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Use Cases of Artificial Intelligence in Private Theatre Management: Potential for Productivity Increases

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Abstract

This thesis conducts a literature research to answer the research question of how private companies in the theatre business can benefit from introducing and implementing artificial intelligence (AI) within their organisational structure. The basics of AI development, types of AI, and the theatre industry are introduced. Basic knowledge of theatre management is presented to identify activities of companies in the business and assess potential use cases in these areas. Use cases of AI are presented for all areas of theatre management except for stage productions and all related activities that require a significant contribution of human work and have proven difficult for automation in the past due to the nature of theatre. The main findings are use cases that help companies reduce operational costs by improving overhead processes and lowering costs in the operation of theatre buildings. Moreover, some use cases, such as AI in pricing, are presented as potential for revenue increases. Overall, companies in the theatre business can benefit from increases in their productivity through the introduction of AI. However, this thesis points out challenges as some applications of AI require upfront investments, and the availability of data for AI is limited compared to other industries.

I Outline

II List of Abbreviations

AD	Audience Development
AGI	Artificial General Intelligence
AI	Artificial Intelligence
ANI	Artificial Narrow Intelligence
Apps	Mobile Application
ASI	Artificial Super-Intelligence
CSRD	Corporate Sustainability Reporting Device
DL	Deep Learning
ERP	Enterprise Resource Planning
FoH	Front of House
HRM	Human Resource Management
LLM	Large Language Model
ML	Machine Learning
NLP	Natural Language Processing
NN	Neural Network

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1 Introduction

1.1 Research Problem

Artificial Intelligence (hereafter AI) has been a hotly debated topic for a few years. The emergence of OpenAI's ChatGPT tool has generated much publicity and put AI on the public's radar. The development of AI, however, has been a topic of scientists for the last 100 years, and breakthroughs have been achieved in the field from a technological standpoint since the 1980s (Balasubramaniam et al., 2024, pp. 1–3; Jiang et al., 2022, pp. 3–5).

Although definitions of AI vary, it is generally perceived as a machine or program that can imitate human intelligence and be used to expand capabilities for research and analysis purposes (Jiang et al., 2022). Like other technologies, AI is expected to offer companies productivity and quality gains while lowering production costs. Therefore, many industries are looking at ways to implement AI in various processes (Mutschler et al., 2024, pp. iii–v).

The theatre industry has been changed by new technologies over the last several decades. The emergence of new lighting systems, communication systems and especially the internet has vastly impacted how theatres operate and are perceived by their audiences (Karcz-Ryndak, 2024, p. 234). However, not only have superficial aspects of the industry changed, but theatre management has also diversified, and organisations have developed different models for operating theatres and productions. In some definitions of Theatre Management, as many as twelve different operational models are described (Bonet & Schargorodsky, 2018, p. 54).

This thesis will focus primarily on private companies operating in the business. The development of private theatre has been heavily influenced by the emergence of musical theatre over the last 100 years. This "Broadway-style" theatre has produced worldwide phenomena like the musicals "The Phantom of the Opera" and "Disney's The Lion King", both global financial successes with productions in different countries all around the globe (Savran, 2017). Nowadays, theatre-producing companies often operate more than one theatre and are active internationally through actual operations or licencing activities. Examples are the Buena Vista Theatrical Group Ltd. (Disney Theatrical Group), Delfont Macintosh Theatres, ATG Entertainment and Stage Entertainment (Gordon & Jubin, 2023).

The structures needed to operate a business in the theatre industry are complex and have increased in complexity due to the internationalisation of theatre. The business activities of theatre corporations are diverse and range from creative development and the actual production activity over facility management and real estate activities to more corporate support activities in finance and marketing (Bonet & Schargorodsky, 2018; Gordon & Jubin, 2023).

Even though substantial financial successes are possible in the theatre world, one in four productions fails on a large scale. Therefore, improving productivity and cost efficiency is a key factor for corporations in the industry. Literature often describes the cost-sickness of theatres and their operating companies. Cost sickness mainly refers to the phenomenon of theatres being unable to increase productivity at par with productivity due to the nature of theatre. (Frey, 2019, pp. 17–18). The need to improve cost efficiency holds especially true in a post-COVID world. The pandemic has strained the industry and drained financial resources with revenue losses of about 1.3 billion US-Dollar on Broadway in the season of 2020/21 (*Statistics - Broadway in NYC | The Broadway League*, n.d.). With the COVID-19 pandemic only a few years in the past and production costs rising, the theatre industry is still struggling and in need of finding new ways to lower costs and improve productivity at the same time.

Therefore, this thesis aims to outline and analyse possible use cases of AI in theatre management and their potential benefits and challenges for private companies in the theatre industry. If applicable to the use case, the readiness of the outlined use cases will be examined. This thesis will answer the research question of how companies in the theatre sector can benefit productivity from using AI in their organisational structure and processes. This thesis will focus on larger private companies that operate on a profit-oriented basis, as these companies are more likely to implement AI in their processes at an earlier point due to their need for profitability and competitiveness.

1.2 Research Method

This thesis will conduct a comprehensive and systematic literature review regarding current and potential future use cases of AI in relevant functions of theatre management. In addition, use cases of AI in related industries are researched that show potential to be adopted into the theatre industry. The use cases outlined will be evaluated regarding their applicability to the theatre industry and functionalities of theatre management. The presented use cases will then be discussed to reveal their

potential benefits for the organisation and processes while examining the risks and overall challenges associated with introducing AI into theatre management.

1.3 Course of Investigation

Chapter two of this thesis will lay the theoretical foundations for the development and capabilities of AI as well as theatre management and its functions. In terms of AI, the chapter will explain the types of AI and give an overview of the technology's historical and potential future development. For theatre management, the basic concepts will be presented. Moreover, companies' working methods in the business will be explained, and a potential organisational structure will be outlined.

Chapters three and four will focus on the scientific ways of working for the systematic literature review and the methodology of pre-selecting use cases presented in this thesis. In chapter five, the literature review findings will be presented and categorised by functionalities of theatre management. The presented use cases will also be analysed regarding their applicability for companies in the sector and their potential challenges in application.

Chapter six will discuss the findings of the research and the analysis in terms of the research question while considering the potential benefits and threats of the presented use cases as well as other obstacles in the application process. In addition, the overall effect on processes and the organisational structure will be determined.

Chapter seven summarises the findings of this thesis and gives an outlook on the development in the field. The chapter will conclude the thesis with a critical acclaim to the approach and lessons learned for future research in this field.

2 Definitions and Conceptual Framework

2.1 Artificial Intelligence

2.1.1 Definition of Artificial Intelligence

The definition of AI is unclear in many regards, as AI is still a relatively new technology. As mentioned in the introduction, AI is generally perceived as a machine or program that can imitate human intelligence that can be used to expand capabilities for research and analysis purposes (Jiang et al., 2022, pp. 1–2). However, different definitions are mentioned in the literature. The Turing Test, for example, states that AI is achieved

once a machine can communicate with humans without being perceived as a machine but rather as another human (Jiang et al., 2022, pp. 1–2; Turing, 1950).

2.1.2 Development of Artificial Intelligence

AI has been a subject of scientists for the last century. Even before 1956, scientists laid the foundations for AI and have envisioned systems comparable to today's understanding of AI (Jiang et al., 2022, p. 3). The Turing Test, for example, laid a foundation for understanding AI that has been significant until today. The development of AI is marked by so-called AI winters, which have seen little to no progress in the field for extended periods. AI winters and phases of fast development have taken turns over the last decades (Jiang et al., 2022, p. 4). However, with the rise of computerised systems and the ability to gather more reliable and robust datasets starting in the 1980s, the development of machine learning (hereafter ML) models and, therefore, actual AI applications started. A factor contributing to the increasing speed of AI development is the increasing public awareness, as AI systems have won against humans in numerous competitions in recent years (Jiang et al., 2022, pp. 4–5).

In more recent times, AI has seen fast developments with applications in numerous technological solutions and industries. The healthcare industry, especially with its large amounts of complex data, has been a key driver for AI development as the estimated effects on quality and efficiency in times of resource shortages are immense. Another sector that has been driving innovations in AI is the transportation sector, with research on autonomous vehicles and traffic estimation systems. In these two cases, but not limited to these cases, the development of AI is closely linked to other technological progress in areas like robotics, smart twins, extended reality and the Internet of Things (Jiang et al., 2022, pp. 11–12). Especially in the early days of AI research, robotics and AI were closely linked. Even though the research fields have separated over time, they influence and depend on each other to form autonomous systems that can take over human labour activities (Rajan & Saffiotti, 2017, pp. 1–2, 6–8).

