



Research Article

Development of Industry 4.0 in the Hotel and Restaurant Business

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Abstract

Digital transformation or «Industry 4.0» appears on the agenda of companies all over the world. The hotel and restaurant business is a diverse, highly competitive industry and belongs to one of the fastest growing service sectors with significant potential for the development of digital technologies. The purpose of this study is to identify the role of digital innovations in the industry of hospitality and the adaptation of enterprise management to the possibilities of the digital revolution or to the conceptual breakthrough that it suggests. The article discusses the conceptual aspects of «Industry 4.0», analyzes the current state and prospects for the development of digital transformation of the industry, and explores pilot projects for the implementation of Industry 4.0 in the hotel and restaurant business. Based on the conducted research, the basic conditions for ensuring successful digital transformation and reducing the risks of digital innovations of enterprises of the hospitality industry were determined.

Keywords: industry 4.0, digital transformation, robotics, hotel and restaurant business

Introduction

In recent times, many authors have observed the beginning of a new industrial revolution, or industry 4.0, signs of which are considered to be overall computerization, robotization and the formation of "smart networks" (Geissbauer

et al., 2014; Schwab, 2016; Verevka, 2018; Goncharova and Bezdenezhnykh, 2018; Lebedev, Mokeeva and Rodionov, 2018). The fourth industrial revolution, better known as Industry 4.0, got its name from the initiative of 2011, led by businessmen, politicians and scientists who identified it as a means of improving competitiveness of

the German manufacturing industry through enhanced integration of "cyber-physical systems", or CPS, into factory processes. Compared to Industry 3.0, which meant automation of individual machines and processes, Industry 4.0 includes through digitization and integration of the value creation chain data: offer of digital products and services, operation of co-specialized physical and virtual assets, transformation and integration of all business operations, partnership, as well as customer service optimization.

Consequently, Industry 4.0, in the narrow sense, representing the name of one of the ten projects of the German government Hi-Tech strategy until 2020, which has received worldwide recognition due to the clarity of goal formation, describes the concept of Smart Manufacturing based on IoT (Internet of things). In view of this, Industry 4.0, in a broad sense, can be defined as a new understanding of the organization of production and management of the entire value creation chain throughout the entire product life cycle on an automation development and data exchange platform, including the creation of cyber-physical systems, IoT and digitalization.

The term "transformation" is used to describe the change process that the business must go through in order to function in a digital economy. Technologies are the basis of Industry 4.0; business transformation is impossible without them. The most advanced technologies that will change the business models of companies or of the entire industries include: Internet of Things (IoT), artificial intelligence, robotics, Big Data analysis, 3D printers, augmented and virtual reality (AR and VR).

The digital platform acts as a catalyst for the economics, the initiation of which in any industry allows management to solve issues of optimization, quality and safety of operating processes more quickly and efficiently, leads to a significant reduction in costs and acceleration of operating cycles, making production more flexible and competitive.

The hospitality and catering industry is a diverse and highly competitive industry. Among the competitors in the industry are single sandwich shops, cafes and restaurants, coffee shops, pizzerias and fast-food chains, as well as luxurious fine dining restaurants offering customers a wide selection of dishes. The hotel industry is considered one of the most attractive and actively developing business areas. Each year, the global hotel industry brings about 400– 500 billion U.S. dollars and is under the auspices of the travel and tourism sector, with a cumulative annual contribution to the global economics making up to 8.5 trillion U.S. dollars (Statista, 2018). Enterprises of the hospitality industry master an increasing number of activities that lead to the reorganization of management systems. Many modern hotels now represent not only one company, but a group of companies united in a holding structure. One of the world's largest hotel chains (groups) are InterContinental Hotels Group, Marriott International, Hilton Worldwide, Accor, Starwood Hotels & Resorts и Wyndham Hotel Group. As a result, the focus of the management of hotel chains is largely shifted to the operation of the entire complex of enterprise resources and organization of the effective management. Therefore, under the conditions of today, the hotel administration companies and hotels face an acute problem of creating a new management system that meets the challenges of the global digital environment. Unfortunately, it should be noted that many business leaders haven't adapted yet to the possibilities of the digital revolution or to the conceptual breakthrough that it suggests.

