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RESEARCH ARTICLE

Lean Management's Effect on Industry 4.0 Regarding Innovation

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Abstract

This study intends to investigate the relationship between lean management, Industry 4.0, and innovation perceptions in employees of companies in Turkey's general tourism sector and to determine whether these perceptions have an impact on how lean management influences perceptions of Industry 4.0. Businesses are compelled to participate in innovation activities due to the fourth industrial revolution, or industry 4.0, which is characterised by the rapid advancement and change of technology. On the other hand, there is a dearth of empirical research on the impact of lean management practises in enterprises on innovation and industry 4.0. Thus, by examining the connection between lean management, industry 4.0, and the innovation process as well as the impact of lean management on these three elements, the study seeks to advance the area.

The sample consists of 527 employees in employment in the tourism sector (hotels, agencies). Surveys were used to gather data, which structural equivalency modelling was used to assess. According to the study's findings, lean management has a favourable impact on innovation and industry 4.0. Another finding is that innovation affects Industry 4.0. The emergence of new and creative ideas in businesses will lead to the creation or development of advanced production technologies. The principal discovery of the study indicates that innovation functions as a mediator in the correlation between industry 4.0 and lean management.

Keywords: Lean Management, Innovation, Industry 4.0, Tourism businesses

Introduction

At the beginning of the twentieth century, scientific management ideas began to emerge in management principles and practices, and a discipline was formed under the name of the scientific management movement. Indeed, all systematic and scientific knowledge on the subject of this discipline has been systematised into theories and has entered the scientific maturation process since the middle of the twentieth century. The most prominent subject here was Frederick W. Taylor.

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Taylor asked three fundamental questions while theorising scientific management thought. The first is where the principles of scientific management differ from other classical understandings. Second is why and how better results will be achieved in scientific management than others. The third question Taylor asked is whether getting the right person to head the company is the most important issue or not. He stated that he developed the Taylor theory to find answers to these questions (Taylor, 1985). The Scientific Management Theory, which started the first studies on business, emerged at this stage.

The supporters of the theory believed that it was possible to conduct business management according to scientific principles, and in this process, under the leadership of Taylor, they suggested that management should be a discipline with clearly defined and unchanging principles instead of relying on vague ideas (Örnek, 1991).

In today's competitive conditions, lean management plays a significant role in establishing a sustainable advantage from the rational outputs of any production tool or technique. It is crucial for businesses that use high-cost production systems and need solutions to the crises in existing markets. Lean management techniques are typically built on eliminating all business endeavours that do not add value to the market for rival competitors' actions.

Meanwhile, the business and related service-production activities are handled holistically. Another issue that should be considered here is that employees' physical and intellectual contributions to service quality must be at the core of lean management.

Like lean management, innovation is one of the basic concepts that should increase service quality. The twenty-first century is still feeling the effects of the industrial revolution. Previously, businesses were conducted with economies of scale and high production volumes, which provided severe competitive advantages. However, today, the situation has begun to change with the emphasis for low cost, high quality, and convenience. Historically, these conceptual changes, encountered in the 1970s and 1980s, first emphasised low cost but later revealed that quality was more important for competition. In addition, the interaction gained momentum with the quick shift in the industries' competitive landscape, the significance of economic-based sustainability, and the prominence of environmentally friendly initiatives and activities.

Therefore, the intensity of the production processes in question, with the impact of changing importance levels of the concepts of low cost, high volume of production and quality, and from another point of view, the approaches such as the contingency approach, total quality management, and learning organisations, has been at the centre of the studies that will contribute to the creation of innovation, along with the novelties and thoughts formed within the extent of Industry 4.0, a significant process of change.

Tourism has continued to increase over the past 60 years, making it one of the biggest and fastest-growing industries in the world; it is expected that there would be more than 1.8 billion foreign visitors worldwide by 2030. (UNWTO, 2017). Numerous development opportunities are available to heterogeneous tourism-related enterprises, such as tour operators, intermediaries, transfer firms, lodging facilities, and dining establishments. However, as technology advances, social, economic, political, and environmental issues will all have a significant impact on their future. One trend that undoubtedly has a big influence and being relevant in the growth of tourism is the advancement of technology. Industry 4.0's adoption of cutting-edge technology is well known for its disruptive power, affecting various industries, including travel and tourism. (Korže, 2019).

With the development of technology, like many other industries, tourism has seen a rise in the use of e-applications. The fourth industrial revolution, or Industry 4.0, is what we are currently experiencing, which has completely transformed numerous industries due to the automation, electrification, computerisation, and digitalisation of tasks (Kagermann et al., 2013). During the fourth industrial revolution, or Industry 4.0, the innovations that create added value in the tourism sector have become more critical than ever (Imanovic et al., 2016). Due to the significant contribution the tourist industry makes to the growth of national economies, the transition to the digitalisation era is essential for the sector to support the economics of the nation. Additionally, regularly monitoring and adjusting to the digitisation processes is how tourism organisations can outperform their rivals in terms of performance (Okatan & Yıldırım, 2021). Again, the effective use of technological opportunities is an important issue regarding giving tourists the possible service. As a result, using digital tools in tourism with the advancement of technology can be quite beneficial for travel agencies (Dülgaroğlu, 2021).

Every sector has some critical strategic factors ensuring its growth and sustainable development. The most important variables in the fiercely competitive tourism industry are innovation and the creation of new services. Companies in the service industry are compelled to innovate by changes and transformations, and innovation is essential to raising the calibre of services, particularly in the travel and tourism sector (Işık et al., 2019). The tourist industry is a large segment within the service sector, which is significantly affected by innovation activities. With the increase in competition, the essential way for a service industry to offer a long-term edge over competitors is to make a difference with innovation in its products or services. Therefore, tourism businesses that perform innovation activities will be able to create customer satisfaction, improve their company's performance and acquire a long-lasting competitive edge. Studies on applying lean management in many industries, including construction and health, occupy a notable place in the literature. However, there is no study focusing on the tourism sector. Therefore, addressing the applicability of lean management in the tourism sector will close a gap in the literature about its effects on production.

This research's objective is to investigate the connection between Industry 4.0, lean management and innovation perceptions in the employees of businesses operating in the tourism sector in Turkey (hotels, agencies) and to reveal whether their innovation perceptions affect the effect of understanding Industry 4.0 through lean management. In this regard, it is intended to make a literary contribution by revealing employees' perceptions or awareness. The staff members were given a questionnaire for this reason. The current economy and production dynamics were considered in the subject selection; the modern methods seen as the requirements of the businesses, and the meaning areas formed for interaction were examined and defined for tourism businesses.

In the article, lean management, innovation and industry 4.0 were discussed conceptually, studies in the literature dealing with the relationship between these concepts were included, research data were collected, and the necessary analyses were made and reported. Then, the results were discussed, and the study was completed with a general evaluation and conclusion, which suggested more comprehensive future studies.

Lean Management

John Krafcik, an MIT researcher, used the concept of "lean" in 1988. He is the first engineer to be employed by the NUMMI automotive company, a partnership between the Japanese auto manufacturer Toyota and the American auto manufacturer GM. "Lean Management" is stated as "Toyota Production System" (TPS). In the beginning, "TPS" and later "Lean Administration" started to attract the attention of academia and the business world as a production and management methodology. TPS was also viewed as the driving force in industrial development in general and the creation of the Japanese miracle specifically in the growth of the automotive sector. This understanding of administration is thus also referred to as the "Japanese Administrative System".

Lean Thinking is an approach established to determine the added value, sequence the actions that will create value to achieve the best result, implement them instantly when requested, and perform the tasks more efficiently and effectively. In short, lean thinking means simplicity. The essence of this simplicity is the minimisation of human labour. On the other hand, lean management achieves the maximum return after this minimisation. This way becomes more effective in meeting customer demands (Womack & Jones, 2003). Lean management is a production theory that focuses on the timely delivery of the best quality product to the consumer and its production at the lowest cost.

Today, many businesses are trying to develop various improvement methods. Many effective techniques have been tried, including six sigma, kaizen, and total quality management. Although these methods are successful when they fit the setup of the businesses, many busi-

nesses cannot benefit from them. Lean management is mentioned worldwide for the first time in Womack and Jones' "The Machine That Changed The World". During promotional trips for the book, they encountered many companies eager to implement lean manufacturing, raising the question, "how do we do lean manufacturing?". The primary rule is to eliminate the waste completely and let the customer make all definitions (Womack & Jones, 2003).

Since the 1990s, the use of lean methods and the literature have been developing. Lean management has been successfully implemented in industries to increase service quality while maximising production and efficiency. Although the concept of lean has become synonymous with large companies, mass production and the automotive industry, it has also started to gain an important place in small and medium-sized businesses, or SMEs and the service sector. Numerous industries apply lean management, including healthcare, instruction, construction, maintenance, insurance and financial services, product development, IT-supported services, airlines, food and beverage services, logistics services, and public services, and continues to grow within the service industry (Cuatrecasas, 2004; Gupta et al., 2016; Perdomo-Verdecia et al., 2022).