The following illustration shows the currently outlined and imagined development stages of AI. Currently, all AI applications are based on artificial narrow intelligence, the lowest step in AI development (hereafter ANI).
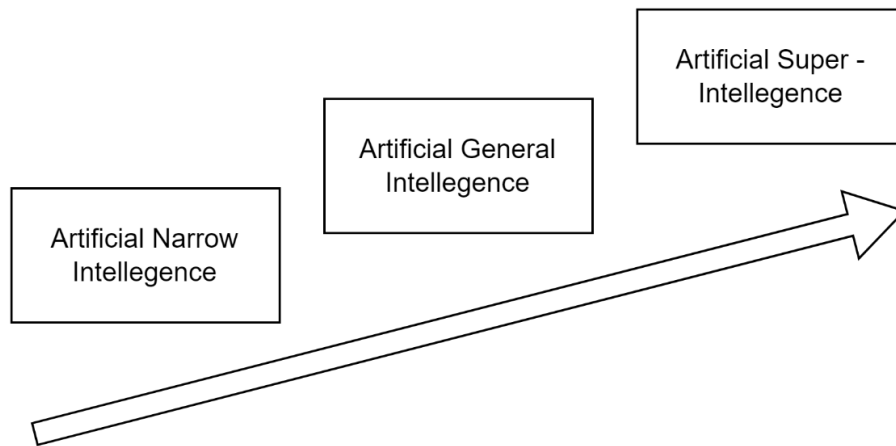
Figure 1: Development Stages of AI

Source: Own illustration, based on Jiang et al. (2022), p. 14.

ANI systems are specialised in specific tasks and are limited in their ability to evolve on their own. Humans train ANI to act in the desired ways so that they provide perfect outcomes for all current AI applications. They can gather and analyse data or make decisions based on an underlying data set (Jiang et al., 2022, p. 8).

In the future, AI is expected to develop into more complex systems. Artificial General Intelligence (hereafter AGI), the next step in the evolution of AI, is expected to be more than just a tool for humans. Instead, collaboration between AI and the human workforce will be more prominent. In further development steps, AI systems can create new machines with their own intelligence and without human intervention. The achievement of singularity, a state in which AI exceeds human capabilities in creating AI systems that can build machines, is also a further development step that can be expected. The result would be a new type of AI, the so-called Artificial Super-Intelligence (hereafter ASI). Even though scientists see a path for future development, it is not clear at the moment when the next significant steps in AI development beyond ANI will be achieved, leaving ambiguity for the application possibilities of AI in the years to come (Jiang et al., 2022, pp. 12–15).

2.1.3 Types of AI

Within the field of ANI, several sub-categories can be distinguished. One of the most important and widely used AI applications is ML. ML models are specific algorithms that are created for specific use cases. ML can be based upon an underlying decision tree or similar decision mechanisms and is trained to make decisions using large

amounts of data (Jiang et al., 2022, p. 5). Automated ML is an extension of ML models that need human supervision and maintenance. Automated ML aims to define optimal ML models with the least human input possible in an automated and, therefore, more efficient way (Mutschler et al., 2024, pp. 3–5).

Deep Learning (hereafter DL) is a category of ML that uses artificial neural networks (hereafter NN) to create the ability for AI applications to behave in desired ways and to produce desired outputs. NNs consist of individual processors called neurons. Each neuron has a designed task. While some neurons identify input variables and overlook the environment, others are responsible for triggering actions or creating an output. The individual neurons are connected in specific ways to form an NN. NNs are structured to work in the same way as human intelligence. Overall, DL enables the wide usage of AI for specific use cases with high reliability of correct results (Schmidhuber, 2015, pp. 86–87).

Generative AI can produce materials such as texts, images or music that are unique and similar to what humans can produce (Balasubramaniam et al., 2024, pp. 1–2). Natural Language Processing (hereafter NLP) imitates and analyses how humans use language to understand and convey information (Balasubramaniam et al., 2024, p. 257). A new trend in this field is the introduction of Large Language models (hereafter LLM) such as ChatGPT that can produce human-like writing and handle large amounts of text as input and output of the algorithms (Balasubramaniam et al., 2024, pp. 1–3).

2.1.4 Economic Relevance of Artificial Intelligence

Advances in technologies similar to AI have benefited the economy in the past. The usage of machines and robots has brought productivity gains to companies. The implementation of AI is expected to bring benefits to the economy by innovating processes and making the use of human time more effective. Simultaneously, technology changes are always associated with costs. These costs can be either direct costs of implementation or indirect costs that occur in society (Ing & Grossman, 2023, p. 3). In the case of AI, this primarily concerns employees with low qualifications, as their jobs are more likely to be replaced by the new technology (Czarnitzki et al., 2023, p. 201; Ing & Grossman, 2023, p. 3).

Contrary to past innovations, AI can be implemented into complex processes like research and development (Gao & Feng, 2023, p. 4). On a firm level, studies have found that AI benefits the overall firm productivity positively and significantly, even

though some productivity gains are represented in higher software expenses (Czarnitzki et al., 2023, pp. 196–198). Still, implementing AI into the company processes can substantially impact productivity (Czarnitzki et al., 2023, p. 201; Gao & Feng, 2023, p. 16). In the past, companies have increased their competitiveness by automating processes using technology. The main reasons are lower costs associated with production that enable companies to achieve a better position in the market and, consequently, growth. Therefore, the developments in AI technology are important for companies in all industries. The developments should be followed closely to remain competitive in global markets. (Gao & Feng, 2023, p. 16; Ing & Grossman, 2023, pp. 30–35).

2.2 Theatre Management

2.2.1 Definition of Theatre Management

Theatre management typically describes all activities that are related to operating a theatre. In a broader sense, theatre management can also include the production of stage shows in the theatre itself. It combines business activities with creative activities and is, therefore, to be differentiated from regular business management. In its basic principles' theatre management cannot be viewed as entirely distinct from business management. Management in business is typically described as a process that includes the stages of planning, coordination, leading, and controlling. These stages are also vital for theatre management (Rhine, 2017, pp. 1–17).

As theatre management combines creative and economic tasks, it can be split into two sides. While the business side of theatre management handles economic aspects of the business, such as marketing and sales, the artistic side works on the production itself. The artistic side also includes activities such as the creative production of new plays and musicals and the operation of special theatre equipment like lights (Rhine, 2017, pp. 6–7). However, the two sides of theatre management depend on each other and have some activities in common. The artistic side relies on the support of the business side to be financially sustainable and work, while the business side would not exist without the artistic side (Rhine, 2017, p. 19).

Depending on the structure of the theatre, the need to act economically or like a regular business varies. In total, twelve different forms of theatres are described in the literature. However, the main distinction can be made in the ownership of theatres.

Public theatres receive funding from governmental bodies. They generally serve a social function and are supposed to contribute to society in return for public funding. Private theatres, however, do not receive public funds and act in a manner comparable to a regular business. In the case of private presenting theatres, the business activity is focused on a commercial vision and the intention of profitable theatre production (Bonet & Schargorodsky, 2018, pp. 50–54).

2.2.2 Development of the International Theatre Business

The theatre has been a part of cultural life in civilisations for approximately 2,500 years. Even though the essence of what theatre is has not changed much, the context in which theatre is presented and how theatre is produced has changed a lot (Bonet & Schargorodsky, 2018, p. 40). Theatre is diverse in how it is presented and managed worldwide, as cultural and social factors have led to different developments in theatre over time. There are differences in the creative vision that theatres pursue and how theatres are managed and linked to their related society (Bonet & Schargorodsky, 2018, p. 41; Gordon & Jubin, 2023, pp. 55–60). In the last 100 years, however, globalisation has influenced theatre strongly. Globalisation has created new forms of theatre and has helped the emergence of new genres that are popular around the globe. At the same time, some shows and production companies have expanded and are active globally (Gordon & Jubin, 2023, Chapter 1; Savran, 2017).

Especially musicals have proven to be a commercially successful product in different markets. Consequently, private companies with corporate structures have formed in the genre (Gordon & Jubin, 2023, pp. 55–60). One of the largest theatre markets, Broadway in New York City, can exemplify corporate structures in theatres. Table 1 (see next page) shows the revenue development of Broadway theatres between the seasons of 1990/91 and 2023/24. A Broadway season starts in the first week of June and ends in the last week of May in the following year.

The revenues of Broadway productions have increased significantly over the last seasons. Between the 1990/91 season and the highest grossing season of 2018/19, the total gross increased by 585%, with an average growth rate of 6.5% per year. A significant setback for grosses has been the COVID-19 pandemic, which has caused theatres on Broadway to close partly in the season of 2019/20 and entirely in the season of 2020/21 (The Broadway League, 2021). However, the reopening of theatres

and the return of audiences led to grosses comparable to those before the pandemic, achieved in the last two complete seasons.

Season	Gross (Mio. US-Dollar)	Season	Gross (Mio. US-Dollar)
1990-91	267	2007-08	938
1991-92	293	2008-09	943
1992-93	328	2009-10	1.020
1993-94	356	2010-11	1.081
1994-95	406	2011-12	1.139
1995-96	436	2012-13	1.139
1996-97	499	2013-14	1.269
1997-98	558	2014-15	1.365
1998-99	588	2015-16	1.373
1999-00	603	2016-17	1.449
2000-01	666	2017-18	1.697
2001-02	643	2018-19	1.829
2002-03	721	2019-20	1.358
2003-04	771	2020-21	-
2004-05	769	2021-22	845
2005-06	862	2022-23	1.578
2006-07	939	2023-24	1.539

Table 1: Broadway Grosses between 1990 and 2024

Source: Own table, based on data by *Statistics - Broadway in NYC | The Broadway League*, n.d.

