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Economic Conditions for the Development of Historic Hotels in Poland in 2023–2024

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Abstract

Theoretical background: The authors see a research gap related to the lack of studies on the economic determinants of the development of historic hotels on a nationwide scale and the essence of the importance of accounting in the hotel industry.

Purpose of the article: The aim of this article is to examine the economic factors that influence the development of historic hotels in Poland.

Research methods: Analysis of existing data, literature criticism, and a survey of a deliberately selected group of owners and managers of historical hotels (permanent and seasonal) of all categorisation levels

in Poland, hotel facilities, both in cities and rural areas. It is necessary to mention the limited access to confidential sensitive data, the refusal of representatives of some hotels to participate in the research, and the suspension or cessation of operations of a number of facilities. The results of the study may be of interest to owners and managers associated with the hotel industry, as well as students of studies related to hotel management.

Main findings: The research showed the complexity of the nature and scale of the impact of economic and financial factors on the development and operation of historical hotels in Poland. A large number of entities participated in the study (403 out of 438 historical hotels), which covered facilities throughout Poland. Identification of key economic conditions influencing the development of historic hotels in Poland. Determinants such as geographical and architectural, financial, qualitative, legal, and specific factors (including additional services, applied management strategy) were identified.

Introduction

The hotel industry is one of the oldest types of economic activity in the world (O’Gorman, 2010). Today, it plays a significant role in the global tourism economy, especially in generating income and creating jobs. Hotels meet a wide range of diverse and often sophisticated needs of guests (Kyfyak & Kyfyak, 2024). The development of historic hotels is an example of the constant changes that are taking place in the hotel industry (Tang & O’Neill, 2025). After many years of popularity of modernist chain hotels around the world, the time has come for facilities that adapt to the specific requirements of the modern tourist to a much greater extent. Historical hotels offer services that differ significantly from the standard accommodation services of many previously known hotels (Elshaer et al., 2022). Taking into account the growing popularity of historical hotels around the world, it is worth analysing the factors that influence its development.

Literature related to historical hotels has been present since the beginning of the 20th century (Ludy, 1927), although its intensification occurred at the beginning of the next century. During this period, many significant studies appeared in the field of historical hotels, including: Morehouse (2013), Peche (2019), Ownley Cooper (2020), or Wallach et al. (2008). In the case of domestic authors, Kaniewska (2009), Kaniewska and Micuła (2007), or Hyski and Bednarzak (2012) are worth mentioning. However, when analysing the world literature, it should be noted that most publications on the discussed topic concern selected aspects of the functioning of historic hotels or are limited to specific local systems. Therefore, the authors see a research gap related to the lack of studies on the economic determinants of the development of historic hotels on a nationwide scale and the essence of the importance of accounting in the hotel industry.

The main research problem is to identify the economic factors that influence historic hotels. In connection with the research problem formulated in this way, based on the literature review, the authors posed the following research questions:

RQ1: What are the key economic factors that influence the development of historic hotels?

RQ2: What elements do customers pay attention to when choosing a historic building as a place to stay?

RQ3: What costs dominate in the hotel industry?

RQ4: What is the role of accounting in hotel management?

RQ5: Is there cooperation between historical hotels and start-ups?

The motivation for continuing with the topic discussed was the personal scientific interests of both authors.

The remainder of the article is organised as follows. Section 2 presents a review of the literature on the historical hotel industry and economic determinants of growth. Section 3 contains the applied methodology. Section 4 discusses the results of the study.

Literature review

Historic hotel industry

Historic hotels in the world literature first appeared in the first half of the 20th century. The current and past state of historic hotels in the world appeared in the literature in Ludy (1927). Morehouse (2013) described the unique services of the historic Millennium Biltmore Hotel. Peche (2019) analysed the historical hotel market in San Antonio. Ownley Cooper (2020) provided a broad discussion of historic hotels in the state of North Carolina. Wallach et al. (2008) described historic hotels in Los Angeles and Hollywood.

Outside the US, Kalinina and Golovchenko (2022) attempted to analyse the concept of historical hotels and their impact on shaping the tourist attractiveness of Irkutsk and other Russian cities. According to the authors, the concept discussed is based on providing adequate human resources, creating a historical atmosphere of stay, as well as appropriate arrangement, availability of additional hotel services or cultural programmes. Volokhov (2017) characterised the key benefits and characteristics of hotels located in historical buildings. Dimitrov (2023) analysed the development of the hotel industry from a historical perspective in the Macedonian city of Bitola.

Kendir et al. (2023) conducted research on opinions about historical hotels in Amasya, Turkey. The research results of the authors indicated that customers value the architecture of hotels, the quality of rooms, food, and the level of service the most. They criticized the most noise and lack of parking spaces. Yabancı (2022) addressed the importance of historical hotels in Istanbul in his literature. The research results showed that these facilities are widely considered important elements of the industry because they create emotional, cultural, and utilitarian values. Xie and Shi (2020) discussed the characteristics of historical hotels in Turkish Anatolia. According to the authors, the attractiveness of the facilities is based on the rich historical and cultural legacy of the historical region discussed.

The analysis of historic hotels in Johannesburg was carried out by Rogerson and Rogerson (2018). The research results revealed the role of the best facilities in the city as centers for the implementation of new technologies and centers of elite sociability. The influence of quality and innovation on the pricing policy of historic hotels in Slovakia was discussed by Čircowa and Gburova (2023). According to the authors, historic hotels face complex challenges related to modernisation and competition in today's domestic and global markets. The prices they set for their services are based on key factors that influence their competitiveness and long-term sustainability. The experiential quality issues of heritage hotels, using the example of hotels in Malang, Indonesia, were addressed by Hussein and Hapsari (2020). The research results showed three dimensions of the experiential quality of heritage, namely physical experiential quality, experiential quality of interactions, and quality of heritage aspects. The historical hotel industry as a quasi-freedom machine was discussed by Minca et al. (2014) using the Lloyd Hotel in Amsterdam as an example. The authors examined the historic Lloyd Hotel in Amsterdam, which was recently adapted to serve as a "quasi-freedom machine" for cultural and heritage guests.

In Poland, Kaniewska and Micuła (2007) conducted an inventory and discussion of the past of 234 domestic historical hotels and their tourist offers, divided into individual regions. Kaniewska (2009) conducted a description of selected historical accommodation facilities. Szmygina (2009) examined the possibilities, premises, limitations, and challenges that accompany the adaptation of historic facilities to contemporary utility functions. Musiaka (2012) attempted to discuss the characteristics that facilitate the tourist use of medieval castles in Pomerania, Warmia and Mazury and their impact on the surroundings.

Rouba (2004) raised the issue of organising historical hotels. The author divided the organizations into national, international, and parahotel ones. He also devoted his attention to Polish industry organisations. Ciesielska et al. (2006) raised the issue of historical hotels in relation to industry organisations. The results of the research of the authors showed that consolidation processes in historical hotels are a typical phenomenon in the 21st century.

The hotel industry in castles and palaces appeared in Szerfer (2013). The author's research results showed that hotel facilities located in historical monuments attract guests with the atmosphere of years gone by, legends from the past, personalities of former owners and the unique character and climate of the rooms offered.

Sala (2021, 2022a, 2022b) discussed the conditions for the development of historic domestic hotels of a higher standard. Sadkowski and Sala (2021, 2022) characterized the impact of the pandemic on quality management in historical hotels in Poland and perception of quality costs. The authors' research results showed that historic hotels do not use quality cost calculations and that employees' knowledge about them is low. Rajko et al. (2022) discussed the quality costs of historic boutique hotels in Kraków and Zagreb.

Economic determinants of hotel industry development

The factors shaping the development of the hotel industry can be identified with those that determine the development of tourism demand. They can be classified into six groups as factors: economic, demographic, legal and political, media influence, and psychosocial factors (Dziedzic & Skalska, 2012). Economic factors are divided into price and non-price factors (Dwyer et al., 2010). In turn, Wodejko (1998) classified economic measures as: general economic (including unemployment rate, level of national income), income (including the level of development of social forms of tourism), and price (including the level of prices of tourist products, their changes). The most important economic determinant in the macroenvironment of the tourism market is the individual income of households calculated per person (Dziedzic & Skalska, 2012).