How do restaurants and hotels use digital solutions and why do some still refrain from new technologies? Is it worth stimulating the digitalization of the industry, which for the most part still works on analog solutions? This given range of issues defined the purpose and main objectives of this study. The following methods and approaches were used to achieve the purpose of the presented study, namely to identify the role of digital

innovations in the field of hospitality and their development prospects: information gathering, observation, systematization, analysis and synthesis, concretization and generalization, comparative analysis.

Digital Technologies Market Analysis in the Field Of Production and Services

Digital transformation or «Industry 4.0» appears on the agenda of manufacturing companies all over the world. At the present time, 91% of production plants invest in digital factories (Pukha, 2018). The obvious consequence of this process is

the growth of the markets and sales volumes of all supporting technologies: computer aided engineering systems (*Computer-Aided Design - CAD*) and (*Computer-Aided Engineering - CAE*), industrial control, electronic communications, production automation software, digital production equipment and automated material and technical supplies service systems, which proves the dynamic development of Industry 4.0. The dynamics of the global industrial automation market volume is shown in Figure 1 (Statista, 2017).

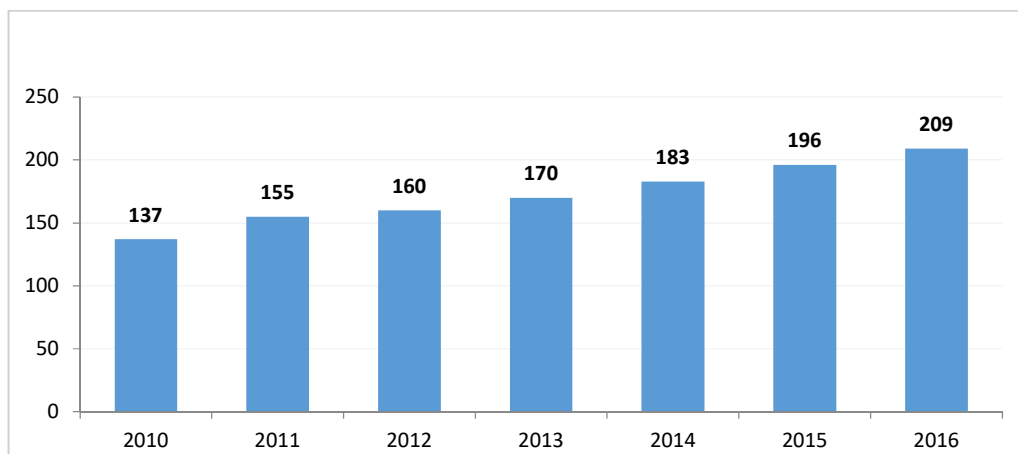


Fig.1: World dynamics of the industrial automation market, billion dollars

Source: built by author on the basis of data from Global industrial automation market, 2017

So, for 2010-2016, the total market volume increased 1.5 times and exceeded 200 billion dollars. International researches predict further growth of the global industrial automation market by 5-6% per

year (Research and Markets, 2018). Especially high growth is observed in the field of robotics as an integral part of the automation market (Figure 2) (Statista, 2018).