Large and global companies operate in the market, one example being Disney Theatrical Productions, a company specialising in producing musicals based on popular Disney movies. Disney has also been successful in conquering markets other than Broadway. Through cooperation with European and Japanese production companies like the Dutch producer Stage Entertainment, Disney has successfully introduced its musicals to a worldwide audience (Gordon & Jubin, 2023, Chapter 8).

2.2.3 The International Theatre System and its Markets

Generally, the international theatre business has developed a system of four markets. These markets can be local due to the physical nature of theatre or international when it comes to employment or intellectual property. The markets cannot wholly be

separated in terms of their belonging to the artistic and business side of theatre management, as artistic and business functions are often closely intertwined, and the two sides of theatre management are dependent on each other (Bonet & Schargorodsky, 2018, pp. 42–44; Rhine, 2017, p. 19). The following illustration (Figure 2) shows the markets in relation to the actors present in the respective markets.
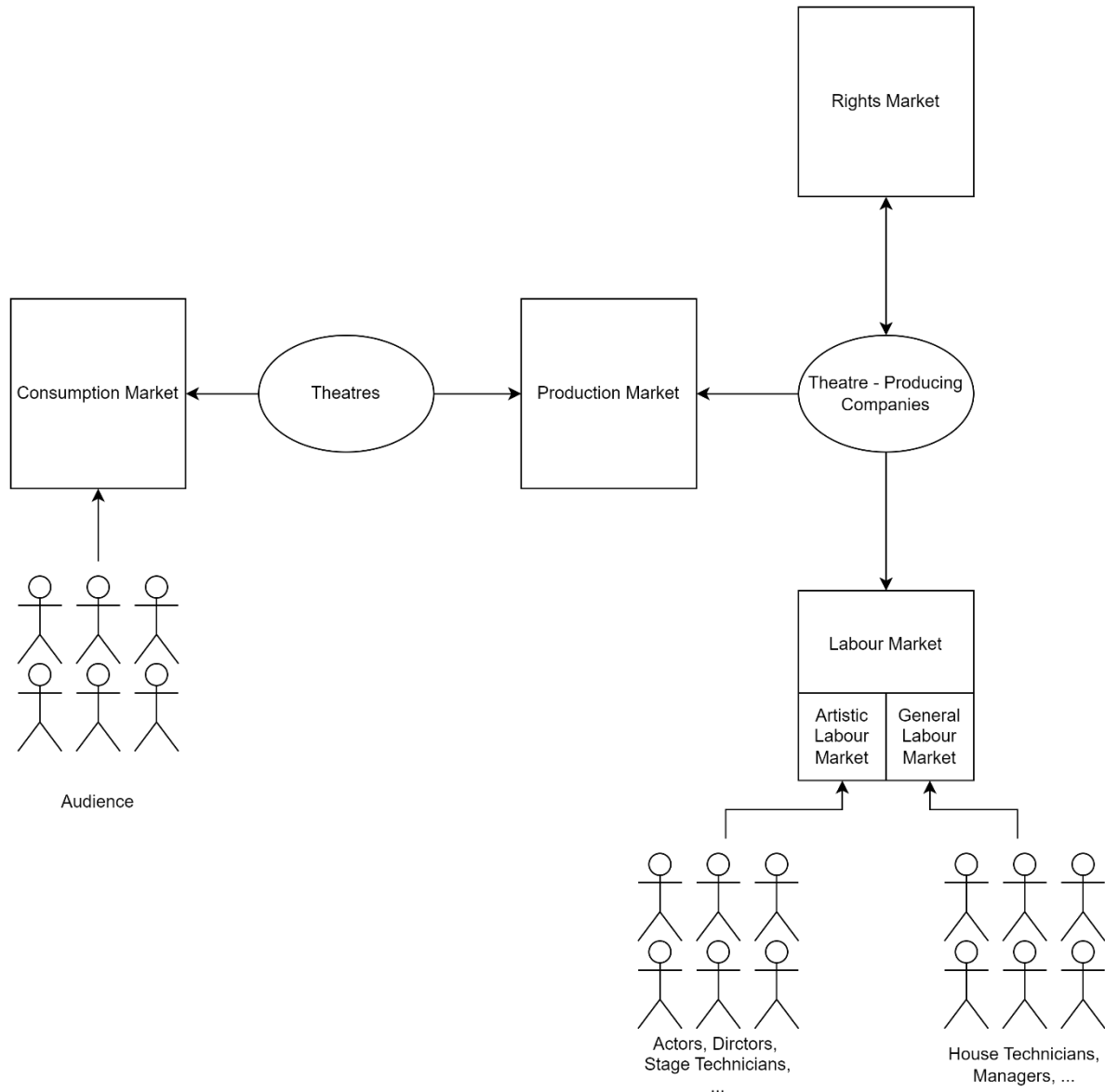

Figure 2: Theatre System

Source: Own illustration, based on Bonet & Schargorodsky, 2018, p. 45, simplified to reflect only relevant markets and players for the purpose of the thesis.

The consumption market consists of audiences who want to see theatrical productions on the one hand and the companies and theatres producing these shows on the other hand. All companies and public entities that are producing shows or other forms of live entertainment participate in this market. Companies are trying to select the content that will most likely cater to the audiences' needs (Bonet & Schargorodsky, 2018, pp. 44–45). Due to the physical nature of the theatre business, the consumption market is generally local and is determined by the available audiences and cultural offerings. Competition between producing companies is more intense in larger cities, and audiences have more choices than in smaller cities (Bonet & Schargorodsky, 2018, pp. 45–46).

However, the local consumption market can be influenced by tourism as well. Theatre and tourism are connected and influence each other. In London, one of the most significant international theatre centres, a large proportion of the audience are tourists (Hughes, 1998, p. 450). The development of commercial Broadway has also been influenced by cultural tourism. The development was influenced by how Broadway theatre has changed since the 1990s and how theatre has become a major contributor to tourism and is now acting as an attraction for the city (Bennett, 2005, pp. 412–418). Therefore, the local consumption market considers the local population and tourists visiting the vicinity. Independent of the nature of audiences, the consumption market determines the commercial success of a show. In the consumption market, the achievable admission prices and the number of guests visiting a show are determined and, therefore, if a show can generate enough turnover to support its production costs (Bonet & Schargorodsky, 2018, p. 46).

The second is the production market, where theatre owners and producing companies come together. In this market, private and public organisations are trying to find suitable spaces for their production. Technical limitations of theatre buildings and requirements of a show are crucial factors for decisions in this market. (Bonet & Schargorodsky, 2018). However, not all companies need to participate in this market. Primarily in Europe, some large players like the Stage Entertainment Group operate their own theatres for their productions (Gordon & Jubin, 2023, p. 274).

The third market is the labour market, where producing companies must find actors, technicians, and administrative staff. The theatre industry is a service industry heavily reliant on the human workforce due to its cultural component and product. The labour

market for companies in the theatre business is challenging to navigate. It differentiates between more common professions in overhead functions or Front of House (hereafter FoH) operations to more specialised artistic and technical jobs. Keeping the whole staff motivated is a key factor for success in the business. At the same time, it imposes a challenge for companies in the business (Bonet & Schargorodsky, 2018, pp. 138–143).

The last market that has developed during the globalisation of theatre is the rights market. On the rights market, production companies seek to secure production rights for certain shows (Bonet & Schargorodsky, 2018, pp. 166–168). As mentioned, the Disney Theatrical Group cooperates with Stage Entertainment for continental European productions. Cameron Mackintosh has also exported his musicals to global markets since the 1980s. These agreements are based on licensing agreements (Gordon & Jubin, 2023, p. 69).

2.2.4 Activities of Theatre Companies

Based on the knowledge of previous chapters, the various activities of theatre companies can be outlined. On the business side of theatre companies, most of their functions are comparable to those of companies in other industries (Rhine, 2017, pp. 4–7). A big part of theatre management is marketing, a typical business function. Within the field of marketing, companies conduct research to understand their consumers and the overall market and to be able to provide a product that will sell tickets to audiences. Other important tasks of the marketing departments are the branding of the theatre and the plays and promotional tasks (Rhine, 2017, Chapter 8). In recent years, audience development (hereafter AD) has become a key strategy to attract new visitors. The main goal is to sell tickets to new audiences who have not visited theatres before (Bonet & Schargorodsky, 2018, pp. 122–124). Other commercial tasks include selling tickets through often digitalised ticketing systems (Rhine, 2017, pp. 119–120).

Additionally, the business side of theatre management focusses on financial tasks. Theatres must provide financial statements just like other companies, which requires an accounting department to comply with accounting standards and laws. Moreover, financial planning is important for theatres. As margins are typically slim compared to other industries, theatres must plan precisely and create plausible and durable budgets. Sticking to budgets and controlling the financial situation is another important task on the financial side (Bonet & Schargorodsky, 2018, p. 158; Rhine, 2017, Chapter 7).

