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VEZETÉSTUDOMÁNY

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THEMATIC BLOCK

STUDIES AND ARTICLES

A Budapesti Corvinus Egyetem szakfolyóirata
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GUEST EDITORIAL FOREWORD TO THE THEMATIC BLOCK ON "CHALLENGES AND SOLUTIONS IN PROJECT MANAGEMENT"

Project management has always been an important topic in modern management, since companies – no matter whether they are for-profit or nonprofit – adapt to internal and/or external changes with the help of projects. Moreover, there are such complex activities in companies where the application of the project management toolkit might increase their efficiency and effectiveness. Although nowadays the importance is inevitable, organizations provide the necessary support for management (both regarding resources and authority), and there are numerous, advanced methodologies applicable both for a specific industry or in general, the project success rate is still lower than expected. However, the ratio of successful projects has increased recently – more than doubled in the last decade – but still, there is room for improvement. If we consider that experts expect an increase both in terms of the number of initiated projects and the professionals to be employed, it could be easily seen, that project management could be a crucial element not just for the client organizations, but for all players in the modern business ecosystem.

To foster scientific research on project management Budapest Management Review announced a call for papers in 2023 with a focus on contemporary issues in this discipline. This thematic block provides a publication opportunity for scholars to present their current research to increase the potential for achieving project success, and address topics that could be valuable for academics and non-academic organizations as well.

The topics in this thematic block are widespread, however, all of the authors argue that competencies are important regardless of the industry and project type in project management. The authors, like their fellow researchers and professionals, stress, that there could be two crucial and fundamental elements in project management serving as the cornerstone of future success. Firstly, it is important to realize what can and should be considered as a project, or when to apply project management elements in case of an activity, and one should find a process (or life cycle) for it that should be adapted. Although there are numerous choices, it is also important to find the most appropriate and tailor it to the given project, context, and/or the complex (set of) activity(/activities). Secondly, organizations should find those talented and hardworking people (especially the project managers) who can contribute to implementing the given project result. This latter, i.e. talent, is encapsulated in competencies, and – as with every profession – project management has its own set of competencies, which has evolved considerably in recent decades. This evolution is still in progress thanks in particular to the turbulent environment fueled by technological progress. Moreover, the set of competencies that should and could be applied might vary project by project, industry by industry, or organization by organization. Based on these, both the editors and authors believe, these papers could contribute to the current knowledge of project management and might be found interesting by every person who is interested in project management.

The first paper is a valuable systematic literature review on project management competencies. The authors focused on the leading journals of the field: International Journal of Project Management, and Project Management Journal. Their choice ensured that the corpus of papers was relevant and of scientific quality at the same time. As a result of their analysis, they not only provide a general overview of the definition of competencies, highlight the common characteristics among these, and introduce a novel approach to categorization, but also point out what potential research gaps can be identified which need further analysis . This paper might be beneficial for those, who would like to understand the modern project competencies literature and find potential future direction in the field.

The second paper also addresses an important and interesting topic, namely defining the expectations towards product managers. This definition is approached from two angles. The first angle is a broad and abundant literature review that clearly describes the roles and responsibilities of the product managers, while the second angle is an empirical analysis that deducts the results based on a survey of job advertisements. This dual approach ensures that both academic and practical approaches are realized in the paper at the same time. The findings can be valuable both for those, who would like to continue analyzing this project management role or for those aiming to hire professionals for such a position.

The third paper focuses on the common intersection of sport and project management. Sport management is a very special area in management studies for numerous reasons, one of them could be the difference regarding the attitude on team and management levels. Professional sport organizations tend to adopt advanced methodologies from various disciplines to improve their operational performance. Project management is also one of those applicable disciplines, but in most of the cases, the applications focus on managing infrastructural or event projects. This paper analyzes whether sport seasons can be considered as

a projects, and in this way, whether coaches or other team managers can apply (part of) the project management toolkit to improve the final results. The author uses a narrative literature review where the papers on project and sport season literature are compared. In the end, the author could identify several similarities, which suggest further promising areas of applications for project management tools and techniques in sport management. The paper is not only a pioneer in this area, but also might pave the path for practitioners to increase their team's efficiency and effectiveness by means of applying elements from this management discipline.

The guest editors firmly believe that this thematic block is a valuable contribution to the body of project management knowledge and hope that the discussions started here will be continued in the future.

Bálint Blaskovics and Csaba Deák
guest editors

VIKTÓRIA PAPP-HORVÁTH – JÁNOS TÓTH – NIKOLETT TÓTH

THE EVOLUTION OF THE PROJECT MANAGEMENT COMPETENCE CONCEPT – A SYSTEMATIC LITERATURE REVIEW

A PROJEKTMENEDZSMENT KOMPETENCIAKONCEPCIÓJÁNAK FEJLŐDÉSE – SZISZTEMATIKUS SZAKIRODALMI ÁTTEKINTÉS

This research aims to get closer to the definition of project management (PM) competence and understand its models by conducting a systematic literature review (SLR). The focus of this study is on the individual level PM competence of the project manager and the project team members. The paper introduces the competence models of the most important project management standards, which provide a guideline for professionals and serve as a base for the different PM qualifications. The literature review reveals which PM competence groups and elements have become the focus of attention in certain periods, which new competences have been uncovered, how the concept models have changed (in their professional content and regarding their structure), and how these results could be built into the upcoming standards and how they could shape the concept of project management competence in the future and serve as a basis for new research.

Keywords: **project management, project management competence, systematic literature review**

Jelen kutatás célja, hogy közelebb kerüljön a projektmenedzsment (PM) kompetencia definíciójához és modelljeinek megértéséhez egy szisztematikus szakirodalmi áttekintés (SLR) elvégzésével. A tanulmány fókuszában a projektmenedzser és a projektmenedzsment-csapat egyéni szintű PM-kompetenciájának vizsgálata áll. A cikk bemutatja a legfontosabb projektmenedzsment-szabványok kompetenciamodelljeit, amelyek iránymutatást adnak a szakemberek számára, és egyben a különböző PM-képesítések alapjául is szolgálnak. A szakirodalom-elemzés rávilágít arra, hogy bizonyos időszakokban mely PM-kompetenciacsoportok, kompetenciaelemek kerülnek a figyelem középpontjába, melyek új kompetenciákra hívják fel a figyelmet, hogyan változnak a koncepciómodellek (szakmai tartalmukban és szerkezetükben), és ezek az eredmények hogyan építhetők be a készülő standardokba, és hogyan formálhatják a projektmenedzsment-kompetencia fogalmát a jövőben és szolgálhatnak alapul a jövőbeli, új kutatásokhoz.

Kulcsszavak: **projektmenedzsment, projektmenedzsment-kompetencia, szisztematikus irodalmi áttekintés**

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The competence of the project manager has a major influence on the project performance and through this, it indirectly contributes to the business performance of the whole organisation (Pinto & Kharbanda, 1995; Crawford, 2005). Some researchers have made attempts to establish a coherent competence terminology (Boak, 1991; Woodruffe, 1991; Winterton & Winterton, 1999) or compared its definitions (Szabó & Csepregi, 2011). Some authors refer to it as a "*fuzzy concept*", which is also a useful term, because it connects education and job requirements (Boon & van der Klink, 2003). The concept of competence is considered to be a diffuse term in the organizational and occupational literature because several different meanings are associated with it (Robotham & Jubb, 1996). Although providing a theoretical definition of competence may be challenging, there is a practical

and functional need for that, because competence plays an important role in personal-, output-, and educational models or standards (Mangham, 1986). Especially understanding project management competence is essential for project success (Berényi, Blaskovics & Deutsch, 2017).-, output-, and educational models or at standards (Mangham, 1986).

At first, the term competence should be distinguished from competency, which are incorrectly used as synonyms in the common language. Competency is the behaviour someone must display for effective workplace performance, while competence is an aspect of the job (sets of deliverables, output of roles), this confusion derives from the fact that the two are often put together (what should be done/competence and what need people to do it effectively/competency), which results in competency dimensions where the two are inseparable (Woodruffe, 1993). Dealing with this topic, certain sources focus on the project managerial role's outputs, others on behavioural aspects, so both terms (competence and competency) will be used in this article adopting the form used by the primary sources.

It is important to mention that Woodruffe (1993) distinguishes technical skills (focusing on the professional components of a job) from the behavioural competency.

Le Deist & Winterton (2005) identified three competence approaches: the behavioural (US tradition); the functional (UK tradition) and the multi-dimensional and holistic (France, Germany, and Austria). Table 1. provides an overview of the competence and the competency definitions.

Table 1.

Competence and competency definitions in the literature

Competence	Competency
White (1959); personality characteristics which result in superior performance	Boyatzis (1982) and Spencer & Spencer (1993); it is underlying characteristics casually related to superior performance
McClelland (1976); it is the underlying characteristics and attributes that lead to effective task execution	Birkett (1993); individual attributes such as knowledge, skills, and attitudes needed to perform a task in a particular context
Faerman, Quinn, Thompson & McGrath (1990); it is the knowledge and skills necessary for carrying out a project	Parry (1996); is the cluster of related knowledge, skills, and attitudes that affect a significant part of one's job
Manpower Services Commission (1986); it is the use of behavioral characteristics to perform activities to the job standard	New Zealand Qualification Authority (1997); it is the ability to use knowledge, skills, and attitudes in carrying out a task according to the set the standards in a specific context

Source: Salman, Ganie & Saleem (2020, p. 721)

In 2018, a comparative systematic literature review highlighted the most important problems related to the project management competence concept, namely: a complete and uniform competence list is lacking, there are problems with the taxonomy, and competences are not ranked based on their importance (Nijhuis, Vrijhoef & Kessels, 2018). This literature review is limited only to qualitative or quantitative research studies from the year 2000, which provide an order of competencies. Besides, Horváth (2019) provided an overview of the definitions of project management competence within the literature and the professional standards and created a two-dimensional model (focusing on the content and structural composition of the competence), which contributed to a better understanding of this topic.

In academic discourse, there is currently a lack of comprehensive literature reviews that exclusively rely on publications from Q1-ranked project management journals (cf. Crawford, 2005; Horváth, 2019). This gap particularly affects the analysis of research trends and thematic patterns present in the competence definitions employed by researchers within this specific field. Such a review would aid scholars and decision-makers in staying abreast of the latest and most reliable scientific findings, thereby contributing to the advancement of scholarly discourse and progress. This gap particularly affects the analysis of research trends and thematic patterns present in the competence definitions employed by researchers within this specific field. Such a review would aid scholars and decision-makers in staying abreast of the latest and most reliable scientific findings, thereby contributing to the advancement of scholarly discourse and progress.

Based on the aforementioned gap, our research aims to reveal how project management competence is represented in the articles of the selected Q1 ranked project management journals (namely the International Journal of Project Management, Project Management Journal) and based on their content analysis understanding /revealing how could the findings be integrated into the future issues of the PM competence standards or how could they contribute to the further development of the project management competence concept.