Achieving a competitive advantage and modernising business processes in the hotel industry is possible thanks to the implementation of innovative solutions (Cobos et al., 2016). Improving websites and equipping them with advanced functions based on advanced technologies is one of the examples of innovative solutions (Shabanov et al., 2021). Kaluderović (2019) emphasizes the importance of modernising infrastructure and improving the quality of basic equipment as factors that support the development of tourism.

The concern of the hotel industry for the quality of services provided due to its impact on internal results (productivity, costs, waste) and external results (sales revenues, market share, customer satisfaction, company image) is noticed by Milovanović (2014). An attempt to evaluate the implementation of TQM in Serbian hotels by Milovanović showed the existence of a relatively high level of quality concerns.

The success and development of a hotel can be ensured by a combination of marketing, economics, planning, and design activities, but also by attention to location and a professional team (Cloete & Venter, 2007). Research conducted in hotels in Ukraine allowed to identify such development factors as: infrastructure development, local and regional hospitality, the use of automated management systems, the level of digitalisation, the management's focus on brand promotion, image and branding, as well as the development of an effective development management strategy (Aleskerova & Fedoryshyna, 2023).

The ecological approach (care for the environment, implementation of ecological processes) in hotel operations also draws attention, which brings benefits in the form of reduced operating costs or improved image. This is confirmed by research on the Romanian hotel industry (Stefanica et al., 2020).

The development of the hotel industry should also be related to the issue of sustainable development. Ecological motivations (moral, instrumental, relational) and green business strategies enable the achievement of sustainable development goals. This is confirmed by the results of research conducted in Pakistan in 5-, 4- and 3-star hotels (Yousaf et al., 2021). Spencer and van Zyl (2015) present the key success factors for the hotel industry in Cape Town:

- strategic factors (location, financing, financial and budget planning, physical buildings);
- operational factors (hotel finances, human resources, marketing, warehouse procedures, and daily operating methods);
- human resource factors (identification, recruitment, training and deployment of personnel at all levels of the organisation's activities);
- technological factors (relating to the electronic control of the hotel's operational functions).

Mateczak (2017) confirms the dependence of growth in hotels in Poland on the economic situation. Economic growth has a similarly positive impact on the development of hotel infrastructure and tourism as a whole. Mashika et al. (2021) identify such key success factors in modern hotel, restaurant, and tourism (HRTOS) as: skills and experience, qualified personnel, competitive opportunities, significant fixed assets, organisational resources, intangible assets, partnership or joint cooperation.

An important group of economic factors are price measures. The determinants of accommodation prices in rural tourism in Romania were examined by Gordan et al. (2023). It turns out that prices are largely influenced by luxury amenities (spa, saunas, swimming pools) and location in areas with lower population density (rural areas). The determinants of hotel development in the example of the Chinese city of Sanya were also examined by Ma et al. (2022). The researchers indicate equipment, price level, market popularity, and traffic conditions as the main factors.

Fuentes-Medina et al. (2018) wrote about the critical success factors of Paradors hotels in Spain based on guest feedback. Research results indicate that the location attributes of the facilities are critical success factors that are expected *a priori*, considering the nature of the business of such facilities, based on the unique nature of the buildings.

Papamo and Naipinit (2023) wrote about the factors that influence the improvement of hotel business in Thailand after the global COVID-19 pandemic. According to the authors, the COVID-19 pandemic has affected hotel operations and revenues. The research results indicate that more attention should be paid to hygiene, modern marketing strategies based on websites instead of face-to-face contacts, and the use of digitalisation for interpersonal contacts. The impact of COVID-19 and ecological factors on the economic development of China's hotel industry was also reported by Ba et al. (2022). Income, labour, carbon dioxide emissions, waste emissions, and water consumption are the internal drivers of China's tourist hotels, while the industrial structure, urbanization rate, energy efficiency, and information technology are the external drivers of China's tourist hotels.

Economic, financial and organisational aspects of the development of hotel enterprises were discussed by Puciato (2016). In his work, the author emphasised the importance of maximising profits and minimising costs in hotel operations. Moreover, he emphasised the important role of accounting and proper financial management in the operation of hotels. Financial issues in the management of a tourist enterprise were characterised by Binczysko (2011). The author described the management of a tourism

enterprise using international accounting standards, managerial knowledge, and the ability to use information systems in the field of purchasing, sales, marketing, personnel, and finance. The selected conditions for the development of the hotel industry in Poland in the years 2004–2013 were described by Firlej and Spychalska (2015). The research results of the authors revealed the importance of the economic situation of the country, the location of the facilities, the macroenvironment, the state of security and communication in the country, and standardization as key factors determining the development of the hotel industry in Poland in 2004–2013.

Sala and Musiał (2007) wrote about the determinants of the development of the tourism economy, including the hotel industry in the Limanowa subregion. In their conclusions, the authors pointed to the creation of new attractive tourist products, supporting existing and new types of tourism, and supporting the development of accommodation facilities, especially agritourism.

Research methods

To achieve the assumed goal, the authors used a prepared four-stage research procedure. Its stages and methods used by the researchers are illustrated in Table 1.

Table 1. Research procedures and methods

Stage	Name	Method used
1	Preparing the interview questionnaire	Analysis of the literature on the subject
2	Conducting interviews with employees of the researched facilities	Face-to-face interview
3	Interview transcription and research results analysis	Coding of interview data + data analysis
4	Collecting important data obtained from research and formulating research conclusions	Synthesis + inference

Source: Authors' own study.

In the first stage, the authors analyzed the literature on the subject and, based on the information collected, prepared an interview questionnaire, which was divided into three blocks of questions organized as follows.

Block I: Economic factors in the development of historic hotels.

Block II: Accounting in the hotel industry.

Block III: Startups in historic hotels.

The questions in Block I allowed us to identify the factors that influence the development of historical hotels (RQ1) and indicate the elements that determine the choice of a historical facility by hotel guests (RQ2). The questions included in Block II provided answers on the dominant costs of historical hotels (RQ3), as well as the role of accounting in hotel management (RQ4). The questions of Block III allowed us to determine whether there is any type of cooperation between hotel facilities and startups (RQ5).

The second stage consisted of conducting interviews with employees of the surveyed organisations. Research in historical hotels located in Poland was carried out between June 2023 and March 2024. The interviews were online. The selection of research entities (hotels) was preceded by a thorough market analysis using primarily a publicly available government hotel database (CWOH – Central register list of hotel facilities¹) and a database of objects entered in the register of monuments. Contacts with respondents were based on previously prepared databases and contact details.

In the third stage of the study, the authors carried out a comprehensive analysis of the collected research material and attempted to develop the research results. The activities carried out involved the transcription of interviews, coding of the data from interviews, and analysis and interpretation of the data obtained. A coding key based on the method of creating a general code scheme was used to code the data. Each response was assigned an appropriate numerical value and the coded responses of the employees were entered into a response sheet, which was used to interpret the results of the interviews.

The last and fourth stage of the investigation consisted of synthesising the results obtained and formulating conclusions from the investigation carried out.

The study involved 403 hotels of the 438 existing facilities of this type (92% of all historical hotels located in Poland were studied). 35 facilities were not studied because 10 of them refused to participate in the study, and 25 are hotels that are permanently closed, temporarily closed, or undergoing renovations. In few questions hotel representatives spoke for customers, because satisfaction surveys are carried out in hotels and that the answers result from these surveys. The hotels surveyed were represented by people holding different positions. The authors presented the surveyed hotels in the form of a Pareto–Lorenz diagram (Figure 1).

