated as an e-Document; *"e-Producer Receipt"* refers to a producer receipt produced in e-Document (11). *"e-Ledger"* (only general journal and general ledger) refers to all electronic records that should be in included in a ledger according to the TPL and/or the Turkish Commercial Law (TCL) (12). *"Ledger-Declaration System (LDS)"* refers to a system that allows self-employed taxpayers who keep ledgers based on the operation account method and taxpayers who are subject to the simple entry method to keep accounts in the electronic environment. This System can be used via the Internet at the web address without the requirement of any accounting program (13). The e-Invoice application that entered into force with the TPL General Communiqué No. 397 in March 2010 has been operative and a requirement since 01.09.2013. The e-Ledger application under the No. 1 Electronic Ledger General Communique, the general journal & ledger particularly those that had been kept on a balance sheet basis, has been obligatory since 01.09.2014. The e-Archive invoice application started in 2013, and the e-Dispatch application has been in effect since January 2017, the e-SEV and e-PR applications since January 2018. Taxpayers and self-employed individuals have been using the LDS since January 2018 while other taxpayers have been starting to use it by 01.01.2019.

As part of the strategy to extend e-Document and e-Ledger applications, some amendments in the regulations by

the RA were provided, related communiques were initially updated and/or updated drafts were issued, and after these predictions were provided in table (14). In order to combine General Communiques on e-Ledger and e-Document applications, the "Draft General Communique of Tax Compliance Law on Electronic Ledger and Document Applications" was prepared on 15th April 2019 and public opinion requested. In order to extend the scope of e-Ledger and e-Document applications to include newly defined taxpayer groups, to include new electronic document applications to the legislation in accordance with the demands of taxpayers (e-Bank Receipts, e-Insurance Policy, e-Insurance Commission Expense Documents, e-Exchange Purchase and Sale Documents, e-Notes of Expenses), and to simplify legislation, one communique was presented instead of the 19 General Communiques issued in the past. In the Draft Communique, it was proposed that taxpayers whose total sales exceed 5 million TL in 2018 and subsequent years will be obliged to move to e-Invoice and e-Ledger applications by the 1st January 2020, taxpayers should move to e-Archive Invoices by the 1st September 2019, and taxpayers will be obliged to move to e-Dispatch, e-SEV and e-PR by the 1st January 2020, as well as new amendments to add draft e-new documents applications (15).

In this section of the study, web-based research and findings are presented in order to exhibit the current status of Industry 4.0-focused Turkish e-Accounting Applications. The statistical findings that are periodically obtained in the studies conducted via the RA's web page are presented summary (See. Table 1).

Table 1. Descriptive statistical findings for e-accounting applications

e-Accounting Application	Findings
e-Invoice application	Total number of registered users of e-Invoices application was 104.206 on 19.05.2019, 80.350 on 06.10.2018 (16), 79.909 on 09.09.2018 (17), 63.056 on 09.10.2017 (18), 62.982 on 29.05.2017 (19), 52.442 on 16.12.2016 (20), 19.142 in January 2014 (21), and 3.323 in October 2013 (22).
e-Dispatch application	Total number of registered users was 682 on 19.05.2019.
e-Archive application	Total number of registered users was 36.177 on 19.05.2019.
e-SEV application	Total number of registered users was 3.410 on 19.05.2019.
e-PR application	Total number of registered users was 74 on 19.05.2019.
e-Ledger application	Total number of registered users was 84.998 on 19.05.2019, 71.743 on 06.10.2018 (16), 71.508 on 09.09.2018 (17), 61.026 on 09.10.2017 (18), 60.380 on 29.05.2017 (19), and 53.883 on 16.12.2016 (20). Total number of software developers and software packages that received compatibility approval from the RA was 175-192 on 19.05.2019. This numbers were 174-190 on 06.10.2018 and 09.09.2018 (17) (16), 171-187 on 09.10.2017 (18), and 169-186 on 29.05.2017 and 16.12.2016 (19) (20), 26 in January 2014 (21), 16 in September 2013 (22) and 9 in April 2013 (23).

Other research study, using e-Accounting applications as the paradigm, theoretical and practical information was integrated with the aim of addressing the following questions from a pragmatic perspective: "In which phase of the accounting paradigms in the e-Transformation process is Turkey currently?", "What is the history of the e-Transformation process in Turkey, and what will it look like in the future?" (17).