Project management competence in standards

The project management standards serve as a basic knowledge repository for the professional community, and they are used for associated certification programs as well. As Eraut (1994) describes the formation of a professional association was highly dependent on the distinctive "competence territory" which determines an exclusive area of the practice. The standards of this distinctive knowledge as reference works that could be used for the certification (Morris, Crawford, Hodgson, Shepherd & Thomas, 2006), so they are able to assess the PM competence and could also serve as a base for competence development. "*A standard is a document, established by consensus and approved by a recognized body, which provides for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given*

context "(Project Management Institute, 2018, p. n.a.). Project Management Institute applies the following typology for its standards on its webpage (www.pmi.org): (1) foundational standards – foundation of PM knowledge, (2) practice standards & frameworks – which introduce how the tools and techniques introduced in a foundational standard should be applied, (3) practice guides – additional guide and information to the previous standards, (4) PMI standards+, (5) and the PMI Lexicon of Project Management Terms – definitions of PM-related terms. Practice standards and industry-specific extensions – e.g. Software Extension to PMBOK® Guide – Fifth Edition (Project Management Institute, 2013) or the Construction Extension to the PMBOK Guide Third Edition (Project Management Institute, 2008) – could be built on the foundational standards.

Both the 6th and the 7th editions of the PMBOK Guide are involved in our study because the newest issue of the standard does not invalidate the previously issued version (Amaro & Domingues, 2023). The *PMBOK® Guide* (6th ed.) describes competence as "*the skill and capacity required to complete assigned activities within the project constraints*" (Project Management Institute, 2017a, p. 319), while the 7th edition defines it as "*the combination of ability, knowledge, and skill*" (Project Management Institute, 2021, p. 156). PMCD is considered to be a framework standard that could be used for personal PM competency evaluation and development purposes. It describes the competent project manager, who can "*consistently apply their management knowledge and personal behaviors to increase the likelihood of delivering portfolios/programs/projects that meet stakeholders' requirements*" (Project Management Institute, 2017b, p. 3.) and competency is described here as "*the demonstrated ability to perform activities within a ... project environment that leads to expected outcomes based on defined and accepted standards*" (Project Management Institute, 2017b, p. 3.)." (Project Management Institute, 2017a, p. 319), while the 7th edition defines it as "*the combination of ability, knowledge, and skill*" (Project Management Institute, 2021, p. 156).

In this framework, standard competency is broken down into three dimensions: (1) *knowledge competence* focuses on what the project manager knows about the application of the processes, tools, and techniques related to the project activities; (2) *performance competence* describes how the project manager apply the project management knowledge to successfully complete the project; (3) *personal competence* describes how the project manager behaves during the implementation of the project management activities and the attitudes and core personality characteristics (Project Management Institute, 2017b).

In the case of the performance competencies the ten knowledge areas of the 6th PMBOK serve as competence units and the processes of these knowledge areas are the elements of the competence.

Besides these standards, PMI developed a related model, the so-called Talent Triangle for project professionals to provide a guide for the Project Management Professional (PMP)® credential holders to plan their future competence development and education in the field of project management. It has undergone some structural changes in the last years and the current version consists of the following three skill areas (also referred to as strategic knowledge areas):

1. Ways of Working (formerly Technical Project Management) – including skills that are connected to tools and techniques of the different project management approaches,
2. Power Skills (formerly Leadership) – including interpersonal skills which are required to influence stakeholders and manage the project team,
3. Business Acumen (formerly Strategic and Business Management) – including skills that help to understand the organisational-, sectoral- and business environment of the project, the micro and macro influences, and the function-related and domain-related aspects of the project (Project Management Institute, 2022).

Parallel with the PMI, the International Project Management Association also defined the set of required competencies. The IPMA ICB 4.0 standard includes the IPMA "Eye of Competence" model, which divides the project management competences into three competence areas (perspective competences, people competences, and practice competences).

The IPMA defines competence as "*the application of knowledge, skills, and abilities in order to achieve the desired results*" (International Project Management Association, 2015. p. 15.). The terms used in this definition are introduced in Table 2.

Table 2.
Terms related to the IPMA competence definition

Knowledge	„the collection of information and experience that an individual possesses." (p.15)
Skills	"specific technical capabilities that enable an individual to perform a task. For example, being able to build a Gantt chart might be considered a skill." (p.15)
Ability	„the effective delivery of knowledge and skills in a given context. For example, being able to devise and successfully manage a project schedule might be considered ability." (p.15)

Source: own compilation based on International Project Management Association (2015)

Based on the overview of the standards, certain similarities regarding the PM competence concept could be identified. Three main categories could be distinguished: (1) the first category focuses on personal and social competences (interpersonal skills), (2) the second includes competences related to the project management technical tools and techniques, (3) the third consists of competences required to understand the business and operational environment of the project.

Research methodology of the literature research (SLR)

The literature on competencies is considered to be abundant. There are numerous papers focusing on identifying the required competencies both in general or sector specifically, and the number of those papers is also high which aims to summarize, collect, or provide a framework for competencies (see e.g., Crawford, 2005; Müller & Turner, 2007). Researchers carried out literature reviews as well, however, the above-mentioned one has a crucial limitation, because it analysed only those research-based papers that ranked the competencies (Nijhuis et al., 2018). Thus, this paper aims to provide a comprehensive systematic literature review analysing competencies in both theoretical and research-based papers and the focus is on the individual level of project management competence.

Systematic Literature Reviews (SLR) could be used when we would like to (1) summarize empirical evidence of a phenomenon (treatment or technology), (2) identify gaps in the current literature, (3) create a framework, that could serve as a base for further investigation (Kitchenham, 2004). An eight-step guide is provided to conducting a successful SLR, which includes the upcoming elements: (1) identify the purpose, (2) draft protocol and train the team, (3) apply practical screen, (4) search for literature, (5) extract data, (6) appraise quality, (7) synthesize studies, (8) write the review (Okoli, 2015, p. 884), which could be divided into four phases: planning (1-2), selection (3-4), extraction (5-6) and execution (7-8) (Okoli & Schabram, 2010).

The Scimago Journal & Country ranking page's (https://www.scimagojr.com/) publications database served as a starting point for the journal selection. The newest list available was the 2022 publication list at the time of our research (as of November 2023). The following filtering criteria were specified to narrow down the publication database: only journals were involved in our review, the word "project" should be a part of the journal title, the journal should fall into the SJR (SCImago Journal Rank) Best Quartile (Q1), and the category of the journal should be Business and International Management or Management of Technology and Innovation or Strategy and Management or Management, Monitoring, Policy and Law (Q1). As a result of this screening, two journals remain the focus of our investigation: the International Journal of Project Management, and Project Management Journal.

Limited to the two selected professional project management journals, the process of selecting articles dealing with project management competence continued on the following websites' advanced search interface: IJPM – https://www.sciencedirect.com/journal/international-journal-of-project-management, PMJ – https://journals.sagepub.com/search/advanced?SeriesKey=pmxa. The search for the terms "*competence*" and "*competency*" was conducted in the title, abstract, and keywords. No limitation regarding the year or publication was determined. The primary screening resulted in 145 records, (89 papers in IJPM and 56 papers in PMJ). After checking the list, 6 records were excluded because the search words ("*competence*" or "*competency*") could not be found in the title/abstract/keywords, which modified the number of records to 139 (87 papers in IJPM and 52 papers in PMJ).

The rigor of the search process has a significant effect on the literature review's quality (Vom Brocke et al., 2009), so the selection criteria were determined in advance, based on which the primary list was narrowed down to the final sample. The full text of the selected 139 records was screened based on applied content selection criteria (Table 3.).

Table 3.

The selection criteria for journal articles

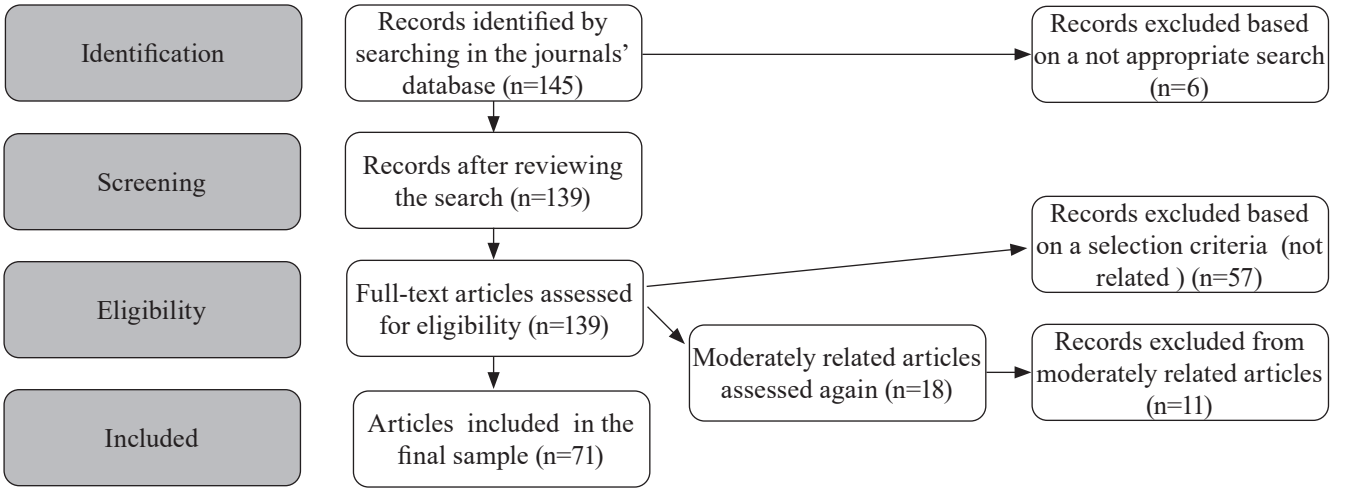
Selection criteria	Description of the selection criteria
Closely related to the research aim	Focus on individual (level) project management (PM) competence focusing on the project manager or the project team members Focus on individual competencies at special project types Focus on certain elements of the project management competence
Moderately related to the research aim	Competency standards are the focus Focus on competence development Focus on educational activity
Not related to the research aim	Focus on the competence of the sponsor / functional management (or other special stakeholders e.g., management consultant, principal contractors) Focus on organisational PM competence (organisational competence goals, competence assessment, career planning, HR strategies, competitive advantage, organisational competence development, competencies focusing on project partnerships and contractors) Focus on the PMO's (project management office) competence Focus on project maturity Focus on PM research methodology or new research approach Focus on collective PM competencies Competence is used in the journal article with different meanings/or generally talks about competence Focuses on program management or portfolio management competencies

Source: own compilation

64 records met our primary selection criteria (closely related). In the case of those articles, that were moderately related to our aims (18 records), a second content screening was conducted, and those articles which analysed the competence development and the educational activity from an organisational perspective (including topics like career planning, competence assessment techniques, organisational key performance indicators KPIs) were also excluded from the final sample (11 out of the 18 records were eliminated and 7 was selected to the sample). As a result, the final sample consisted of 71 records (41 papers in IJPM and 30 papers in PMJ). Figure 1. introduces the flow chart of the article selection.