"Lean management is a management type established for the realisation of lean manufacturing, where the delegation of authority is increased, everyone is responsible for their work, and zero hierarchy is targeted" (Tikici et al., 2006).

The objectives of lean management are to reduce costs by preventing waste and using the workforce most efficiently. Human resources act as the building block in the operation of processes and are not seen as a cost area. In this context, the way to prevent waste and ensure that processes operate at the highest level is to create cooperation and include human resources in the processes (Engelund et al., 2009).

There is more than one definition for lean manufacturing and lean management. Lean manufacturing is all systems and techniques that adopt the vision of optimising the offered value by eliminating waste and simplifying the product and service creation phase, and eventually increasing the profitability of the company (Sığırcı, 2001).

One method that emerged because of lean thinking is called lean management. Value, excellence, and value streams are all part of lean thinking (Deran & Beller, 2014). Therefore, lean management can be described as a management style that is closely related to the following principles:

1. *Principle of flow:* A simple transformation can be described as a journey involving two large movements. The first of these movements is to create flow, and the second is to create pull. The first focus should be on creating flow, and as with all important journeys, having a checklist is thought to help ensure that the organisation does not stray (Byrne, 2015).

2. *Value principle:* The starting points of lean thinking are values. Manufacturers create these values and customers can define them. The producer who created the values cannot always define them correctly. For example, they think that American firms create value in the short run through competition tactics and profit transfers from the supplier at the head of the chain. German companies with strong technical equipment define values in relation to the technical complexity of their products and technologies. In Japan, the issue of where values are created is important. Value is being able to reconsider from the standpoint of the client. For value to have meaning, it must be expressed regarding a good or service that can fulfil the requirements of clients in a certain time and at a certain price (Warnecke & Hüser, 1995).

3. *Value stream principle*: The next stage of lean thinking is to ensure that the value-creating stages are in flux. To be more precise, it involves redefining the roles of functions, departments and firms in a manner that favourably influences the development of value for businesses. Although this idea contradicts the departmentalised accumulation mentality, which is generally accepted as true in our minds, it states that by working on a workpiece from raw material to final product, tasks can be performed much more accurately and efficiently. In short, it can be seen that things get a lot better when the focus is on the product and what the product requires, instead of the organisation or equipment, so that the activities required for the design, order and manufacturing stages take place in a continuous flow (Sığırcı, 2001).

4. *Pull principle:* Another principle of lean thinking is the concept of "pull". In its most general definition, pulling means that no product or service is produced in the previous processes without the request of the customer in the next processes. The best way to grasp the basic logic of pull thinking is to start with the customer's demand for a particular product and look back through the entire process from the product to the customer's arrival (Düren, 2002).

5. *Principle of excellence:* It becomes increasingly entrenched in the minds of those involved in the business that there is no end to the time, effort, place, error reduction and cost reduction process at the stage of offering a product that is very close to their customers' demands. Perhaps the best promoter of excellence is transparency. The first step in this lean method is the fact that suppliers, subcontractors, system integrators, distributors, employees and customers, in short, everyone can see everything. For this reason, it becomes easier to find healthier ways to create value, and there is very positive and instant feedback for the employees who make the improvement. As stated in this section, lean is the key point of the business and a strong supporter of efforts to improve (Çanakçıoğlu, 2019).

Additionally, even if Lean Management is best for standardised processes, businesses are increasingly being forced to adopt more adaptable strategies to fulfil the expectations of the clients (Handscomb et al., 2020). Thus, agile management should also be considered in addition to lean administration. In addition, whether or not the industry determines how much money can be saved by applying lean concepts. An analysis of a case study that appeared in the International Journal of Production & Operations Management (Lewis, 2000) specifically shed light on this issue.

Innovation

The concept of innovation has recently become a concept that attract the attention of researchers in various fields. In general, innovation is a progressive act of distinctive goods and services that add value to companies in an intensely competitive environment by developing new ideas. With the developing new conditions in the changing competitive environment, consumers tend to turn to new style products and services that are beyond the ordinary, that are developed formally, that bring constant added value, and that are revealed with their visuals.

Consumers show these needs and orientations in a fast and rapid transformation line. In such a challenging and extremely competitive environment, all companies, whether large or small, can maintain their competitiveness by innovating in their products or services and thus survive. For this reason, companies today can only meet the rapidly developing needs of consumers through innovation and manage the conditions of competition in their own direction. Accordingly, the innovation referred to as "innovation" not only does something new, advanced, harmonious and different, but also opens a new way that can create economic value for the benefit of the company (Işık & Keskin, 2013).

According to Schumpeter (1961), innovation means novelty in the basic sense. In this period, innovation was generally expressed as "the series of works that offer practical solutions to the needs and that can be used commercially and accepted as a novelty". Schumpeter described innovation as inventing a new production technique, producing a new product, or enhancing the quality of an already-existing one.

According to Myers & Marquis (1969), innovation is more than just a method, a fresh concept, an invention, tool, or result; it is the whole process consisting of many sub-processes.

In its broadest sense, innovation is the combination of creativity and practice (Lyons et al., 2007). Therefore, innovation is the use of a creative idea commercially. In this sense, it starts from the first stage and reaches the consumer at the end.

According to Kucmarski (1996), most today's managers see innovation as an essential tool for increasing incomes. On the other hand, the managers' tendency to consider innova-

tion as a fundamental business strategy has not increased. All managers must see innovation as a powerful determinant that increases competitiveness in building their strategy. Freeman and Soete (1997) suggest that businesses can draw a path by using the opportunities and alternatives specific to their companies while determining their strategies. For example, short, medium, and long-term strategies can be set; these companies can merge with other companies or switch to different markets with different products and methods. Because of all these different actions, they may encounter significant risks and dangers, especially in technology, materials, and chemistry. The majority of those who fail to manage these processes will not survive. They will face the necessity of re-entering the innovation cycle and have to manage it. This is because their competitors will lower product costs using the innovation cycle and will seize the market earlier. Therefore, they will realise they cannot move forward without implementing an agile, defensive or imitative innovation strategy.

According to the Oslo Manual, one of the first documents that come to mind for inventiveness, "An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practises, workplace organisation or external relations" (Oslo Manual, 2005).

The Innovation Support Guide prepared by the Turkish Chamber of Commerce and Exchanges (TOBB) defines innovation as "transforming an idea into a sellable product or service, a new or improved manufacturing or distribution management, or a new social service method".

In addition, Çavuş and Akgemci (2008) draw attention to establishing a team and ensuring the participation of employees with a system that will make it easier to understand technological, social, and local changes to turn innovation into a fundamental skill.

Lean management and innovation approaches intersect within the body of businesses and organisations desiring to perform high-quality activities in the institutional sense. Employee-centred innovation management emphasises employees and their functional power and places considerable value on them; it agrees with the lean management approach. Accordingly, the strategy of creating a working environment that appeals to employees' physical and mental health in lean management is a significant management move towards more qualified activities. The steps realised to improve the operational performance and psychological state of the employees in line with the idea of innovation bring the two management approaches closer.

Industry 4.0

In the past decade, information and communication technologies (ICT) have become more prevalent, and a radical transformation has been witnessed in daily life. The size of computers

is decreasing and they are disappearing into almost all technical devices. Primarily, items converse via the Internet or World Wide Web. This tendency has spread to the industrial sector as well, which stands to gain more from the developments in computer science and ICT.

This movement is known as the "4th Industrial Revolution," or Industry 4.0, in Germany (Kagermann et al., 2013). Shorter product life cycles are closely linked to highly personalised goods and the development of modern factories into "smart factories," which aim to solve and defeat the difficulties posed by the current intense global competition (Weyer et al., 2015).

Industry 4.0 refers to the Fourth Industrial Revolution. It is acknowledged as the next development after the outsourcing boom of the 1990s and the lean revolution of the 1970s, and the digitisation of the manufacturing industry with mechanisation systems in the early 2000s (Uy & Rabo, 2019). The concept of "Industrie 4.0" originates from Germany's digitalisation programme aimed at boosting the manufacturing sector's competitiveness (Ghobakhloo et al., 2021). The idea of Industry 4.0 first surfaced in 2011 at a trade show in Hannover, Germany and brought a wave of development to the industry (Nascimento et al., 2021). It has received tremendous attention in academia since its publication in 2011. Many scientific advances have greatly enhanced our knowledge and comprehension of the Industry 4.0 phenomenon (Ghobakhloo et al., 2021. The goal of Industry 4.0 in Germany was to develop these systems through collaboration between universities and commercial businesses, with funding for research and development coming from the government (Zengin et al., 2021).