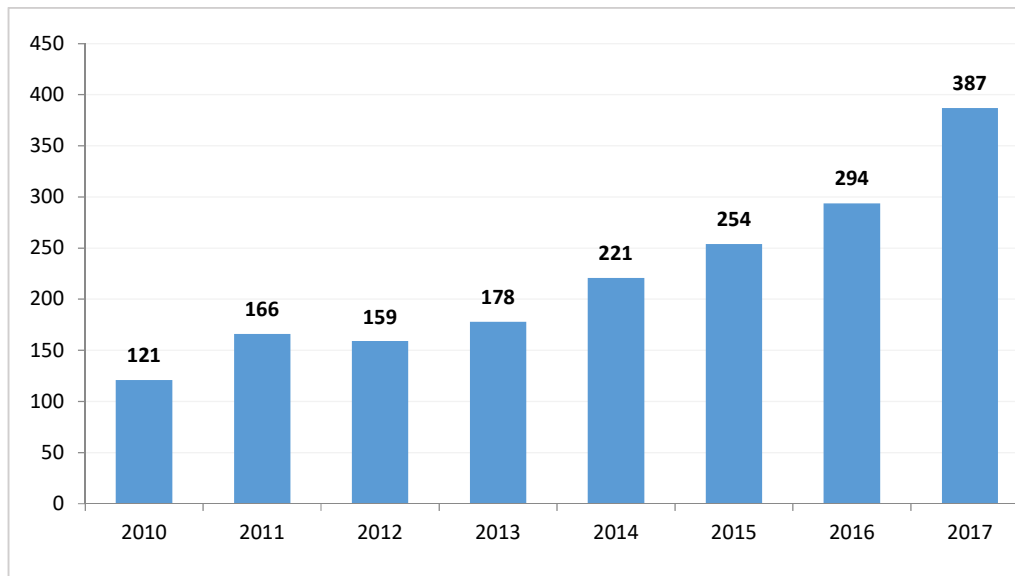


Fig.2: World dynamics of sales of industrial robots, thousand units

Source: built by author on the basis of data from Worldwide sales, 2018

Sales of industrial robots increased in 2017 compared to 2010 by more than 3 times and amounted to 33 billion dollars, and the number of operating robots - 1.8 million units (Bataev et al., 2018). Along with the main "catalysts" of the growth of world sales of industrial robots - the automotive industry and electronics, industrial robots are also actively used in heavy equipment and consumer goods industry, woodworking industry, food and chemical production for solving a wide range of tasks. These and other trends, to a great extent, shape the future development prospects of Industry 4.0 in the production sector.

The service robotics market is growing even faster. The service sector amounts to 65% of global GDP (*The World Bank*, 2018). Therefore, it is logical to assume that service robotics has a greater growth potential compared with industrial robotics. The substantiation of this trend can be considered with the fact that the market of service robotics in terms of growth rates consistently exceeds the market of industrial robotics. So, according to the report of the International Federation of Robotics (*IFR*, 2018), in 2017, the sales volume of service robots for

professional use increased by 39% to 6.6 billion dollars. The total number of robots sold in this category increased by 85% compared with 2016.

The sales volume structure of the world market of professional service robots is illustrated in Figures 3 and 4.

The highest demand has been observed for logistics systems, accounting for 63% of the total units' number and 36% of the total sales (in value) of professional service robots. In addition to logistics, the main areas of application of this category are also:

- Defense (11% of the total units' number and 14% of the total sales value of professional service robots);
- Public relations (10% of the total units' number and 3% of the total sales value);
- Agriculture sector (6% of the total units' number and 15% of the total sales);
- Medicine (3% of the total units' number and 29% of the total sales).

Annual sales volume of all other kinds of professional service robots, such as

professional cleaning, demolition and construction robots, inspection and maintenance systems, rescue and security

applications, underwater systems and mobile platforms in general use is significantly lower.

