

A COMPARATIVE ANALYSIS OF AUTOMATED AND ON-DEMAND BERTH BOOKING SYSTEMS IN NAUTICAL TOURISM PORTS

Abstract

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Purpose - Today when digital technologies are included in each business segment it is logical they are also applied in marinas. Subject of this research is application of software for berth reservation in marinas and comparison of reservation management in marina that uses automated reservation system and marina that uses “booking on request” system through reservation platforms.
Design/methodology/approach – This paper is based on the analysis of collected data. The data are from secondary inter source, respectively realized berth bookings in transit marinas in the period from July to September 2023 and 2024. Obtained data are analysed using descriptive and comparison method.
Findings - The analysis of collected data indicates the need of implementation or advancement of digital technologies in the field of reservation systems in marinas. Both analysed models of reservation fulfil their purpose, which is managing berth capacity of marinas, but automated berth reservation model is better in managing real time reservations.
Contribution - This research gives insight to understanding the functioning of berth reservation systems in marinas and highlights the advantage of using automated booking systems.
Keywords nautical tourism, booking, smart technologies, yachting, berth, marina management

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INTRODUCTION

In recent years, we have witnessed a significant growth in various technologies in all spheres of life, including nautical tourism, where the application of technologies was slightly delayed compared to the hotel industry. The reason for the slightly later implementation certainly lies in the fact that the hotel industry developed much faster than nautical tourism, and consequently, available technologies were applied more quickly in that industry. Nautical tourism is one of the younger tourism branches in the world, and therefore in Croatia as well, but also one of the fastest-growing branches of tourism in recent years. The beginnings of more serious nautical tourism began in the 1970s. The key reason for this is the appearance of vessels for sports and leisure, which began to be manufactured using a completely new technology that did not exist until then, namely the construction of vessels from polyester resins. The pioneer in the production of such vessels was the famous Italian designer and shipbuilder Carlo Riva, and the first serial vessel produced using this technology was the Bertram Riva (Riva-anniversary, 2024), which was presented at the Genoa Boat Show in 1970. In Croatia, the first serious development of nautical tourism began in the 1980s with the establishment of the ACY (Adriatic Club Yugoslavia Brioni) trading company, today ACI. In the period from 1984 to 1986, the first 16 marinas were built and put into operation (ACI MARINAS, 2024), which was extremely fast for the time. The popularity of the Croatian coast among sailors around the world is certainly confirmed by the fact that the Croatian coast is the most valuable national treasure thanks to its attractiveness and indentation with over 1200 islands, islets and reefs. Favourable climate, good sailing conditions almost all year round, and excellent nautical infrastructure are just some of the reasons why the Adriatic coast is the most successful tourist product that Croatia can offer. The table below shows a comparison of the number of nautical tourism ports in Croatia, the area of the water area, as well as a comparison of the number of berths by vessel group, over a ten-year period.

Table 1. Overview of the number of marinas, surface area and number of berths in Croatia in 2013 and 2023

Year	2013	2023	Index
Number of nautical tourism ports in Croatia	106	224	211,32
Aquatic area, m ²	3 278 064	4 823 256	147,14
Number of berths, total	16 940	19 131	112,93
Of which for vessels of length			
Up to 6 m	727	854	117,47
6 – 8 m	1 446	1 696	117,29
8 – 10 m	2 900	2 315	79,83
10 – 12 m	4 569	5 027	110,02
12 – 15 m	4 350	5 601	128,76
15 – 20 m	2 322	2 648	114,04
More than 20 m	626	990	158,15
Length of developed shore for mooring vessels, m	63 110	75 118	119,03

Source: Author's processing based on data from the Central Bureau of Statistics for 2013 and 2023.

Table 1. shows that in the relatively short period between 2013 and 2023, the number of nautical tourism ports increased significantly. According to data from Croatian Bureau of Statistics Nautical tourism – Capacities and Turnover of ports, 2013, there were 106 nautical tourism ports in 2013, while by 2023 this number had grown to 224. When examining the increase in capacity, the number of berths has not grown proportionally to the increase in the number of nautical tourism ports. In 2013 (Nautical Tourism Capacity and Turnover of Ports, 2014), there were 16,940 berths, while in 2023 (Nautical Tourism – Capacities and Operations of Nautical Tourism Ports in 2023), this number increased to 19,131. The reason for the disproportionate increase in the number of marinas compared to the number of berths lies in the fact that the average length of vessels has increased over time. In the 1980s, when the first marinas were built, the average vessel length was about 10 metres, whereas today it is nearly 16 metres. For this reason, the capacities of existing marinas are decreasing over time, as the size of moored vessels continues to grow, along with a significant increase in the share of multihulls (catamarans and trimarans). Furthermore, Croatia's entry into the EU has played a role in boosting nautical tourism.