The National Institute of Standards and Technology defines "cloud computing as a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction." Cloud computing providers deliver their services according to three basic models of Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) (24). For today's e-accounting applications, integrated systems and web-based cloud information technology are used (25). E-Document and e-Ledger applications in Turkey are cloud-based. However, compliant software should be used for the applications, such as LUCA. LUCA Oracle (the first Internet-based central accounting system in Turkey), developed by TÜRMOB and Meteksan Systems for its members through collaboration with Oracle technology at the beginning of 2007, is the first successful application of the "Providing Software as a Service" model of the "Cloud Architecture" technology in Turkey and received the "Award for the Most Successful Solution Project for European Union Participation Countries" (26). Furthermore, in October 2013, at the Euro Cloud Congress and Award Ceremony held in Luxembourg, it was recognized as "Turkey's Best Cloud Service Product" among two countries and received the Logo Software award in the category of "Cloud Service Customer Category" with Netsis Software (27). Netsis, based in Izmir in Turkey, became the first compatible software approved by the RA for e-Invoice integration solution (28). Then these two companies (Netsis & Logo) have merged. Through the

flexibility provided in the hardware and software infrastructure of another example "uyumsoft", enterprises are Industry 4.0 focused. Another software company in our country, Uyumsoft AŞ, received the "Digital Innovation" award at the 5th Green Economy Awards ceremony organized by the New Initiatives Initiative Platform Association on 20.03.2019 for its efforts on the contribution of digitalization to environment. (29). The concept of the IoT, used to define that the Internet is dependent on the data entry by people into the computers, was firstly used by Ashton in 1999 in a company presentation (30) The unaudited data received from the operations are collected in the main hub through the help of fiber optic networks, in the form of a spider's web, the documents regarding the records are accessed through the system, the auditor attends to the inventory stock calculation of the customer's company as an observer from his own company with the help of cameras and robots, and conducts the audit visually by monitoring records such as the placing of stocks on smart shelves in the depot (31).

Electronic financial statements and footnotes are specified in the electronic environment. According to new development in Turkey, as of 26th March 2019, the "Electronic Financial Reporting Project" was initiated under the auspices of the Public Observation Authority (POA) to process the independently audited financial statements in the computer environment and use them in financial analyses (32). Another new development in Turkey, on 2nd May 2019, the regulations on electronic transfer of certified councillorship certification reports were newly issued through the Internet tax unit system.

5. A Bibliometric Analysis on Industry 4.0 Focused E-Accounting and Turkish E-Accounting Applications

In this section of study, the previous studies conducted on Industry 4.0-focused e-Accounting Applications were firstly retrieved using the Web of Science (WOS) database using the keyword "e-Accounting" (all of years, Indexes: SCI-EXPANDED, ESCI, A&HCI, SSCI, CPCI-SSH, CPCI-S), and the obtained data set was bibliometrically analyzed using BibExcel software (See. Table 2).

Table 2. Clarivate Analytics Web of Science findings for "e-Accounting"

General Information	Findings
General	Total Publication: 7, H-Index: 2, average citations per item: 0,86, sum of times cited: 6
WOS categories	Record count three (42,857%) business and computer science information systems; record count two (28,571%) is computer science theory methods, education educational research, management; and record count one (14,256%) is business finance, computer science artificial intelligence, computer science hardware architecture, engineering electrical electronic (See. Fig.1)
Publication years	Record count one (14,286%) is 2015, 2014, 2012, 2011, 2010, 2009, 2008
Document types	All of them (100%) are "Proceedings paper"
Organizations-enhanced	Record count one (14,286%) is Bilecik Seyh Edebali University, Bogazici University, Bucharest University of Economic Studies, China Universtiy of Mining Technology, Idea Technology Solutions, Multimedia University, University of Vienna
Authors	Record count one (14,286%) is Guney A.; Ionescu B., Ionescu, I., Stanciu, A. Mihai, F., Tudoran, L.; Camei B., Bayar, S., Ulkar, M. G.; Mohammed S.; Dong R.Z.; Velmurugan, M.S., Sallehhuddin, A; Schaffhauser-Linzatti, M., Pernsteiner, S., Michalski-Karl, R., Hinterleitner, I.
Source Titles	Record count one (14,286%) is "Role of technology in accounting and e-accounting; From e-Accounting Towards Cloud Accounting in Romania"; "A Simple Auditing Mechanism for Financial Reports in e-Ledger Project"; "Analysis and Design of an Effective E-Accounting Information System (EEAIS)"; "On the Establishment of False E-accounting Certification System Based on Forensic Accounting"; "Mitigation Plans for Undermining Threats of Digital Accounting"; "e-Accounting at the University of Vienna - Developing Applicable e-Learning Tools for Large-Scale Accounting Classes"
Conference-Meeting Titles	Record count one (14,286%) is ERPA International Congress On Education (ERPA Congress, Jun 06-08, 2014: 852-855); Proceedings of the 7th International Conference Accounting And Management Information Systems (AMIS, Jun13-14 2012: 983-1004); 9th International Conference on Application of Information and Communication Technologies (AICT, Oct 14-16 2015: 244-248); Digital Information and Communication Technology and Its Applications (PT, Jun 21-23 2011: 75-82); Ninth Wuhan International