Figure 1.

PRISMA flow chart of journal article selection



Source: own compilation based on Nuti et al. (2015)

Following the research aim, the papers were analysed based on fourteen content-related questions to define clusters and identify which topics are the most relevant and addressed. These fourteen questions can be summarized into three categories which are as follows:

- (Project management) competency related: meaning whether the author or authors gave definitions or approaches to competencies. This category encompassed three questions (defining competency, defining project management competency, and identifying problems addressing the previous two).
- Research methodology and focus: meaning based on which aspect(s) the authors analysed the papers. This category encompassed five questions (industry, geographical location, project type, framework, type of research).
- Context: meaning the primary focus of the article. This encompassed six questions (standards, age, gender, experience, qualification, theoretical subject area).

Results

Descriptive analysis

The earliest article in the literature selection was published in 1991 in PMJ. One more paper was listed from the 1990s, the rest of the articles involved in the analysis were published after 2000. As Figure 2. demonstrates, between 2001 and 2004 there was a lack of selected publications in the sample, after 2007 a steadily increasing trend could not be seen, but there was an increasing number of years with a medium-high number of publications in the subject area in the journals studied. Regarding this, the years 2007, 2008, and 2015 can be highlighted with 5-5 articles, in 2010 we counted 7, but the largest number of relevant papers in the period under review, ending in 2023, is in 2013 with 11 articles most of which were related to education, learning, training.

Concerning the geographic scope of the studies under analysis, a notable characteristic within the sampled articles is the limited direct specification of geographical locations by authors, with a significant portion remaining ambiguous and challenging to infer indirectly. Nevertheless, within the subset of articles wherein authors explicitly delineate the geographical parameters of their research, the United Kingdom, Australia, and Sweden emerge as prominent focal points. An evident parallelism surfaces between the nationality of the primary authors, as previously examined, and the geographical locales delineated within the studies under consideration.

Following the examination of geographical parameters, the predominant sectors of focus were the construction and information and communication sectors. While the engineering sector also featured prominently in the retained sample, the majority of articles exhibited a more generalized sectoral perspective.

The categorization of articles within the sample, distinguishing between research articles and literature review articles, reveals a prevalent predominance of research articles.

Examining the citation numbers (considering Google Scholar citation numbers), it can be ascertained that within the analysed articles, the lowest citation count is 0 (this is connected to recently published articles), while the highest reaches 1586. The top three referenced articles sequentially comprise a literature review authored by Turner and Müller (2005) with 1586 citations, examining the leadership style of project managers as a success factor. Following this, from the same authors, is a 2010 article investigating the leadership competency profile of successful project managers, accruing 1232 citations.

A challenge encountered in the analysis of the 71 articles was the diverse nature of the samples they encompassed. The authors used a wide range of tools and techniques such as interviews, questionnaires, video diaries, and observation. Besides this the research subjects or people involved in the research were difficult to identify in several cases, several articles used a wide range of project members or stakeholders not treating project managers as

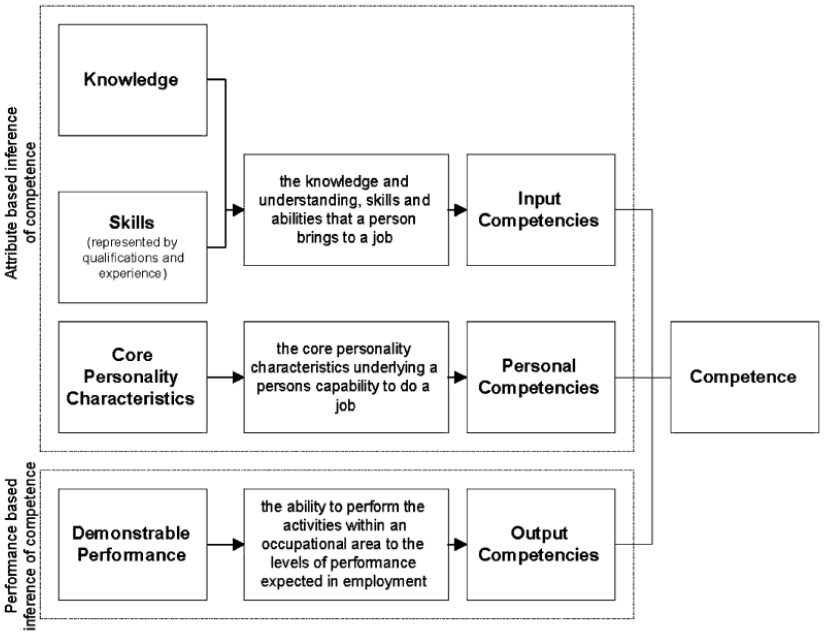
clearly separated. From the point of view of our research, we can mainly start from the interview and questionnaire-based sample articles, the approximate interval of the interview-based sample size is 3 – 30 interviewees per article, and the maximum number of usable questionnaire results ranged from circa 400 to 435 per person per study.

Content analysis

For the sample of 71 articles, we examined whether each article described competence in the context of project management standards. For the articles in the sample, only 38 papers discuss competencies concerning standards, while 33 articles do not. This also indicates that in nearly half of the published articles, there is a specific reference to standards, although direct linkage between research findings and application in standards is relatively rare. Standards mostly feature in literature reviews, and there is much less emphasis on authors bridging research outcomes back to standards.

When examining the relationship between competence and age (n=71), it can be observed that 13 papers address this relationship, while 58 papers do not consider it as a topic. The analysis shows that 12 papers discuss competence about gender, while 59 papers do not discuss age with competence. 36 articles examine competence concerning project manager experience, while 35 do not link these concepts. Of the articles in the sample, 29 examine competence in the context of project managers' qualifications (academic or professional association qualifications), while 42 do not link the two.

Figure 2.
The integrated model of competence identifying components of the overall construct



Source: Crawford (2005, p. 9).

Among the articles that remain in the sample, we should highlight the work of Crawford (2005), who presents an integrated model of competence, listing its different components, highlighting two broad categories at the first level, namely the attribute-based inference of the competence and the performance-based inference of the competence. We consider this article and the model presented therein as foundational literature for the examined topic; therefore, we deem it important to provide a more detailed description of it.

These two groups are further subdivided into two subcategories, the attribute-based category consists of knowledge and skills, which together are referred to by the author as input competences, and the third element within the group is personality traits, from which the author refers to personal competences (Crawford, 2005). One element within the performance-based category is demonstratable performance, from which we can infer output competences. (Crawford, 2005). Based on this model, taking into account the competency frameworks of professional organizations discussed by the systematic literature review, listing 3 levels, which are individual, collective, and organizational level competencies. In their article, Havila, Medlin & Salmi(2013) consider competences in the project closure phase, which could be further interpreted based on the model presented by Crawford (2005) by assigning each element of the model to each phase of the project, possibly highlighting the importance of their existence and their different roles according to the function and content of the phases, although not included in the sample articles, following a similar path taken by Skulmoski & Hartman (2010) and Wen & Quiang (2019).

One-third of the analysed papers define competencies, the remaining papers investigate this phenomenon in an inherent manner. Thus, out of the 71 papers, only 23 gave an approach or definition towards general competencies, and 20 for project management competencies (and the other 2 dealt with them indirectly). Out of these 20 papers, 17 considered competencies and project management competencies separately, providing an approach or definition for both. Altogether 17 papers identified problems related to defining or analysing competencies. It is worth mentioning, that 8 papers only identified problems without defining any of the competencies (and the sixth defined only competencies in general, however, the authors did not separate project management competencies and competencies in general). Altogether 39 papers were suitable for analysis (considering the overlaps among the categories). Examining the content of the 39 articles included in the sample, we initially created subcategories. These subcategories were not based on the attribute-based and performance-based schools (based

on Crawford, 2005), which researchers have traditionally used to categorize articles. Instead, we introduced a new tripartite classification, highlighting publications aiming to apply and adapt theories previously developed (typically in other disciplines) to the project management context (theory-based). Additionally, we differentiated articles that originated from a project management perspective, where the analysis of the environment was based on individual or situational factors. These can be heterogeneous based on the approach towards competencies, and because of this, one single definition or guideline cannot be identified. However, there are certain patterns which the authors follow if they tend to describe competencies, and based on that, three separate categories can be identified (Table 4.):

1. INDIVIDUAL perspective of the competency: The first category approaches from an individual perspective, e.g., they focus on the inherent characteristics of the person possessing the competencies.
2. SITUATIONAL perspective of competency: The second category broadens this perspective and considers the competent individual as a part of a complex set of people, so competencies can be considered situational.
3. THEORY-BASED perspective of the competency: the third category considers competency from a theoretical approach and defines them from the perspective of a related theory (e.g., behavioural theory or interpretative approach). There could be potential overlaps between categories (when one article belongs to more than one cluster), in these cases the main approach of the original paper was considered in the classification (e.g., those papers that were focused on the individual perspective directly and adapted the behavioural approach indirectly, were classified as papers belonging to category one).

The *Individual* category can be divided into two subcategories:

1. *Intelligence, power, and efficacy* has characterised by the triad of, in which ideas identifying deeper characteristics associated with the individual and causal links to the successful performance of each task are displayed, closely related to the individual's performance and the personal competences required to perform it (c.f. Alam et al., 2008; Pinto et al., 2017; Ballesteros-Sánchez et al., 2019).
2. *Knowledge, skill, attitude, or equivalent with this (knowledge, skill, attribute)* consists of the items, which are related to the individual, focusing on the combination of knowledge, on the ability to do a task, and on core personality characteristics and a behavioural (c.f. Blackburn, 2002; Buganza et al., 2013; Mazur et al., 2014).

The *Situational* category, extended to include environmental elements beyond the individual, could also be divided into three subcategories:

Table 4.