¹ <https://turystyka.gov.pl/cwoh>

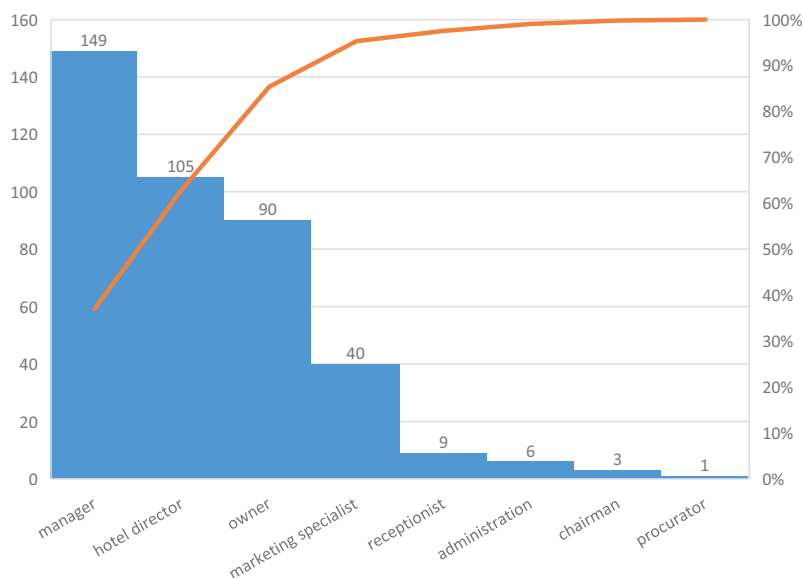


Figure 1. Pareto–Lorenz diagram of respondents

Source: Authors' own study.

The largest group of people surveyed in hotels (almost 90%) were managers (149), hotel directors (105) and owners (90). The remaining 10% were marketing specialists, receptionists, administrative staff, chairmans, and procurators.

The distribution of the surveyed hotels according to their size is illustrated in Figure 2.

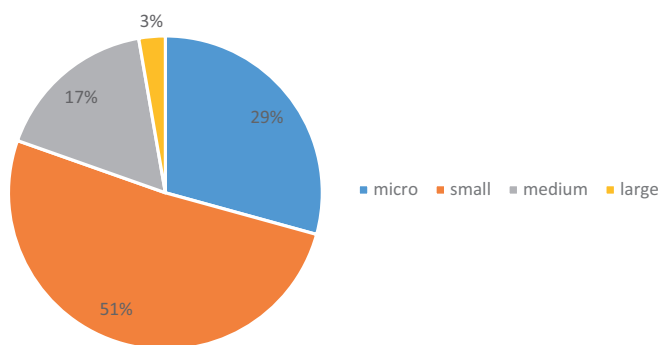


Figure 2. Distribution of the surveyed objects according to the size of the enterprise

Source: Authors' own study.

Among the hotels surveyed, more than 50% are small enterprises. Micro-organisations make up 29% of all surveyed, and medium-sized organisations – 17%. Large entities are the least represented (3%).

The distribution of the surveyed hotels according to the number of years of operation on the market is illustrated in Figure 3.

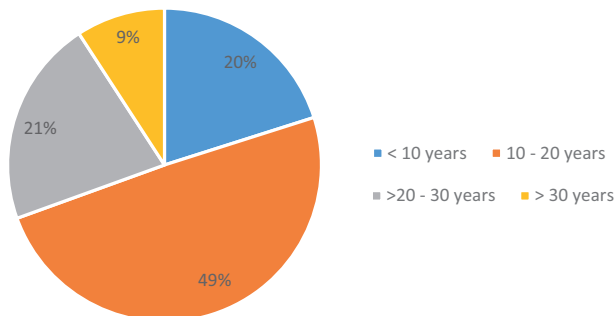


Figure 3. Distribution of the surveyed facilities according to the number of years of operation on the market

Source: Authors' own study.

49% of the organisations analysed have been operating on the market for 10–20 years, 30% of the hotels have been operating on the market for longer (over 20 years or more), and 20% of the group are entities operating on the market for no longer than 10 years.

The arrangement of the hotels analysed by the province in which they operate in Poland is illustrated in Figure 4.

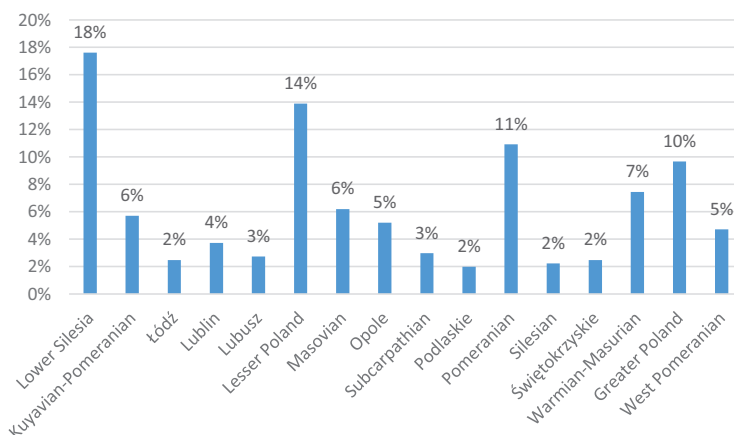


Figure 4. Distribution of the objects studied by province

Source: Authors' own study.

The most numerous represented provinces are Lower Silesia (18%), Lesser Poland (14%), Pomerania (11%), and Greater Poland (10%). The fewest hotels (2% each) come from the following provinces: Łódź, Podlaskie, Silesia, and Świętokrzyskie.

It is worth emphasising that the results obtained constitute a small fragment of the analysed reality of the hotel services market, so generalising conclusions for the entire hotel industry would be an abuse. The authors approach the results obtained with caution, and the constructed conclusions can be the basis for further research in organisations providing such services.

Results

The results of the research obtained will be discussed in this part of the publication. They will be complemented by a graphical presentation of the most interesting answers.

Block I. The first two questions concerned the applied pricing method (no. 1) and the competitiveness elements of historical hotels on the hotel market (no. 2). Respondents indicated that the dominant pricing method is the demand method (38%), every fourth respondent chose the competition method (25%), the cost method was indicated by 18% of hoteliers, the remaining units were unable to determine the correct one (19%). In turn, the factors of competitiveness of historical hotels on the hotel market are illustrated in Figure 5.

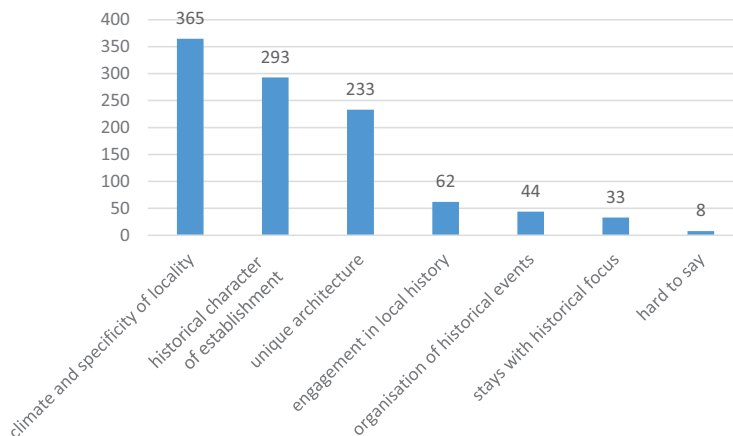


Figure 5. Competitiveness factors of historic hotels in the hotel market

Source: Authors' own study.

The vast majority of historic hotels attribute the competitiveness of their facilities to factors such as climate and specificity of the location (in 365 facilities out

of 403), historic nature of the facility (293/403) and unique architecture (233/403). Respondents attributed a lesser importance as a factor of competitiveness of these facilities to involvement in local history (62/403), organisation of historical events (44/403) and organisation of stays with history in the background (33/403).

The next questions in this block concerned the impact of the historic nature of the facility on its operating costs (no. 3) and identification of other factors significantly affecting the operating costs of this type of hotel (no. 4). The respondents indicated that the historical nature had a significant impact on the costs of their organizations (63%). 16% had the opposite opinion and 21% did not. The list of cost drivers in historic hotels is illustrated in Figure 6.



Figure 6. Factors determining the level of costs in historic hotels

Source: Authors' own study.

The main factors influencing the level of costs in historical hotels are primarily: the specificity of the historical building (in 195 hotels out of 403), the requirements of the conservator of monuments (171/403) and the prices of historical furniture and arrangement (92/403). Only a few considered the employment of specially qualified staff (17/403) and the membership fee in historical hotel organisations (5/403) as cost-generating factors.

In the next two questions, the authors tried to obtain an answer regarding the role of the hotel's categorisation in guests' decisions when booking (no. 5) and the impact of the historical character on its occupancy (no. 6). The answers to question no. 5 are illustrated in Figure 7.