Other tasks on the business side relate to facility management tasks, including the upkeep and operation of office facilities and theatre buildings themselves (Bonet & Schargorodsky, 2018, p. 206). Moreover, theatres operate FoH Services. FoH refers to all theatre areas that are accessible to guests. These areas include the theatre entry, the foyer, and the auditorium (Rhine, 2017, p. 119). FoH Service implies that theatres offer guests the possibility to buy food and beverages or merchandise in the theatre. However, more basic tasks such as entry control and ushering are inevitable to ensure the operation of a theatre. The monetised offerings are an additional source of revenue for theatres (Rhine, 2017, pp. 123–125). Additionally, the theatre industry as a service industry relies on its employees, meaning that efficient Human Resource Management (hereafter HRM) is important for companies to survive. HRM in a theatrical context is a complex task that requires companies to recruit and maintain skilled personnel with limited resources (Bonet & Schargorodsky, 2018, p. 138).

On the artistical side of theatre management, there are many activities that relate to the production of a show. These activities include artistic jobs such as casting departments, actors, and directors, as well as technical jobs such as stage technicians (Rhine, 2017, pp. 89–90). Another function of the artistic side is the creation of new plays in the content development department. General activities concerning the rights to play specific productions are important for theatre companies. Obtaining the rights for plays that sell tickets for the local market is a vital task, and navigating the complex field of copyrights stresses the whole organisation. However, a company can also sell licences for plays created by that company, providing an additional source of revenue (Bonet & Schargorodsky, 2018, pp. 166–168).

On a higher level, the company leadership needs to coordinate between the artistic and business side of theatre management as the two rely on each other to produce profitable theatre. Keeping up internal communication is key to running a theatre business, and management needs to arbitrate between the sides of the business. In addition, higher management is responsible for long-term visions and creating strategies for future growth (Bonet & Schargorodsky, 2018, pp. 84–85).

2.2.5 Organisational structures of theatre companies

The organisational structure of companies in the theatre business can differ depending on the specific company's activities. To simplify the structure for this thesis, a company that engages in all activities and owns its theatres is being outlined. The organisational

structure of the company could look similar to the chart below. The lines represent the company's reporting paths.
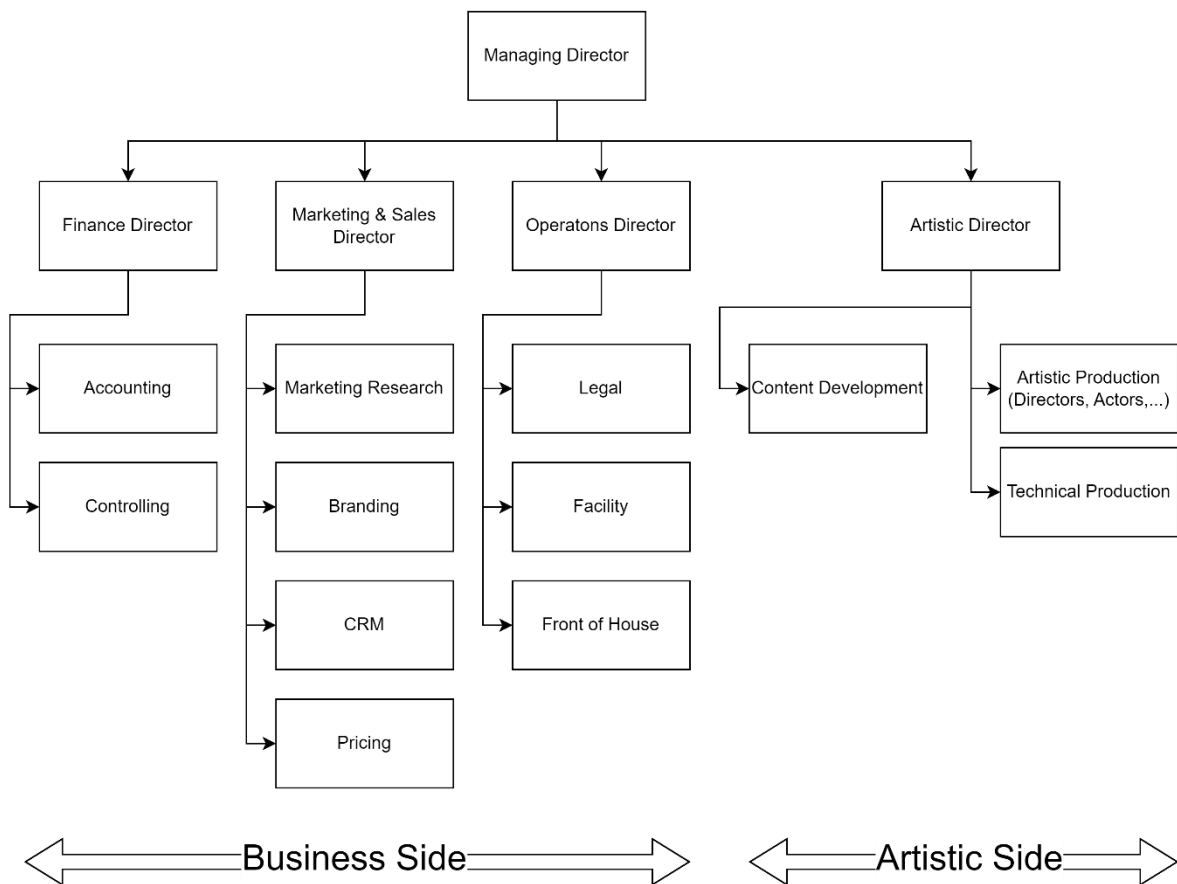
Figure 3: Organisational Structure Chart

Source: Own illustration, based on Rhine (2019), p. 73-77.

In the company structure, the business side and artistic side of the company are separated from each other and are only connected on a high level by the managing directors. The company's structure is based on the functionality of the different departments. All departments of the company are equally able to work with other departments on various projects and the production of plays.

Contrary to organisational structures in other industries, structures of theatres are typically not formed around processes or products but focus on the departments' function. The main reason for this is the way that theatres are working. Every production of a show is comparable to a project in other industries. The production of

a show has a defined starting point and ends with the load-out of the set and costumes after the final performance. During the project time, specialised skills in all functions are needed. Therefore, theatres often follow a matrix structure as it facilitates coordination between departments and enables departments to work on more than one production at a time. (Rhine, 2017, pp. 73–77).

2.2.6 Theatre Industry and Technology

In the past, the theatre industry has been influenced by many technological advancements. One of the most significant leaps has been the introduction of computers into all activities. On the business side of the theatre industry, this has influenced the important function of sales. With the rise of computers, digital and automated ticketing systems have emerged (Rhine, 2017, p. 50). Ticketing systems have progressed throughout the years and now offer the ability to make online ticket purchases, provide app support, and track data. The tracking of data enables theatres to understand their audiences better. This tracking also helps the marketing function better target audiences (Rhine, 2017, pp. 120–121). Overall, digital ticketing systems have increased productivity by tracking sales and automatically creating reports and new possibilities in customer relation management (hereafter CRM).

On the artistic side, technological innovations such as digital light and sound boards have increased productivity on the technological end of production (Rhine, 2017, pp. 50–51). Overall, technological advances have increased theatres' productivity in two main ways. For one, the costs associated with running a production or costs in overhead functions have been lowered. The second factor is the revenue increase with a relatively small change in cost, for example, due to the introduction of digitalised ticketing systems.

2.2.7 Current problems of the Theatre Industry

The theatre industry relies on physical labour more than other input factors. This is a common fact in many service industries. As a result, the costs of companies in the industry are primarily based on payroll for its employees on stage, behind the stage, and in all other administrative and overhead functions. At the same time, the potential for productivity increases in the creative workforce is limited due to the nature of theatre. The limitation mainly arises from professions such as musicians, actors and stage technicians who have tasks in producing a show that cannot be easily substituted

by technology (Frey, 2019, pp. 17–18). The main reason for this limitation in productivity increases lies in the unchanged need for rehearsal time and the number of actors and musicians. A play needs the same numbers of musicians and actors as it did a few years ago if a theatre wants to maintain quality (Frey, 2019, p. 18; Rhine, 2017, pp. 50–51). As wages in the theatre industry are rising at a similar rate as in the rest of the economy, the cost of theatrical production is continuously rising. Some authors describe this phenomenon as "cost sickness" (Frey, 2019, p. 18). Public theatres offset the rising production costs with higher financial aid from public bodies. However, for private companies, increasing ticket prices is the only way to offset higher production costs (Frey, 2019, p. 18).

The COVID-19 pandemic increased problems for the industry. As a result of the pandemic, theatres worldwide have remained closed for extended periods. For example, theatres on Broadway remained closed throughout the whole season of 2020/21. Compared to the season of 2019/20, which was also partly affected by theatre closures related to COVID-19, the industry suffered a revenue loss of about 1.3 billion US dollars (*Statistics - Broadway in NYC | The Broadway League*, n.d.). This fact has changed the business in several ways, with companies looking for new sources of revenue, such as film adaptation of stage productions. Nonetheless, the pandemic forced smaller companies and venues to close, changing the landscape of theatre and musical in ways that are yet to be determined (Gordon & Jubin, 2023, p. 1).

The combination of these two problems pressures the theatre industry to find innovative ways to reduce costs wherever possible. However, finding the potential to cut costs is a difficult task. As seen in Chapter 2.2.6, the introduction of technology is one of the main ways that theatres have tried to reduce costs and improve productivity.