In addition, in 2019, the Ordinance on Classification and Categorisation of Nautical Tourism Ports (OG 72/2008) was amended, introducing the following types of nautical tourism ports:

1. Anchorage,
2. Vessel landfill,
3. Dry marina,
4. Marina.

The new Ordinance on Categorization of Nautical Tourism Ports and Classification of Other Facilities for Berthing and Accommodation of Vessels (OG 120/2019) classifies nautical tourism ports as marinas, while other facilities for berthing and accommodation of vessels are categorized as follows:

1. Nautical anchorage,
2. Nautical mooring,
3. Vessel landfill,
4. Dry marina.

This change also affected the number of nautical tourism ports, as nautical moorings are now included in their classification, unlike the previous 2008 ordinance. Nautical tourism, as an economic sector, interacts with various industries, including maritime affairs, vessel accommodation, rental, servicing, and other related activities (Jugović et al. 2013, 61). Additionally, it is closely linked to the development of essential nautical infrastructure, namely nautical tourism ports. Marinas in nautical tourism experience frequent and dynamic market changes, accompanied by increasing guest expectations. Today, with digital technologies integrated into nearly all business sectors, their implementation in marinas is a natural progression. To better adapt to market conditions and maintain control over revenues, marinas have started using IT programs and booking platforms that allow guests to reserve a berth in advance. Some marinas use their own applications and reservation systems for berth bookings. However, due to the high costs of developing, implementing, and maintaining such systems, most relies on external partners or reservation platforms. This research focuses on the application of berth booking software in marinas and compares reservation management in marinas that use an automated reservation system with those that rely on an “on-demand” reservation system provided by a reservation platform. This paper compares two models of berth booking in marinas and aims to assess the impact of automated bookings versus “on-demand” bookings. This research offers insight into the functioning of the berth booking system in marinas and highlights the benefits of using an automated system for providing reservation services through external partners.

1. LITERATURE REVIEW

A review of the available literature shows that the field of nautical tourism is continuously growing, particularly in Croatia, where in 2023, revenue from nautical tourism reached a record EUR 161 million, excluding VAT, marking a 12.1% increase compared to 2022 (CBS press release).

Sustainability and nature conservation are undoubtedly the most crucial aspects of nautical tourism. In her work from over 20 years ago (Kovačić, 2003, 144), she observed that the growing demand for both utility and commercial berths is closely tied to an increase in pollution. One of the contributing factors is the lack of proper facilities to dispose of black and grey water from vessels due to insufficient equipment. Twenty years later, the ORDINANCE ON BOATS AND YACHTS (13/20) was introduced, which stipulates that all boats with built-in toilets must comply with the standard (Small Craft – Toilet Waste Retention Systems ISO 8099:2000; EN ISO 8099:2000). The ordinance alone is insufficient without amendments to the law on seaports, which are addressed in the Act on Amendments to the Maritime Code (OG 17/2019). This act stipulates that port authorities and concessionaires of special-purpose ports are required to equip ports with appropriate facilities and devices for handling and receiving solid and liquid waste, cargo residues from vessels, oily waters, and sewage, as defined by the provisions of the MARPOL Convention 73/78, as amended. What is currently missing as a crucial element is the monitoring and control of black and grey water tank discharge from boats. At present, no ordinance or law specifies when and how these tanks must be emptied, leaving it up to users to decide whether and when to do so. The development of nautical tourism, like most other industries, is accompanied by advancements in digital technologies that can be applied to various business segments. An increasing number of available “smart” technologies can be integrated across various aspects of marina operations, including capacity management, berth booking, wireless billing and administration, monitoring electricity and water consumption, waste

management, AI technology applications, and more. In addition to the numerous benefits offered by digital technologies, one of the most significant is their application in waste management in marinas. This is particularly important in regions like Croatia, where there has been a sharp increase in demand for transit berths during the season, driven by the growth of the charter market and the rising number of charter vessel users.

Analysing the impact of digitalisation in marinas, Krpetić et al. (2012) propose a wireless system for monitoring marina occupancy and conditions. In this system, each berth is equipped with a sensor that detects whether a vessel is present. When a vessel leaves the marina, it automatically logs off the network, allowing the marina to see that the berth is vacant. This system ensures that marina staff always has access to real-time information about the marina's occupancy status. In some busy transit marinas that lack this technology, it often happens during the summer months that, while numerous vessels are waiting to moor, the naval service docks them but doesn't have time to immediately relay the information to the reception, which is then entered into the system afterward. As a result, some vessels may be moored in the marina without being recorded in the system. In such situations, the bigger challenge is manually tracking which vessels have paid and are required to leave the marina by checkout time and which vessels still have their documents at the reception. According to Brnić, Jugović, and Aksentijević (2024, 198), nautical charter in Croatia, as part of Mediterranean nautical tourism, is experiencing growth and generating significant economic benefits. However, it is crucial to monitor market changes to address sustainability challenges, continuously improve quality, and maintain the destination's attractiveness.