	Conference on E-Business, Vol. I-III (May 29-30 2010: 743-747); Creating Global Economies Through Innovation and Knowledge Management: Theory & Practice, Vol. 1-3 (Jun 29-30 2009: 1146-1157); 7th European Conference on E-Learning, Vol. 2 (Nov 6-7 2008: 123-127).
Countries	record count two (28,571%) is Turkey, one (14,286%) is Austria, Malaysia, Peoples R. China, Romania
Languages	All of them are English
Research Areas	Record count three (42,857%) is Business Economics; two (28,571%) is Computer Science; one (14,286%) is Education Educational Research, Engineering

Figure 1 shows WOS categories visualization (See Fig. 1).

Fig. 1: WOS Categories Visualization

In the study, the data obtained from WOS was cleared and the desired data were withdrawn from the data set via BibExcel. Since there are the same descriptive results from the data, this article is not included in the format. As a continuation of the study, social network analysis will be conducted with the use of VOS Viewer program for bibliotectic mapping.

Also working on the study published in Turkey for Turkey e-accounting practices were examined. For this purpose, TUBITAK ULAKBIM was used. In order to determine the place of Turkey's contribution to universal science and international publications ranking, TUBITAK ULAKBIM Cahit Arf Information Center within the bibliometric analysis work is carried out. In these studies is obtained in various fields such as cumulative; country comparisons, branch of science comparisons, contribution to world science, public and private sectors producing publications and international co-authorship and so on information. Since 2013, TR Directory journals by ULAKBİM have been recommended to Clarivate Analytics to be included in Clarivate Analytics WOS databases (33). In this context, made through ULAKBİM Discovery in the screening related to e-Accounting, two articles, which were written by us (as a gave reference), were reached. In addition to, made by TR Directory in the title of electronic accounting look for, it are generally one - two studies. This subject is usually discussed with used concepts (e-State applications, e-Commerce, e-Transformation and so on). Therefore, no statistical results were presented.

6. Conclusion

Today, with the use of three-dimensional printers, objects can be moved from one place to another place, and brain studies can be conducted through artificial intelligence, big data analysis, virtual reality, simulation, and data mining. To simplify, the daily use of smartphones to robots, and dark factories accordingly are inside our lives anymore. As a result of these, an assurance was provided to be reached through legal regulations on "Protection of Personal Data" in Turkey. In undergraduate and graduate courses in Turkish universities, there is increasing awareness of these e-Applications with the use of modernist and innovative technologies.

The extended e-State Applications of RA for Turkey, within the context of the interactive tax department, Internet tax department, and e-Operations, together with e-Invoices, e-Dispatch, e-Archives, e-SEV, e-PR, e-Tickets, e-Ledgers and e-LDS, e-Declarations, e-Prepared Declaration System, and e-Notice Services have rapidly started to be used. This study addressed and analyzed Industry 4.0-focused Turkish e-Accounting applications. In addition, it was seen in the WOS and TUBITAK ULAKBIM database that few studies have been conducted in this area in Turkey and no bibliometric analyses have been done. Studies regarding this issue have been initiated in recent years. It is considered that the study subject is nascent in bibliometric analysis and it is expected that this study will constitute an example for future studies and contribute to the literature.

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