Transformation To Sustainability of The Logistics Sector with Industry 4.0 Technologies: A Content Analysis

Lojistik Sektörünün Endüstri 4.0 Teknolojileriyle Sürdürülebilirlik için Dönüşümü: Bir İçerik Analizi

Deniz TÜZÜN
Canan MADRAN

Introduction and Purpose of Study

With the increasing global awareness, many companies are transforming towards sustainability with Industry 4.0 technologies. The purpose of this study is to investigate whether businesses in Turkey transform their activities in line with sustainable development goals with industry 4.0 technologies. The study was organized by creating the following research questions within the expectations of the research. 1) Is sustainability concerned when performing the activities of logistic companies operating in Turkey? 2) In what scope do the logistics companies address the Sustainable Development Goals? 3) Do logistics companies use Industry 4.0 technologies in logistic processes while achieving their sustainable development goals? Considering the literature, the number of studies examining the intersection of sustainability and Industry 4.0 issues is quite limited. This study is important in terms of revealing the interaction of the logistics sector in Turkey with Industry 4.0 technologies for sustainable development.

Literature Analysis (Conceptual / theoretical framework)

When the literature on the subject is examined, it is seen that both sustainability and Industry 4.0 issues are given wide coverage. In this study, the intersection of both subjects in the logistics sector has been examined. About the subject, Abrahamsson (2011,) stated in his study, that the use of innovative technologies is effective in the increase of the importance of logistics within the scope of sustainable competition. Wang et al. (2015), stated in their studies, that the concept of Industry 4.0 includes transformations that will develop solutions to resource consumption problems in order to improve sustainable development by controlling all processes in the supply chain. Kayıkçı (2018), highlights the benefits of digitizing supply chain processes and examines the impact of digitization in logistics on sustainability in her study. Her study is conducted as a case study between FMCG companies and their transport service providers in Turkey and is based on a qualitative method and linked semi-structured interviews. García-Arca et al. (2020), focused their research on redesigning packaging for sustainable logistics. While designing, they highlighted the importance of the choice of relevant technologies (like shipping and storage information on RFID tags) in logistics for sustainable packaging. Demir and Cicibaş (2017), comparing Industry 4.0 technologies with Industry 5.0 in terms of sustainable development, stated that the scope of Industry 5.0 also includes different visions such as human-machine cooperation and bioeconomy. In another study by Bai and Sarkis (2020), it was

1 Dokuz Eylül Üniversitesi, deniz.f.sen@gmail.com
2 Dokuz Eylül Üniversitesi, canan.madran@deu.edu.tr
emphasized that for Industry 4.0 technologies to progress in parallel with sustainable development, technologies should be considered and evaluated more with this perspective.

The issue of sustainability, which was addressed only with the environmental dimension in the past years, is now examined with a more holistic perspective, including the economic and social dimensions. At this point, the efforts of enterprises to reach sustainable development goals by addressing environmental, social and economic dimensions are very valuable. Industry 4.0 technologies, which we have heard frequently recently, include technologies that businesses include in their transformations in line with their sustainable development goals. While conducting the research, the logistics sector, which is thought to have an impact on sustainability in all processes, was chosen as an example. For this reason, examining these two issues, which are important on a global basis, through the example of the logistics sector will fill this gap in the field. In addition, the study can provide an enlightening perspective by guiding the transformation that businesses will make in order to compete in the international market and add value to the supply chain processes for sustainable development.

**Design and Method**

Many studies are carried out on a global scale to solve environmental problems of the Planet Earth. The "Sustainable Development Goals", which are created by the United Nations, offer businesses a roadmap for sustainable development. By the enlargement to 17 Sustainable Development Goals, the scope of the sustainability included not only environmental, but also economic and social dimensions. Thus, when it comes to sustainability of the earth ecosystems and civilization, all environmental, economic and social efforts of enterprises in general become extremely important. Since the activities of the enterprises directly affect the economic development of the countries, the sustainability understanding they adopt and the transformations in this direction will cause both economic, social and environmental effects for the countries. Industry 4.0 technologies play a major role in the transformation adopted by businesses to achieve more efficient processes. With technological transformation, more efficient processes are aimed, while the effect of these technologies, transformation need, and firm’s understanding of sustainability has been a matter of curiosity. In this thesis, it is aimed to explore the extent of transformation experience with Industry 4.0 technologies and their relationship with the sustainable development goals achieved in various processes such as warehousing, inventory management, packaging and transportation of logistics companies operating in Turkey.

While designing the research, to form the basis of the 3-part theoretical text, which includes Sustainable Development, Industrial Revolutions and Logistics, it is explained through an in-depth literature review and examples from the industry. In the implementation made in the last part of the study, content analysis method was used to investigate the existence and scope of Industry 4.0 technologies in the sustainability studies of companies in the logistics sector. The design used in this study is exploratory and descriptive research. The reason for choosing the exploratory research type in this study is that the research subject is new and there are not many publications in the literature on the reflection of the relationship between sustainability and Industry 4.0 technologies in the logistics sector. With this research, exploratory research type was preferred as it was aimed to discover this faint connection and gain a more concrete quality. It is also a descriptive study because of the general description of the situation.
In the study, 20 companies which is international and local logistics companies operating in Turkey were selected as the sample. International companies are determined by looking at the top 20 countries in the Logistics Performance Index. Local companies were selected from companies in the UTIKAD list. Documents of 9 international companies and 3 local companies have been accessed from the Sustainable Global Reporting database. For the remaining 8 local companies, it was first checked whether they published a sustainability report or not. If the report was not published or if there are few reports, the press releases, news and sustainability pages on the websites were scanned and the relevant documents were selected. 141 documents and 7532 pages in total were examined as data. In order to analyze the documents, appropriate categories were created according to the subjects. Certain codes have been determined for each category created. The obtained documents were uploaded to the ATLAS.ti program and analyzed according to the codes and categories created, and the results were obtained. Thus, it was aimed to reach the findings by making a qualitative analysis within the scope of the research subject.