Analysing existing technologies and research, Manojlović, Stanovčić, and Perović (2024, 104) conclude that the use of digitalisation in nautics has multidimensional effects. They aim to integrate existing knowledge in tourism and digitalisation, focusing on how technology impacts the transformation of the nautical sector, with an emphasis on enhancing the tourist experience. Innovative technologies enhance the productivity of marinas and optimise their operational processes (Radulović 2022, 83). The application of digital technologies, which generally improve business operations, allows smart technologies to facilitate the rapid flow of key information to end users—boaters. There are highly useful mobile applications that provide boaters with essential information about marina locations, arrival methods, berth availability, and other services offered by the marinas and surrounding areas. These apps also enable communication with marina staff and provide everything necessary for a comfortable stay. Such applications are excellent multifunctional tools that can be used across various segments of a marina's operations, including sales, marketing, and customer relationship management.

For example, the share of digital technologies or e-business in marinas in Montenegro increased from 17.5% to 62.5% over a five-year period (Vukičević, Ljubić 2016, 353). This significant growth highlights that many marina managers have recognised the benefits of using digital technologies in marina management, particularly in the areas of security and monitoring. By observing berth bookings in marinas, we can draw a comparison with ships arriving at port. By applying the JIT (Just in Time) Arrival method for managing or receiving ships at berth, according to the PBP (Prebooking Berth Allocation Policy), we can determine a time frame for vessel arrival, minimising waiting times. This also allows for speed adjustments, contributing to fuel savings and reducing harmful gas emissions (Mubder 2024, 611). The same principle can be applied to marina berth reservations, where digital solutions for booking and managing marina capacity optimise crew operations and make it easier for berth users to find available spaces, reducing the time needed to secure a berth and lowering fuel consumption. In his research, Poljičak et al. (2022, 79) concluded that commercialisation in the field of nautics is underway, with an increase in the use of sailboats and motor vessels over 12 metres in length, while the number of smaller vessels used for personal purposes is starting to decline. The same research found no significant correlation between the number of vessels and the number of nautical tourism ports, nor between the number of vessels and the number of berths. In addition to the various technologies currently available and used in nautical tourism, whether related to vessels or marinas, navigation safety remains one of the most important aspects. It largely depends on the knowledge and experience level of individual boaters (Kasum et al. 2018, 186).

2. SMART TECHNOLOGIES IN NAUTICAL TOURISM PORTS

As technology becomes an integral part of everyday life, taking over many of our responsibilities, smart technological solutions are increasingly being implemented in marina operations. Since marinas are complex business entities that require a highly organised management approach, the application of new digital technologies can significantly optimise operations, enhance environmental sustainability, and ultimately provide end users with a better experience. Although digital technologies have been applied in the marina business worldwide for some time, their use in nautical tourism in Croatia began only in the last twenty years. Today, an increasing number of marinas are recognising the benefits of digitisation and the use of smart technologies to better manage their infrastructure and the various services they offer, with the ultimate goal of meeting the needs of their users—boaters. Thus, with the growing development of smart technologies, numerous opportunities for their application in marina operations are emerging. Some of the key areas where digital technologies can be applied include dock and capacity management booking systems environmental protection enhancing customer satisfaction.

2.1. Dock and capacity management

The key business segment of a nautical tourism port is the provision of berth accommodation services. Effective dock and capacity management in marinas can now be enhanced through the application of digital technologies, which streamline operations and optimise resource consumption.

The application of digital technologies in berth management and capacity control is primarily reflected in the use of sensors at berths to detect the presence of a vessel. This technology enables real-time monitoring of the marina's capacity, as well as the tracking of electricity and water consumption. Additionally, some digital solutions facilitate wireless communication between the vessel and the marina, reducing administrative tasks. The authors (Car, Pilepić, Šimunić, 2019, 173) conclude that IoT has immense potential in tourism and the hospitality industry, as it allows for the simultaneous connection of numerous devices, providing a wide range of opportunities in these sectors.

2.2. Berth booking in marinas

Digital technologies offer numerous business management opportunities in nautical tourism ports, with smart technologies being particularly applicable in managing spare capacity in marinas. Smart technologies encompass the use of online and mobile applications for booking berths, developing and utilising online booking platforms, and enabling advance payments for berths. The main advantage of these systems is a faster and simpler booking process for both berth providers and end users – boaters. Based on set criteria, advanced digital technologies in marinas can automatically assign berths according to the size and type of vessel, greatly simplifying the process of selling berth services. Additionally, it allows for dynamic management of berth prices and capacities, adjusting according to the season and/or marina occupancy. Depending on the capabilities of the marina management, berths can be booked using either the marina's own systems and applications or services from specialised booking platforms.