Competency definition clusters in the investigated articles

Nr.	Category	Subcategory	No.	Author(s)
1.	INDIVIDUAL	Intelligence, power, efficacy	3 papers	Alam, Gale, Brown & Kidd (2008)
				Pinto, Patankul & Pinto (2017)
				Ballesteros-Sánchez et al. (2019)
		Knowledge, skill, attitude, or equivalent with this (knowledge, skill, attribute)	3 papers	Buganza, Ortiz-Marcos & Rodríguez-Rivero (2013)
				Mazur, Pisarski, Chang & Ashkanasy (2014)
				Blackburn (2002)
2.	SITUATIONAL	Abilities to complete tasks	2 papers	Lin, Chen, Hsu & Fu. (2015)
				Gruden & Stare (2018)
		Ensure and develop adequate performance in the workplace completed with personality traits, attitudes, and behaviours	7 papers	Stretton (2007)
				Loufrani-Fedida & Missonier (2015)
				Córdoba & Piki (2012)
				Li, Sun, Shou & Sun. (2020)
				do Vale, Nunes & de Carvalho. (2018)
				Dainty, Cheng & Moore (2005)
				Skulmoski & Hartman (2010)
		Input, personal, and output competencies	2 papers	Bredillet, Tywoniak & Dwivedula (2015)
				Crawford (2005)
3.	THEORY-BASED	Integrated concept of job competency	2 papers	Skulmoski & Hartman (2010)
				Dillon & Taylor (2015)
		Personality characteristics	2 papers	Mazur & Pisarski (2015)
				Chen & Partington (2006)
		Standard-based	2 papers	Chen, Partington & Wang(2008)
				Ahsan, Ho & Kahn (2013)

Source: own compilation

1. *Abilities to complete tasks*: The authors investigate the task-solving aspect of the competency. They argue that a specialized system of abilities should be understood at the individual and team level, complemented by experience in complex situations and the use of existing knowledge and skill sets, as well as personal characteristics (c.f. Lin et al., 2015; Gruden & Stare, 2018).
2. *Ensure and develop adequate performance in the workplace completed with personality traits, attitudes, and behaviours*: this subcategory contains the most significant number of articles due to its multiple definitions of competency. The authors placed workplace contribution at the centre of the competence definitions. To perform and develop the activity at the expected level of performance at work, at individual and team levels, while achieving appropriate attitudes and behaviours, requires both relevant experience and personal attitudes, as well as personal qualities that make the person accepted in the field of project management (c.f. Dainty et al., 2005; Stretton, 2007; Skulmoski & Hartman, 2010; Córdoba & Piki, 2012; Loufrani-Fedida & Missonier, 2015; do Vale et al., 2018; Li et al., 2020).
3. *Input, personal, and output competencies*: the third subcategory synthesizes and summarizes competencies at a high level in the form of "Input, personal, and output competencies". The threefold decomposition in Crawford's (2005) model, which pioneered this approach, has been extended by Bredillet et al. (2015), whereby personality traits, attitudinal characteristics, and behaviours appear alongside knowledge, skills, and experience.

Theory-based, which is the third main category, focuses on general theoretical approaches in the articles and it can be broken down into three subcategories:

1. *Integrated concept of job competency*: authors identify competency and its elements (e.g. declared knowledge, skills, problem-solving, etc.) and related knowledge as a necessary element to perform a job (c.f. Skulmoski & Hartman, 2010; Dillon & Taylor, 2015).
2. *Personality characteristics*: authors approach the concept of competence from the perspective of theories on the core characteristics of individuals (c.f. Mazur & Pisarski, 2015; Chen & Partington, 2006).
3. *Standards-based*: authors have used a theoretical approach based on interpreting competence as captured in different project management standards to define competence (c.f. Chen et al., 2008; Ahsan et al., 2013).

Based on the conducted analysis, two competency definition approaches emerge. In the first case, the general competency approach is considered, and derive the project management competence definition from this general concept and applied in the project management context and then broken down into competence elements. In the second case, the authors start to identify elements of the project management competency, which could form part of a general PM competence concept.

Summary

Our research aimed to reveal how project management competence is represented in our sample. It could be seen from our analysis that a bit more than half of the papers involved in the sample (38 out of 71) tried to connect the concept of competence to (at least) one of the project management standards, so it was confirmed that the standards serve as a base for the academic community when they deal with competence. Although it also could be seen that the findings of the papers usually do not aim to form a direct link to the standards (neither to its competence areas nor to its competence structure), so our primary goal that we could identify how the standards will be modified in the future based on the investigated articles could not be revealed from this analysis. The analysis was conducted to shed light on the fact that researchers use standards as a reference in the literature review part of the articles but rarely examine the results obtained in the context of competency frameworks presented in standards. Indirectly, research findings can be incorporated into standards in the future, but generally, it is evident that research results are not directly integrated into the further development of standards. The evolution of the project management profession is continually accompanied by the emergence of new competency elements, which provide a suitable platform for research and presentation in these journals. However, these must be consciously linked to the content and structural categorization of standards more deliberately than at present-use standards as a reference in the literature review part of the articles but rarely examine the results obtained in the context of competency frameworks presented in standards. Indirectly, research findings can be incorporated into standards in the future, but generally, it is evident that research results are not directly integrated into the further development of standards. The evolution of the project management profession is continually accompanied by the emergence of new competency elements, which provide a suitable platform for research and presentation in these journals. However, it is important that these are consciously linked to the content and structural categorization of standards in a more deliberate manner than at present.

Based on our research, we considered Crawford's integrated academic PM competence model (Crawford, 2005) as one of the most significant academic concept models in this topic area, because the constructed PM competence model reflects the international competence schools and tries to integrate them. It was the fourth most cited article in the sample. The first three most cited articles focused on the relationship between leadership and PM competence based on the work of Müller and Turner (Turner & Müller, 2005; Müller & Turner, 2007; Müller & Turner, 2010).

Our analysis confirmed that project management competence is still a fuzzy concept, but our research con-

tributes to the theory of the project management competence concept by identifying new competence definition clusters, which could help researchers and practitioners approach the different aspects of competence. 31 of the examined articles (n=71) provided an understanding or definition of competencies, and based on these papers, three categories can be formulated. The first contains the research which considers competencies as an inherent characteristic of the project manager. The second considers competencies as situational, i.e. as a phenomena understood in terms of the surrounding set of people. The third category encompasses those papers, where the researchers deducted the understanding of competencies from a (broadly) accepted organizational theory. Moreover, 38 authors considered their researchers in terms of one of the competency frameworks mentioned earlier (PMI, IPMA), while the other authors of the sample formulated their findings based on other approaches. Based on the aforementioned findings, this research contributed to the literature through classifying the different, competency-based literature and could provide a solid for further developing the current competency frameworks (see e.g., Berényi et al., 2017; Project Management Institute, 2018).

Limitations and further research

While the quality of the studies of the sample was ensured by choosing high-ranking journals, limiting the selection to two Q1 journals recognized the challenges of researching emerging topics, often delayed in quality journal publication. Challenges in obtaining empirical samples and shortages of literature obstruct a comprehensive investigation. Forthcoming topics are commonly found in online articles or conference papers, reinforcing challenges due to the accelerated pace of change. This temporal gap between practical issues and representation in Q1 journals may hinder standard-setting and influence in education. Notwithstanding, an expanded sample is vitally important for robust research, the choice of two Q1 journals is justified by the unique challenges of investigating nascent themes. Several research articles concentrating on PM competencies may use words and expressions like skill or capability, these articles could be omitted from our investigation as our scope of keywords did not include, for example, the terms skill and capability. The heterogeneity of the studies was also a main obstacle for example during the determination of the level of the competence and the target person or research subject whose competence was analysed in the articles, the wide range of study types also hindered the clarification.

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Appendix 1.

IJPM and PMJ articles:

International Journal of Project Management			
Author(s)	**Year**	**Title**	**DOI**
Adenfelt, M., & Lagerström, K.	2006	Enabling knowledge creation and sharing in transnational projects	https://doi.org/10.1016/j.ijproman.2005.09.003
Alam, M., Gale, A., Brown, M., & Kidd, C.	2008	The development and delivery of an industry led Project Management Professional Development Programme: A case study in Project Management Education and Success Management	https://doi.org/10.1016/j.ijproman.2007.12.005
Anglani, F., Pennetta, S., Reaiche, C., & Boyle, S.	2023	Crossing digital frontiers with cultural intelligence-a new paradigm for project managers	https://doi.org/10.1016/j.ijproman.2023.102543
Blackburn, S.	2002	The project manager and the Project-Network	https://doi.org/10.1016/s0263-7863(01)00069-2
Blomquist, T., Farashah, A.D., & Thomas, J.	2018	Feeling good, being good and looking good: Motivations for, and benefits from, project management certification	https://doi.org/10.1016/j.ijproman.2017.11.006
Bredillet, C., Tywoniak, S., & Dwivedula, R.	2015	What is a good project manager? An Aristotelian perspective	https://doi.org/10.1016/j.ijproman.2014.04.001
Bredin, K., & Söderlund, J.	2013	Project managers and career models: An exploratory comparative study	https://doi.org/10.1016/j.ijproman.2012.11.010
Buchanan, D.A.	1991	Beyond content and control: project vulnerability and the process agenda	https://doi.org/10.1016/0263-7863(91)90032-Q
Buckle, P., & Thomas, J.	2003	Deconstructing project management: a gender analysis of project management guidelines	https://doi.org/10.1016/S0263-7863(02)00114-X
Buganza, T., Kalchschmidt, M., Bartezzaghi, E., & Amabile, D.	2013	Measuring the impact of a major project management educational program: The PMP case in Finmeccanica	https://doi.org/10.1016/j.ijproman.2012.07.003
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ANDREA SIPOS – BÁLINT SZABÓ

EXPLORING THE EXPECTATIONS OF THE PRODUCT MANAGER ROLE: THE CASE OF THE HUNGARIAN SOFTWARE INDUSTRY

A TERMÉKMENEDZSER-SZEREPKÖR ELVÁRÁSAINAK FELTÁRÁSA A MAGYAR SZOFTVERPIAC PÉLDÁJÁN KERESZTÜL

Stakeholder-driven development has become significant in the software industry. As a result, product managers have taken on a crucial role in IT projects by considering the demands of stakeholders, business objectives and knowing available technological solutions. The theoretical section of this article provides an overview of the evolution and characteristics of the product manager role. This paper empirically explored the various expectations towards product managers through the example of the Hungarian software industry by the content analysis of job advertisements (n=212) from LinkedIn. The identified patterns show that the product manager role differs depending on the size of the company. The results show that as the size of a company increases, leadership and active listening skills become increasingly important. On the other hand, micro- and small enterprises demonstrate the highest level of responsibility regarding cooperation. The findings of this article can offer valuable guidance for future product managers.

Keywords: **product manager, software industry expectations, content analysis, competencies, responsibilities**

A szoftverpiacon az érdekelt felek (stakeholder oldal) igényeinek a szem előtt tartása kiemelt jelentőségű lett. Ennek eredményeképpen a termékmenedzserek ma már kulcsszerepet töltenek be az IT-projektekben a stakeholder igények, az üzleti célkitűzéseknek és a rendelkezésre álló technológiai megoldások ismeretek birtokában. Jelen cikk elméleti része a termékmenedzser-szerepkör kialakulásának és feladatainak áttekintését foglalja össze. Ezután LinkedIn álláshirdetések (n=212) tartalomelemzésével tárja fel, hogy az IT-piac milyen elvárásokat támaszt a termékmenedzser-szereplők irányába. Az eredmények részletesen bemutatják azokat az alapvető készségeket és feladatköröket, amelyeket a vállalatok gyakran kiemelnek az álláshirdetésekben, így elsajátításuk kiemelten fontos. Két készség, a vezetés és az aktív figyelem, esetén a statisztikai számítások alátámasztották, hogy ezen készségek a cégméret növekedésével egyre fontosabbak a vállalatok számára. Továbbá az is elmondható, hogy a mikro- és kisvállalatok életében sokkal fontosabb a kooperáció. A cikk eredményei hasznos útmutatást nyújthatnak a jövő termékmenedzsereinek.