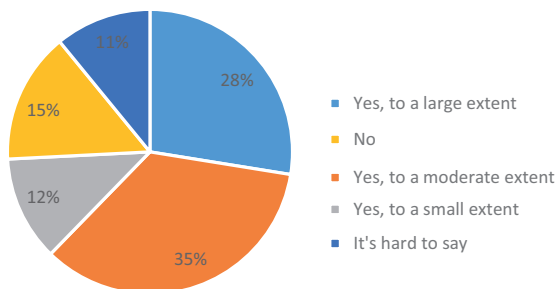


Figure 7. The impact of hotel categorization on guest bookings

Source: Authors' own study.

Hotel guests should pay attention to the facility category when making reservations. This is confirmed by 74% of the organisations surveyed (to a moderate extent – 35%, to a large extent – 28%, and to a small extent – 12%). 15% of the respondents have the opposite opinion. The results obtained for question no. 6 are illustrated in Figure 8.

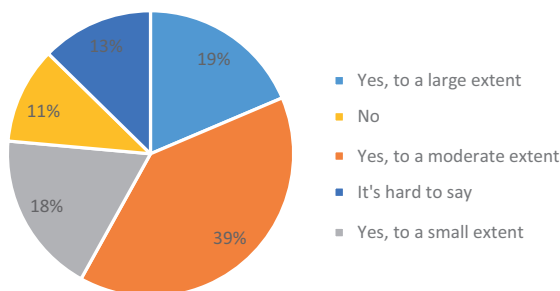


Figure 8. The impact of the hotel's historic character on its occupancy

Source: Authors' own study.

The results indicate that the historical character affects the occupancy rate of the facility, which is confirmed by 76% of hoteliers (to a moderate extent – 39%, to a large extent – 19%, to a small extent – 18%). The remaining people do not see such an impact (11% have the opposite opinion, and 13% have no opinion on the matter).

The next questions from this block allowed us to identify the factors that determine the choice of a historical hotel by customers (no. 7) and the services (apart from accommodation) on which guests spend the most (no. 8). The determinants of the choice of a historic hotel are illustrated in Figure 9.

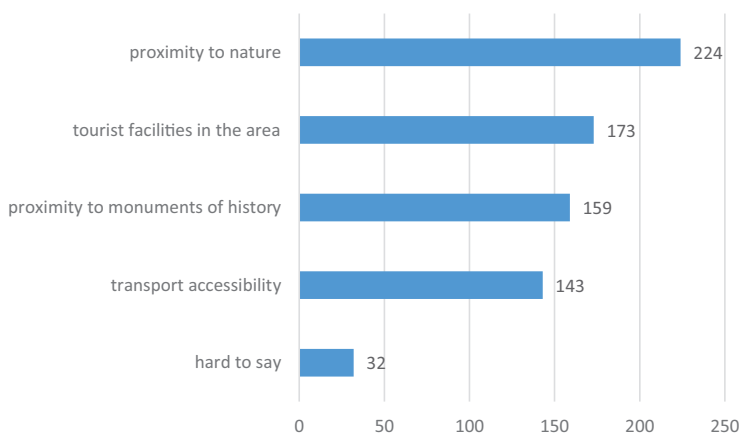


Figure 9. Determinants of guests' choice of a historical hotel

Source: Authors' own study.

The most important factors influencing customers' decisions about choosing a historical hotel are: proximity to natural assets (224/403), tourist development of the area (173/403), proximity to historical monuments (159/403). Accessibility by transport should also be considered an equally important factor (143/403). The structure of customer expenditure on services other than accommodation is presented in Figure 10.

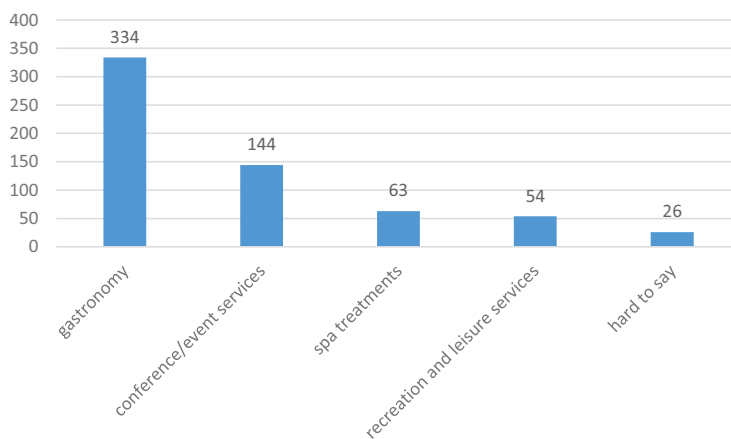


Figure 10. The structure of guest expenditure during a stay at a historic hotel

Source: Authors' own study.

The expenses of hotel guests during their stay in a historical facility are mainly related to gastronomy (334/403). 144 respondents also indicated expenditures on services related to the organisation of conferences/events, only 63 on SPA treatments and 54 on recreational and leisure services.

The authors then asked representatives of the hotels surveyed about the dominant customer profile in their facility (no. 9) and about the determinants of the amount of expenditures incurred by guests of their accommodation facilities (no. 10). The customer profile in the surveyed entities is illustrated in Figure 11.

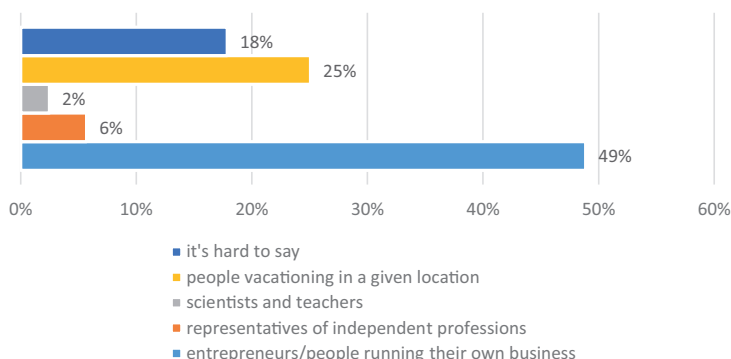


Figure 11. Customer profile in a historic hotel

Source: Authors' own study.

The clients of historical hotels are entrepreneurs/people running their own businesses (49%), people vacationing in a given location (25%), representatives of the free professions (6%) and scientists and teachers (2%). Figure 12 presents the most important determinants of hotel guest expenditure according to hoteliers.

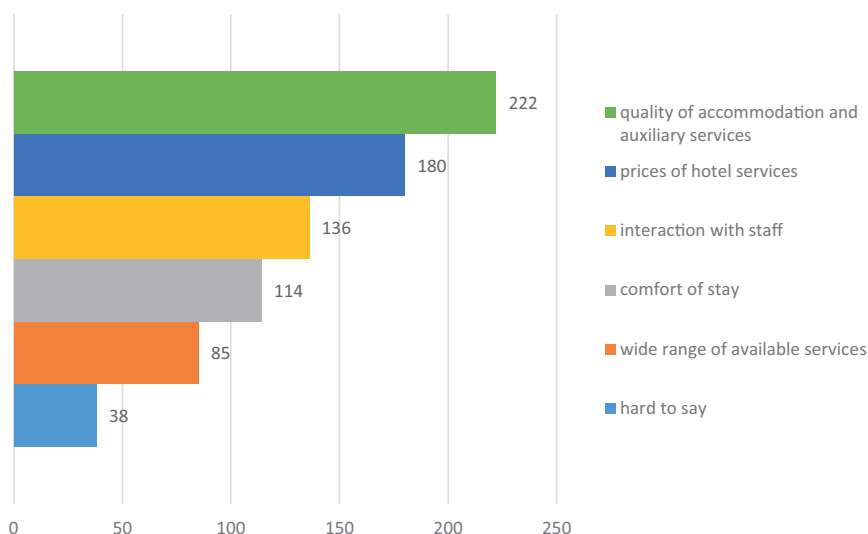


Figure 12. Determinants of guest spending in historic hotels

Source: Authors' own study.

The most important determinants of the size of guest expenditure in historical facilities are: the quality of the offered accommodation and accompanying services (222/403) and the prices of hotel services (180/403). It is also necessary to pay attention to such factors as the manner of service of the hotel staff (136/403), the comfort of the stay offered (114/403), and the wide range of services in the hotel (85/403).