2.3. Sustainability in Marine Management

The key component of nautical tourism is the environment and its preservation. As emphasised by authors D. Gračan and R. Alkier (2003), the correct and environmentally conscious behaviour of humans toward nature is essential, serving as a fundamental prerequisite for the sustainability of nautical tourism. The authors (Tselentis et al., 2014) state in their research that environmental certifications such as the Blue Flag, ISO standards, and the Golden Anchor are closely linked to the integrative model of sustainable development for nautical tourism ports. By obtaining these certifications, ports become significantly more attractive to tourists. These are all factors that play a role in selecting a destination when reserving a berth. In recent years, we have unfortunately witnessed the rise of mass tourism, which has also begun to appear in certain areas along the Adriatic coast of Croatia. Sustainable development is crucial for the future of tourism and the only way to mitigate its negative impact on the environment. Alongside the growth of mass tourism, digital technologies are increasingly being used to help preserve natural resources. Today, most marinas monitor electricity and water consumption by vessels to prevent unnecessary waste of resources. One of the new technological solutions for marinas, developed in Croatia, is Docker. The Docker concept is designed as an extension of the pier or pontoon through which vessels are accessed, offering three connections: electricity, water, and a facility for discharging black tanks. What makes Docker unique is its ability to be managed through mobile applications, allowing both users and marina management to control operations seamlessly. If the system detects a voltage drop or an issue with the vessel's electrical installations, it automatically cuts off the power supply to prevent potential electrical hazards. The system also monitors the fluid level in the vessel's black tank, notifying both the user and the marina. When the tank reaches 80% capacity, it alerts them that emptying is required. Docker has world premiere on METSTRADE show 2022 RAI Amsterdam 15.11.2022-17.11.2022 (Kontis, 2024). The development and growing accessibility of smart technologies, along with their increased application in business, can significantly enhance the sustainable management of resources and waste in nautical tourism ports, contributing to a higher level of overall sustainable tourism.

2.4. Enhancing customer satisfaction

As previously mentioned, the use of digital technologies in business offers numerous opportunities to enhance not only marina operations but also interactions with service users. By utilising digital tools and systems, users can plan their trip in detail, significantly reducing stress and enhancing overall satisfaction. For instance, by using an app or system for booking berths, a boater can plan their itinerary and access essential information about the destination, marina, available services, and nearby amenities. They can also obtain arrival instructions, check the weather forecast, make payments, and communicate with marina staff.

Additionally, such systems allow real-time updates for changing berths or adjusting arrival times. The application of digital technologies in the berth booking process is highly significant for several reasons. In addition to simplifying marina capacity management, the use of smart technologies offers the end user—boater—the assurance that a berth will be available at the chosen time and location. This enhances user satisfaction, as it allows for better planning of extended stays at sea, which is particularly important during the summer months.

Some digital solutions offer users berth services, assistance with docking, automated check-in and check-out, as well as connections to energy cabinets in marinas, along with monitoring of water and electricity consumption on board. All of the above simplifies user access to the marina and its services, saving time and enhancing customer satisfaction, while also improving the quality of service and increasing the marina's revenue (Maglić et al., 2021, 182). On the other hand, in addition to improving

marina operations, management can also use digital tools for marketing and sales purposes, thereby reaching a larger number of both existing and potential users. By using software, marinas can create personalised offers for users, enhancing customer satisfaction with the services provided and, in turn, driving an increase in revenue.

3. METHODOLOGY

Effective capacity management is the primary responsibility of marina management. This involves a combination of several key elements, including berth planning, pricing strategy, the introduction of digital and technological innovations, and environmental sustainability, all of which are essential for the marina's long-term profitability. As digital solutions continue to develop, numerous opportunities for their application in nautical tourism ports are emerging. Today, there are various models that assist marina management in overseeing marina capacities in real time.

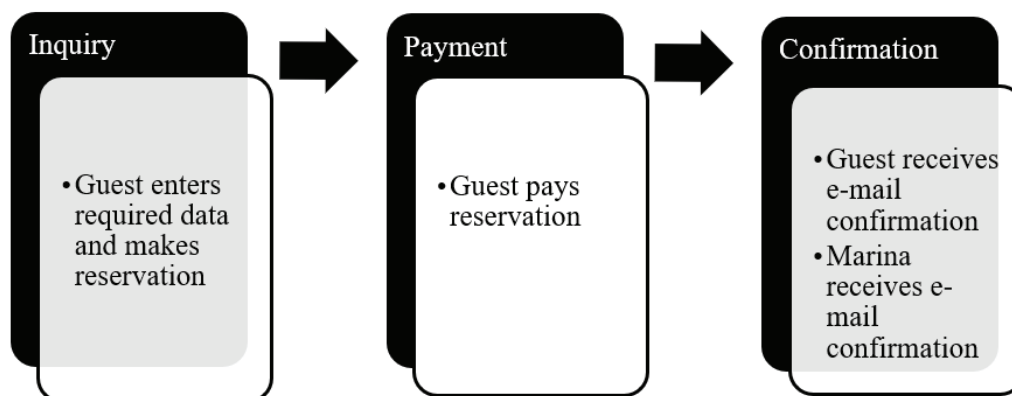
One of the most important digital solutions is berth reservation systems, which can be managed through a single interface in marinas. Despite the availability of ready-made capacity management solutions, many marinas still refrain from adopting smart technologies in this area due to the high implementation costs, even though these solutions offer numerous benefits. This paper compares two models for booking berths in the marina: one is an automated reservation system, while the other operates on an "on-demand" booking principle. Both models analysed are based on the example of booking platforms.