The Industrial Revolution is described as the transformation that took place between the end of the eighteenth century and the mid-1800s, in which small-scale workshops were transformed into industrial workshops carrying out large-scale production. It is also expressed as the technological change that allowed the workforce to turn into machines (Frederick, 2016). It is believed that Industry 4.0 marks the start of the fourth industrial revolution and displays the most recent automation technology trend that is becoming increasingly common in the manufacturing sectors (Sony, 2018). Every unit involved in manufacturing, whether directly or indirectly, is planned to work together, and information technologies and digital data software operate together in a cohesive way. (Schuh et al., 2014). Industry 4.0 designates the industrial sectors as having entered the fourth industrial revolution. This new revolution shows itself as an increase in digitisation and diversification and the association between the products, value chains, and business models (Banger, 2017).

As Industry 4.0 provides information about the developments related to future factories, it is seen as an intelligent technological system with a dramatic impact on the industrial sector; and it is the subject of much research (Pereira & Romero, 2017). Industry 4.0 has become a really interesting technology to achieve efficient, accurate, and precise business outcomes (Rajput & Singh, 2019). Meanwhile, Industry 4.0 technologies have created advantages such as higher flexibility, shortening delivery times, and adaptation to customer demands with

small batch sizes (Wang & Wang, 2016). The fundamental feature of Industry 4.0 is that it includes automatically self-configuring and self-optimising systems that allow more agile and low-cost operations in production (Asdecker & Felch, 2018).

In summary, the fourth industrial revolution idea, or Industry 4.0, significantly affects the country's economy, business world, society, and environment. The effects of Industry 4.0 and advancements in technology on companies operating in various sectors are increasing day after day. Industry 4.0 is a new process with many components, including cyber-physical systems, artificial intelligence, analytics, cloud technology, the objects with internet, and intelligent factory. It is predicated on the cooperation of humans with machines, thus aiming to bring customer-specific products to the market faster and more flexibly. In other words, companies are increasingly moving with the idea of Industry 4.0 as a crucial tactic for surviving in a cutthroat market.

Literature Research

Lean Management and Tourism

Today, lean management continues to evolve and is implemented in numerous service industries, including food, finance, and transportation, and mostly occurs within public services (Hadid & Mansouri, 2014; Leite & Vierira, 2015; Gupta et al., 2016; Narayanamurthy & Gurumurthy, 2016). Lean management (Vlachos & Bogdanovic, 2013; Farrington et al., 2018; Perdomo-Verdecia et al., 2022) practices have become priority issues in the tourism sector literature, and the number of studies needed is increasing. Below is a summary of a few few studies that have been done on the topic in the literature:

Vlachos and Bogdanovic (2013) looked into how lean thinking could be used in European hotel companies. With the dearth of lean practice literature in the hotel business, this study might be regarded as a crucial resource. The study claims that one can use the "Five Step Model" as a management tool to reduce waste and boost customer value. The underlying premise of the model is that there are five sequential sequences of actions from Value to Excellence.

Al-Aomar and Hussain (2019) developed a methodology for recognising, classifying, and prioritising lean approaches applied in a hotel supply chain. In order to characterise the lean techniques used in the United Arab Emirates' four- and five-star hotels, they gathered information using a questionnaire. Six primary lean application categories and 19 particular lean methods pertaining to a hotel supply chain were identified by the study. JIT, Kaizen, Quality, Inventory, Maintenance, and Standardisation are examples of the defined categories. The study's findings indicate that, of the lean application categories that were found, JIT and Kaizen have the highest priority. In addition, prompt customer service, an efficient enhancement

framework, and supplier delivery on schedule are the three lean approaches that are most appropriate for a hotel supply chain.

In their study on hotel lean management, "Where we are and where can we go?" Perdomo-Verdecia et al. (2022) attempted to provide answers to these queries. There were only 36 references retrieved, indicating the dearth of studies conducted in this field. With the popularity of VSM and 5S applications, the adoption of lean management solutions in hotels appears to be quite limited. The reference study unequivocally demonstrated the necessity for considerably more research on specific practices—some of which are underreported—in many hotel operations.

Innovation and Tourism

Innovation is a means to competitiveness, environmental sustainability, and economic success. Therefore, tourism-related firms should always be innovating. Furthermore, given how quickly rivals imitate winning concepts, innovation in the tourist industry is crucial to giving destinations a long-term competitive edge over rivals. As a result, competitors should find it difficult to embrace advances (Giotis & Papadionysiou, 2022).

The innovation theory of Schumpeter provides a basis for the literature on tourism and innovation (Alsos et al., 2014). The study, finding, creation, promotion, approval, and commercialisation of novel goods, systems, organisational configurations, and practices are all considered forms of innovation, according to the notion. This strategy is recognised as a widely acknowledged strategy for all other service sectors and the tourism industry (Hjalager, 2002; Nordin, 2003). Below is a summary of a few studies that address innovation in tourism and the connection between innovation and tourism in the literature:

Topsakal et al. (2018) used a questionnaire to gather information on how small and medium-sized tourism enterprises are embracing innovation ideas in Antalya (Kaleiçi), Turkey. The investigation's findings indicate that although small and medium-sized tourism enterprises want innovation to improve service quality, cost is the primary barrier to innovation.

Mendoza-Moheno et al.'s study from 2021 sought to pinpoint the social and technological frameworks that community-based tourism organisations use to sustain their socio-technical innovation system. The results of the study add to the discourse on stakeholder cooperation and offer an effective model of an organisation that satisfies social, environmental, and economic demands. The study's demonstration of the interaction between technical and social systems is one of its key contributions.

Giotis and Papadionysiou (2022) analyzed the empirical research to assess the influence that managerial and technological advances play in the tourism business. Within the context

of the fundamental role that tourism benefits from advances in technology and management, this paper tries to offer a thorough summary of the empirical studies conducted to look into these topics. The findings of a few studies showed that a company's ability to foster innovation is increased when it has a pleasant workplace with suitable personnel, a management style that is appropriate, and managers and employees who work together. Additionally, several management implications have been put up to help managers create effective strategies for companies operating in the tourism sector.

Industry 4.0 and Tourism

Every day, industry 4.0 developments have an increasing impact on the economy, finance, and commercial sectors. The industrial revolution has sped up the growth of the tourism industry. Consequently, the tourism industry is among those where Industry 4.0 technologies have a bigger pragmatic effect. Given the service-oriented nature of the tourist industry, it can be argued that Industry 4.0 advancements will significantly alter how people perceive travel.

There is not much research in the literature on the connection between Industry 4.0 and the travel and tourist industry. A few of these studies are outlined below:

To better understand the present circumstances and future prospects of service automation and robot adoption by travel, tourism, and hospitality-related businesses, Ivanov et al. (2017) carried out a study that included a description of the difficulties that these businesses will have while implementing these technologies to assist visitors.

Osei et al. (2020) planned to thoroughly evaluate the expectations of business 4.0 for the lodging and tourism business by conducting a scientific projection to uncover the expectations of the fourth industrial revolution for the hotel industry. Remarks about the expectations (good and bad) for the lodging industry were included in the study. The discussion concludes with the practical and societal ramifications.

In his research, Şengel (2021) outlined the historical progression of the relationship between contemporary tourism trends and the industrial revolution. The goal of this study was to ascertain how the industrial revolution affected contemporary tourist movements from the outset to the present. The research findings indicate that the industrialisation initiatives that sparked the industrial revolution have had a major influence on the development of contemporary tourism movements.

Chang et al. (2022) conducted a study on the adoption of the blockchain technology for tourism based on UTAUT and the connectivity theory. Their work highlights the potential of using social media (YouTube) to increase user knowledge and potential interest in the domestic travel industry, as well as providing an actual implementation of blockchain technology.

Method

In this section, we used SPSS and AMOS to analyse the data collected through the survey technique. In this context, the statistical methods and techniques used have been explained.

Purpose of the Study

This study aims to reveal the role of the innovation perceptions of employees in businesses operating in the tourism sector in Turkey (hotels, agencies and restaurants) on the effect of lean management perceptions on Industry 4.0 perceptions.

Method of the Study

This study is a quantitative research in which measurements can be repeated and objective, and various statistical methods are used (Elitaş, 2011).

Universe and Sample of the Study

The universe of the study consists of employees employed in the tourism sector in Turkey (hotels, agencies). According to TUIK data, around 34.334.000 people are in the workforce in Turkey (TUİK, 2022). If the size of the universe is 250,000 or more, the minimum sample size should be 384 (Gürbüz & Şahin, 2017). Therefore, the participation of 527 employees in the study provides a sufficient sample size.

Assumptions and Limitations of the Research

The scales used in the study have been qualified to explain the factors (lean management, innovation, industry 4.0) that are the subject of the analysis. Reliability and validity analyses were also performed in this study for scales that showed high reliability and validity in previous studies; the reliability of the measurement tools used was determined to be high. Therefore, it is assumed that the questionnaire reflects the current situation regarding the perceptions of lean management, industry 4.0, and innovation within the organisation.