**Findings and Discussion**

The findings obtained in the ATLAS.ti program are shown more concretely with the diagrams below.
Figure 1: Goal 9 "Industry, Innovation and Infrastructure" & "Industry 4.0 Technologies"

- Industry, innovation and innovation are used extensively and these are the most common use codes with technology codes.
- The total number of matches of codes with "technology, digital transformation and smart technologies" codes is 529.
- Matching codes with Industry 4.0 technologies is 85 in total.

Figure 2: Goal 12 "Responsible Consumption and Production" & "Industry 4.0 Technologies"

Source: Created by the author with the program ATLAS.ti
• It is noteworthy that concept of renewable energy has been used quite frequently, while concept of fossil fuels is used less frequently.
• The total number of matches of the codes with the "technology, digital transformation and smart technologies" codes is 220.
• The matching of the codes with the Industry 4.0 technologies themselves is 38 in all codes.
• RFID technology has been found to match more than others.

**Figure 3:** Goal 13 "Climate Action" & "Industry 4.0 Technologies"

Source: Created by the author with the program ATLAS.ti

• In firm publications, the concepts of climate change, carbon emission and footprint are used more to describe climate action.
• There is less matching with the zero waste code. Firms use this aim less in their discourse.
• The total number of matches of the codes with the "technology, digital transformation and smart technologies" codes is 127 in total.
• The matching of the codes with the Industry 4.0 technologies themselves is 38 in all codes.
• It has been observed that RFID technology is matched more densely than others.
• There was no match with the Industry 4.0 code.
It is interesting that transport matches little with the code of "autonomous vehicles".
There is an intense match with the RFID code (17 matches).
The total matching with the "technology, smart technologies and digital transformation" codes is 251.
The number of matches of Industry 4.0 technologies with their names is 80 in total.
The total number of matches between the sustainability code and "technology, smart technologies and digital transformation" codes is 152.

- It can be said that RFID technology has a more intense match with 18 matches.
- The number of Industry 4.0 code and sustainability matches are only 2.

**Figure 6: "Sustainability" & "Climate Action Codes"**

Source: Created by the author with the program ATLAS.ti

- Sustainability matches most with climate change, carbon emission and footprint codes.
- Although the sector has started to use new concepts in the field of "climate action", the discourse of zero waste is very low.

**Conclusion**

Businesses around the world have great responsibilities in order to solve global problems in line with the 17 Sustainable Development Goals determined by the UN. Businesses that have a certain impact on the emergence of problems in many goals are trying to transform in order to solve these economic, ecologic and social problems. This transformation focuses on improvements and efficiency in all processes of companies. With its many processes, the logistics sector has a direct impact on sustainability issues. For this reason, the logistics sector must transform in line with the 17 goals discussed. It is inevitable to use today's Industry 4.0 technologies for transformation to occur. Businesses now aim to increase their efficiency by optimizing these technologies in many processes. Today the main aim of the Industry 4.0 technologies has to be providing efficiency in the operations and more important than this, to change the direction of the performance to for the sustainability of all type of companies.

In the international market, it is very important for companies to share their performance with customers and stakeholders in a transparent manner. In this sense, it is very important for businesses to publish sustainability reports in terms of protecting their brand values in the international market, improving business reputation, and transparently revealing the performances of the enterprises. While collecting data for the study, it was observed that many large local companies in the logistics industry did not publish their sustainability reports, unfortunately. 7 out of 20 selected companies which are local companies within this research do not have a sustainability report. Therefore, businesses should be encouraged to publish
sustainability reports. In terms of reporting, international companies operating in Turkey provide good leadership to local companies.

As a general result, it can be defined that there is a weak but clear discourse about connection of Industry 4.0 technologies and sustainable development goals in Turkish logistics industry. However, the analysis results showed that concept of "technology" is always used in publications for all kinds of applications in companies. Also, RFID technology has also been found to match more than others. The reason for this can be interpreted as the more cost-oriented efficiency of RFID technologies in warehouse and inventory management. Businesses are still at the beginning level in the use of Industry 4.0 technologies on the road to sustainability. The use of Industry 4.0 technologies in the logistics sector has not yet reached the maturity level, so the effect of Industry 4.0 technologies on sustainable development goals is still quite weak. Nevertheless, use of concepts of smart technologies and digital transformation in the industry's discourse indicates that there is a development in this long way sustainability.

Considering the recommendations regarding the study, more research is needed in order to examine the intersection of two globally important issues in more detail and to reveal their examples in different fields. Sectoral studies to address the issue from different angles may be more enlightening for the relevant sectors. In addition, quantitative research methods can be used in addition to content analysis in the application part, and more concrete results can be achieved.