3.1. Automated model booking system

The process of booking berths using the automatic booking system is completed in just a few simple steps. To make a reservation at the desired marina, the guest fills out a form with the required information (name, surname, vessel length and type, vessel name and designation, berth usage dates, and preferred marina) on the web interface. Since the system is automatic and monitors the availability of free berths in the selected marina for the chosen date, with capacity settings based on vessel length, the guest cannot proceed with the booking process if the capacity for the entered vessel length on the selected date is already full.

If there are available capacities for the entered vessel length and date, the system directs the guest to the next step, which is payment. Once the payment is successfully processed, the guest receives a reservation confirmation via email, containing all the necessary details. This includes information about the vessel, the guest (including contact details), the reservation date, the berth usage date, the selected marina, and instructions on how to modify or cancel the reservation. After a successful booking, both the guest and the marina's reception receive an email with all relevant reservation details, including the assigned berth.

Diagram 1.: Reservation process based on automated model



Source: Authors

Using the above model, the guest can book a berth for their vessel in the selected marina in just three simple steps, either through a web interface or an app previously downloaded and installed on their mobile device. The automated booking system simultaneously integrates and monitors all reservations made through both the web interface and the app.

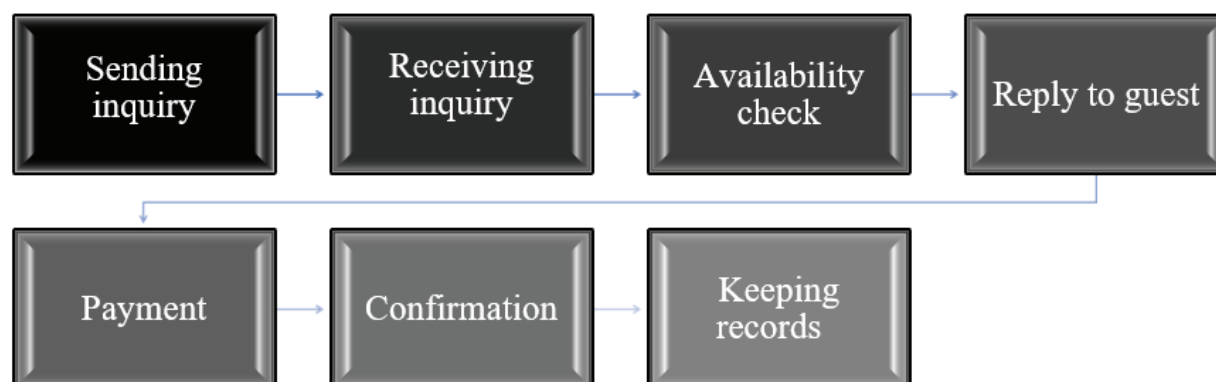
Once the capacity for a given day is fully booked, no further reservations can be made. Reservations can be made for any day where there is still available capacity. Marina staff can easily track, in real time, the number of reservations made and the remaining capacity for each vessel length on the computer screen, allowing for efficient capacity management. Similarly, in case of unforeseen circumstances (e.g., bad weather), the marina manager or reception staff can block reservations for the current or following day in the system when many vessels are expected to arrive. This prevents the possibility of overbooking. Conversely, if more berths become available than initially specified, the number of available reservations for that day can be increased. Through real-time communication with the reception, the marina staff has accurate information on how many berths

are reserved for each vessel length, which spaces are available for vessels arriving without a reservation, and which spaces need to be kept for vessels that have already made a reservation. All of the above enables marina managers to maximise the use of available berth capacity, which is a key factor in successful marina management.

3.2. On demand booking process

Even with modern software for managing marina capacity available, most marinas continue to manage capacity using conventional methods. This means they lack software that automates reservation management, relying instead on reception staff to handle booking arrangements. This berth booking process operates on an “on-demand” basis and involves several steps, as illustrated in Diagram 2.

Diagram 2.: Reservation process “on demand”



Source: made by author

The berth booking process following this model starts with the guest filling out a form on the web interface, where they provide personal information, vessel details, berth date, and the desired marina. The reception staff of the selected marina receives an email containing the reservation request and the entered data. After confirming the available capacities with the naval service, the reception desk sends an email response to the guest. The timeframe for responding to a guest is limited to two hours. If the reception staff does not confirm the reservation to the guest within the specified timeframe, the reservation request is rejected, and the guest receives an email informing them of the lack of capacity. If there are available capacities, the reception desk staff sends an e-mail to the guest containing a link to the payment interface. Upon payment, both the guest and the reception staff receive an email confirming the reservation. The reception staff keeps records of completed reservations manually, meaning confirmed reservations are entered into the reservation book. The booking model described differs from an automated model, which allows booking in just a few steps and only takes a few minutes. The analysis of software applications for booking berths in marinas was conducted using secondary data from two observed nautical tourism ports over a two-year period. In the first observed year, marinas used an automated system for booking berths, while in the second year; the berth booking process followed an “on-demand” model.