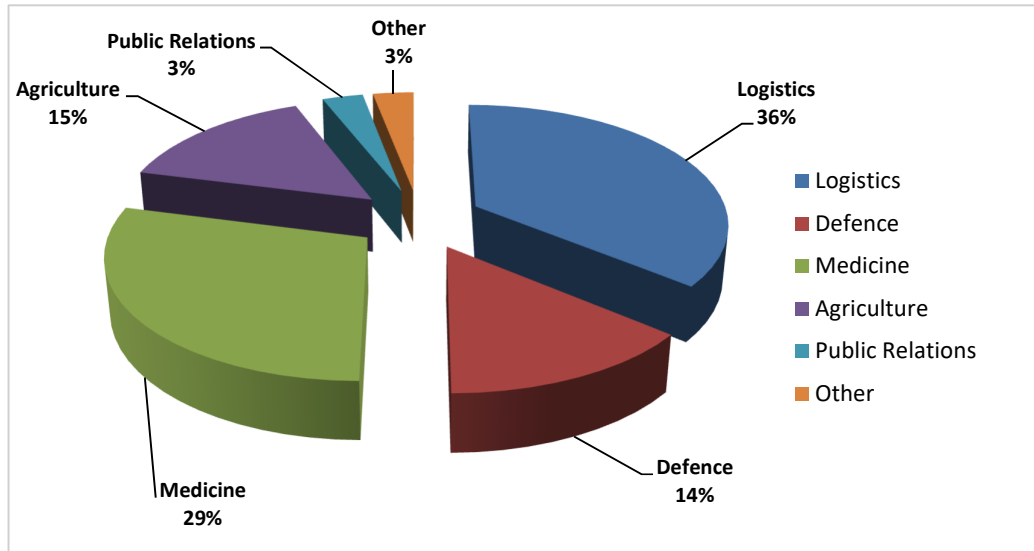


Fig. 3: Structure of the total sales value of the professional service robots in 2017, in percent

Source: calculated by the author on the basis of data from World Robotics, 2018

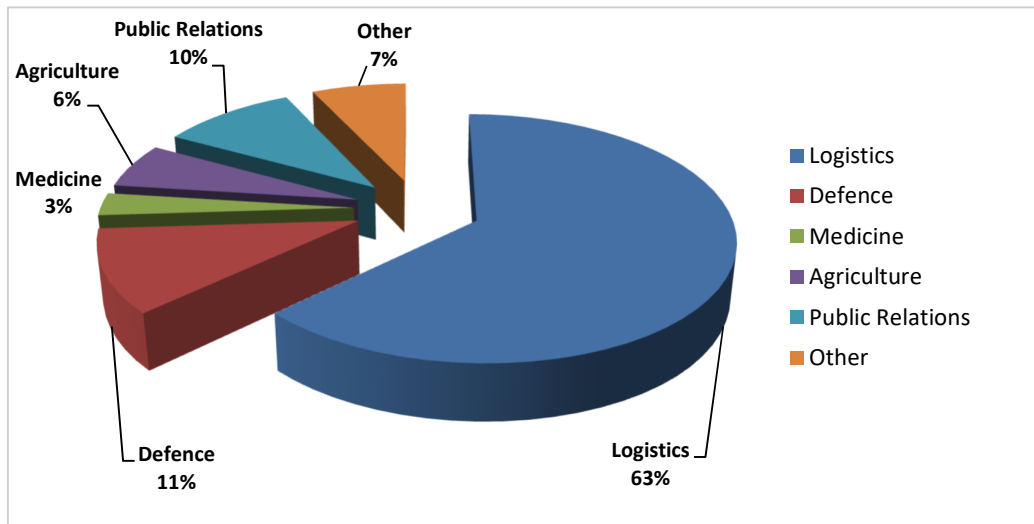


Fig. 4: Structure of the total number of service robots for professional use sold in 2017, in percent

Source: calculated by the author on the basis of data from World Robotics 2018

Figure 5 shows the dynamics of the actual world sales volume of professional service robots in areas of use, as well as *IFR*

assessment of their future development prospects is given.