3   Systematic Literature Review

The literature review on use cases of AI has been carried out in three stages. In the first stage, titles of literature connected to the topic have been searched using publicly available tools such as *Google Scholar, EconBiz* and library systems from the university of Applied Sciences Hamburg and the Berlin State Library. In addition, AI tools such as *Perplexity.ai* have been used to supplement the search for literature sources. In the second step, the availability of researched literature titles was determined. All literature titles that are not publicly available or licenced by either the

HAW Hamburg, the State Library of Hamburg or the State Library of Berlin must be excluded in this step as they are not accessible for research purposes.

In a third step, the abstracts of fitting literature were screened to ensure actual connections between the research topic and examined literature. If the literature fits the research topic, it has been included in the library for research purposes. The library was extended through the usage of another AI tool called *ResearchRabbit*. *ResearchRabbit* enabled more effective research of related literature and extended the research depth. In total, 202 publications have been included in this list. Not all use cases that could be presented based on literature must be presented in this thesis.

In a fourth step, the actual text of the publications was read. This encompasses at least the passages relevant to the research topic, as well as the introduction and conclusion. Literature was categorised by use case and functionality of theatre management. In this step, texts were chosen for citation, offering the best insights for their specific use case and enabling a productive writing process. In total, 33 pieces of literature are cited for use case purposes, which means a reduction of 84% compared to the abstract review.

Additional literature research has been done to provide knowledge of the basic principles of AI and theatre management. Research in these fields has been similar to the literature review for use cases. In total, 53 sources are cited in this thesis.

4 Methodology

During the literature research, too many potential use cases for AI within theatre management were identified. Therefore, only a selection of use cases can be presented in this thesis. A broad definition of AI was considered to identify the most promising use cases, and all intelligent solutions that interfered most with the activities mentioned in Chapter 2.2.5 and provided economic benefits were further assessed. The decision on which use cases to present is also based on the availability of literature. A secondary criterion for presented use cases is their actual effect on a theatrical organisation. Only use cases that are directly represented in the mentioned activities of theatre companies are being evaluated.

To further limit the presented use cases, use cases of AI that target production activities are excluded for two main reasons. Due to the physical nature of the product and the show itself, the possibility of productivity increases in stage productions is

limited. Although technological advances have led to increases in the productivity of shows, the main cost factors remain unchanged. Theatre needs performers on stage, or it will not serve its purpose. As performers need the same amount of time to rehearse a show and the number of performers for a given show stays at the same level, this crucial part of the theatre business cannot benefit from productivity gains (Rhine, 2017, pp. 50–51). Moreover, the availability of literature in the field is strictly limited. Production activities include artistic production from directors and actors, stage management and technical production, stage technicians, and lighting and stage automation departments.

The remaining use cases target theatre companies' administrative and economic functions, such as marketing, finance, and human resources, as well as some operational topics, such as the operation of theatres themselves without production. A second field of use cases that has been included is creative production. In these areas, use cases for AI will be presented in the following chapter while focusing on the economic factors and less on the technological part of implementation and ways of working in general.

5 Use cases of AI and their applicability for Theatre Management

5.1 Finance

5.1.1 Accounting

Introducing AI into accounting processes can have several positive impacts on the transparency and accuracy of a company's accounting information. AI can automate all traditional tasks within the field of accounting, starting with simple bookkeeping tasks and continuing with more complex tasks such as information sharing and decision-making based on accounting data (Li & Zheng, 2018, p. 814).

This ability of AI to innovate and automate the whole process has many benefits. For one, the chance of fraud is reduced if the AI works autonomously to provide all accounting data. As a result, people reviewing accounting data have fewer possibilities to manipulate it. In addition, ML models can help companies to detect fraud actively in accounting data. Although AI cannot reduce the root course of financial fraud, it is a technology that can help reduce the risk for all concerned stakeholders (Li & Zheng, 2018, pp. 813–814; Yi et al., 2023, pp. 129115–129116).

In addition, AI-processed accounting data is more efficient as the most time-consuming accounting tasks are automated. Human personnel are only required to review the results of the accounting process rather than doing manual accounting work themselves. The gained time can be used to reduce errors and have more transparent accounting data (Li & Zheng, 2018, pp. 813–814). Regarding management accounting, AI tools can help analyse accounting data for management and provide insights for decision-making. It can also help to review the company's overall performance compared to its size (Li & Zheng, 2018, p. 815).

Another use case for AI in accounting departments is the usage of investment decisions. ML and DL models can help predict cash flows related to specific projects and offer companies the possibility to better access a potential investment's financial viability. Moreover, AI can help to assess all risks that are associated with the investment and can lay a better knowledge foundation for all investment decisions (Leitner-Hanetseder et al., 2021, pp. 541–542; Yi et al., 2023, pp. 129109–129110).

The overall innovation of the accounting process by using AI can help companies reduce the headcount of controlling departments. The gains in efficiency of the process through automation of routine tasks lead to less work that needs to be carried out by human workers. However, AI cannot replace the accounting departments entirely at the moment as human supervision and training of AI in the process is still needed (Leitner-Hanetseder et al., 2021, p. 544; Li & Zheng, 2018, p. 814). For companies in the theatre industry, using AI in accounting processes allows for cost reductions in an important overhead function for compliance with local accounting laws and, therefore, increases productivity.

5.1.2 Budget Process

In corporations' financial controlling tasks, AI can be used in the budgeting process. For example, AI models can help with analytical tasks such as creating budgets. They can help forecast sales and costs based on the company's historical data. ML and AutoML models can be used in the context of financial forecasting. Based on historical data, AI can accurately provide forecasts for short- and long-term analysis (Jain & Kulkarni, 2023, pp. 11–12). NLMs can also help benchmark budget decisions. AI can help understand all stakeholders' needs through data-gathering and analysis techniques. As a result, AI can help in the budget decision-making process (Marotta & Au, 2022, pp. 7–8). However, AI cannot help to reduce the general weaknesses of

budgeting. AI, for example, does not automatically mean more frequent budgeting or does not imply more flexibility for employees throughout the year (Marotta & Au, 2022, pp. 9–10).

AI cannot only be used in the process of creation budgets but can also be used in variance analysis to compare budgets versus actual results. Through text-generating NLP models, AI can analyse and explain the differences between actual numbers and planned numbers on a more objective basis than through human analysis (Jain & Kulkarni, 2023, p. 11)

Overall, using AI can help reduce complexities in the budget process through its analysis capabilities, leading to more time- and cost-efficient budgeting processes (Marotta & Au, 2022, pp. 11–12). The insights generated from financial analysis of deviations from budgets can also gain in quality (Jain & Kulkarni, 2023, p. 13). A significant challenge, however, is the possibility of rejection by the workforce. With fixed targets allocated via an AI process, employees might feel undervalued and more pressured than before, leading to adverse effects on the usability of budgets (Marotta & Au, 2022, pp. 10–11). Moreover, data quality is essential for accurate results in AI-supported budgeting processes (Jain & Kulkarni, 2023, pp. 12–13).

5.1.3 Enterprise Resource Planning Systems

Enterprise resource planning (hereafter ERP) systems are not solely used in a financial context. They combine functions of all core business activities like supply chain management, HRM, and, in some cases, customer relations management. The benefits of ERP systems lie in the centralisation of financial and non-financial data that facilitates important processes such as reporting and other manual processes (Godbole, 2023, pp. 8–9).

AI-supported ERP systems have several benefits compared to traditional systems. The capabilities of ML and NLMs can supplement the functionality with results in better predictive analysis and an overall increased efficiency of ERP systems (Bawa, 2023, pp. 1187–1188; Godbole, 2023, pp. 10–11). Research has shown that the time needed to process tasks is reduced, and results are more accurate than with conventional ERP systems. Moreover, AI-supported systems show higher results in satisfaction of users (Godbole, 2023, pp. 10–11).

5.2 Marketing

5.2.1 Marketing Strategy and Brand Creation

AI can contribute three main capabilities to the marketing strategy development process. One of the potential uses of AI is the automated collection of data in all aspects of the company's activity. This ability includes customer data like product usage and consumption. However, the collection of data by AI is not only limited to data that can be observed. The usage of AI for tasks in survey design, survey administration, and supervision can support the process or help automate all related processes completely. (Huang & Rust, 2021, p. 33).

The second ability that helps in the creation of marketing strategies is the analytical capability of AI. AI can quickly analyse the behaviour of customers and the overall market based on the previously gathered data. By analysing social media and other relevant datasets, AI can create market insights and predict trends or future consumer needs. In the field of predicting the future needs of consumers, AI is already used by companies like Amazon, which uses AI to distribute merchandise throughout its warehouses better (Eriksson et al., 2020, pp. 804–805; Huang & Rust, 2021, p. 33).

AI's ability to understand customer groups is another potential use case in marketing strategies. AI can potentially recreate human feelings and be able to understand these feelings. This ability can help the marketing department to understand consumer sentiment towards certain products. This feeling capability has the potential to help retain existing customers as well as gain new customers (Huang & Rust, 2021, p. 34).