Hoteliers were also asked about the level of revenue per room in relation to hotels with a modern character (no. 11). 39% indicated that these are comparable revenues, 17% see higher revenues, and 16% see lower revenues. 28% do not have an opinion on this matter.

In the last two questions of Block I, an attempt was made to identify the benefits that the historical nature of the hotel brings (no. 12), as well as the strategy used by the surveyed organisation (no. 13). The benefits are summarized in Figure 13.

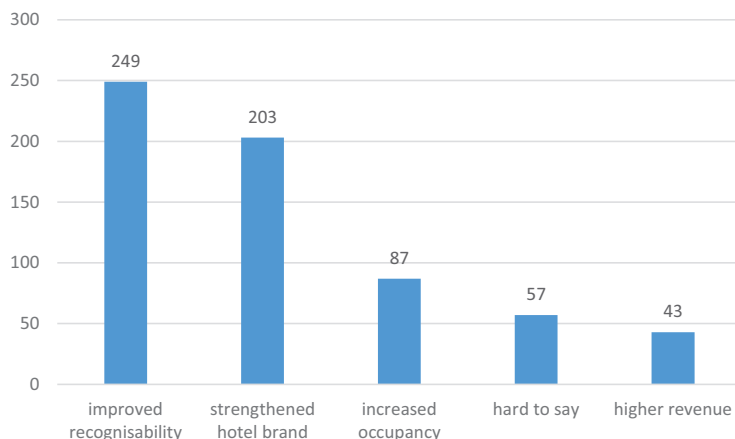


Figure 13. Benefits of the historic character of the hotel

Source: Authors' own study.

The most important noticeable benefits of the historical character of the hotel were indicated by the respondents: improved recognition (249/403) and strengthening the hotel brand (203/403). Less than 1/4 of hoteliers see benefits in the form of increased occupancy (87/403) and growing revenues (43/403).

In the case of question (no. 13) on strategy, the distribution of answers is illustrated in Figure 14.

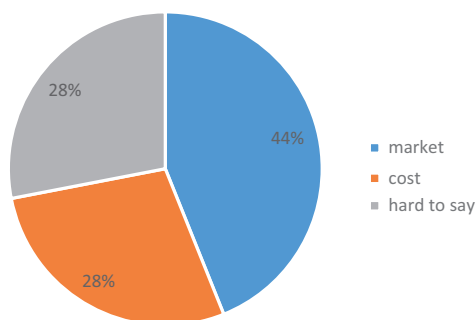


Figure 14. Strategy used in the management of historic hotels

Source: Authors' own study.

44% of organisations use a market strategy focused on maximising profits. 28% use a cost strategy that focuses on minimising costs, and 28% were unable to indicate any of the above.

Block II. The first question from this block concerned the management accounting tools used in the economic practice of the entity (no. 14). Figure 15 presents the distribution of the answers to this question.

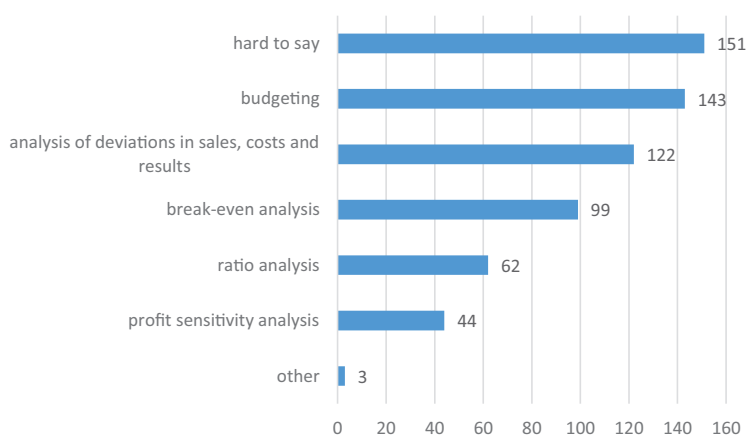


Figure 15. Management accounting tools used in historic hotels

Source: Authors' own study.

The most popular accounting tools used in hotel facilities are: budgeting (151/403), analysis of sales, costs, and results variances (143/403), and break-even analysis (99/403). Hotels also use analyzes such as ratio analysis (62/403) and profit sensitivity analysis (44/403). More than 37% of the respondents were unable to indicate any of the tools used in the daily business practice of their unit.

The next two questions in this block were to allow the authors to identify the activities that generate the most funds in historical hotels (no. 15) and which absorb

the most (no. 16). Figures 16 and 17 illustrate the answers to the questions no. 15 and 16, respectively.

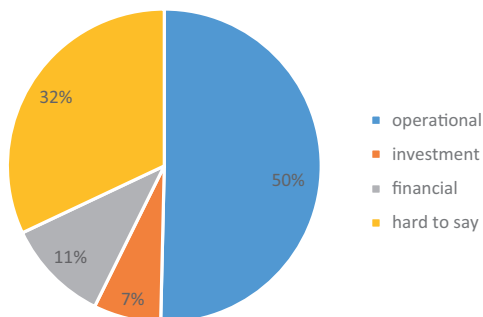


Figure 16. The most cash-generating activities in historic hotels

Source: Authors' own study.

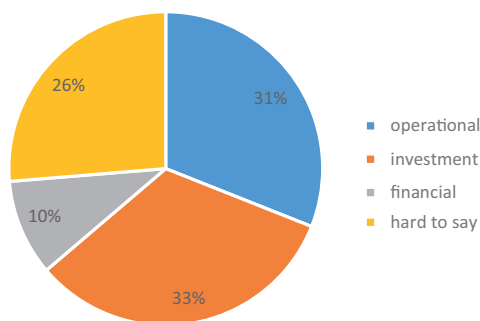


Figure 17. The most cash-consuming activity in historic hotels

Source: Authors' own study.

The largest amount of cash in historical facilities is generated by operational activity (50%), financial activity is only 11%, and investment activity is 8%. The largest amount of funds in the organizations surveyed is spent on investment activity (33%) and operational activity (31%) and only 10% on financial activity. Generating funds, especially from operational activity, and spending them primarily on investments and core activity is a good indicator of cash management in historical hotels.

The next question (no. 17) allowed the authors to diagnose which costs play the most important role in the hotels analysed. The list of costs is presented in Figure 18.

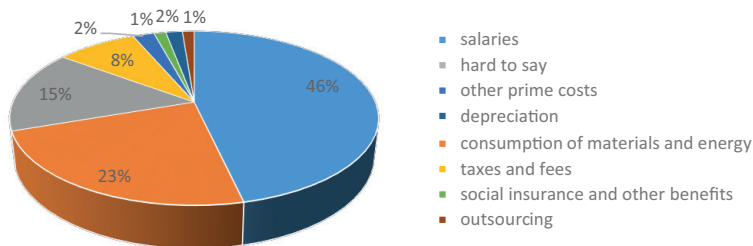


Figure 18. The highest costs occurring in historical hotels (according to the set of 4 costs – type arrangement)

Source: Authors' own study.

The dominant costs in historical hotels are salaries (46%). Costs of material and energy consumption (23%) also have a significant impact on the functioning of these entities. 8% are taxes and fees, while the remaining cost items do not play a major role in the cost structure of hotel facilities. 15% of the respondents do not know the costs they incur in their organizations.

The last question of Block II (no. 18) asked about the role of accounting in the decision-making process of the management of the surveyed hotel. The respondents were to choose a number on a scale of 1 to 5 (where 1 means *no influence*, 2 – *small*, 3 – *medium*, 4 – *large*, and 5 – *crucial*). The weighted average score of the answers obtained is 3.62, which means an average indicating a large role of accounting in decision making by decision makers in hotel facilities. The distribution of the answers is illustrated in Figure 19.