The human element is the basis of the study, and the data includes evaluations of the employees. Therefore, the general limitations of social sciences research are also valid for this study. The reliability of the findings is limited to employees' evaluations and the characteristics of the survey technique used in data collection.

Data Collection Tools

As the adopted research and measurement method was based on numerical (quantitative) data, the survey technique was used for data collection. The questionnaire starts with 5 qu-

estions prepared to collect the employees' demographic information (gender, age, education level, marital status, and working time). In the first part of the questionnaire, the 24-item Lean Management Scale developed by Derin (2008) was used to measure the lean management perceptions of the employees. The second part of the questionnaire consists of an 8-item scale used by Arpacı (2019) to determine the innovation process. The third part includes a 6-item scale used by Zengin et al. (2021) to measure Industry 4.0. The scales used are of the Likert type.

Research Hypotheses and the Model

Because of the literature review above, the following hypotheses were developed (5.1., 5.2, 5.3.).

The hypotheses of the study are as follows:

H1: Lean management has a positive impact on industry 4.0.

H2: Lean management positively affects innovation.

H3: Innovation has a positive impact on industry 4.0.

H4: Innovation plays a mediating role in the effect of lean management on industry 4.0.

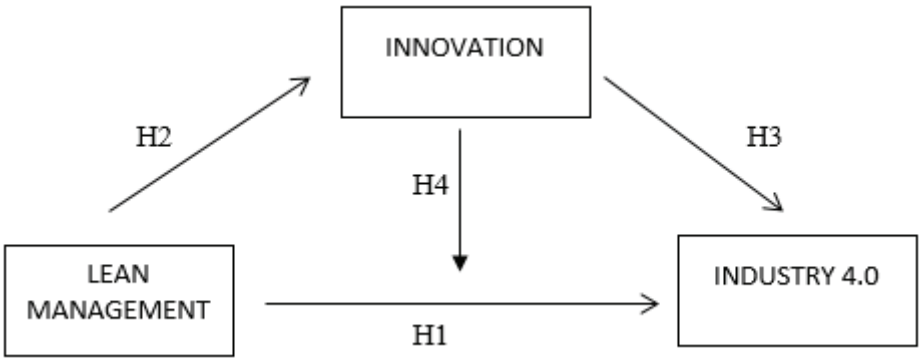

Figure 1. Research Model

Data Analysis

In this study, statistical package programmes were used to analyse the data. The significance level was taken as p = 0.05. First, the reliability and validity of the scales were tested. The reliability of the scales was calculated through internal consistency using Cronbach's alpha coefficients. Exploratory and confirmatory factor analyses were used to test the reliability and validity of the questionnaires. First, correlation analysis was employed to test the

hypotheses that form this study's basis and determine the relationship between lean management, industry 4.0, and innovation. In the study, the structural equation model was used to determine whether the variables were statistically significant. In this direction, the structural model was tested with the AMOS programme. The relationships between the variables were examined using goodness-of-fit statistics and hypotheses to test the model's validity. The bootstrap method was used to test the mediating roles between variables, and the 5-point Likert scale was used in this research. In the selection of the sample, a simple random method was used, which makes the chance of entering the sample equal for every employee in the phase.

Findings

The findings regarding the demographic information of the employees participating in the study are shown in Table 1.

Table 1
Demographic Information

Variable	Category	f	(%)
Gender	Female	156	29.6
	Male	371	70.4
Age	21-30-year-old	110	20.9
	31-40-year-old	206	39.1
	41-50-year-old	158	30.0
	51-year-old and more	53	10.1
Marital Status	Single	150	28.5
	Married	377	71.5
Education	Elementary-High School	33	6.3
	Associate's degree	89	16.9
	Bachelor's degree	252	47.8
	Postgraduate	153	29.0
Working Time in the Tourism Sector	1-5 years	223	42.3
	6-10 years	113	21.4
	11-15 years	80	15.2
	16-20 years	39	7.4
	20 years and more	72	13.7
Annual Income	4,000-6,000-TL	95	18.0
	6,001-8,000 TL	79	15.0
	8,001-10,000	117	22.2
	10,001 TL and more	236	44.8
Managerial Position	Yes	261	49.5
	No	266	50.5

First, an item analysis was conducted to test the reliability of the scales. The item-total correlation of all items was above 30, which is the cut-off point. Therefore, there was no need to remove any item from the scale in the first step (Çanakçı et al., 2019).

The second stage of the reliability and validity analysis was conducted to test the reliability and validity of the lean management, innovation, and industry 4.0 scales separately. For this purpose, exploratory factor analysis with Varimax rotation was performed using the principal component method.

Regarding the exploratory factor analysis results, the factor load of the Lean1, Lean6, Lean7, and Lean19 items in the lean management scale was below 0.40, and they were excluded from the analysis. KMO, which confirms the applicability of the descriptive factor analysis to the data, and the degree of sphericity (Barlett's Test of Sphericity), which show that significant factors can be obtained from the research data. The Cronbach alpha coefficients are displayed in the table below.

Table 2
Exploratory Factor Analysis Results

Variables	Dimensions	Scale Item	Factor Loads	Cronbach's Alpha		KMO	Barlett Test of Sphericity (p)
LEAN MANAGEMENT	Lean 1	Lean5	.791	.880	.963	.969	8341.357; p=0.000
		Lean4	.782				
		Lean9	.714				
		Lean3	.665				
		Lean2	.656				
		Lean8	.604				
	Lean 2	Lean20	.758	.956			
		Lean16	.733				
		Lean12	.731				
		Lean13	.715				
		Lean22	.708				
		Lean24	.706				
		Lean23	.704				
		Lean11	.703				
		Lean17	.686				
		Lean14	.671				
		Lean21	.667				
		Lean10	.661				
		Lean15	.655				
		Lean18	.574				
Eigenvalue: 7.492; Total Variance: 64.434							

Variables	Dimensions	Scale Item	Factor Loads	Cronbach's Alpha		KMO	Barlett Test of Sphericity (p)
INNOVATION	Innovation	Inno3	.879	.931	.931	0.922	3162.631; p=0.000
		Inno2	.862				
		Inno1	.858				
		Inno6	.826				
		Inno8	.818				
		Inno4	.815				
		Inno7	.771				
		Inno5	.741				
		Eigenvalue: 5.409; Total Variance: 67.612					
INDUSTRY 4.0	Industry 4.0	Ind_4_6	.902	.894	.894	.870	1896.388; p=0.000
		Ind_4_5	.864				
		Ind_4_4	.833				
		Ind_4_2	.784				
		Ind_4_3	.778				
		Ind_4_1	.697				
		Eigenvalue: 3.961; Total Variance: 66.018					

Confirmatory Factor Analysis for the Lean Management Scale

After the exploratory factor analysis, confirmatory factor analysis was performed using the AMOS package programme on the lean management scale. Regarding the item loads obtained from the regression model, all the regression items' loads were higher than 0.50. The analysis showed that the modifications between Lean4-Lean5, Lean10-Lean18, Lean11-Lean12, and Lean20-Lean21 would increase the chi-square and fit values.

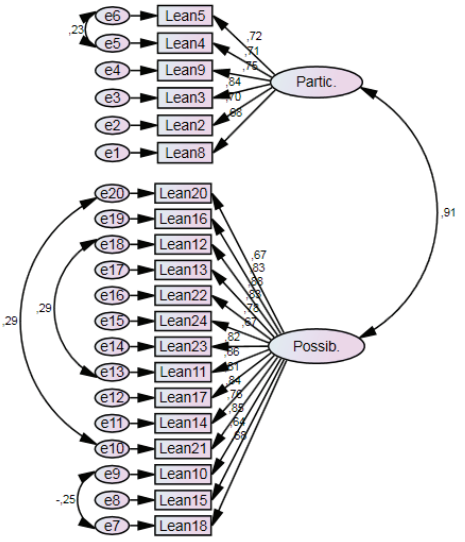

Figure 2. Modified Confirmatory Factor Analysis of the Lean Management Scale

Confirmatory Factor Analysis for the Innovation Scale

After the exploratory factor analysis, confirmatory factor analysis was performed on the innovation scale. Regarding the item loads obtained from the regression model, all the regression items' loads were higher than 0.50. The analysis showed that modifying Inno1-Inno2 would increase the chi-square and fit values. In addition, Inno6 and Inno7 were excluded from the analysis because they highly overlapped with other factors.