The above-described data collection, analysis, and "feeling" capabilities can help companies in key tasks of strategic marketing planning. The first is customer segmentation, which is used in marketing to create smaller subgroups of the overall customer market and characterise these groups according to their needs and wants. AI-supported customer segmentation can be used, for example, in the tourist industry by dividing the overall group of tourists into segments that are more likely to travel to specific destinations than others (Huang & Rust, 2021, pp. 37–38). Based on the segmentation of customers, AI can help identify the segments most likely to respond to the company's marketing actions. Human interaction is still needed for the final choice, but AI can support the decision process (Eriksson et al., 2020, pp. 805–806; Huang & Rust, 2021, p. 38).

In theatre management, the above-described ability of AI can also help AD. Although a precise definition is not presented in the literature, AD is generally defined as a "planned, organisation-wide approach to extending the range of relationships with the public, it helps a cultural organisation to achieve its mission, balancing social purpose, financial sustainability and creative ambitions" (Hadley, 2021, p. 5). AD includes various underlying activities such as decisions on programming, meaning what shows are played and how certain audience groups are targeted through different marketing channels (Hadley, 2021, pp. 58–60). ML models' capabilities to create customer segments based on data and statistical methods and to understand and characterise each segment's needs is a crucial factor that can contribute to better results with less human workload in the complex AD field.

AI cannot only help in the planning stage of a marketing strategy but can also be used in other fields of execution as well. In terms of branding, AI can help identify the right design for products like logos by supporting the creation process and tracking the success of a design choice. AI can also open new ways to address customers by personalising the experience for individual customers to their preferences (Huang & Rust, 2021, p. 39). The personalisation of communication is another case for the potential implementation of AI. AI can create advertisements that meet the needs of every individual person and help track the efficiency of direct marketing, like e-mails, by better understanding the customer's emotions regarding specific content (Huang & Rust, 2021, p. 40).

5.2.2 Customer Relationship Management

Building a lasting customer – brand relationship is another field that can benefit from using AI. The main benefit lies in the already introduced ability of personalisation. Based on gathered customer data, AI can adapt individual communication in a way that benefits the relation between individual customers and the company. Especially in a digitalised environment, companies can target individual customers more precisely (Deryl et al., 2023, p. 3). The personalisation of customer communication is made possible by using generative AI that uses customer data to produce images and text most likely to correspond with the individual customer (Park & Ahn, 2024, p. 2). Studies have found that using AI for material creation is an effective way for marketing departments to strengthen the customer's bond with the company and to introduce a strong and coherent brand personality. Ultimately, more personal communication leads

to a higher purchase intention, at least for luxury consumer goods (Park & Ahn, 2024, pp. 9–10). Whether the same effects can be achieved for entertainment is yet to be explored.

Most large retail chains offer their customers mobile applications (hereafter apps). These apps accompany the purchase process from the pre-sale to the post-sale stage. Apps gather information regarding customer behaviour and help customers make informed purchase decisions (Lu et al., 2023, pp. 4–5). In the case of theatre, apps could be used to accompany guests before their visit and help in case of questions regarding the theatre visit. Moreover, NLP models, whether integrated into an app or the company website, can enhance customer experience. Through chatbots, customer's questions can be answered reliably at any given time without needing customer service agents, making the overall relation between customer and company more effective (West et al., 2018, pp. 326–327).

However, the highest success in implementing AI-supported CRM tools has been seen in industries with frequent contact with customers. E-commerce has been wildly successful in implementing AI in all aspects of CRM (Grewal et al., 2021, p. 230). Additionally, companies that want to introduce AI in CRM processes face challenges regarding customer privacy concerns and unwanted biases that might result from the underlying functions (Grewal et al., 2021, p. 231).

5.2.3 Pricing

In addition to these marketing functions, AI can be used in other functions like pricing. The automation of price setting can reduce human workload as complex calculations are fully automated. Research has shown that ML models can optimise pricing structures by including private information, such as the customer's willingness to pay, into the pricing structures (Huang & Rust, 2021, p. 39).

Implementing AI tools in the pricing process can help reduce the workload and improve efficiency and productivity when it comes to the price setting of theatres. AI cannot only consider essential variables like demand but also analyse competitors' pricing structures and individualise pricing structures for the customer. Even though progress in this area has been made over the last few years, AI pricing models may still produce wrong outputs that are not in sync with competitors' prices. For the overall market, AI pricing has the potential to contribute to monopolistic pricing, posing challenges to introducing AI-supported pricing models. (Kopalle et al., 2023, pp. 583–590).

The usage of mostly manual models to vary ticket prices is nothing new for theatres. In the past, pricing based on demand has allowed theatres to maximise their profits. However, this pricing method was and still is connected to constant work to adjust prices (Rhine, 2017, pp. 138–139). Introducing AI tools that can take over some of these tasks while more accurately anticipating customers' willingness to spend on tickets could maximise the revenue per guest theatres achieve.

5.3 Legal Activities

Contract creation is a time-consuming task for legal departments within companies. LLMs like ChatGPT can help reduce the workload by supporting the writing process. Experiments have shown that LLMs can produce contracts that match the requirements to fulfil laws' requirements from a content perspective. Moreover, AI can help create contracts in a language that is more accessible to a broader audience by explaining certain expressions within the needed content. LLMs can also produce precise and logical contract structures based on the contents and the contract language. Overall, using AI in the contract creation process can help reduce the workload for the legal departments of companies by providing first drafts of contracts and helping with content and language issues during the process (Autto et al., 2024, Chapter 3.2-3.4).

These AI capabilities can mainly be used for theatres to answer licensing questions. Licensing activities are important for private theatre companies that specialise in producing shows that other companies create. The Stage Entertainment Group is a prominent example of a company heavily dependent on licencing activities (Gordon & Jubin, 2023, p. 274).

Moreover, AI's help in legal activities can extend to compliance tasks. AI can help companies access the status quo in topics like corporate social responsibility and can help identify potential initiatives for more sustainability within corporations. More importantly, the abilities of LLMs and NLPs to analyse the company's compliance with laws and regulations, such as the European Corporate Sustainability Reporting Device (CSRD) (Kustiyana & McGuinness, 2024, p. 12).

Overall, the use cases in legal activities apply more to larger corporations within the sector, such as Stage Entertainment or Disney, which actively participate in complex show licencing. However, AI tools can also help to comply with regulations such as the European CSRD. Nonetheless, the use cases in legal activities are aimed more

towards larger corporations that must report according to sustainability standards or operate internationally.

5.4 Human Resource Management

In HRM, AI has several possibilities for application in theatre companies. In everyday human resource departments, AI can help automate repetitive tasks and reduce the workload of human resource managers (Palos-Sánchez et al., 2022, pp. 5–6).

In recruitment processes, AI can support recruiters by helping them select employees. For example, LLMs can read and understand applications and filter out suitable candidates for human review (Palos-Sánchez et al., 2022, pp. 6–7). Typically, Applications that specialise in reading applications compare applications received against a set of criteria set by human resource managers when positing the job offer. This ability reduces the need for human work, which is time-consuming, especially for larger companies that receive many applications. However, the usage also comes with risks which need to be considered. For example, there have been cases where AI discriminated against certain applicants based on gender, race or age (Albassam, 2023, pp. 11–12).

In later stages of the application process, NLMs and other AI capabilities, such as face recognition, can be used to analyse an applicant's suitability by analysing video material from interviews. The usage can give insights into the applicant's language skills and personality traits, which might be important when filling certain positions. Similar to the usage of AI for screening and matching candidates' positions, there are concerns regarding privacy and algorithmic bias, meaning the discrimination of certain applicants (Afzal et al., 2023, p. 5; Albassam, 2023, p. 13).

The potential use cases for AI in recruiting are almost infinite, and other use cases like the active search for employees by reaching out to potential candidates who are not in search of new positions at the moment but might be interested in the position offered by the company are possible (Palos-Sánchez et al., 2022, pp. 6–7). The ability of AI to gather large amounts of data for applicants from different sources can lead to an overall innovation of the recruitment process with improved efficiency and better hiring outcomes (Albassam, 2023, p. 20).

Besides the recruitment process, AI can also be used in other HRM fields. For example, AI has shown potential for usage in employee training. AI can analyse employees' knowledge by gathering and analysing data. Through the analysis,

potential employee knowledge and training gaps can be detected, and training modules can be targeted directly at these gaps. With the usage of AI in employee training, the overall efficiency of continuous learning can be improved in a business environment that becomes more complex (Rožman et al., 2023, p. 18). Also, AI applications in managing the employee–company relationship are possible as AI can help managers understand employee behaviour and analyse employee engagement. These analyses, in combination with the ability of AI to predict the suitability and sentiment of employees towards compensation and the more straightforward evaluation of employee performance, help managers retain talent acquired in costly processes beforehand (Afzal et al., 2023, pp. 4–6).

Even though interest in the application of AI in HRM processes is immense, the complexity of the field does not yet allow for the broad use of AI applications (Palos-Sánchez et al., 2022, pp. 20–21). Privacy concerns, discrimination concerns, the need for human supervision and employee resistance towards AI in HRM processes are other factors that contribute to the hesitant implementation (Albassam, 2023, p. 20; Palos-Sánchez et al., 2022, p. 21). Overall, implementing effective processes, including AI, is often difficult for companies even though the usage of AI in HRM processes will be a crucial factor for the competitiveness of companies in the future (Palos-Sánchez et al., 2022, p. 23).