Kulcsszavak: **termékmenedzser, szoftverpiaci elvárások, tartalomelemzés, készségek, feladatkörök**

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Software development was officially established as a profession in 1968 when the informal and haphazard code-and-fix approach was replaced by formal Software Development Lifecycle (SDLC) models. These models were implemented in Information Technology (IT) projects to ensure project success (Kneuper, 2018). Since the 1980s, these SDLC models have been increasingly used in emerging developments due to the rise of personal computers. This technological advancement has facilitated the creation of custom software specifically designed to meet users' unique needs due to the growing importance of ergonomics (Szabó & Hercegfi, 2023). In IT projects that could be monitored along streamlined steps, a significant market share could be acquired rapidly by the first company to develop software that satisfies a new user need (Jindal, Sarangee, Echambadi & Lee, 2016).

With the increasing presence of product development activities in the IT industry, solving a problem is no longer sufficient. The company that offers the most optimal solution to potential customers emerges as the leader in the market (Lesser & Ban, 2016). The significance of stakeholder-driven development has increased in the management of IT projects (Kessler & Sweitzer, 2007). Therefore, successful organisations prioritise the comprehensive requirements of users, customers, and decision-makers in their development processes (Berander & Andrews, 2005).

Conscious interaction with various actors within the organisation is necessary to consider the needs of stakeholders. As a result, product managers have become crucial participants in IT projects. They are responsible for all additional tasks related to the software product being developed, such as product strategy and pricing (Kittlaus & Clough, 2009).

The primary responsibility of IT project product managers is to generate value by devising optimal solutions, introducing them to the market, and further improving them while considering user, business, and technological requirements (Ebert & Brinkkemper, 2014). Consequently, a product manager's core responsibility is to monitor a product's whole life cycle. This involves handling various challenging tasks, depending on the nature of the development projects in corporate practice (Steinhardt, 2017). Centralised control over the entire life cycle is critical for achieving project success (Lukassen & Schuurman, 2023).

The theoretical part of this article provides an overview of the emergence of the software product manager role and expectations towards it. The empirical research then uses content analysis of LinkedIn job advertisements (n=212) to identify product managers' expected competencies and responsibilities in the Hungarian IT industry. Academic research has applied content analysis to identify distinct professional expectations, such as those in cybersecurity and journalism (Marta-Lazo et al., 2018; Parker & Brown, 2019). However, implementing this methodology is scientifically novel concerning the role of a product manager.

Theoretical background on the product manager role

The conscious focus on product development commenced during the latter part of the 19th century after the Second Industrial Revolution. According to McGrath (2004), four separate but interconnected generations of product development types have existed since then.

Following the Second Industrial Revolution, initial product developments were undertaken without formal development protocols, prioritising the commercialisation of inventions.

Subsequently, during the 1950s, as the second generation began, there was a growing necessity to rationalise development procedures to attain project success. This was driven by the escalating number of projects to be executed and, more importantly, the substantial resources needed for each development. During this time, several formal SDLC models have emerged based on well-established project management life cycle approaches such as predictive, iterative, incremental, and agile (PMI, 2021).

Following this, starting in the 1980s, the third iteration of improved process models prioritised the acceleration of product development to minimise the time required for delivering products to market. Faster time to market (TTM) is a crucial factor in today's business landscape, as it enables companies to gain a competitive advantage and potentially emerge as industry leaders (Grützner et al., 2016).

Beginning in the 21st century, fourth-generation processes have prioritised research and development (R&D) activities in product development projects. Along with attaining an accelerated TTM indicator, fulfilling stakeholder needs to the greatest extent possible has become the highest priority (Brem & Wolfram, 2014). This has predominantly confirmed the importance of the product manager role in product development projects within organisations (Rauniar, Doll, Rawski & Hong, 2008; Wagenblatt, 2019).

The emergence and the evolution of the product manager role

Although conscious product development originated in the middle of the 20th century, the product manager role was first associated with Neil Hosler McElroy's name in the fast-moving consumer goods (FMCG) sector in the 1930s and later spread to the software industry (Banfield, Eriksson & Walkingshaw, 2017).

McElroy (1931), a former advertising manager at Procter & Gamble, submitted a comprehensive three-page corporate document to the Promotion Department outlining the specific qualifications and characteristics he sought in potential new team members (Aimé, Berger-Remy & Laporte, 2018). McElroy suggested hiring two 'Brand Man' employees to monitor the entire product life cycle rather than being in charge of a department or subtask, as was done previously (Spring, 2013). Brand Man team members were also required to assume complete accountability for promoting their products (Aaker &

Joachimsthaler, 2012). Since the initial Brand Man position encompassed marketing activities alongside various product-focused responsibilities, it significantly influenced the subsequent evolution of marketing and product management disciplines.

After their inception, these Brand Man product managers were primarily focused on devising and executing development and marketing strategies for specific brands and products, predicting and defining financial and operational outcomes for products, consistently monitoring the implementation of development project plans, and adjusting operational activities according to changing circumstances (Fernandes, 2016).

Later, during the 1970s, product managers became the primary source of information for organisations managing product development projects, as evidenced by their diverse responsibilities. According to Luck (1969), product managers possess a comprehensive knowledge of all aspects of the product and its diversified responsibilities. These responsibilities encompassed communicating the exact product requirements and feasible timelines to project managers (Banfield et al., 2017). As a result of this complex, end-to-end responsibility, product managers had to simultaneously maintain relationships with both external and internal stakeholders in the development project, as well as with strategic, managerial, and operational level employees (Steinhardt, 2017). In the 1970s, the product manager role became critical for the successful implementation of the project (Finch, Levallet, McIntyre & Pyde, 2023).

Hise & Kelly (1978) employed a questionnaire (n=198) to explore the job characteristics of product managers. The research revealed that over 90% of participants reported that their daily job responsibilities encompassed tasks such as setting production goals, choosing suitable approaches to accomplish them, devising advertising strategies, and forecasting sales. The findings indicate that in the 1980s, product managers experienced a shift in their daily work focus from promotion and sales responsibilities, which were emphasised during the 'Brand man' era, to product development. However, the primary objective of creating products that satisfy the needs of stakeholders remained unchanged (Aimé et al., 2018).

By the late 1970s, a significant proportion of the largest companies in the FMCG sector had adopted a product-centric approach as a fundamental component of their operations. Specifically, 84% of the largest US companies were equipped with some form of product management (Cummings, Jackson & Ostrom, 1984). The primary factor behind this was the rise of new products and television advertising due to an economic recovery after World War II. The increased focus on products led to a greater emphasis on the strategic management of interconnected brands. Consequently, many companies incorporated product management into their operations to ensure high-quality manufacturing.

Although the conceptualisation of McElroy's 'Brand Man' role originated from marketing responsibilities and business needs, technological pressures within IT companies have necessitated implementing the product manager role at the project level from the 1980s (Kittlaus, 2017). An instance of difficulty that the organisation could not resolve occurred during Microsoft's Excel for Mac product development. The project team needed help strategising how the software would be functional and optimally fulfil user requirements, considering the complexity of the development process. There needed to be more in the project team's ability to accurately interpret and communicate the gathered user requirements to the developers, even though the marketing department was relaying them. The organisation hired a product manager to address this issue, whose primary responsibility was communicating user needs, collecting requirements, designing the user interface, and preparing specifications (Chisa, 2014).

Consequently, during the 1990s, many IT companies incorporated product management into their business operations. However, the value of the product manager's job in development projects was undeniable during this time. Nonetheless, certain modifications were necessary to facilitate its practical implementation. Low & Fullerton (1994) proposed using the proprietary approach, which entails granting product managers increased authority, assigning them a formal managerial role, and directing their efforts on market processes rather than convincing colleagues.

In the early 2000s, there was a shift towards R&D product development projects. Therefore, during the production process, there was a strong emphasis on understanding consumer demands and developing products that effectively fulfilled those needs. This strategy has strengthened the position and significance of product managers in the operations of IT businesses (Pranam, 2018).

Product manager role in the software industry

Given the frequent occurrence of changing business, technical, and stakeholder requirements, product managers in the software industry typically need to make decisions frequently, bringing them close to the software engineering processes (Maglyas, Nikula & Smolander, 2013). This aligns with the definition formulated by Ebert & Brinkkemper (2014), which affirms that product managers are organisational actors who possess comprehensive knowledge of the product's components and are primarily accountable for the value of the software for both the customers and the organisation.

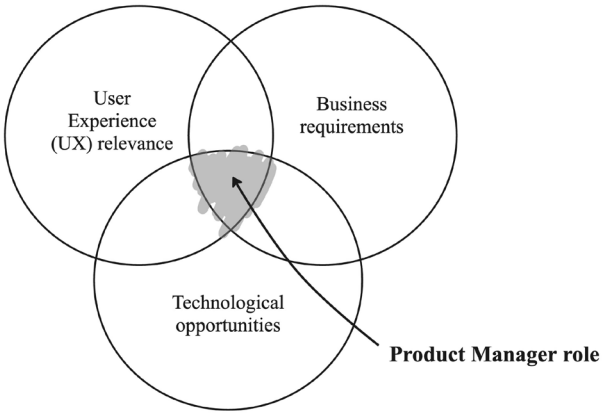
According to Lica (2021), IT product managers ensure that businesses create valuable software products that address usability, feasibility, and viability. These factors became increasingly dominant in software development as a focus on user experience (UX) emerged around the turn of the millennium (Szabó & Hercegfi, 2023). UX includes the overall impressions and emotions a user experiences when interacting with software, making it essential for product managers to address (Quiñones, Rusu & Rusu, 2018).

Considering the significance of UX within the software industry, IT product managers are required to possess a comprehensive understanding of methodologies for product discovery and delivery. Thus, product managers

accomplish an interdisciplinary role across development teams, planning, designing, and consistently introducing better products to the software market (Strader, 2010). Consequently, the IT product manager's role encompasses addressing stakeholder concerns (UX relevance), comprehending the interdependencies among various business requirements, and considering how they can be executed by emulating the most efficient technological opportunities (Figure 1) (Eriksson, 2011).

Figure 1

The interdisciplinary role of a product manager in the software industry



Source: own compilation derived from Eriksson (2011)

Expectations of a product manager in the software industry

The expectations for product managers are diverse, reflecting their interdisciplinary roles. Springer and Miler (2018) state that the responsibilities of a product manager in the IT industry involve having a comprehensive understanding of the business needs and potential of the software product and its associated services. This includes knowledge of the legal and privacy aspects, financial considerations, and marketing and sales implications. It also involves monitoring market trends and competitors and in-depth comprehension of stakeholders' requirements.