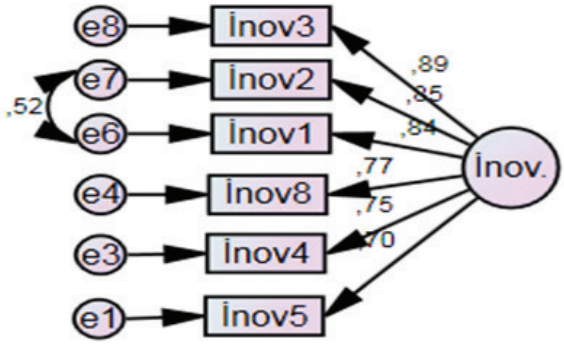

Figure 3. Modified Confirmatory Factor Analysis of the Innovation Scale

Confirmatory Factor Analysis for the Industry 4.0 Scale

After the exploratory factor analysis, confirmatory factor analysis was performed on the Industry 4.0 scale. Regarding the item loads obtained from the regression model, all the regression items' loads were higher than 0.50. The analysis showed that the modifications between Ind401-Ind405 and Ind403-Ind406 would increase the chi-square and fit values.

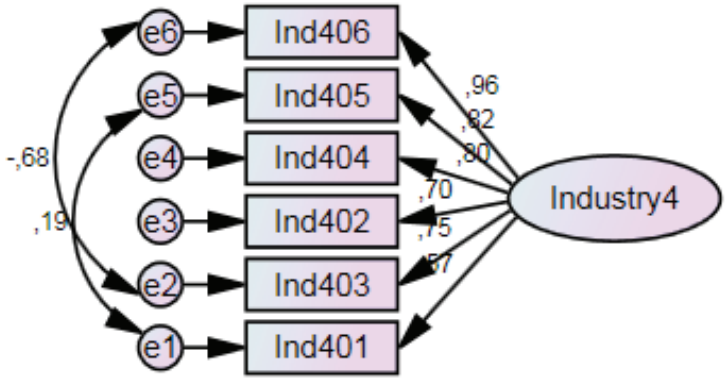

Figure 4. Modified Confirmatory Factor Analysis of the Industry 4.0 Scale

Table 3
Reference Values for the Goodness of Fit

Index	Reference Value	
	Good Fit	**Acceptable Fit**
CMIN/DF	0< χ2/sd ≤ 3	3< χ2/sd ≤ 5
CFI	.95< CFI≤ 1	.90 < CFI≤ .94
TLI	.95< TLI≤ 1	.90 < TLI≤ .94
IFI	.95< IFI≤ 1	.90 < IFI≤ .94
RMSEA	0 ≤ RMSEA ≤ .05	.05 ≤ RMSEA ≤ .08
RMR	<0.05	<0.08

Source: Tasgin and Korucuk, 2018

Table 4
Goodness of Fit Indices of the Models for Confirmatory Factor Analysis

Variables	CMIN/DF	CFI	TLI	IFI	RMSEA	RMR
Lean Management	3.3585	.948	.941	.949	.070	.047
Innovation	4.078	.989	.980	.989	.076	.032
Industry 4.0	2.807	.993	.985	.993	.021	.059

CR (Composite Reliability) is a value that measures the internal performance of a factor. It is desirable for the value to be greater than 0.70. The CR value is constructed based on Cronbach's Alpha being considered as a better alternative. The AVE (Average Variance Extracted) value is a value that measures the similarity between the items of a factor. It is desirable for the value to be greater than 0.50.

The table below shows the CR composite reliability values of the lean management, innovation process and industry 4.0 scales. According to the table, the CR value is over 0.70, which shows that the scale is reliable. For the convergent validity of the scale, the mean self-variability is expected to be higher than 0.5 and the composite reliability ratio is expected to be greater than the mean self-variability (CR > (AVE) / AVE > 0.5).

It is evident from the figures in the table that AVE (self-variability) is greater than 0.5 and CR composite reliability) is greater than 0.7. These are the values at which there is enough convergence in the model (Hair et al., 2009).

Table 5
Validity-Reliability Matrix

Factors	**CR**	**AVE**	**CR>0,70**	**AVE>0,50**	**CR>AVE**
Lean Management	0,94	0,51	0,94>0,70	0,51>0,50	0,94>0,51
Innovation	0,95	0,68	0,95>0,70	0,68>0,50	0,95>0,68
Industry 4.0	0,92	0,66	0,92>0,70	0,66>0,50	0,92>0,66

Hypothesis Testing

First, correlation analysis was used to test the hypotheses that formed the research's basis

and determine the relationship between lean management, innovation, and industry 4.0. The results of the correlation analysis are shown in Table 5. The table shows a positive and significant relationship between the organisation's lean management approach and innovation (.795**). At the same time, there is a positive and significant relationship between the lean management approach and industry 4.0 (.440**).

Table 6
Relationship Between Variables

Factors	1	2	3
1-Lean Management	1		
2-Innovation	.795**	1	
3-Industry 4.0	.440**	.498**	1

*p<.05, **p<.01

Analysis of the Structural Equivalence Model

A structural equivalence model was used to determine the statistically significant relationships between the variables. For this purpose, the previously determined structural model of the research was analysed with the AMOS programme. The relationships between variables were examined using goodness-of-fit statistics and hypotheses to confirm the model's validity.

To test the effect of the mediating variables, the mediator was removed from the model, and the prediction power of the independent variable on the dependent variable was calculated. As a result, lean management has a 42.4% effect on industry 4.0. Accordingly, H1 is accepted. The estimations of the tested model are shown in Figure 5.

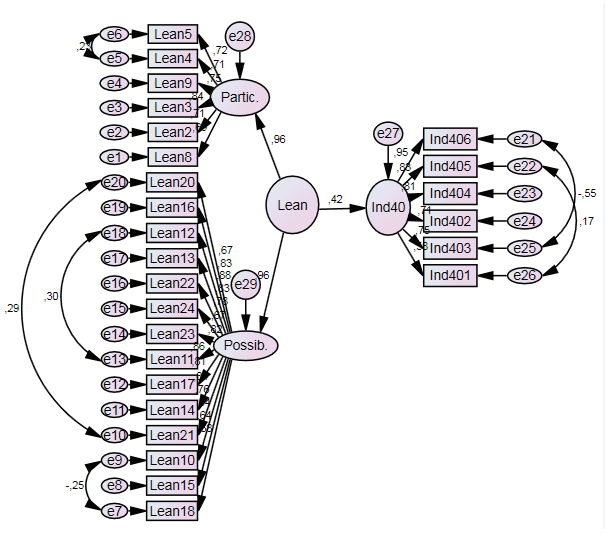

Figure 5. Standardised Estimation Results Showing the Effect of Lean Management on Industry 4.0

The fit indices of the model and the reference values specified in the literature are given in Table 6.

Table 7
The Goodness of Fit Indices of the Models Showing the Effect of Lean Management on Industry 4.0

Index	Reference Value		Measurement	Result
	Good Fit	Acceptable Fit		
CMIN/DF	0< χ2/sd ≤ 3	3< χ2/sd ≤ 5	3.089	Acceptable Fit
CFI	.95< CFI≤ 1	.90 < CFI≤ .94	.942	Acceptable Fit
TLI	.95< TLI≤ 1	.90 < TLI≤ .94	.935	Acceptable Fit
IFI	.95< IFI≤ 1	.90 < IFI≤ .94	.942	Acceptable Fit
RMSEA	0 ≤ RMSEA ≤ .05	.05 ≤ RMSEA ≤ .08	.063	Acceptable Fit
RMR	<0.05	<0.08	.056	Acceptable Fit

The effect of lean management on innovation is shown in Figure 6. Accordingly, lean management's effect on innovation is 87.8%. Thus, H2 is accepted. The estimations of the tested model are shown in Figure 6.

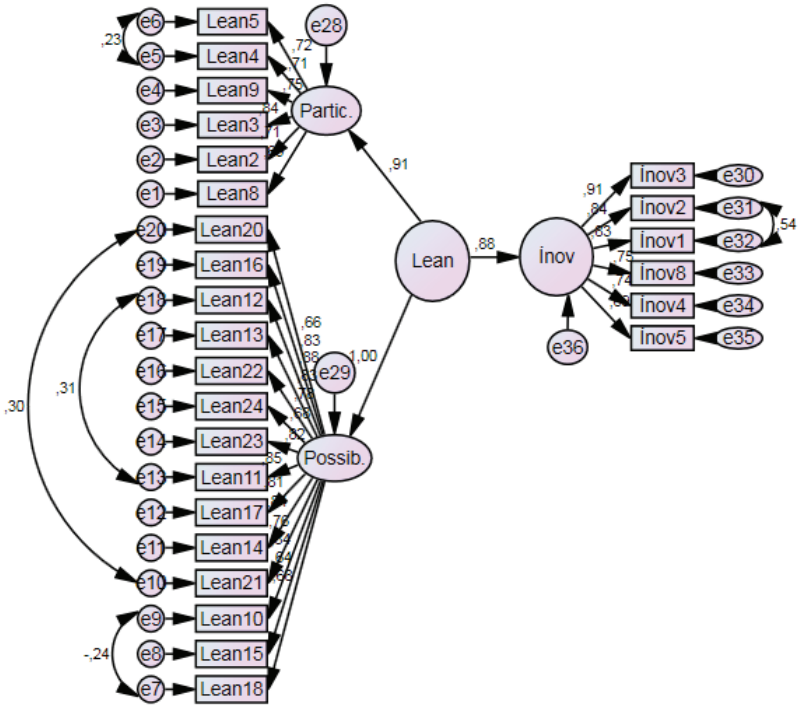

Figure 6. Standardised Estimation Results Showing the Effect of Lean Management on Innovation