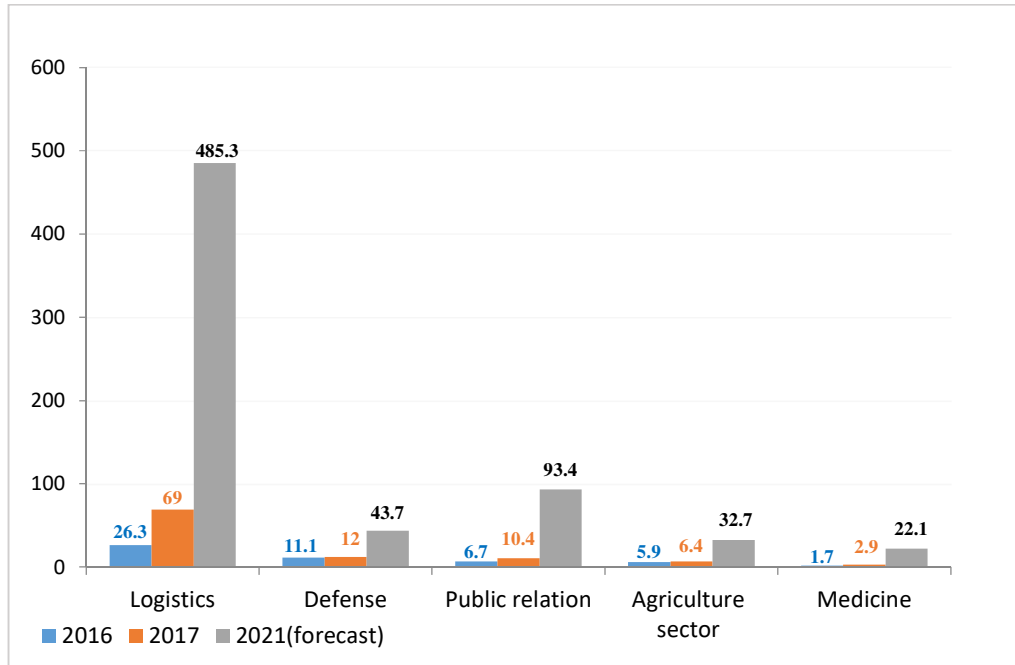


Fig. 5: Dynamics of sales of service robots for professional use in main applications, thousands of units

Source: built by author on the basis of data from World Robotics, 2018

The highest growth has been observed in three areas: logistics, medicine and public relations. Only in 2017, sales volume of service robots for logistics systems increased by more than 2.5 times, medical robots - by 1.7 times, robots for general usage - by 1.5 times. At the same time, two areas among the three market growth leaders have the highest potential: service robots for logistic systems (mobile robots designed for work indoors and outdoors, robots for handling and sorting of cargo) and service robots designed for work in public spaces (robots for performance of service in hotels and restaurants; robots for building the route, assistance and provision of information; robots for advertising and marketing; entertainment robots; other kinds of service robots designed for work in public spaces).

Based on the conducted analysis we can draw the following conclusions:

- At the present stage, the hospitality industry, as well as, the service sector in general lags significantly behind the production in the implementation of automation and robotic facilities.
- The rate and potential for growth of this market in the service sector is significantly higher compared with the sector of industrial production
- The hospitality industry belongs to some of the most high- growing service sectors, with the second largest potential for digital technology development after logistics.

«Digital Vortex» and the Adaptation of the Enterprises of the Hospitality Industry to Digital Transformation

The results of the above conducted analysis, to a large extent, confirm the theory of "digital vortex", which has been put forth by the specialists of the company *Cisco* (2015), as the inevitable movement of various industries towards a "digital center" in which products, value chains, as well as business models, as forms of adding, bringing to the customer and preservation of value, are being digitized as much as possible.

The authors of this theory have developed a methodology for determining the potential of digital breakthroughs in the economic sector, and also have applied it to 12 economic sectors under study based on interviews of about a thousand company top managers in 13 countries (Australia, Brazil, United Kingdom, Germany, India, Italy, Canada, China, Mexico, Russia, USA, France and Japan). According to the results of this study, industries are being subject to digital changes to different extents: the closer the industry is to the center, the faster and more extensively it will be involved in the digital whirlpool. The high-tech industry will certainly be at the very heart of the "digital vortex", the mass media and entertainment industry will take the second place, and retail will be the third. Tourism and hospitality industry take the seventh place in the ranking of the potential for digital transformations. The movement in the "digital vortex" exists not only due to the impact of technology. The digital technologies are facilitative of the creation of the new business models that, in its turn, create new values for customers. The result of the digital revolution may be the disappearance of many companies and the re-profiling of markets, and moreover these processes will occur at a rapid rate. The research showed that as a result of the development of modern digital technologies in each of the 12 economic sectors under study, about 40% of existing organizations will disappear over the next five years. Competitors that are able to destroy their business may appear within the industry or come from the outside

(startups). In the end, the winner will be the one who offers the brightest ideas to solve the problems of their clients. Despite the fact that the risk of a digital divide leading to the complete destruction of a company in the tourism and hospitality industry is recognized by experts as the highest (49% of the respondents consider such a probability as possible), 45% of companies either do not see the risks associated with digital revolution, or treat them not seriously enough and do not see the need to bring the issues of digital transformation of the company to the level of the Board of Directors.