4. RESULTS

The observation of performance and analysis of the software application for booking berths was conducted in six nautical tourism ports. The number of reservations made in each marina over a 24-hour period during July and August of 2023 and 2024 was observed to determine the marina’s capacity, based on the booking model used. In 2023, reservations could be made at any time throughout the 24-hour period using the automated system, while in 2024; reservations were only accepted during the marina reception’s working hours, from 7 am to 9 pm. A t-test was applied to test a significant statistical sample, and the results indicated that 3 out of the 6 observed marinas were statistically significant. Table 2. lists the reservations made in each observed marina, specifically for 2023 and 2024.

Table 2. **Reservations made in 2023 and 2024 in six different marinas according to hour of creation**

	M ₁		M ₂		M ₃		M ₄		M ₅		M ₆	
	'23.	'24.	'23.	'24.	'23.	'24.	'23.	'24.	'23.	'24.	'23.	'24.
H	R _{JA}	R _{JA}	R _{JA}	R _{JA}	R _{JA}	R _{JA}	R _{JA}	R _{JA}	R _{JA}	R _{JA}	R _{JA}	R _{JA}
0	2	0	1	0	0	0	1	0	0	0	2	0
1	1	0	1	0	1	0	1	0	0	0	1	0
2	1	0	0	0	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	1	0	0	0	0	0
4	1	0	1	0	0	0	1	0	1	0	1	0
5	3	0	2	0	0	0	0	0	0	0	1	0
6	3	0	1	0	1	0	1	0	1	0	2	0
7	8	14	5	4	3	7	4	0	5	9	8	7
8	21	44	20	13	8	8	5	7	8	33	28	20
9	34	48	21	16	11	14	12	10	14	41	48	26
10	43	42	17	8	11	19	12	4	24	23	43	19
11	41	21	15	9	16	6	13	8	17	14	36	9
12	31	10	13	7	7	5	10	0	11	5	39	6
13	24	7	19	4	8	1	5	1	11	5	26	1
14	21	3	12	2	3	1	8	0	10	3	22	2
15	21	3	8	2	5	2	9	2	11	3	21	5
16	21	2	11	2	5	1	6	1	6	5	21	0
17	17	11	12	1	4	2	5	2	5	5	18	2
18	20	6	17	3	5	2	5	4	9	9	21	7
19	16	9	6	7	10	1	5	0	5	3	17	1
20	12	11	10	4	10	1	5	2	4	3	16	1
21	16	5	7	2	2	0	3	0	5	0	10	1
22	11	0	6	0	5	0	2	0	4	0	9	0
23	8	0	3	0	2	0	3	0	1	0	5	0
T	374	236	206	84	115	70	115	41	154	161	396	107

H – hour; M1, M2, M3, M4, M5 and M6 - Observed Marinas; RJA – reservations July-August; T – total
Source: authors

Table 3. presents the results obtained from the performed t-test. The test shows that, of the six observed marinas, statistically significant differences occurred in three marinas: M₂, M₄, and M₆.

Table 3. **t-Test of reservations made in 2023 and 2024 in the observed marinas**

	M ₁		M ₂		M ₃	
	V ₁	V ₂	V ₁	V ₂	V ₁	V ₂
M	15,58333	9,833333	8,583333	3,5	4,7916	2,916666
V	161,6208	211,9710	48,88666	19,47826	19,496	23,64492
O	24	24	24	24	24	24
P(T<=t)	0,15180308		0,004209033		0,168671754	
	M ₄		M ₅		M ₆	
	V ₁	V ₂	V ₁	V ₂	V ₁	V ₂
M	4,7724	1,708333	6,4166666	6,7083333	16,5	4,458333
V	16,0499	8,21557	38,831916	117,9547	213,637	52,69384
O	24	24	24	24	24	24
P(T<=t)	0,003818401		0,90964426		0,000742636	

M – mean; V – variance; O – observations; V₁, V₂ – variables
Source: authors

As shown in Table 3, the results obtained from the t-test indicate that the p-value for marina M_1 is 0.15180308, for marina M_2 is 0.004209033, and for marina M_3 is 0.168671754. In marina M_4 , statistical significance is 0.003818401; in M_5 it is 0.90964426, and in M_6 it is 0.000742636. Given that the test value for the significance level is 0.05, the test results indicate that M_2 , M_4 , and M_6 are statistically significant. M_4 and M_6 were selected for further observation due to their similarities.

The observed M_4 and M_6 share common characteristics, such as position – both are in the centre of the area and on the island; berth availability – both offer annual, monthly, and daily berths; and high attendance – both marinas are popular among boaters during the summer months. In addition to the above, both marinas feature a dry berth and a crane capable of accommodating vessels on the mainland section of the marina.