Table 8
The Goodness of Fit Indices of the Models Showing the Effect of Lean Management on Innovation

Index	Reference Value		Measurement	Result
	Good Fit	Acceptable Fit		
CMIN/DF	0< χ2/sd ≤ 3	3< χ2/sd ≤ 5	3.360	Acceptable Fit
CFI	.95< CFI≤ 1	.90 < CFI≤ .94	.940	Acceptable Fit
TLI	.95< TLI≤ 1	.90 < TLI≤ .94	.933	Acceptable Fit
IFI	.95< IFI≤ 1	.90 < IFI≤ .94	.940	Acceptable Fit
RMSEA	0 ≤ RMSEA ≤ .05	.05 ≤ RMSEA ≤ .08	.067	Acceptable Fit
RMR	<0.05	<0.08	.050	Acceptable Fit

The effect of innovation on Industry 4.0 is shown in Figure 7. Accordingly, the effect of innovation on Industry 4.0 is 51.4%. Thus, H3 is accepted. The estimations of the tested model are shown in Figure 7.

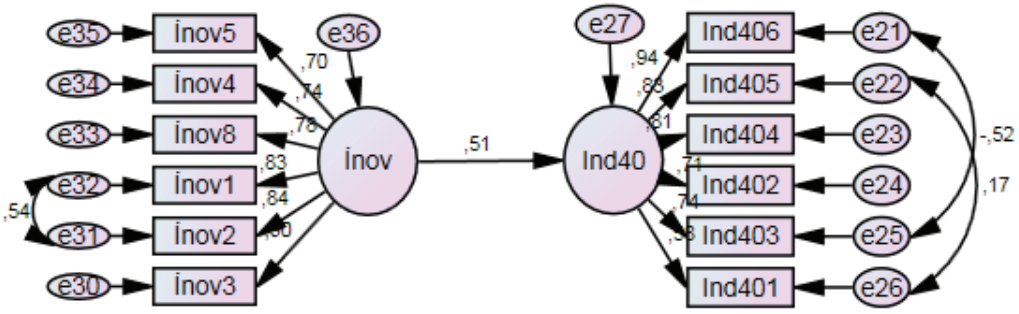

Figure 7. Standardised Estimation Results Showing the Effect of Innovation on Industry 4.0

Table 9
The goodness of Fit Indices of the Models Showing the Effect of Innovation on Industry 4.0

Index	Reference Value		Measurement	Result
	Good Fit	Acceptable Fit		
CMIN/DF	0< χ2/sd ≤ 3	3< χ2/sd ≤ 5	3.984	Acceptable Fit
CFI	.95< CFI≤ 1	.90 < CFI≤ .94	.966	Acceptable Fit
TLI	.95< TLI≤ 1	.90 < TLI≤ .94	.955	Acceptable Fit
IFI	.95< IFI≤ 1	.90 < IFI≤ .94	.966	Acceptable Fit
RMSEA	0 ≤ RMSEA ≤ .05	.05 ≤ RMSEA ≤ .08	.075	Acceptable Fit
RMR	<0.05	<0.08	.063	Acceptable Fit

In the research model, lean management was considered an exogenous variable, and implicit variables such as innovation and industry 4.0 were considered endogenous variables. The innovation was added to the model as a mediating variable. The Bootstrap method was

also used to reveal the validity of the mediating role while testing the relationships between the variables. In the Bootstrap method, the sample was increased by 1000, and the Bootfactor was set as1. The maximum likelihood estimation method, which is accepted to be suitable for cases where the data show a normal distribution, was applied in this study. Figure 8 shows the estimation results of the model tested in the AMOS programme using the Bootstrapping method.

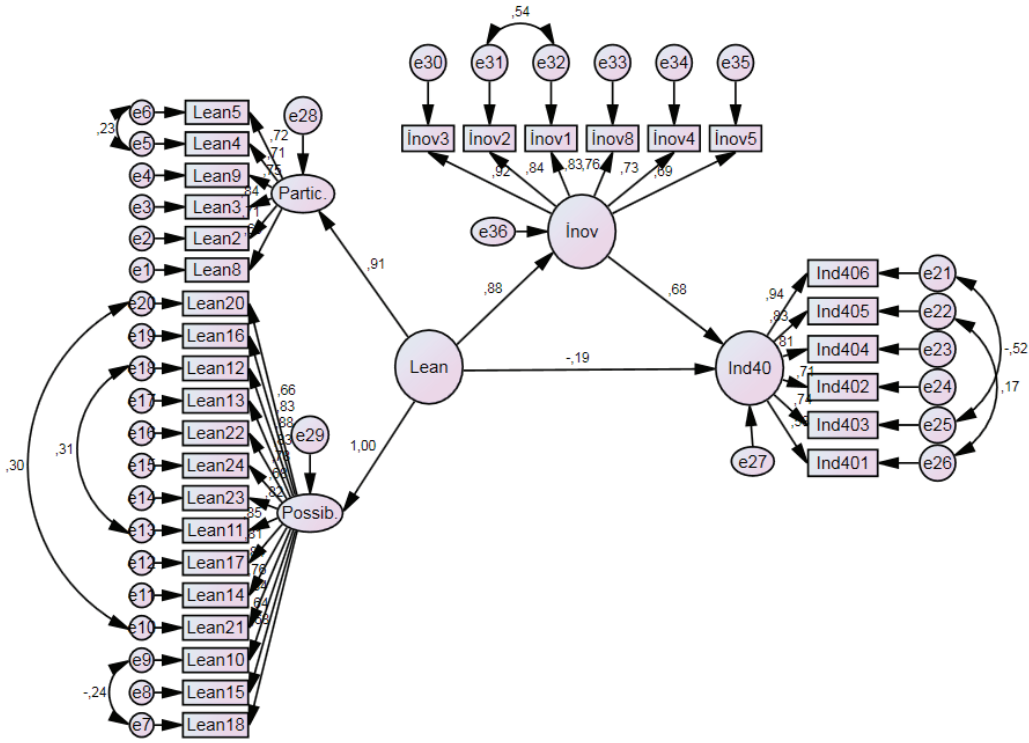

Figure 8. Displaying Standardised Estimation Results on the Model

Regarding the effect of lean management on industry 4.0 in the context of innovation, the innovation (mediator) was removed from the model first, and lean management's direct effect on industry 4.0 was examined. This effect was significant (.424 and p=000). Data related to this model are shown in Figure 2. Then, the innovation process, the mediating variable, was added to the model, and the analysis was repeated. In this case, the effect of lean management on industry 4.0 was significant (.186 and p=.001). As can be seen, the direct effect of lean management on industry 4.0 is significant without a mediator. On the other hand, when the mediator variable innovation is added to the model, the effect of lean management on Industry 4.0 decreased. Regarding the Bootstrap test results, the mediator variable's effect was significant. When the mediator variable was added to the model, the effect of lean management on industry 4.0 did not

disappear and decreased, which shows that innovation plays a mediating role in the interaction between lean management and industry 4.0. It is also possible to interpret this situation as lean management affecting industry 4.0 both directly and through innovation because the mediation effect was also significant according to the results of the Bootstrap test.

Regarding the goodness of fit indices of the model in Table 9, they indicate an acceptable fit.

Table 10
Reference Values for the Goodness of Fit

Index	Reference Value		Measurement	Result
	Good Fit	Acceptable Fit		
CMIN/DF	$0 < \chi 2/sd \leq 3$	$3 < \chi 2/sd \leq 5$	3.086	Acceptable Fit
CFI	$.95 < CFI \leq 1$	$.90 < CFI \leq .94$	.931	Acceptable Fit
TLI	$.95 < TLI \leq 1$	$.90 < TLI \leq .94$	.924	Acceptable Fit
IFI	$.95 < IFI \leq 1$	$.90 < IFI \leq .94$	.931	Acceptable Fit
RMSEA	$0 \leq RMSEA \leq .05$	$.05 \leq RMSEA \leq .08$	.063	Acceptable Fit
RMR	<0.05	<0.08	.059	Acceptable Fit

Discussion and Conclusion

Due to the intense competition brought by globalisation, businesses face some difficulties in terms of cost, quality, and time. The increasing number of competitors increases the customers' decision-making options and causes harsh competitive conditions. To survive in this competitive environment, businesses want to determine efficient methods and processes the entire value chain. The lean management approach focuses on producing more with less time, efforts, and equipment and meeting customers' expectations. Uncertainty is a factor that makes management difficult in businesses; its presence complicates the management. Management eliminates this uncertainty and complexity by simplifying the processes and making them lean and elementary. Consequently, the decision-making processes of the business gain momentum as uncertainty and complexity decrease. From this perspective, lean management is an approach that focuses on creating more efficient working conditions by reducing non-value-adding activities and significantly increasing business performance. The lean management approach eliminates waste by continuously improving the production process. Businesses should adopt the lean management approach to improve their innovation processes and keep up with changing competitive conditions because developing new products and processes plays a vital role in gaining competitive power. Therefore, lean management can significantly contribute to the improvement of a business' innovation capacity. In addition, the concept of Industry 4.0, called the fourth industrial revolution, has emerged recently in the production sector. After a detailed review, it can be said that lean manufacturing methods and Industry 4.0 technologies are intertwined and act on each other.