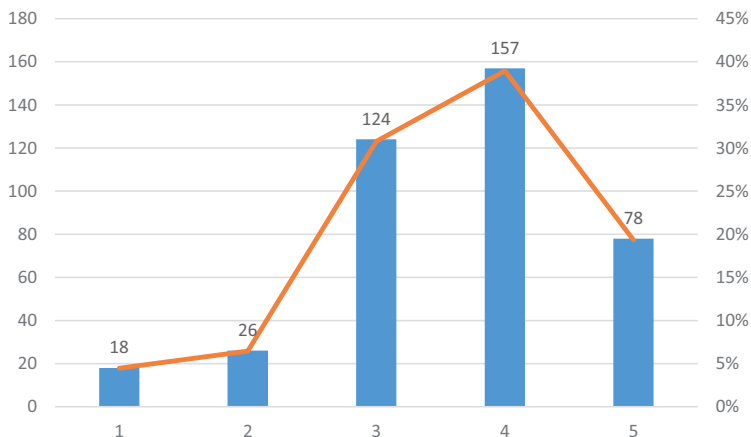


Figure 19. Assessment of the role of accounting in the historical hotels studied

Source: Authors' own study.

Looking at the results, it can be seen that accounting has no influence on the decisions made by the management only in 18 of 403 facilities, and in 26/403 it has a small influence. The prevailing belief is that the role of accounting is large (157/403) and medium (124/403). On the other hand, in practically every fifth historical hotel (78/403) accounting is of key importance in the decision-making process.

Block III. Respondents were asked to answer the question about their organisation's cooperation with start-up companies (no. 19). The distribution of answers is illustrated in Figure 20.

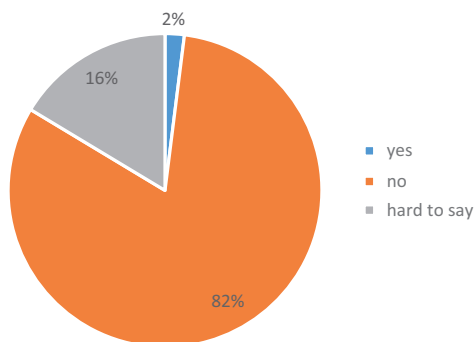


Figure 20. Collaboration between historic hotels and start-ups

Source: Authors' own study.

The answers provided indicate that cooperation between hotels and start-ups is practically nonexistent (82%). Only 2% of the facilities have such cooperation. According to the answers to question no. 20, it involves assistance in marketing and promoting the facility, support in concluding contracts, sending guests, and exchanging goods for goods. In the opinion of the respondents, it takes the form of a partnership agreement.

Discussion

RQ1: What are the key economic factors that influence the development of historic hotels?

The responses to the survey allow us to state that the key determinants influencing the development of historical hotels are geographical and architectural factors, financial factors, qualitative factors, legal factors, and specific factors.

The results of various studies allow us to state that economic factors can be divided into two categories: price and non-price (Dwyer et al., 2010). This type of ordering is related to the emphasis on the role of price as the main determinant. In the authors' opinion, such an approach is not appropriate because it gives marginal importance to all other factors unrelated to price and collects them in one large group.

Another classification is presented by Wodejko (1998), who divides measures into the general economy, income, and price. The importance of price measures is also highlighted by the results of the research by Gordan et al. (2023). The price level as one of the key determinants is indicated by the research by Ma et al. (2022).

According to Dziedzic and Skalska (2012), economic factors are one of six groups of determinants of the development of the hotel industry and tourism. Such an arrangement allows the identification of a broader perspective of potential elements that influence hotels.

The ecological motives and green business strategies presented by Yousaf et al. (2021) and Stefanica et al. (2020) were not included in the research results obtained for this publication, but they are worth paying attention to, especially in the era of the growing importance of the idea of sustainable development.

Aspects related to quality and proper personnel management were emphasised by Milovanović (2014), Alecu (2013), Basera and Mwenje (2021), Spencer and van Zyl (2015), Mucharreira et al. (2019).

RQ2: What elements do customers pay attention to when choosing a historic building as a place to stay?

The most important factors influencing customers' decisions about choosing a historical hotel are: proximity to natural assets, tourist development of the area, proximity to historical monuments. Accessibility by transport should also be considered an equally important factor.

Saura et al. (2018) identified in their research that the surrounding hotel environment has an impact on the customers' decision, i.e. clean air in the facilities and surroundings, lack of noise, and abundance of nature and plants in the hotel ecosystem. The results of these studies are similar to the answers obtained in historic Polish hotels.

Customer engagement affects higher coordination costs in hotels but also does not show a direct positive impact on the perceived quality of the relationship, as Ma et al. (2017) argue. The issue of hotel guest engagement has not been examined in this publication and may be the subject of in-depth research.

An interesting aspect was raised in his work by Waśkowski (2015). The development of sports tourism related to the need to participate in sports events and improve results, get to know new places related to sports, feel the unique atmosphere and prestige of sports events may also be important when guests choose a historical object as a place to stay overnight.

RQ3: What costs dominate in the hotel industry?

The conducted research has shown that the hotel industry is dominated by costs related to salaries, as well as costs of material and energy consumption, taxes, and fees. The benefits in the form of reducing operating costs by using an ecological approach were noticed by Stefanica et al. (2020). Puciato (2016) in his publication indicates the need to minimise costs in hotel operations. A significant role in the hotel cost structure is played by undistributed operational costs and non-operating revenues and costs

(Sarnecki 2020). Operating costs include wages and the consumption of materials and energy, and thus the dominant costs in historical hotels identified in this publication.

The overdue debt of companies in the hotel industry in Poland amounts to PLN one billion. Painful for the industry are the increases in the prices of energy, media, and external services, as well as rising labour costs, related to, among others, further increases in the minimum wage (Regiony RP, 2025).

RQ4: What is the role of accounting in hotel management?

The results of the research obtained indicate that the role of accounting in hotel management is average. Such results are different from previous studies.

Puciato (2016) highlighted the important role of accounting and proper financial management in hotel operation. Binczysko (2011) characterised the management of a tourist enterprise using international accounting standards. This confirms the importance of accounting in the management of hotel facilities.

RQ5: Is there cooperation between historical hotels and start-ups?

Based on the research conducted, it was shown that there is no cooperation between startups and historical hotels. Such results may suggest two issues. First, hoteliers do not really cooperate with startup-type entities and do not plan to do so, and second, that hoteliers do not have sufficient knowledge about startups, but cooperate with entities of this type without being able to identify that these partner organisations are startups.

The report of the Startup Poland Foundation (2024) indicates that hotels constitute only 2% of companies that cooperate with startups. This result confirms the very weak participation of hotels in the cooperation with start-ups.

Cooperation between hotels and startups could bring significant benefits to accommodation facilities, such as an increase in the number of customers and greater recognition. Startups such as travel portals (Tripoffice, Tripsomnia), accommodation platforms (Slowhop), as well as useful technologies such as SmartHotel, are appearing in the traveltech market (Startup PFR, n.d.).

Conclusions

The main research objective was achieved. In the course of the conducted research, the authors managed to answer the research questions posed.

The answers obtained in Block I allow us to state that the key determinants influencing the development of historical hotels (RQ1) are:

- geographic and architectural factors (climate and specificity of the place, historic character of the facility, uniqueness of architecture, natural values, proximity of monuments, tourist development of the area, communication accessibility);
- financial factors (level of prices of individual services, prices of historical furniture and arrangement, level of costs, especially remuneration and consumption of materials and energy, spending of collected funds on investment activities);

- qualitative factors (quality of accommodation and accompanying services offered, method of service by hotel staff, offered comfort of stay);
- legal factors (requirements of the conservator of monuments);
- specific factors (possession of additional services such as catering, organization of conferences/events, SPA treatments, and recreational and leisure services, applied management strategy).

The choice of a historical facility by hotel guests is influenced by such elements (RQ2) as: hotel category, historical character, quality and prices of accommodation and accompanying services, proximity to natural values, tourist development of the area, proximity of monuments, availability of catering services.

In historical hotels, the main factors that dominate are salaries and consumption of materials and energy (RQ3). The largest amount of cash is generated by operating activities and is absorbed by investment activities. Popular accounting tools used in hotel management include:

- budgeting;
- analysis of sales, cost, and result variances;
- analysis of the break-even point.

The role of accounting in the decision-making process in historical hotels is average, with an indication of high (RQ4).

Cooperation between hoteliers and startups is practically nonexistent and not developed (RQ5).