One of the world's leading retailers, the *Metro group* and the *Lausanne School of Hotel Management* conducted a study within the framework of which they analyzed the use of digital solutions in the hospitality industry and provided answers to the most, if not all, questions related to the digitalization of the economic sector. The study involved 3405 independent restaurant employees (from managers and owners to chefs) from Japan, Germany, France, Italy and Spain. At the same time, employees of completely different food outlets were polled: there were fully-featured restaurants, cafes / bars, fast food businesses, and canteens, and even commercial kitchens that are working only as carry-out service for take-away ready meals (Gagarin, 2017). The survey found that the main reasons why restaurant operators in France, Germany, Japan and other countries refrain from investing in digital technologies are the lack of priority and development strategies, as well as high costs. Thus, it should be noted that many business leaders have not adapted yet to the possibilities of digital transformation or to the conceptual breakthrough that it suggests.

Implementation of Digital Innovations in the Hospitality Industry

However, in order to meet new trends, as well as to increase management efficiency and to reduce costs, restaurants have to automate processes and to implement digital solutions. Customers increasingly want to pay bills from their mobile devices.

According to the same survey, 27% of restaurant visitors prefer to pay for dinner other than in cash. Gadgets with special software that allow the waiter to accept an order, to send it to execution and to form an bill in a few taps are becoming a universal solution. For example, the startup from Boston called *Toast* specializes in development of such software. Seven years ago, the company began to offer a cloud-based platform for solving several tasks — accepting and processing orders, creating invoices, accepting payments and collecting analytics. In restaurants, the platform was solved on *Samsung* tablets used by waiters. At the present time, the startup is manufacturing its own hardware devices *Toast Go*. A gadget with Internet access is designed entirely for working with restaurant software and is intended for “extreme” working conditions - for example, it is protected from moisture and heat (in case coffee is spilled on the tablet or it falls on the cooker).

In May 2018, a new fast and healthy food restaurant *Spyce* was opened in the center of Boston, which has been equipped with a robotic kitchen. This cafe has an open kitchen, where there are seven independent units for preparing food. Visitors choose in the electronic menu one of the dishes of international cuisine. Then the ingredients automatically fall into one of the machines for cooking. Two cooks, who are engaged in cutting kitchen-stuff and serving are working in the whole food outlet.

In China, in November 2018, *JD.com*, a large online retailer, opened the first fully robotic restaurant and announced plans to launch up to 1,000 such catering points by 2020. All processes are automated in this restaurant: ordering, preparing and directly cooking of food, plating and waiting tables. The restaurant is able to accommodate about 300 visitors for dinner, while guests take turns at the same table about three times per hour in the evening and at lunch time. The cafe *JD.com* offers about 40 kinds of dishes, which are mainly prepared by quickly roasting with constant stirring. In the future, it is planned to increase the menu list to more than 200

items. In addition to taking food, the restaurant offers the opportunity to play interactive games in the format of virtual reality.

Early February 2018, a new cafe opened in Shibuya, a shopping and business district of Tokyo, where a one-armed robot named Sawyer is working as a barista. In order to drink coffee prepared by a robotic waiter, visitors of the cafe called *Henn na Cafe* (to be translated from Japanese as “an unusual cafe”) has to select and to pay for a drink in the vending machine, and then to hand over the check with the QR code to the barista. The robot not only fulfills the order, but also talks to the customer. It takes the robot a few minutes to complete the order. Sawyer can serve up to five customers. It should be noted that the travel agency H.I.S., which owns the innovative cafe, also owns a network of hotels in Japan, the *Henn na Hotel*, which also uses robots. So, in 2015, they opened the first hotel in the world where most of the living employees has been replaced by the robots. Devices of different models and shapes acted as administrators, hotel maids, receptionists and other employees. However, in January 2019, the management of the *Henn na Hotel* (“Strange Hotel”) had to cut more than half of the 243 robots and hire people. The reason is inefficiency and persistent problems in the workplace. Despite the thematic direction of the hotel, associated with robots, the guests admitted that the robots rather annoyed them during their rest. The administration of *Henn na* believes that the problem lies in the too rapid development of some technologies and the obsolescence of others. Many robots have worked in the hotel for almost four years, and during this time many devices have «gone forward», including *Siri* or *Google Assistant*. The hotel management did not give up the concept of an automated hotel, but acknowledged that the complex still needs people yet (ProHotelia, 2019).