The tourism sector is at a very different point today, with the development of technology. Industry 4.0, which includes many industries in the world, and the innovation process have also affected the tourism industry.

Among these innovative movements in the tourism sector, there are issues such as businesses designing beautiful websites, developing mobile applications, providing search and research opportunities and conveniences to their customers with social networks, web, agencies.

In addition, one of the most effective methods of providing quality service at low cost for businesses is to adopt the principles of "Lean Management". Like many businesses that consider themselves "Lean", tourism businesses are in a better position than their competitors in the current economy. Lean management practices in tourism businesses differ from lean practices in the production environment because they are service businesses. The intangibility of services, the difficulty of measuring service outputs, and the creation of value for the customer can complicate the applicability of lean management practices in tourism businesses.

This study addressed the simultaneous relationship between lean management, Industry 4.0, and innovation for the businesses operating in the tourism sector (hotels, agencies) in Turkey. The findings showed that lean management is effective in Industry 4.0. According to this result, it can be argued that lean management forms the basis for Industry 4.0 and, at the same time, is supplemented by Industry 4.0. Therefore, it is thought that integrating Industry 4.0 technologies into lean management processes will increase tourism businesses' productivity (Figure 8). Kolberg and Züehlke (2015) stated that Industry 4.0 applications support lean manufacturing approaches and can be a tool in realising lean manufacturing. Their results support the results obtained in this study.

Regarding another finding obtained in the study, lean management was found to be effective in innovation. According to this result, tourism businesses should implement a lean management approach to improve their innovation capacities. Therefore, it can be stated that lean management will improve the innovation processes of tourism businesses and provide high flexibility in offering new products or services to businesses. Abdallah et al. (2019) stated that innovation-oriented companies tend to benefit from lean management to improve their innovation capacity, which supports the results of this study.

Another finding is that innovation affects Industry 4.0. The emergence of new and creative ideas in businesses will lead to the creation or development of advanced production technologies. Industry 4.0 is an industrial revolution that includes high technological development and transformation; therefore, it is closely related to innovation (TÜSİAD, 2016). Tourism businesses should attach importance to innovation activities for adapting to the age of Industry 4.0. In addition, tourism businesses that want to increase their innovation level and adapt to

the Industry 4.0 age are thought to survive in a competitive environment and reach a better position than their competitors.

The study's main finding is that innovation is a mediator in the relationship between lean management and industry 4.0. In cases where lean management positively affects industry 4.0, the inclusion of innovation in the process will further increase the performance of industry 4.0. Especially in today's global world, the rapid change and development of technological activities have accelerated the efforts towards industry 4.0. In this direction, businesses will gain momentum in the transition to industry 4.0 by focusing on innovation and adopting lean management.

The deepening of global competition has expanded its sphere of influence. Industry 4.0, innovation, and especially lean management concepts in planning and implementing cost, activity, high production, new product development, market creation, generating new ideas, and R&D processes of the businesses and making them sustainable have an essential and critical place in the current dimension of the discussions. Businesses operating in the tourism sector are rapidly developing and changing. This development becomes more critical with the effect of lean management, innovation, and industry 4.0 practices. However, tourism businesses should focus more on lean management than on industry 4.0 and innovation, and lean methods should be adapted to the industry's specific needs.

As a result, this quantitative study in the professional and business sectors addressed the relations between lean management, industry 4.0, and innovation regarding the businesses operating in the tourism sector. Future studies can make comparative studies, including tourism and other sectors or the countries where the research will be conducted can be extended.

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References

Abdallah, A.B., Dahiyat, S.E. and Matsui, Y. (2019). Lean management and innovation performance: Evidence from international manufacturing companies. *Management Research Review, 42*(2), 239-262.

Al-Aomar, R. and Hussain, M. (2019). Exploration and prioritization of lean techniques in a hotel supply chain. *International Journal of Lean Six Sigma, 10*(1), 375-396.

Alsos, G. A., Eide, D. and Madsen, E. L. (2014). Introduction: Innovation in Tourism Industries. Chapters, 1-24. (In Handbook of Research on Innovation in Tourism Industries). Cheltenham, UK: Edward Elgar Publishing.

Arpaci, Y, O. (2019). Relationship between Outsourcing and Innovation in Businesses. (Unpublished docto-

ral dissertation). Pamukkale University, Institute of Social Sciences, Denizli.

Asdecker B. and Felch V. (2018). Development of an Industry 4.0 Maturity Model for The Delivery Process in Supply Chains. *Journal of Modelling in Management, 13*(4), 840-883.

Banger, G. (2017). Industry 4.0 Extra. Ankara: Dorlion Publications.

Byrne, A., (2015). Lean Transformation. Ed.: Melis İnan, İstanbul: Optimist Publishing.

Chang, M., Walimuni, A. C. S. M., Kim, M. and Lim, H. (2022). Acceptance of tourism blockchain based on UTAUT and connectivism theory. *Technology in Society*, 71, 1-13.

Cuatrecasas, L. (2004). A lean management implementation method in service operations. *International Journal of Services, Technology and Management, 5*(5/6), 532-544.

Çanakçı S.D., Çanakçı T. and Geçgin, E. (2019). Destination Image of Kars Province and Eastern Express Experience. *International Journal of Society Research. 11*(18), 1876-1896.

Canakcioglu, Mustafa, (2019). Tools to fight waste in lean thinking philosophy. *Journal of Social Sciences Research, 8*(3), 270-282.

Çavuş, M. F. and Akgemci, T. (2008). The Effect of Employee Empowerment on Organizational Creativity and Innovation in Enterprises: A Study in Manufacturing Industry. *Selcuk University Journal of Social Sciences Institute,* 20, 229-244.

Deran, A. and Beller, B. (2014): Value Stream Costing as a Tool of Lean Management in Hospitals and an Application in a Public Hospital. *Selcuk University Journal of Social Sciences Institute,* 32, 161-174.

Derin, N. (2008). The Effect of Lean Management on Internal Image According to Employees' Perceptions: A Study in Private Hospitals in Turkey. (Unpublished doctoral dissertation). İnönü University Institute of Social Sciences, Malatya.

Duren, Z. (2002). Management in the 2000s. Istanbul: Alfa Publications.

Dülgaroğlu, O. (2021). Digitalization in Tourism: Smart Tourism Applications, Digital Tourism and Tourism 4.0. *Journal of Tourism and Management, 2*(1), 1-15.

Engelund, Eva H. Breum, Gitte and Friis, Alan (2009). Optimization of large-scale food production using Lean Manufacturing principles. *Journal of Foodservice, 20*(1), 4-14.

Elitaş, C. (2011). Research Methods in Accounting. Ankara: Gazi Bookstore.

Farrington, T., Antony, J. and O'Gorman, K. D. (2018). Continuous improvement methodologies and practices in hospitality and tourism. *International Journal of Contemporary Hospitality Management, 30*(1), 581-600.

Frederick, D. E. (2016). Libraries, Data and the Fourth Industrial Revolution (Data Deluge Column). *Library Hi Tech News, 33*(5), 9-12.

Freeman, C. and Soete, L. (1997). The Economies of Industrial Innovation. London: MIT Press.

Ghobakhloo, M., Iranmanesh, M., Maroufkhani, P., Grybauskas, A., Vilkas, M. and Petraitė, M. (2021). Industry 4.0, innovation, and sustainable development: A systematic review and a roadmap to sustainable innovation. *Business Strategy and the environment, 30*(2), 1-21.

Giotis, G. and Papadionysiou, E. (2022). The Role of Managerial and Technological Innovations in the Tourism Industry: A Review of the Empirical Literature. *Sustainability,* 14, 1-20.

Gupta, S., Sharma, M. and Vijaya Sunder, M. (2016). Lean services: a systematic review. *International Journal of Productivity and Performance Management, 65*(8), 1025-1056.

Gürbüz, S. and Şahin, F. (2017). Research Methods in Social Sciences: Philosophy-Method-Analysis. An-

kara: Seçkin Publishing.

Hadid, W. and Mansouri, S. A. (2014). The lean-performance relationship in services: A theoretical model. *International Journal of Operations & Production Management, 34*(6), 750-785.