Both marinas meet high environmental standards – they hold the “Blue Flag” award and utilise digital technologies for managing and optimising electricity and water consumption, including IoT technology. The remaining facilities in the marinas are almost the same in terms of capacity, as indicated in the table below.

Table 4: Comparing main characteristics M_4 and M_6

Services in marina and capacity:	M_4	M_6
Wet berths	157	159
Dry berths	15	16
Maximum vessel length annual berth	18m	17m
Maximum vessel length daily berth	35m	50m
Fuel station distance from marina	0,2nm	0,5nm
Crane	8t	10t
Toilets adapted for persons with special needs	✓	✓
Restaurant	✓	✓
Rent a Car/scooter	✓	
Laundry	✓	✓
Grocery store	✓	
Parking	✓	✓
Apartments	✓	✓
EV Charging station	✓	✓
Toilet and shower facilities	✓	✓
Maintenance and repair shop	✓	
ATM	✓	✓
Diving centre	✓	
Free WI-FI	✓	✓
Blue Flag	✓	✓
Hair salon		✓

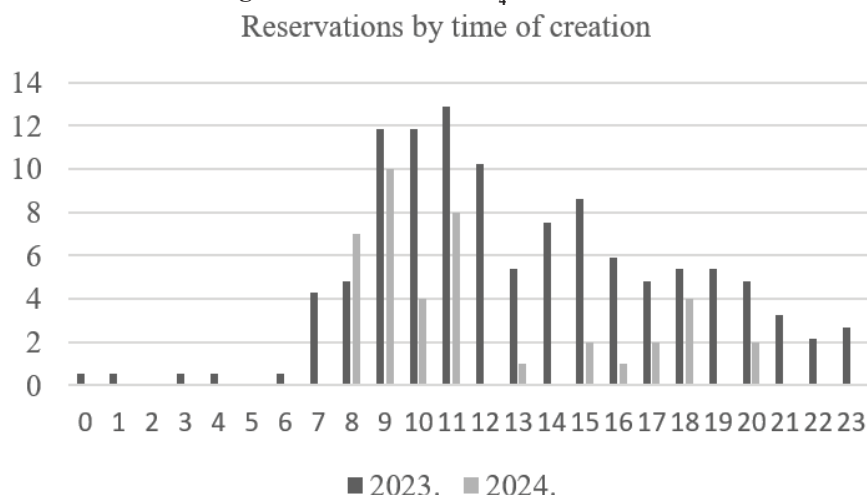
Source: Authors by the web of observed marinas

The analysis of booking management in these marinas is based on the processing of data from completed bookings during the season, specifically from July to September in 2023 and 2024. The collected and analysed data consist of bookings made through the booking platform using the automated system in 2023 and bookings made through the “on-demand booking” model via the same platform in 2024.

Observing the functioning of the berth booking system according to the automated model, several key advantages were noted compared to the other observed model. The first advantage is the ease of use for all participants in the process. On one hand, the booking process is simple, requiring only a few steps, and is “user-friendly” for guests, enabling them to easily reserve a berth during their stay on the vessel. On the other hand, the workload of the reception staff regarding bookings is minimal, as the system monitors capacity occupancy. Once defined capacities are filled, further bookings cannot be processed. In this way, the guest is informed at the start of the booking process whether the desired marina has available capacity. If not, the system prevents the creation of a booking inquiry, significantly reducing the need for employee involvement at the marina reception and saving time. This is especially important during the morning hours, up until 2 PM, when the reception staff’s workload is at its highest. This is typically when vessels depart from the marina, and payments are processed at the reception.

This is confirmed by the collected data, as shown in Chart 1. According to the booking times at Marina M_4 during 2024, when bookings were made using the “booking on request” model, the reception staff was especially burdened in the morning, when their workload was at its peak. During this time, they had to handle reservation enquiries, which likely affected the quality of their execution of regular tasks, such as payment processing and check-out for vessels departing the marina. Bookings on demand were only accepted during the reception’s working hours, from 07:00 to 21:00, as responding to booking demands is time-sensitive and necessitates email communication between the guest and reception staff. On the other hand, with the automated system, bookings can be made at any time throughout the 24-hour period, without requiring additional involvement from the reception staff.