Similarly, *McKinsey* points out that robots will not be able to replace people, but will change the appearance of working places. About 60% of professional activities using already existing technologies can be

automated by 30 percent. However, only less than 5% of professions can be fully automated (NAURR, 2016). And this, first of all, in our opinion, will occur in mass customer service, where the main competitive advantage of the company is the speed of service or price (fast food, retail, bed & breakfast, etc.). But in the field of personal service robotics (consumer robotics), customer perception of security is closely related to psychological comfort. According to analysts, for many market segments (personal assistants, etc.), optimal solutions have not been found yet in terms of appearance and interfaces, which should ensure simplicity and comfort in the use of robots. In order to make robots be able to compete with people in individual customer service, the logic of their behavior and control must reach a new level of complexity.

Therefore, hoteliers should certainly make strategic decisions about where and when to invest in technology upgrades. This process begins with an understanding of whether innovation is an essential step in creating a memorable positive experience for guests or just their passing fancy.

Recently, trends in the field of digital transformation are changing, and there is a transition from advertising to real functions for users and owners of complexes. The advantages in increasing comfort, saving resources and overall simplicity of interactions with users are becoming noticeable. So, innovator in the hospitality industry, a network of hotels and resorts *Four Seasons* in 2017 launched a multi-channel message passing service, in which there are no robotic answers. The service is for 100% operated by people and is equipped with the function of accurate and prompt translation in more than 100 languages. The average response time is no more than 90 seconds. Guests of hotels and resorts in the network can use the *Four Seasons Chat* service to send any questions and suggestions.

The hotel chain *Marriott International*, which is also one of the technological leaders in the field of hospitality, in collaboration with *Samsung* and *Légrand*,

announced the creation of a working group for the development of smart hotels in late autumn 2017. Key features of the solutions being developed are customer interaction with service personnel via voice commands and mobile phones. It should be noted that several years ago, the same technology leader already had a negative experience in organizing interaction with hotel maids, while it has implemented the *HotSOS Housekeeping* application developed by *Amadeus* and nicknamed «*Rex*», which had to «save time and manpower by more quickly providing hotel rooms for guests» (*ProHotelia*, 2018). The innovation was supposed to facilitate the work of hotel maids. Every morning they received an iPod, on which an application was installed, promptly showing which rooms needed to be cleaned at the moment, and it allowed managers to give them the tasks «in passing» at the request of suddenly arrived customers.

However, the result of the implementation of a new tool was the lack of flexibility and getting problems with guests, because it was difficult for the hotel maids to organize their working day (to plan convenient logistics of their movements, to change the schedule of housekeeping flexibly depending on the wishes of the visitors to the hotel, etc.). This experience shows how important it is not to chase technology, but to be able to analyze how effective and justified will be the integration of innovations in a particular object, as well as to predict what difficulties a hotel or restaurant may encounter after the implementation of a certain technology. In some cases, it is necessary to prepare the infrastructure and personnel for innovations, in a better way and in some cases - to refuse or to postpone integration until a fitter moment.