Hair, J., Black, W., Babin, B. and Anderson, R. (2009). Multivariate data analysis (7th b.). Upper Saddle River, N.J.: Prentice Hall.

Handscomb, C., Jautelat, S., Rodriguez, M., Wienke, L. and Raedemaecker, S. (2020). Lean management or agile? The right answer may be both. McKinsey, Jul. 14, p. 6.

Hjalager, A.N. (2002). Repairing Innovation Defectiveness in Tourism. Tourism Management. 23, 465-474.

http://vetpro40.com/wp-content/uploads/2019/02/End.4.0.Rehber.pdf, Downloaded: 24.03.2022

Işık, C. and Keskin, G. (2013). The Importance of Innovation in Establishing Competitive Advantage in Information Economies. *Atatürk University Journal of Economics and Administrative Sciences, 27*(1), 41-57.

Işık, C., Küçükaltan, E. G., Taş, S., Akoğul, E., Uyrun, A., Hajiyeva, T., Turan, B., Dırbo, A. H. and Bayraktaroğlu, E. (2019). Tourism and innovation: A literature review. *Journal of Ekonomi,* 2, 88-154.

Ivanov, S., Webster, C. and Berezina, K. (2017). Adoption of robots and service automation by tourism and hospitality companies. *Revista Turismo & Desenvolvimento,* 27/28, 1501-1517.

Imanovic, S., Milojica, V. and Roblek, V. (2016). A holistic approach to innovations in tourism. Paper presented at the International Conference on Economic and Social Studies, Sarajevo, Bosnia and Herzegovina, 21–22 April.

Kagermann, H., Helbig, J., Hellinger, A. and Wahlster, W. (2013). Recommendations for Implementing the Strategic Initiative, Industrie 4.0: Securing the Future of German Manufacturing Industry, Final Report of the Industrie 4.0 Working Group.

Kagermann, H., Wahlster, W. and Helbig, J. (2013). Securing the Future of German Manufacturing Industry: Recommendations for Implementing the Strategic Initiative Industrie 4.0. Final Report of the Industrie 4.0 Working Group. Forschungsunion im Stifterverband für die Deutsche Wirtschaft e. V., Berlin.

Kolberg, D. and Züehlke, D. (2015). Lean Automation enabled by Industry 4.0 Technologies. *IFAC-PapersOnLine, 48*(3), 1870-1875.

Korže, S. Z. (2019). From Industry 4.0 To Tourısm 4.0. Innovative Issues and Approaches in Social Sciences, 12(3), 29-52.

Krafcik J. F. (1988). Triumph of the Lean Production System. *Sloan management review, 30*(1), 41-52.

Kucmarski, T. D. (1996). Innovation: Leadership Strategies for the Competitive Edge. USA: NTC Business Books.

Leite, H.R. and Vierira, G.E. (2015). Lean philosophy and its applications in the service industry: a review of the current knowledge. *Production, 25*(3), 529-541.

Lewis, M. A. (2000). Lean Production and Sustainable Competitive Advantage. *International Journal of Operations & Production Management, 20*(8), 959–978. https://doi.org/10.1108/01443570010332971.

Lyons, R. K., Chatman, J. and Joyce, C. K. (2007). Innovation in Services: Corporate Culture and Investment Banking. *California Management Review, 50*(1), 174-191.

Myers, S. and Marquis, D. G. (1969). Successful Industrial Innovations: A Study of Factors Underlying Innovation in Selected Firms. National Science Foundation.

Nascimento, I.T., Silva, M.E.A., Gama, G.R.S and Xavier, M.C. (2021). Application Of Lean Manage-

ment Tools In Industry 4.0: A Systematic Review. *Independent Journal Of Management & Productıon (IJM&P), 12*(9), 856-864.

Mendoza-Moheno, J., Cruz-Coria, E. and Gonzalez-Cruz, T. F. (2021). Socio-technical innovation in community-based tourism organizations: A proposal for local development. *Technological Forecasting & Social Change,* 171, 1-12.

Okatan, D. and Yıldırım, Y. (2021). Endüstri 4.0 Teknolojilerinin Turizm Sektörüne Yansımaları: Literatür İncelemesi. *Journal of Tourism Intelligence and Smartness, 4*(2), 168-185.

Osei, B. A., Ragavan, N. A. and Mensah, H. K. (2020). Prospects of the fourth industrial revolution for the hospitality industry: a literature review. Journal of Hospitality and Tourism Technology. https://www.emerald.com/insight/1757-9880.htm.

Narayanamurthy, G. and Gurumurthy, A. (2016). Leanness assessment: a literature review. *International Journal of Operations & Production Management, 36*(10), 1115-1160.

Nordin, S. (2003). Tourism Clustering & Innovation: Paths To Economic Growth and Development. *European Tourism Research Institute, MiD Sweden University*, 14, 1-81.

Oslo Manual (2005). Guide to Collection and Interpretation of Innovation Data. Ankara: TUBITAK Publications.

Örnek, A. (1991). Public Administration, İstanbul.

Perdomo-Verdecia, V., Sacristán-Díaz, M. and Garrido-Vega, P. (2022). Lean management in hotels: Where we are and where we might go. *International Journal of Hospitality Management,* 104, 103250.

Pereira A.C. and Romero F. (2017). A Review of Meaning and The Implications of The Industry 4.0 Concept. *Procedia Manufacturing,* 13, 1206-1214.

Rajput S. and Singh S.P. (2019). Industry 4.0-challenges to implement circular economy. *Benchmarking: An International Journal, 28*(5), 1717-1739.

Schuh, G., Potente, T., Wesch-Potente, C., Weber, A. R. ve Prote, J. P. (2014). Collaboration Mechanisms to Increase Productivity in the Content of Industrie 4.0. Robust Manufacturing Conference (p. 51-56). Elsivier B:V.

Schumpeter, J. A. (1961). The Theory of Economic Development. New York: Oxford University Press.

Sığırcı, M. (2001). National Productivity Center. *Key Magazine, 6*(68).

Sony, M. (2018). Industry 4.0 and Lean Management: a Proposed Integration Model and Research Propositions. *Production & Manufacturing Research, 6*(1), 416-432.

Şengel, Ü. (2021). Chronology of the Interaction Between the Industrial Revolution and Modern Tourism Flows. *Journal of Tourism Intelligence and Smartness, 4*(1), 19-30.

Tasgin, A. and Korucuk, M. (2018). Development of Foreign Language Lesson Satisfaction Scale (FLSS): Validity and Reliability Study. *Journal of Curriculum and Teaching, 7*(2), 66-77.

Tikici, M., Aksoy, A. and Derin, N. (2006). Lean Management as One of the Radical Elements of Total Quality Management. *Electronic Journal of Social Sciences, 5*(15), 20-33.

Topsakal, Y., Çelik, P. and Yüzbaşıoğlu, N. (2018). Innovation in Small and Medium-Sized Tourism Enterprises (Small Business): The Case of Kaleiçi, Antalya. *Turkish Studies, 13*(3), 737-752.

Taylor, F. W. (1985). The Principles of Scientific Management, Easton, Hive Publishing, Co., Easton, USA.

TÜSİAD (2016). Industry 4.0 in Turkey as An Imperative for Global Competitiveness An Emerging Market Perspective. İstanbul: TÜSİAD Publishing.

Uy, A. O. O. and Rabo, J. S. (2019). IR4.0 Readiness of Accounting Education: Professional Quotient and CHED's accounting program standards. Presented at the DLSU Research Congress 2019 De La Salle University, Manila, Philippines.

UNWTO (2017) Tourism highlights. 2017 Edition. Available at: https://www.e-unwto.org/doi/pdf/10.18111/9789284419029 (14.6. 2023).

Vlachos, I. and Bogdanovic, A. (2013). Lean thinking in the European hotel industry. *Tourism Management,* 36, 354- 363.

Wang L. and Wang L. (2016). Big Data in Cyber-Physical Systems, Digital Manufacturing and Industry 4.0. I.J. *Engineering and Manufacturing*, 4, 1-8.

Warnecke, H. J. and Hüser, H. (1995). Lean production. *Proceedings of the 12 International Conference on Production Research, 41*(13), 37-43.

Weyer, S., Schmitt, M., Ohmer, M. and Gorecky, D. (2015). Towards Industry 4.0 - Standardization as the crucial challenge for highly modular, multi-vendor production systems. *IFAC-PapersOnLine, 48-3* (2015), 579-584.

Womack, J. P and Jones, D. T. (2003). Lean Thinking. (Translator: Yamak, O.). Istanbul: Optimist Publications.

Zengin, Y., Naktiyok, S., Kaygın, E., Kavak, O. and Topçuoğlu, E. (2021). An Investigation of Industry 4.0 and Society 5.0 within the Context of Sustainable Development Goals. *Sustainability,* 13, 1-16 (2682); https://doi.org/10.3390/su13052682