Maglyas et al. (2017) conducted a meta-ethnography study to synthesise three empirical studies about the responsibilities of the product manager role. The researchers identified the core and supporting responsibilities of software product managers. All companies should incorporate the core responsibilities of vision creation, product lifecycle management, roadmapping, release planning, and product requirements engineering. Supporting responsibilities, such as strategic planning, portfolio management, product analysis, launches, support, and development, are not the primary responsibilities of product managers. However, these supporting responsibilities are crucial to the project's success, and product managers actively participate in them (Table 1).

Table 1

Core and supporting responsibilities of a software product manager

Core responsibilities	Supporting responsibilities
Vision creation	Strategic planning
Product lifecycle management	Portfolio management
Roadmapping	Product analysis
Release planning	Product launches
Product requirements engineering	Product support
	Product development

Source: own compilation based on Maglyas et al. (2017)

Table 2

Competencies of a software product manager and their descriptions based on the Competence Dictionary of the U.S. Department of the Interior

Competency	Description
Accountability	Holds self and others accountable for measurable, high-quality, timely, and cost-effective results. Determines objectives, sets priorities, and delegates work. Accepts responsibility for mistakes. Complies with established control systems and rules.
Adaptability	Simultaneously accepts and adapts to change while remaining practical and task-focused in a constantly evolving workplace environment.
Communication	Provides timely, concise, and accurate information to others orally and in writing. Helps others effectively communicate and ensures communication occurs between all organisational levels.
Customer focus (User-Centric Mindset)	Anticipates and meets the needs of customers (e.g. users). Seeks feedback from customers (e.g. users) on how services and products are meeting expectations.
Decision-Making	Makes sound, well-informed, and objective decisions; perceives the impact and implications of decisions; commits to action, even in uncertain situations, to accomplish organisational goals; causes change.
Leadership	Motivates and guides others towards goals. Instills commitment to a standard image and shared values. Adapts leadership styles to a variety of situations.
Problem-Solving	Identifies and analyses problems; weighs relevance and accuracy of information; generates and evaluates alternative solutions; makes recommendations.
Strategic Thinking	Formulates effective strategies consistent with the business and competitive strategy of the organisation in a global economy. Examines policy issues and strategic planning with a long-term perspective. Determines objectives and sets priorities; anticipates potential threats or opportunities.
Teamwork	Encourages and facilitates cooperation, pride, trust, and group identity; fosters commitment and team spirit; works with others to achieve goals.

Source: own compilation derived from DOI (2023)

Product management is a critical role that demands distinct competencies (Table 2). Gorchels (2003) and Ebert (2007) highlight the necessity of strategic thinking and customer focus (precisely a user-centric mindset) in the development of a product.

In their day-to-day work, a software product manager must have leadership, communication and decision-making competencies, as they must convince project team members and other organisational stakeholders of the product's vision through the use of data and logical reasoning, despite holding an expert position rather than a managerial one (Rauniar et al., 2008; Tyagi & Sawhney, 2010).

Productive teamwork is also essential for a software product manager as it promotes merging various competencies and perspectives, resulting in increased innovation, productivity, and achievement of common objectives. To develop and deliver software with adequate UX to the market, the IT product manager can collaborate efficiently with other employees (e.g., developers, designers, dedicated UX researchers, and data analysts) within a cross-functional project team (Torres, 2021; Szabó & Hercegfi, 2023).

The product manager is responsible for the outcomes achieved and can handle and overcome issues encountered during development. Therefore, the product manager needs to possess accountability, adaptability, and problem-solving competencies (Wagenblatt, 2019).

The responsibilities and competencies assigned to product managers in their daily work are highly diverse and can differ based on various factors such as the company, target market characteristics, and type of product (Springer & Miler 2018) (Table 2).

Aim of the research and method

This research aims to identify the specific expectations that companies in industrial practice have toward software product managers. Besides analysing the trends of the current IT market, we also look at the differences in expectations depending on the company size. This article utilises content analysis to evaluate the current state of open product manager positions in the Hungarian IT sector. Our study addresses the following research questions:

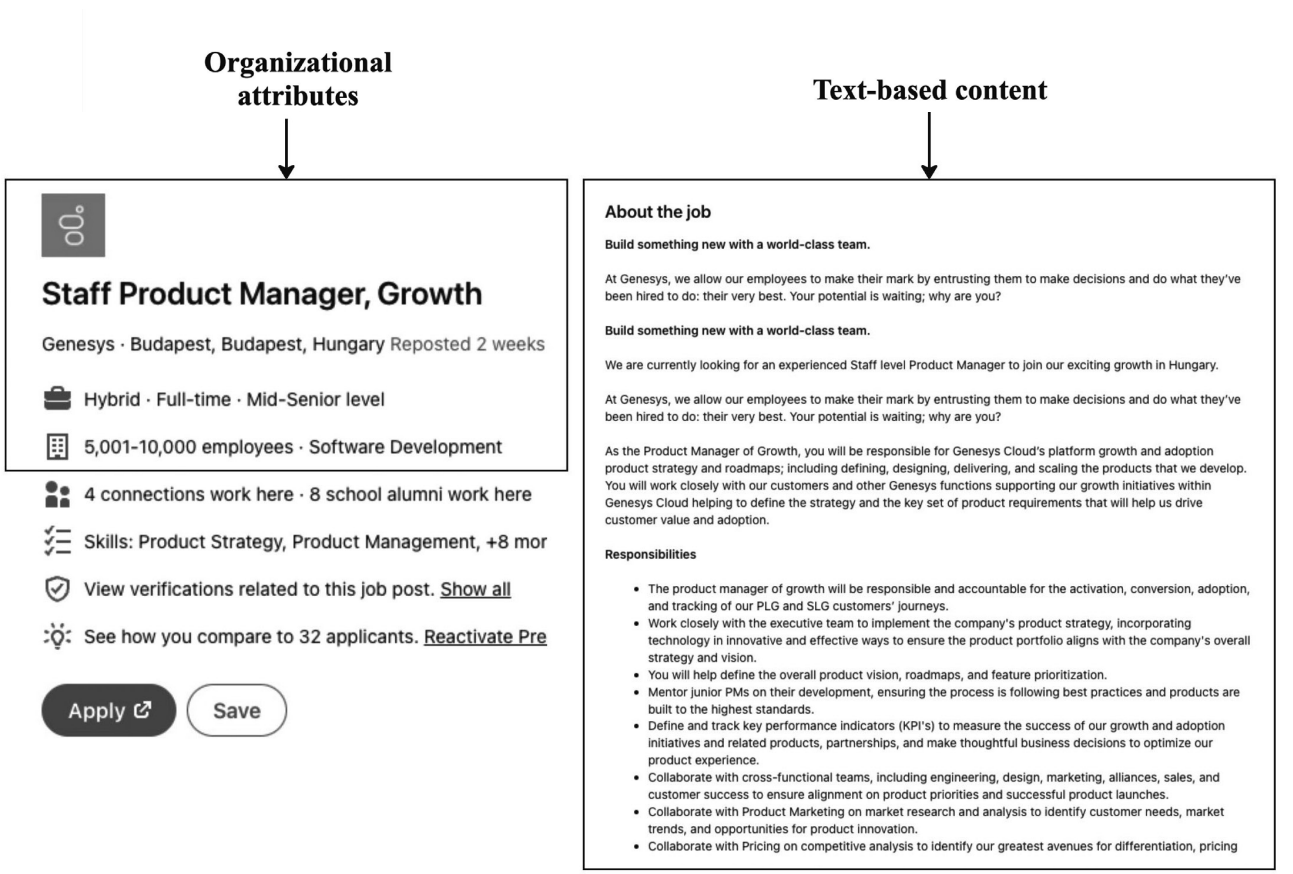
- What are the general expectations toward the software product manager role?
- What are the expected competencies and responsibilities of the software product manager role, depending on the company size?

Characterising the population

Hungary provides an appropriate population for this research because it has a diverse domestic software industry. The Hungarian IT sector comprises various

Figure 2

An example of LinkedIn job advertisements used for content analysis



Source: LinkedIn portal

organisations of different sizes that develop software for widespread sectors, including telecommunications, information services, and computer, electronic, and optical products (HIPA, 2018).

The Hungarian IT market is predominantly dominated by foreign, large companies such as BlackRock, EPAM, Ericsson, Evosoft, IBM, IT Services, Oracle, SAP, and T-Systems, collectively comprising 66% of the market. Additionally, a significant portion (34%) of the IT sector includes micro, small, and medium enterprises (e.g., ApPello, Spend Wize, ARWorks, Tresorit) that have gained global recognition and are renowned for their cutting-edge solutions (Szabó & Hercegfi, 2023).

This suggests that the Hungarian IT industry is sufficiently prominent and diverse, comprising companies of various sizes, making it suitable for our research.

Research method

Marta-Lazo et al. (2018) researched job advertisements from two reputable portals (LinkedIn and Infojobs) specifically targeting journalism graduates. As a similar methodology, content analysis has been addressed in the study. Therefore, we used it as a valuable resource for data analysis on LinkedIn job advertisements for product managers (Soratto et al., 2020). Content analysis aims to derive indicators through systematic and objective methods to describe the content of job offers (Drisko & Maschi, 2016). This allows for the inference of comprehensive knowledge about our research topic.

The job advertisements utilised for the content analysis encompassed two distinct forms of data. At first, LinkedIn advertisements contain various organisational attributes (Figure 2), such as the precise job title, the name and number of employees of the hiring company, the industry sector, the type of employment (office or remote), the work location, and the required level of experience. On the other hand, text-based content encompasses all of the organisation's expectations for product managers. The free-text description provided in a job advertisement on LinkedIn is not bound by strict guidelines, allowing the organisation to determine the quantity and quality of information shared (Figure 2).

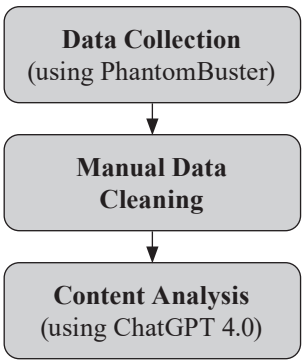
In the current study, we gathered data over an extended duration (from 23 January to 2 July 2023) for content analysis using an automation platform named PhantomBuster (Figure 3).

Nevertheless, owing to the intricate nature of LinkedIn's recommendation algorithm, the outcomes were not limited to 'product manager' advertisements, necessitating the need to refine the results list. Consequently, we cleaned the manual data by reviewing the position titles and descriptions (Figure 3). This allowed us to narrow our focus to job advertising (n=212), specifically for product manager roles.