Certainly, not every idea can give a positive result in an innovative environment, so businesses have to be prepared for risk. Meanwhile, any digital changes must be accompanied by cultural changes, as well as supported by continuous investments and innovations. This makes transformation an endless process. To ensure successful digital transformation

and reduce the risks of innovative projects of hospitality industry enterprises, the following basic conditions, in our opinion, must be met:

1. Innovative vision and implementation of a flexible culture

First of all, business leaders in the industry need to form their own understanding or strategic vision of how digital capabilities can support their business and competitiveness. While tech-savvy competitors and mediators are attacking the value chain and invading the relationship between hoteliers and their guests, traditional hospitality must adapt and be as flexible as possible for their prosperity. Hotel managers and employees will have to change their approach to work, be able to anticipate tomorrow's trends and respond to them faster than competitors, by speeding up the decision-making process. To do this, you need to reduce the number of levels in the organization, as well as develop innovative entrepreneurial thinking and introduce a special culture with constant testing and training, collection of feedback in real time, and development of partner relationships with all types of companies: from tech giants to innovative start-ups.

2. Creation of flexible IT-infrastructure

A key tool for moving from a strategic vision to action is the company's digital strategy, which must have the right platform and structurization to ensure the best guest experience. In modern conditions, the complex and ambiguous problem of digital management of business processes in a hotel enterprise, as a rule, is successfully solved by the *Property Management System* - an integrated system of operations that allows automating all guest service cycles and business processes in a hotel (from the work of maid service to the formation of a complete financial reporting and statistics reflecting the indicators required for the analysis). The hotel's IT infrastructure must also be flexible, allowing operational integration of new services and constant adaptation to

the rapidly changing technological environment. It is important to determine that the services provided by booking services, revenue management systems or payment solutions are safe, efficient and consistent with the geographical and cultural features of the hotel. In order for hoteliers to integrate them quickly and at minimal cost, they must be implemented on a "plug-and-play" principle.

3. Building of personalization service

In conditions of high competition in the hotel business, hoteliers are constantly faced with the need to maintain an individual approach to the guest on the basis of innovative marketing tools. Artificial intellect is of key importance in achieving such mega personalized services. As the transition from interactive to predictive era occurs, artificial intellect can respond to search queries that the guest enters online and put forward the most relevant suggestions regarding guest preferences and the history of their stay at the hotel. The platform algorithms can provide hoteliers with the ability to send necessary messages and relevant information. For example, it may be a birthday greeting to a guest or giving the golfer information about nearby sites. Consequently, the main task of a digital strategy is to collect, process, analyze and aggregate data in accordance with the privacy policy in order to better understand and interact with guests. The actual interest in the application of digital technologies in the hotel business is due to the fact that based on them it is possible to transfer habitual communication mechanisms to the digital environment, which makes it possible to use traditional schemes on a qualitatively new digital basis.

4. Focus on the speed

The modern period of development of society is focused on the accelerated digitalization of all processes and phenomena. So, if quality played a key role in the 1980s, and business process reengineering - in the 1990s, the key

concept of the last two decades was speed. The introduction of new technologies in the field of hospitality is determined by the rate of change in the very nature of the business, including the need for the operational management of business processes and the dynamics of changes in consumer demands under the influence of greater information availability. These new methods of organization of work are necessary to maintain a culture in which the business will actively develop, and to keep up with constantly changing consumer habits.

In such a way, Industry 4.0 is slowly but surely penetrating the hospitality industry. The digital innovation start-ups and pilot projects of high-tech industry leaders discussed in this article indicate the beginning of the digital transformation processes in the enterprises of the hospitality industry, the purpose of which is to create more comfortable and efficient interaction both within the company and with the company's customer to meet its needs, which in their turn, change together with the development of technology.

Conclusion

Transformation affects all aspects of business, ranging from strategic objectives to infrastructure. Therefore, the implementation of Industry 4.0 at the enterprise requires a deep understanding of the interaction, purposeful work of top management and a well-developed strategy. This process does not set as its goal the transformation at any cost and does not reject the values acquired by the company. Its principle can be formulated as «conducting evolution in a revolutionary way». The basis of the transformation is the rule of continuous improvement. It is the awareness of the need to improve something that triggers this process. The companies that cannot transform will fight for survival. In such a way, the digital advantage in the hospitality industry lies not only in the ability to adapt products and services to the needs of individual customers - but also in creating strategies and structures that would better fit the features of the company. On the threshold

of another industrial revolution, the hospitality industry enterprises are faced with the conscious need to find the perfect balance between traditional and digital style by developing their own «digitalization roadmap».

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