In conclusion, economics and accounting have a significant impact on the level of development and management in the historical hotel industry in Poland, which is manifested, among others, in: their development factors, applied pricing methods, application of appropriate management strategy, application of accounting tools, knowledge and awareness of incurred costs and cash flows. It is recommended that the results obtained be the starting point for a more in-depth research that could cover other categories of hotels.

Implications for theory

The results of the scientific research carried out for the purposes of the work were significantly influenced primarily by the current specific economic and political situation, which caused changes in long-term market trends (the ongoing war in Ukraine and the resulting specific economic consequences), as well as the still unfinished process of compensating for the losses incurred by the historical hotel industry during the COVID-19 pandemic. To this should be added the currently implemented investments and disclosed plans to build new historical hotels.

Implications for practice

Taking into account the results of the research conducted for the purposes of this publication, there are clear implications for owners and managers of historic hotels, both those currently operating on the market and those planned for the future. The most important economic factors that can affect the development and success of the discussed hotel segment include, above all, the care taken by managers to ensure the character of the facility itself, its careful location (proximity to monuments, natural values) or the specific climate, which affects the interest and experience of guests during their stay. Constant care for the development and modernisation of the surroundings (e.g. new attractions near the facility, convenient access) is also valuable, which will certainly translate into the length and frequency of guests' stays. Further implications are related to the care to ensure an appropriate level of prices in connection with the quality offered (categorisation). As in the case of other companies, the most important element influencing costs in historic hotels is the staff. Therefore, the proper management of human resources is so important. A valuable implication of the research for practitioners is also the need to develop additional services at the place of stay, which influences guests' opinions and their interest in the facility.

References

- Alecu, E. (2013). New determinant factors of change management in the hospitality industry. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 13(4).
- Aleskerova, Y., & Fedoryshyna, L. (2023). Financial mechanism in the system of economic vectors of development of hotel and restaurant and agricultural enterprises. *Baltic Journal of Economic Studies*, 9(4). <https://doi.org/10.30525/2256-0742/2023-9-4-19-30>
- Ba, D., Zhang, J., Dong, S., Xia, B., & Mu, L. (2022). Spatial-temporal characteristics and driving factors of the eco-efficiency of tourist hotels in China. *International Journal Environmental Research and Public Health*, 19(18), 11515. <https://doi.org/10.3390/ijerph191811515>
- Basera, V., & Mwenje, J. (2021). Model of Quality Management Systems adoption in the hotel industry: A case study of hotels in Zimbabwe. *European Journal of Tourism, Hospitality and Recreation*, 11(2), 230–239. <https://doi.org/10.2478/ejthr-2021-0021>
- Binczysko, W. (2011). *Zarządzanie finansami w przedsiębiorstwie turystycznym*. PWN.
- Ciesielska, O., Rouba, R., & Stasiak, A. (2006). Hotelarstwo w zabytkach – grupy markowe. *Turystyka i Hotelarstwo*, 9, 9–34.
- Cloete, C.E., & Venter, I. (2007). A framework for successful hotel developments. *South African Journal of Economic and Management Sciences*, 10(2), 223–237.
- Cobos, L. M., Mejia, C., Ozturk, A.B., & Wang, Y. (2016). A technology adoption and implementation process in an independent hotel chain. *International Journal of Hospitality Management*, 57, 93–105. <https://doi.org/10.1016/j.ijhm.2016.06.005>
- Čircova, V., & Gburova, J. (2023). Quality and innovation as factors influencing the pricing policy of hotels in historical buildings in the Slovak Republic. In *IBIMA Publishing Communications of International Proceedings*, 11. <https://ibimapublishing.com/p-articles/42MKT/2023/4230023/>

- Dimitrov, N.V. (2023). Brief historical account of the hotel industry in Bitola (On the occasion of 180 years since the first hotel in Bitola 1843). *International Journal of Economics, Management and Tourism*, 3(2), 29–42. <https://doi.org/10.46763/IJEMT2332029d>
- Dwyer, L., Forsyth, P., & Dwyer, W. (2010). *Tourism Economics and Policy*. Channel View Publications.
- Dziedzic, E., & Skalska, T. (2012). *Ekonomiczne uwarunkowania rozwoju usług turystycznych w Polsce*. Stowarzyszenie na Rzecz Badań, Rozwoju i Promocji Turystyki.
- Elshaer, I.A., Azazz, A.M., & Fayyad, S. (2022). Authenticity, involvement, and nostalgia in heritage hotels in the era of digital technology: A moderated meditation model. *International Journal of Environmental Research and Public Health*, 19(10), 5784.
- Firlej, K., & Spychalska, B. (2015). Wybrane uwarunkowania rozwoju branży hotelarskiej w Polsce. *Roczniki Ekonomiczne Kujawsko-Pomorskiej Szkoły Wyższej w Bydgoszczy*, 8, 202–221.
- Fuentes-Medina, M.L., Hernández-Estárico, E., & Morini-Marrero, S. (2018). Study of the critical success factors of emblematic hotels through the analysis of content of online opinions. The case of the Spanish Tourist Paradors. *European Journal of Management and Business Economics*, 27(1), 42–65. <https://doi.org/10.1108/EJMBE-11-2017-0052>
- Fundacja Startup Poland (2024). *Korporacje, które dostrzegły potencjał startupów. Współpraca korporacji ze startupami, Vol. II*. Startup Poland.
- Gordan, M.-I., Pet, E., Popescu, G., Brad, I., Milin, A.I., Adamov, T.C., Ciolac, R., Pascariu, A.R., & Iancu, T. (2023). Factors influencing the accommodation prices of Romanian rural tourism. *Sustainability*, 15(1), 191. <https://doi.org/10.3390/su15010191>
- Hussein, A., & Hapsari, R. (2020). Heritage experiential quality and behavioural intention: lessons from Indonesian heritage hotel consumers. *Journal of Heritage Tourism*, 16(1), 1–20.
- Hyski, M., & Bednarzak, J. (2012). *Funkcje hotelarskie zabytkowych obiektów zamkowych*. Wyd. AWF.
- Kalinina, I., & Gołowczenko, T. (2022). The concept of a historical hotel in the development of tourist attractiveness of the region. *Bulletin of Baikal State University*, 32(2), 343–350.
- Kaluderović, M. (2019). Interaction and conditionality of hotel business and maritime tourism, as a significant factor in increasing revenues in tourism. *Economics*, 7(1), 19–29. <https://doi.org/10.2478/eoik-2019-0002>
- Kaniewska, B., & Micuła, G. (2007). *Polska. Noclegi w zabytkach*. Wyd. Muza.
- Kaniewska, B. (2009). *Bedeker hoteli historycznych*. Globalna Wioska.
- Kendir, H., Arslana, E., & Özçelik Bozkurt, H. (2023). Examining the accommodation experience in historical buildings with content analysis: Amasya Mansions Example. *Journal of New Tourism Trends*, 4(2), 28–40. <https://doi.org/10.58768/joinnt.1402820>
- Kyfyak, V., & Kyfyak, O. (2024). Hospitality development strategy: regional context. *Scientia fructuosa*, 5, 121–134. [https://doi.org/10.31617/1.2024\(157\)09](https://doi.org/10.31617/1.2024(157)09)
- Ludy, R.B. (1927). *Historic Hotels of the World: Past and Present*. David McKay.
- Ma, S., Gu, H., Wang, Y., & Hampson, D.P. (2017). Opportunities and challenges of value co-creation. The role of customer involvement in hotel service development. *International Journal of Contemporary Hospitality Management*, 29(12), 3023–3043. <https://doi.org/10.1108/IJCHM-08-2016-0479>
- Ma, Y., Li, H., & Tong, Y. (2022). Distribution differentiation and influencing factors of the high-quality development of the hotel industry from the perspective of customer satisfaction: A case study of Sanya. *Sustainability*, 14(11), 6476. <https://doi.org/10.3390/su14116476>
- Mashika, H., Kudrina, O., Nurgaliyeva, A., Berkova, O., Metil, T., & Novichkov, V. (2021). Competitiveness of hotel, restaurant and tourism business: Factors and tools. *Geojournal of Tourism and Geosites*, 36(2spl), 681–687. <https://doi.org/10.30892/gtg.362spl16-698>
- Mateczak, A. (2017). Changes in the number and capacity of hotels in Poland. *Tourism*, 27(2), 73–81. <https://doi.org/10.1515/tour-2017-0015>
- Milovanović, V. (2014). Total quality management as a profitability factor in the hotel industry. *Industrija*, 42(3), 115–127. <https://doi.org/10.5937/industrija42-5905>