After examining the advertisement, we initially imported the organisational attributes into an Excel spreadsheet. As part of the content analysis, we applied artificial intelligence (AI) to identify the expectations (e.g., essential competencies and responsibilities) that were in the text-based content (Figure 3). We used OpenAI's ChatGPT 4.0 model to determine the accurate meaning of the parameters being examined, such as essential competencies, in the context of AI. Subsequently, we trained the AI to delineate the criteria for categorising these parameters into groups, such as interpreting leadership as a competence according to the existing competency dictionaries. Following that, we conducted a manual verification of the AI-generated dataset, explicitly examining the set of competencies to ensure the accuracy of the categorisation. In the meantime, we added the new data to the Excel spreadsheet. We created binary variables to signify the presence or absence of predetermined information (such as various competencies) in the advertisement. We employed a similar way in the examination of responsibilities.

Figure 3

Research plan



Source: own compilation

Hypotheses

The research process was devised to utilise the information gathered from the content analysis to address the research questions and examine the following hypotheses:

Hypothesis 1: About the product manager role, companies of varying sizes mention different competencies with varying frequency.

Hypothesis 2: About the product manager role, companies of varying sizes mention different responsibilities with varying frequency.

Results

Characterising the sample

In the present sample (n=212), large companies (e.g. IBM, Morgan Stanley, Revolut) dominate (60.39%), followed by medium-sized companies (e.g. Lensa, Get Bridge) (19.86%), small businesses (e.g. Breezy HR, Carussel) (13.12%) and micro-enterprises (e.g. Deligo Vision Technologies) (6.63%). We classified the organisations by size based on Recommendation 2003/361/EC, which defines micro (less than ten employees), small (between 10 and 50 persons), and medium-sized (between 50 and 250 people) enterprises (EUR-Lex, 2003), while organisations

other than micro (over 250 persons) are considered large companies (Table 3).

Table 3

Composition of the sample by company size

Company size	Number and percentage of job advertisement
Micro-enterprises	11 (6.63%)
Small businesses	28 (13.12%)
Medium-sized companies	42 (19.86%)
Large companies	131 (60.39%)

Source: own compilation

Most (55.66%) of the companies in the sample seeking product managers were from the software development sector. However, there were also companies from telecommunications (5.19%), pharmaceuticals (4.72%), banking (4.25%), automotive (4.25%), human resources (3.77%), education (3.3%), marketing (1.89%), e-commerce (1.42%), insurance (1.42%), and gaming (1.42%) sectors. The remaining organisations, accounting for 12.71% of the total, include sectors such as research, medical device development, international trade, and industrial automation.

Title of the position

Only a minority (16.51%) of the organisations in this sample merely carried the job title 'Product Manager', whereas the majority (83.49%) employed a more precise designation. Therefore, IT organisations seem to supplement the position title with supplementary details that specify the type of product manager they seek. Three distinct categories comprise this additional information.

The first group includes organisations that specify the specific domain in the job title (e.g., 'Product Manager (Software & Cloud Solutions)', 'OpenStack Product Manager'). The second category comprises information that associates the anticipated level of experience required to occupy the position (e.g., 'Senior Product Manager') or explicitly denotes its rank within the organisational structure ('Principal Product Manager', 'Director of Growth Product Management'). Besides that, the third group contains job advertisements in which the job description explicitly outlines the responsibilities of a product manager, despite the absence of a product manager term in the position title. These position titles (e.g., 'IT Product Owner' and 'Product Owner for Automated Driving') are found in IT companies using agile software development.

The current trend in software development is agile methodology, which strongly emphasises ongoing communication with customers and prioritises flexible feedback management regarding evolving requirements (Dingsøyr et al., 2012). Scrum, Kanban, and eXtreme Programming (XP) are the prevailing agile practices in software development, used individually or in combination (VersionOne, 2022). Scrum is an agile framework that provides guidelines for development projects, defining appropriate actions and methods to enhance work efficiency (Szabó & Ribényi, 2018).

In practice, an essential component of the Scrum methodology is the role of the Product Owner (PO), who carries the responsibility for the success of product development. The primary mission of the PO is to discern the software functions that provide the most outstanding value and create a prioritised list of tasks (McGreal & Jocham, 2018). The responsibilities of product managers encompass a more comprehensive array of functions than the Product Owner's role. Depending on the size of the organisation, product managers, in practice, may assume the role of PO. However, in most organisations, it is more effective to distinguish between the two roles (Springer & Miler, 2018).

The role of product manager may be referred to by various titles in the IT industry, which could create challenges for applicants seeking employment. Therefore, as a job seeker, it is not advisable to exclusively filter for 'Product Manager' as this may result in overlooking numerous relevant opportunities.

Experience required

LinkedIn advertisements consistently indicate the level of experience required, offering options such as 'Internship', 'Entry-level', 'Associate', 'Mid-Senior', and 'Director/ Executive' categories. LinkedIn does not provide clear guidelines on the specific level to choose in each situation. Thus, organisations are responsible for determining the appropriate experience level.

Table 4

Average and standard deviation of years expected by organisations towards product managers by experience level

Experience level	Micro-enterprises	Small businesses	Medium-sized companies	Large companies	Total	Average of expected years	Standard deviation
Internship	0	0	0	3	3 (1.41%)	0	0
Entry level	1	3	9	9	22 (10.38%)	3.13	1.46
Associate	2	2	3	20	27 (12.73%)	1.6	1.12
Mid-Senior	4	17	25	81	127 (59.91%)	3.95	1.94
Senior	4	5	5	15	29 (13.68%)	4.22	1.77
Director/ Executive	0	1	0	3	4 (1.89%)	5.5	0.71

Source: own compilation

In most (74.53%) job advertisements, organisations specified the desirable work experience for the product manager position. The mean (M) of 3.66 years and the standard deviation (SD) of 1.97 were obtained for the sample.

For organisations that do not require work experience, internship opportunities were limited (1.42%) (Table 4). Explainable by the larger size of project teams, the current sample consists solely of large companies offering 'Internship' positions. This is because larger businesses are more likely to possess the resources and capability to mentor an intern.

Nevertheless, organisations demand 3.13 years (SD=1.46) of professional experience from entry-level candidates, while associate candidates are expected to possess merely 1.6 years of experience (SD=1.16). Regarding all of this, it is possible that organisations do not understand the distinction between the 'Entry level' and 'Associate' categories. The primary distinction between these two levels is that the 'Entry level' category represents a lower-level entry position, whereas the 'Associate' classification implies an opportunity with a greater likelihood of advancement to a higher position. LinkedIn does not clarify the desired criterion regarding years for various experience levels, causing HR experts to associate them with the typically assumed 1-3 years of junior-level experience in corporate practice.

The 'Mid-Senior' level is the most frequently desired, with 59.91% of organisations advertising in this category. Given the high number (n=127) of 'Mid-Senior level' advertisements, many companies expect more than three years of experience at this level (M=3.95, SD=1.94). The specified 'Mid-Senior' experience values range between 1 and 12 years.

In addition, in the current sample, the 'Senior' level appears with a comparable frequency (13.68%) to the 'Entry level' and 'Associate' category. Organisations require 4.22 (SD=1.77) years of experience for this level (Table 4). Only 1.89% of the sample sought product manager experts for leadership roles at the 'Director/ Executive' level. The lack of representation of higher positions is to be expected, given that most Hungarian IT organisations have relatively small product management teams, which typically require only one leader. The head of product management is generally employed by organisations with international headquarters in most IT-related businesses in Hungary (HIPA, 2018). In Hungarian enterprises, the selection process for senior management positions such as 'Chief Product Officer' or 'Head of Product' involving product managers is predominantly conducted internally, via a network of contacts, or in collaboration with an external human resources agency. The significant degree of accountability and fiduciary responsibilities inherent in these roles are the primary reasons for this.

Qualifications required

Only 49.06% of the organisations specified that a higher education degree was necessary for the product manager role. Out of this sub-sample, 36.54% provided information about the academic discipline in which they expected to obtain a bachelor's or master's degree. The primary disciplines (84.21%) highlighted in this sample were business (e.g., economics, marketing, sales) or IT. Additionally, science (e.g. mathematics) represented 15.79% of the sample. Within the science category, some companies have particular qualification requirements. For instance, McKinsey specifies a Master's degree in Science, Technology, Engineering, and Mathematics (STEM), while having an MBA or PhD is advantageous during the application process.

According to the current sample, it can be inferred that the corporate practices do not definitively establish the specific level of industry knowledge required for a candidate to work as a product manager. Out of the total of 118 job advertisements in the software industry, only 20 mention specific software development knowledge. In addition, only a few job advertisements require specialised industry knowledge. For example, AstraZeneca is specialised in the healthcare industry.

The results show that product management competencies carry more value in the IT market than industry experience and comprehensive domain knowledge. In specific sectors (e.g. healthcare), industry expertise is critical. The findings of this study emphasise the interdisciplinary characteristics of the role of product management.

Language competencies

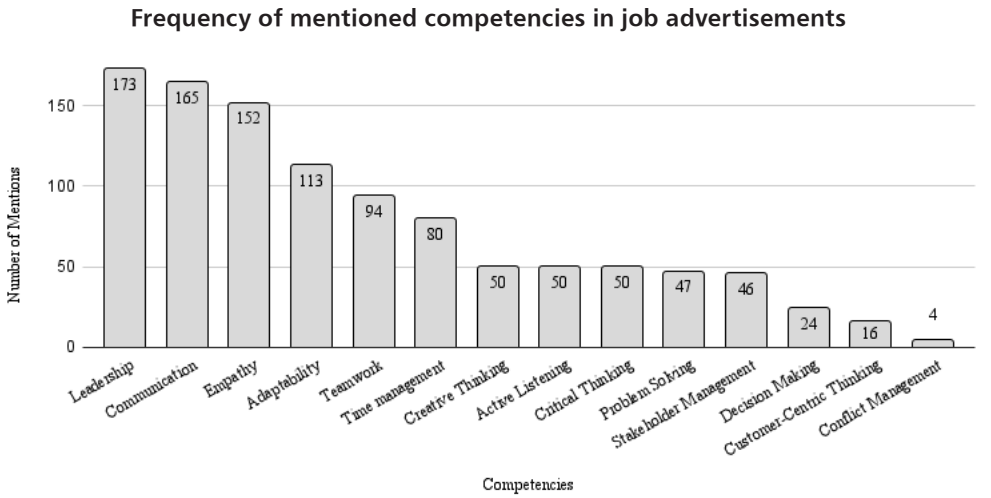
Among the job advertisements in this sample, 45.28% explicitly reference the requirement for language proficiency. English is expressly stated as a requirement in every instance within this subsample. Besides that, German (5.66%), Spanish (0.94%), and French (0.47%) are cited as second languages. In these instances, the second language could be associated with the organisation's location or target market.

The current sample comprised 89.62% of job advertisements written in English, indicating an implicit expectation regarding fluency in English. Furthermore, all job advertisements in Hungarian (10.38%) specified that English language competencies are required. The results show that the product management profession has a clear expectation that candidates possess the ability to operate in English.