The theatre industry, as a service industry, is dependent on employees. Moreover, the operation of theatres and the production of shows require specialised personnel (Bonet & Schargorodsky, 2018, pp. 138–143). Implementing AI can help companies reduce the costs associated with recruiting processes for overhead and technical roles. For artistic professions such as actors and musicians, using technologies such as facial recognition might also be suitable for casting scenarios. However, more research is needed regarding this potential use case.

5.5 Facility Management

The operation, upkeep and overall administration of buildings generally describe facility management. Next to salaries and direct business expenses, it is one of the most significant cost factors for most companies. Therefore, innovation is always needed to lower costs in this field (Atkin & Bildsten, 2017, p. 116). AI embedded in facility management technologies such as machinery will be one of the drivers in this field,

although other non-AI solutions will also contribute to better productivity (Atkin & Bildsten, 2017, p. 119).

An AI solution that could drive change is smart buildings that use sensors throughout the building in combination with AI in various ways (Farzaneh et al., 2021, p. 4). These systems can potentially replace the human workforce for some tasks. The potential to cut costs by reducing human workload is especially relevant for facility-related data analysis and building operations recommendations (Atkin & Bildsten, 2017, pp. 119–120). Smart Buildings have different functions and can be implemented to different degrees. For one, smart buildings are adaptable in different dimensions and do not only react to external conditions. They gather data and optimise the internal environment in a way optimal for the building's users and energy efficiency. Even though the building is determining optimal conditions, users may remain able to control certain aspects of room conditions, which works as feedback for the building and future decisions. Better energy efficiency is one of the main advantages, but smart buildings can still offer users different functionalities, such as meeting room bookings. Information gathered through these booking mechanisms helps achieve even higher energy efficiency as consumption in some building areas can be estimated, and energy usage in peak times can be reduced. (Buckman et al., 2014, pp. 98–104; Farzaneh et al., 2021, pp. 7–8). AI can also help identify equipment failures even before they occur, helping to further reduce workloads in the facility management department of companies (Farzaneh et al., 2021, pp. 18–19).

Theatres are very complex buildings subject to varying levels of utilisation each day. During performances, thousands of audience members may occupy the building, while at other times, only a few employees might be present. The buildings must accommodate the needs of audience members and the production staff (Bonet & Schargorodsky, 2018, pp. 206–209). Therefore, using smart building technology with its described capabilities might help theatre companies reduce costs by optimising energy consumption based on actual usage. However, the challenge for theatres is to incorporate new technology into existing buildings without becoming a danger to the financial sustainability of the operations. (Bonet & Schargorodsky, 2018, p. 206).

5.6 AI in Creative Development

Generative AI has also found numerous applications in creative functions. Artists and authors worldwide are experimenting with AI to support creative processes. In the field

of music, AI is facilitating the creation of entirely new music. AI can create unique melodies that do not infringe any copyrights of existing music. This generative ability enables the creation of music for everyone and not only musicians (Hageback & Hedblom, 2021, pp. 56–58). AI's ability to generate music is advancing fast, and there is a global interest in the technology. There are already various AI systems aimed at the generation of music. However, the generation of music that resembles the quality of human-made music is still tricky for AI. The usage of AI in writing music has even so become a help for some musicians in their daily lives. One main problem in using AI models for music generation is that most models are style-specific. Style-specific means that they cannot be used to generate different music styles, as the results vary in quality depending on the genre (Civit et al., 2022, pp. 11–13).

The emergence of NLP models has also influenced literature and writing. Nowadays, AI can generally support the writing of texts like newspaper articles by collecting and organising information better. For narrative storytelling and script writing, AI can help authors in the creative process in different ways. For example, AI can support this by analysing story arches and finding archetype variations. This ability produces new and innovative story motives that have not been around before. In addition, AI analyses the story the authors wrote and helps fix logical errors or rearrange events in an order that makes more sense, improving productivity in writing coherent stories. AI can also make suggestions on story ideas based on the analysis of data and trends in the world of literature, giving authors a better understanding of how storytelling is evolving and what topics might be of interest for the present time (Hageback & Hedblom, 2021, pp. 50–55).

Studies on writing tools that use AI as a support function or even co-writer for authors have found that AI often leads to new story elements that can make a story more interesting when refined by human intervention. New characters and scenes have often emerged from the interaction between humans and machines in creative writing. One of the key strengths of AI in writing is its unpredictability, as new story elements are created through random input made by the AI tool (Yang et al., 2022).

The usage of AI in content creation departments might, therefore, be an interesting use case for companies in the business as the abilities of AI to help authors create new and exciting stories more efficiently with the possibilities of creating song ideas for potential musicals can help to create new content more productively. Image-creating

AI can make quick sketches of ideas and visualise potential stage designs without incurring costs at the early stages.

However, AI can be used not only to create text but also to translate existing text. Development in this field has been fast, and AI is capable of doing not only word-to-word translations but also translating texts in a more natural way that keeps the messages and intent of the text but creates a more natural-sounding text in the target language similar to the work of human translators. (Hageback & Hedblom, 2021, pp. 54–59). In combination with AI's capability to help create song texts, the ability to translate plays with and without songs into different languages can improve productivity. The AI-driven translation of text and song is an interesting capability for companies specialising in musicals. With the globalised musical market, many plays, especially those by the Disney Theatrical Company, have been performed in different languages than their original (Gordon & Jubin, 2023, p. 249).

5.7 AI in Related Industries

The tourism industry is closely linked to the theatre industry. The linkage can be seen in large cities such as London or New York, where most audience members for theatres are tourists, and the emergence of theatre has shaped the way tourism is perceived in the respective city (Bennett, 2005, pp. 412–418; Hughes, 1998, p. 450). This statement stands for economic reasons with the emergence of cultural tourism and the connection between tourism and the theatre industry in some cities like London, as well as for practices in marketing (Hughes, 1998, p. 450; Zhang et al., 2019, p. 172).

Customers' experience in tourism is shaped by emotions experienced during a trip. Therefore, marketing in the industry is linked towards certain emotions, and to create successful destination advertisements, the linkage to the right emotions is necessary. The tourism industry uses storytelling in its communication to include emotions in the promotion (Zhang et al., 2019, pp. 171–172). In the future, AI could be a crucial player in the design process of destination stories, especially in a digital environment. The ability of AI to understand the needs of customer segments based on data and to create fitting stories in communication can be a great benefit and has promising potential (Zhang et al., 2019, pp. 173–185).

AI is used for marketing purposes in the tourism industry and has shown the potential to reduce uncertainty for businesses, for example, by providing better forecast

analysis. AI's predictive capabilities help businesses mitigate disturbing factors such as booking uncertainty. In addition, using AI has also helped businesses in the industry achieve better customer satisfaction results by providing new technologies, such as better-planned travel itineraries that can react to weather changes. Overall, AI has the potential to help the tourism industry by introducing new product offerings that are better suited to individual needs, ultimately resulting in better customer experiences (Ku & Chen, 2024, p. 12).

Another industry that shows similarities to the theatre industry is the sports industry. Sport and theatre are both part of the social life of cultures. Studies have found that theatres and sports events even overlap regarding their audiences to some extent (Montgomery & Robinson, 2006, p. 36). Moreover, the sports industry has structures similar to the structure of theatres. Especially the organisation of sports events and the operation and management of venues for these events are similar to the operation of theatres.

In the sports industry, several applications are currently being investigated. In the business around the sport, the use cases for AI are almost unlimited. AI can, for example, enhance customer experience during stadium visits or in surrounding processes (Ding, 2019, p. 1). Overall, AI can innovate the industry's business model and open new possibilities, such as using e-sports and e-sport events as new sources of revenue (Ding, 2019, pp. 1–2). The sports industry is trying to find ways to incorporate AI into all aspects of the industry, with a focus on commercialised sports. In the light of theatre management, similar creativity can be expected when it comes to the creation of new genres as well as new revenue sources.

6   Discussion

Productivity in an economic sense is a comparison of input vs output of a process. Therefore, productivity increases can generally be achieved by two different methods. For one, the input into a process can be reduced while maintaining the same output, leading to relatively lower costs per output unit. On the other hand, the output can be increased while maintaining the same level of inputs, which means relatively more output per cost unit (Wöhe et al., 2020, p. 38). Looking at the activities of companies in the theatre business, the two main factors influencing productivity are cost reductions and revenue increases.