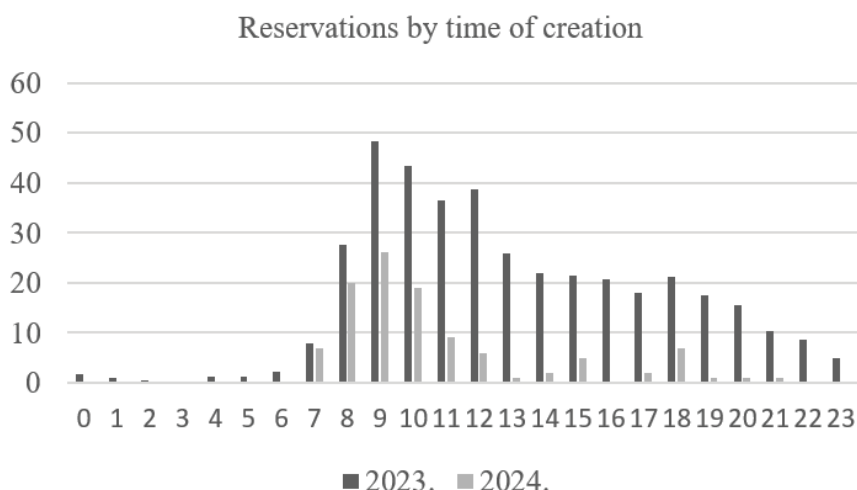
Chart 1. Number of reservations according to creation time in M_4



Source: authors

As in M_4 , the collected data from the other observed marina, M_6 , show that the highest number of bookings in 2024 was made during the morning hours, coinciding with the peak workload of the reception staff. As shown in Chart 2, in 2023, when the automated system was used, bookings were made even outside reception opening hours.

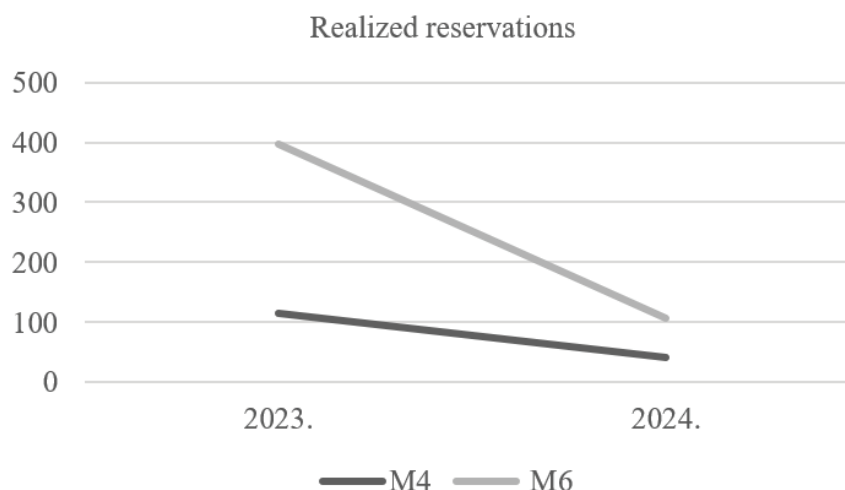
Chart 2. Number of reservations according to creation time in M_6



Source: authors

If we examine the results achieved during the observed period in both marinas, in 2023, when the marinas used an automated booking management system, better results were achieved. In both marinas, the number of bookings made through the booking platform in 2023 was higher than the number of bookings made in 2024.

Chart 3. Number of realized reservations in observed marinas



Source: authors

Similarly, 396 reservations were made in M_6 through the booking platform in 2023, while 107 bookings were made in 2024, marking a significant decrease compared to the previous year. From the above, the implementation of the automated booking management system resulted in a significantly better outcome. When considering additional advantages, such as ease of use, a short realisation period, time savings for both users and reception staff, and minimal possibility of error, it can be confirmed that the automated system is undoubtedly a better option for successful marina capacity management and berth booking.

CONCLUSION

The application of digital technologies in nautical tourism ports offers numerous benefits, not only for marinas but also for the users of the services they provide. Today, digital technologies not only enhance services but also play a key role in environmental preservation, as their application allows for the monitoring and optimisation of energy and water consumption, as well as waste management. From the perspective of service users, the application of digital technologies in managing marina capacities and berth bookings plays a significant role in simplifying the planning of trips. This was confirmed by the conducted research, which shows that significantly fewer bookings were made using the “on-demand” system compared to the automated model. It is highly likely that this model would have produced better results if the reception’s working hours were longer, as bookings could only be made during that time. Another significant problem with this marina booking management system is the considerable amount of time marina staff is required to spend to finalise the entire booking process. In addition to the reception staff, the naval service staff is also heavily burdened. The reception staff informs them about bookings, and they must ensure that a place is always available for vessels that have reserved a berth.

The automated booking system greatly simplifies the tracking of bookings for marina management, reduces the time required, and ensures that guests are much happier as they receive real-time feedback without unnecessary waiting or uncertainty about whether they will secure a berth.

During the tourist season, when the demand on marinas and available berths is highest, the ease of finding a berth and the certainty that a guest’s berth will be waiting for them in the desired marina after a day at sea are crucial factors that significantly impact boater satisfaction.

NOMENCLATURE

ACI - Adriatic Croatia International Club
AI - Artificial Intelligence
EU- European Union
IoT – Internet of Things
JIT- Just In Time Arrival
PBM – Prebooking Berth Allocation Policy
M1, M2, M3, M4gs, M5 and M6 - Observed Marinas

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