- Minca, C., Felder, M., & Chin-Ee, O. (2014). The historic hotel as 'quasi-freedom machine': negotiating utopian visions and dark histories at Amsterdam's Lloyd Hotel and 'Cultural Embassy'. *Journal of Heritage Tourism*. <https://doi.org/10.1080/1743873X.2014.985223>
- Morehouse, W. (2013). *Millennium Biltmore: A Grand Hotel Born of Hollywood Dreams*. BearManor Media.
- Mucharreira, P.R., Antunes, G.M., Abranja, N., Texeira Justino, M.R., & Texeira Quirós, J. (2019). The relevance of tourism in financial sustainability of hotels. *European Research on Management and Business Economics*, 25(3), 165–174. <https://doi.org/10.1016/j.iedeen.2019.07.002>
- Musiaka, Ł. (2012). *Funkcja turystyczna średniowiecznych zamków i jej wpływ na miasta Pomorza, Warmii i Mazur*. Wyd. Uniwersytetu Łódzkiego.
- O'Gorman, K.D. (2010). *The Origins of Hospitality and Tourism*. Goodfellow Publishers. <http://dx.doi.org/10.23912/978-1-906884-08-6-990>
- Owney Cooper, E. (2020). *Historic Hotels and Motels of the Outer Banks (Images of America)*. Arcadia Publishing.
- Papamo, K., & Naipinit, A. (2024). Confirmatory factor analysis for the strategic management model of the recovery of smes hotel business during the COVID-10 situation. *Revista De Gestão Social E Ambiental*, 18(8), e05905. <https://doi.org/10.24857/rgsa.v18n8-010>
- Peché, D.L. (2019). *San Antonio's Historic Hotels (Images of America)*. Arcadia Publishing.
- Puciatto, D. (2016). *Przedsiębiorstwo hotelowe. Aspekty ekonomiczne, finansowe i organizacyjne*. Difin.
- Rajko, M., Sala, K., & Sadkowski, W. (2022). Quality costs in some European boutique hotels – a case study of Cracow and Zagreb. In Z. Baracska, I. Bujan Katanec, T. Hublin (Eds.), *Economic and Social Development. 81st International Scientific Conference on Economic and Social Development – "Green Economy & Sustainable Development. Book of Proceedings* (pp. 126–136). Varazdin Development and Entrepreneurship Agency.
- Regiony RP. (2025). *Hotelarze w Łódzkiem najbardziej zadłużeni, na Mazowszu najwięcej dłużników*. <https://regiony.rp.pl/biznes/art42232281-hotelarze-w-lodzkiem-najbardziej-zadluzeni-na-mazowszu-najwiecej-dluznikow>
- Rogerson, C.M., & Rogerson, J.M. (2018). The evolution of the hotels in Johannesburg 1890–1948. A case of historical urban tourism. *Geojournal of Tourism and Geosites*, 23(3), 738–747. <https://doi.org/10.30892/gtg.23310-324>
- Rouba, R. (2004). Hotele w obiektach zabytkowych. *Ochrona Zabytków*, 1(2), 143–164.
- Sadkowski, W., & Sala, K. (2021). The perception of quality costs and their calculation in the hospitality industry based on the example of the Historic Hotels Association from Poland. In Khalid S. Soliman (Ed.), *Proceedings of the 38th IBIMA Conference* (pp. 3192–3202). November 23–24, 2021, Seville, Spain.
- Sadkowski, W., & Sala, K. (2022). Wpływ pandemii COVID-19 na zarządzanie jakością w historycznych obiektach hotelarskich w Polsce. *Prace Komisji Geografii Przemysłu Polskiego Towarzystwa Geograficznego*, 36(2), 203–214. <https://doi.org/10.24917/20801653.362.13>
- Sala, J., & Musiał, J. (2007). Determinanty rozwoju gospodarki turystycznej w subregionie limanowskim. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 761.
- Sala, K. (2021). *Hotelarstwo unikatowe. Uwarunkowania rozwoju*. Wyd. Uniwersytetu Pedagogicznego w Krakowie.
- Sala, K. (2022a). Hotelarstwo historyczne i butikowe w dobie pandemii i konfliktu na Ukrainie: studium przypadku Poznania. *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie*, 53(1–2), 47–58.
- Sala, K. (2022b). Covid-19 a świadczenia usług w hotelach butikowych na przykładzie województwa pomorskiego. In *Teoria i praktyka przedsiębiorczości*. Wyd. Diecezjalne i Drukarnia w Sandomierzu.
- Sarnecki, C. (2020). *Standardowy System Rachunkowości Hotelowej – Departament Pokoje*. Biznes Hotel. <https://www.biznes-hotel.pl/artukul/standardowy-system-rachunkowosci-hotelowej-departament-pokoje>

- Saura, J.R., Reyes-Menendez, A., & Alvarez-Alonso, C. (2018). Do online comments affect environmental management? Identifying factors related to environmental management and sustainability of hotels. *Sustainability*, 10, 3016. <https://doi.org/10.3390/su10093016>
- Shabanov, V.L., Vasilchenko, M.Y., Derunova, E.A., & Potapov, A.P. (2021). Formation of an export-oriented agricultural economy and regional open innovations. *Journal of Open Innovation: Technology, Market, and Complexity*, 7(1), 32. <https://doi.org/10.3390/joitmc7010032>
- Spencer, J.P., & van Zyl, G.A. (2015). Hotel openings: Critical success factors and challenges. *African Journal of Hospitality, Tourism and Leisure*, 4(2).
- Startup PFR. (n.d.). *Polskie rozwiązania dla turystów – nie tylko wyszukiwarki hoteli*. <https://startup.pfr.pl/pl/polskie-rozwiazania-dla-turystow-nie-tylko-wyszukiwarki-hoteli/>
- Stefanica, M., Vodă, A.I., Butnaru, R.C., Butnaru, G.-I., & Chiriță, M.G. (2020). Ecological purchases made by managers in hotel industry. An approach of the main determining factors. *Amfiteatru Economic*, 22(53), 57–70. <https://doi.org/10.24818/EA/2020/53/57>
- Szmygina, B. (Ed.). (2009). *Adaptacja obiektów zabytkowych do współczesnych funkcji użytkowych*. Wyd. Politechniki Lubelskiej.
- Szerfer, M. (2013). *Magnetyzm historii – hotele w zamkach i pałacach*. <https://turystyka.wp.pl/magnetyzm-historii-hotele-z-zamkach-i-palacach-6044395467702913a>
- Tang, K.D.B., & O'Neill, J.W. (2025). The effects of age on the performance of hotels: Does a historical effect exist? *Cornell Hospitality Quarterly*. <https://doi.org/10.1177/19389655251318178>
- Volokhov, A. (2017). Hotel in a historical building: Advantages and features. *Sovremennyy otel'. Modern Hotel*, 1, 16–17.
- Wallach, R., McCann, L., Taube, D., Zachary, C., & Roseman, C.C. (2008). *Historic Hotels of Los Angeles and Hollywood*. Arcadia Publishing.
- Waśkowski, Z. (2015). Społeczno-ekonomiczne determinanty rozwoju turystyki sportowej na przykładzie biegów maratońskich. *Marketing i Rynek*, 8, 790–798.
- Wodejko, S. (1998). *Ekonomiczne zagadnienia turystyki*. Wyższa Szkoła Handlu i Prawa w Warszawie.
- Xie, P., & Shi, W. (2020). Elucidating the characteristics of heritage hotels. *Anatolia: International Journal of Tourism and Hospitality Research*, 31(2), 1–4.
- Yabanci, O. (2022). Historic hotel buildings in Istanbul City. *Tourism & Heritage Journal*, 4, 1–17.
- Yousaf, Z., Radulescu, M., Sinisi, C.I., Serbanescu, L., & Paunescu, L.M. (2021). Harmonization of green motives and green business strategies towards sustainable development of hospitality and tourism industry: Green environmental policies. *Sustainability*, 13, 6592. <https://doi.org/10.3390/su13126592>