Regarding cost reduction, theatre companies can benefit from using AI in almost all overhead processes. AI improves accounting efficiency in financial functions and reduces the department's needed headcount, leading to direct cost reductions. Moreover, other financial processes, like budgeting, increase efficiency and cost-effectiveness by implementing AI (Li & Zheng, 2018; Marotta & Au, 2022). The same holds for human resource processes where the time efficiency, especially in terms of recruiting processes, is increased (Afzal et al., 2023; Albassam, 2023; Palos-Sánchez et al., 2022; Rožman et al., 2023). These efficiency increases can potentially reduce headcount, at least in some functions such as accounting, leading to direct cost reductions (Li & Zheng, 2018). Next to the overhead functions of corporations, cost reductions are also possible by the introduction of AI in facility management by reducing energy costs due to intelligent heating as well as reducing the need for costly maintenance by predicting failures ahead of time (Atkin & Bildsten, 2017; Buckman et al., 2014; Farzaneh et al., 2021). Additionally, AI can help translate international plays and musicals by facilitating and replacing complex translation processes, making translations more cost-effective (Gordon & Jubin, 2023; Hageback & Hedblom, 2021).

On the other hand, revenue increases by implementing AI are possible in different ways. Another benefit could be the use of AI in AD to gain new visitors and sell more tickets. The overall capabilities of AI in marketing functions promise more targeted approaches for customers with higher chances of selling tickets (Hadley, 2021; Huang & Rust, 2021). This is, for example, possible by using AI to personalise communication and digital storytelling when targeting potential visitors, as in the approach used in tourism. At the same time, the usage of AI in customer communication has the potential to increase the overall satisfaction of customers (Deryl et al., 2023; Lu et al., 2023; West et al., 2018; Zhang et al., 2019). Additionally, AI in pricing processes can help to maximise revenue per guest by considering more personal data like the willingness to pay off each customer (Huang & Rust, 2021; Kopalle et al., 2023; Wu & Monfort, 2023, pp. 491–492). Combining more tickets sold at a higher price with less expense in the pricing strategy can help theatres improve their revenue.

When looking at all use cases in chapter five, some do not directly influence revenue or cost. These use cases are primarily in legal functions and content development (Autto et al., 2024; Civit et al., 2022; Hageback & Hedblom, 2021; Yang et al., 2022). For these use cases, AI can provide support and increase the overall effectiveness of

the departments, while a direct reduction in headcount, like that of the accounting department, is not to be expected. Therefore, AI can help the productivity in these fields without a way of measuring.

Considering the structure chart presented in Chapter 2.2.5, the overall effects of AI can be made visible. The following illustration, Figure 4, uses the same introduced structure chart and colour functions based on the effect AI has on productivity.

```
                    ┌──────────────────┐
                    │ Managing Director │
                    └──────────────────┘
```

| Finance Director | Marketing & Sales Director | Operatons Director | Artistic Director |

| Accounting | Marketing Research | Legal | Content Development | Artistic Production (Directors, Actors,...) |

| Controlling | Branding | Facility | | Technical Production |

| | CRM | Front of House | | |

| | Pricing | | | |

⇐ Business Side ⇒   ⇐ Artistic Side ⇒

Legend

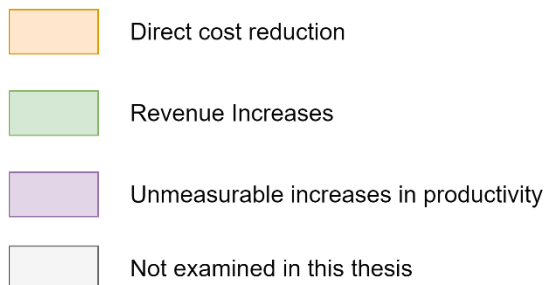|	
▭ (orange)	Direct cost reduction
▭ (green)	Revenue Increases
▭ (purple)	Unmeasurable increases in productivity
▭ (grey)	Not examined in this thesis

Figure 4: Benefits of AI in the Organisational Structure

Source: Own illustration, based on Rhine (2019), p.73-77, colours based on chapter five.

As can be seen in the structure chart, the implementation of AI affects all theatre companies' activities, as outlined in Chapter 2. One of the most positively affected areas is marketing, where AI can increase customer satisfaction and the intent to buy tickets more efficiently than traditional marketing concepts (Wu & Monfort, 2023, pp.

491–492). The exceptions are the unexamined artistic and technical production activities and FOH operation. These areas will likely be affected by AI in some way. However, no evidence is presented in this thesis, and these topics require additional research. Even so, this thesis has presented evidence that the overall structure of companies in the theatre sector can benefit from introducing AI to the company's processes.

Even though the potential benefits are evident in the research done for this thesis, some obstacles could prevent companies from adopting the widespread usage of AI. For example, costs associated with smart buildings may be too high for theatres to afford them even though the long-term effect is cost savings. Overall, theatres operate on slim margins and must be careful when investing, as the business is risky with the possibility of failing productions. A failure can easily imbalance the financial situation of a company in the business and can be fatal when paired with high investments in new technologies (Bonet & Schargorodsky, 2018, pp. 158, 206; Rhine, 2017, Chapter 7). Therefore, it is expected that most advances in the field will be made by larger corporations in the industry with more financial stability than smaller players.

Other challenges in implementation lie in privacy concerns, which are often a topic once personal data is collected. Issues regarding privacy concerns include all use cases in HRM as well as most use cases in marketing strategy, pricing, and CRM. For the same use cases, there are also concerns over the unwanted bias of AI, for example, in recruiting processes or over the decision of whom to target in a marketing strategy (Albassam, 2023, p. 20; Grewal et al., 2021, p. 231; Palos-Sánchez et al., 2022, p. 21). Moreover, another challenge theatre has to face when implementing AI is the availability and quality of data. An extensive database is needed for several AI applications, such as pricing models, branding decisions, and other customer-related aspects. The typical application of AI in these tasks is in a digital environment. The main successes come from using AI in e-commerce tasks where frequent customer contact is needed. (Grewal et al., 2021, p. 230). Theatre, as a more physical business, has the challenge of successfully creating datasets sufficient for use in AI applications. Research on this topic is being conducted at the moment. However, a direct path ahead is not clear in the literature as of the publication of this thesis.

Concerning the research question, implementing AI in several processes within theatre companies can help improve overall productivity across all assessed functions and

processes of theatre management and operation. However, the implementation process needs investments and faces several challenges, such as privacy concerns and the general availability and quality of data used for most AI applications.

7 Conclusion

7.1 Summary

This thesis has answered the question of how private companies in the theatre industry can benefit in terms of their productivity by implementing AI. The private theatre industry has become a significant business over the last centuries, with globalised markets and "Broadway-style" theatre thriving all around the globe. A crucial problem in the industry is the limited possibility for productivity increases in the actual product, a stage production, due to the physical nature of the service. This "cost-sickness" (Frey, 2019, p. 18) puts pressure on organisational structures to find possibilities for cost reductions in areas other than creative production and to innovate processes using new technologies.

Moreover, this thesis has identified AI as a vastly expanding technology used in various aspects of companies with almost infinite use cases. In the following, this thesis presents the most relevant use cases for the theatre industry and analyses their potential benefits and challenges. For the theatre industry, the main benefits of AI lie in cost reductions in overhead functions due to more efficient processes and less headcount needed in some departments. Moreover, AI has the potential to decrease costs in operating theatres as smart buildings become more energy efficient through intelligent thinking. In addition to cost reductions, AI can increase revenue by more targeted approaches to potential visitors and maximising revenue per visitor. However, not all benefits can be measured, and there are some benefits, such as intangible content creation.

AI can significantly benefit theatre companies' organisations and improve almost all processes' efficiency and productivity. Still, it is important to consider that margins in the industry are slim, and introducing AI in several use cases needs significant investments. Therefore, the introduction of AI in the industry will most likely be led by big players, and smaller companies will follow once the technology becomes more accessible and less costly.

7.2 Outlook

This thesis has not touched upon the usage of AI in actual theatrical productions due to the limited availability of research on this topic. In a further field study, use cases for AI, starting with handling automation and reaching other task fields like the support of directors, could be examined and tested. Now, the usability of AI in these fields is limited as there is to the knowledge of the author that no models are available to perform such tasks. Creating applications in this field requires development time and investments, though it is most likely a topic of interest for some companies, including the Walt Disney Company, which could have used such applications in similar task fields in its theme parks around the globe.

Like in the past, the theatre industry will continue to develop and find new methods and technologies to evolve. How these methods and technologies will be used is yet to be determined, and fieldwork with a company in the field is needed to determine the actual needs for AI applications.

7.3 Critical Acclaim

The topic of this thesis is fast evolving. The findings presented in this thesis may be outdated quickly if unforeseen technological advances are made or the implementation of AI goes in other directions. Studies that have been used in this thesis often refer to the limited amount of data available to determine more general effects of AI implementation. For some theatre companies' activities, such as artistic creation and artistic production, the availability of literature is still low. Although there are indications of what use cases can be, the actual usage has not seen much attention in literature until now. Moreover, this thesis does not focus on ethical considerations around AI but focuses purely on potential use cases and their economic effect. The acceptance of AI in fields like arts is not yet determined, and the future development path is still unclear. Therefore, this thesis presents the current state of potential AI usages in the theatre industry based on the current state of research available through the University of Applied Sciences Hamburg, the State Library of Hamburg and the State Library of Berlin.

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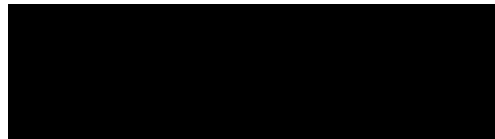## VII Declaration of Consent for Publication

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