Essential competencies

When considering the aggregate frequencies, the competencies that are most frequently referenced as being necessary by organisations in the advertisements are as follows: leadership (81.60%), communication (77.33%), empathy (71.70%), adaptability (53.33%), and teamwork (44.34%) (Figure 4). This implies that companies seek product managers who can inspire and motivate team members, create and communicate a vision for the product under development, and make consequential strategic decisions.

Figure 4



Source: own compilation

Following this, time management (37.74%) is cited as a crucial competence for product managers that requires effectively balancing numerous responsibilities and fulfilling deadlines. Subsequently, creative thinking (23.58%), which involves the application of innovative ideas and solutions, is observed. This is followed by active listening (23.58%), which entails comprehending and being attentive during communication. Next, critical thinking (23.58%) is emphasised, along with problem-solving (22.17%) and stakeholder management (21.69%). These competencies signify the requirement for product managers to possess the ability to examine the encountered difficulties, deconstruct them into components, assess the emerging solutions, and employ logical thinking and reasoning to select the most suitable option. Additionally, they must be capable of effectively communicating altered development directions to the key stakeholders. At the lowest rank on the list are decision-making (11.32%), customer-centric thinking (7.54%), and conflict management (1.88%) competencies (Figure 4). In addition to focusing on customer needs and accepting responsibility for decisions and risks, these underappreciated abilities constitute the fundamental requirements of the product management profession. Consequently, the low frequency of these competencies is not unexpected.

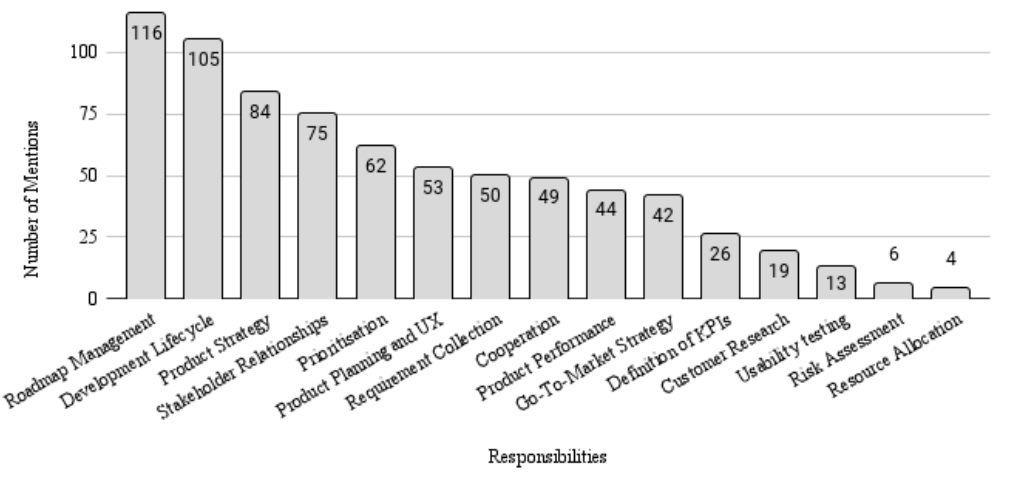
Essential responsibilities

The responsibilities that are most commonly mentioned in job advertisements are roadmap management (54.72%) and development lifecycle (49.53%) (Figure 5). This means that the product manager is in charge of creating a roadmap that specifies the upcoming features that must be developed and the obstacles that must be overcome. Assuring feature delivery through daily close collaboration with developers from concept to launch, the product manager maintains control over the product development lifecycle.

The subsequent task identified was product strategy development (39.62%), ensuring that product objectives align with the organisation's goals. Aside from stakeholder relationships (35.58%), which refers to continuous communication with stakeholders and understanding their expectations, this sample also addressed prioritisation (29.25%), which requires collaboration between product managers and developers to determine the order in which tasks should be implemented, taking into account their business value and user requirements.

The value assigned to product planning and UX is 25%, while requirement collection is valued at 23.58%, both of which are lower. Product planning and UX involve supervising the design of a product while collaborating closely with UX/UI designers. In addition, collecting requirements is one of the primary responsibilities of product managers for comprehensive specifications of the new features. Fulfilling stakeholder demands and considering user requirements are fundamental expectations of the product manager profession. Thus, these respon-

Figure 5



Source: own compilation

sibilities are not expected to be the primary focus of the described criteria.

Cooperation (23.11%) and product performance (20.75%) received comparable ratings in this sample. The product manager's complicated responsibilities require cooperation with individuals and teams throughout product development. Product performance monitoring involves the ongoing process of gathering feedback and analysing data related to the functionality of a software product to understand how the market is responding to it.

The product manager can execute a go-to-market strategy (19.81%), which entails developing a comprehensive plan for launching and marketing a new product or feature.

The job advertisements specify the definition of key performance indicators (KPIs) with a rating of 12.26%. Key Performance Indicators (KPIs) help evaluate product development projects, establish ambitious goals, and quantify the achieved outcomes, making them crucial in the IT industry (Kaganski et al., 2017).

The product manager's role primarily concerns customer research (8.16%) and usability testing (6.13%) activities. In addition, risk assessment (2.83%) and resource allocation (1.89%) were brought up. These responsibilities are related to the efficient allocation of resources such as budget, time, and human resources, as well as identifying potential risks at every stage of the product's life cycle.

Results of the hypothesis tests

Due to their small specimen sizes, microenterprises and small enterprises were merged to conduct the hypothesis tests.

Hypothesis 1 states that companies of varying sizes mention different competencies with varying frequency concerning the product manager role. Because the assessed competencies are binary indicators and the size of the organisation variable is nominal, it is possible to examine the first hypothesis presented in the advertisements by implementing chi-square tests for various competencies. Among the 14 competencies, there were significant differences in the present sample in two cases. These were leadership ($\chi^2(2)=14.843$, $p=0.001$) and active listening ($\chi^2(2)=6.111$, $p=0.047$) competencies (Table 5).

Thus, Hypothesis 1 was partially accepted in the present sample because it was confirmed that companies of different sizes mention leadership and active listening competencies with different frequencies about product managers. The chi-square tests reveal that large companies exhibited a higher prevalence (89.31%) of mentioning leadership competence compared to medium-sized (73.81%) or micro and small companies (64.10%). In addition, it can be observed that the mention of active listening competence was less frequent (10.25%) in micro and small companies compared to medium-sized (33.33%) and large companies (24.43%). Nevertheless, caution should be exercised when interpreting the results pertaining to active listening competence, as the associated p-value is close to 5% (Table 5).

According to Hypothesis 2, companies of varying sizes mention differ-

Table 5

Contingency tables and chi-square test results for leadership and active listening competencies

Company category	Competence	Leadership		Active listening	
		0	1	0	1
Micro and small	Count	14	25	35	4
	Percentage within row	35.90%	64.10%	89.75%	10.25%
Medium	Count	11	31	28	14
	Percentage within row	26.19%	73.81%	66.67%	33.33%
Large	Count	14	117	99	32
	Percentage within row	10.69%	89.31%	75.57%	24.43%
Total	Count	39	173	162	50
	Percentage within row	18.40%	81.60%	76.41%	23.59%
Chi-Squared Tests (α=0.05)	**df**	**X^2**	**p**	**X^2**	**p**
	2	**14.843**	**0.001**	**6.111**	**0.047**

Source: own compilation

Table 6

Contingency table results for cooperation responsibility

Company category	Responsibility	Cooperation	
		0	1
Micro and small	Count	19	20
	Percentage within row	48.72%	51.28%
Medium	Count	34	8
	Percentage within row	80.95%	19.05%
Large	Count	110	21
	Percentage within row	83.97%	16.03%
Total	Count	163	49
	Percentage within row	76.89%	23.11%
Chi-Squared Tests (α=0.05)	**df**	**X^2**	**p**
	2	**21.502**	**0.001**

Source: own compilation

ent responsibilities regarding product manager roles with varying frequency. This hypothesis was also evaluated using a chi-square test for each responsibility. Out of the 15 responsibilities, there was a significant difference in the present sample in cooperation ($\chi^2(2)=21.502$, $p=0.001$) responsibility.

Thus, Hypothesis 2 was partially accepted in the present sample because it was confirmed that companies of different sizes mention the cooperation responsibility with different frequencies towards product managers. The chi-square test indicates that micro- and small enterprises exhibit the highest level (51.28%) of cooperation, whereas it is mentioned less among medium-sized (19.05%) and large companies (16.03%) (Table 6).

Discussion

Our empirical research reveals that companies of diverse sizes offer product manager roles. However, a significant majority of over 60% of the available product manager positions are advertised by large corporations. The dominance of large companies in the sample suggests that product management roles are more prevalent in larger organisations, possibly due to the complexity and scale of their projects.

According to the research findings, it can be concluded that organisations frequently (59.9%) seek 'Mid-Senior' level product managers on LinkedIn. Furthermore, it is a fact that the role of product manager requires a minimum of 3 years of experience, regardless of the level of experience specified in the job advertisement.

In the software market, a small number (1.42%) of internships for entry-level and 'Director/Executive' level opportunities for highly experienced professionals (1.89%). From these, 'Internship' positions are only available at large companies, which is unsurprising, considering that a large company usually has more capacity for mentoring activities. Besides that, instead of posting public job advertisements, companies in the IT market primarily seek product leaders for the 'Director/Executive' level within the organisation through a network of contacts or with the help of an HR agency. This is understandable given the substantial responsibilities of the executive-level product manager position.

According to the analysed job advertisements, product managers must possess professional working proficiency in English and knowledge suitable for effective communication. This could be attributed, on the one hand, to the global scope of the data source and, on the other hand, to the fact that most of the companies operate in an international market, where effective communication with customers and partners requires product managers to have command of proficient English language abilities.

Regarding IT product manager positions, a degree in economics (e.g., marketing, sales) or IT is the most commonly required qualification (84.21%). Product management is multidisciplinary, so these conditions frequently meet the organisation's expectations. In selecting product managers, practical job experience is prioritised over formal education.

Based on this sample, it can also be concluded that the organisations do not specify the precise level of industry expertise that a product manager candidate must have. Based on an examination of the job advertisements, it appears that in the IT market, product management knowledge is more crucial than domain expertise.

The theoretical framework of our work outlined the overarching expectations and competencies related to product management positions in the IT industry. The literature underlines the interdisciplinary aspect, emphasising the necessity of a thorough understanding of business demands, technological opportunities, and stakeholder requirements. Theoretical perspectives emphasise the importance of specific competencies in software product management roles, such as strategic thinking, teamwork, customer focus (user-centred mindset), leadership, communication, problem-solving, decision-making, adaptability, and accountability.

The study's results section presents empirical evidence based on the content analysis of LinkedIn job advertisements (n=212). The findings support all aspects of the theoretical framework except for the competency of accountability. Product managers are responsible for ensuring the success of the products they oversee. Continuously taking ownership of their decisions is necessary for the product manager role, making accountability an implicit competence. Furthermore, empirical research demonstrates that specific additional competencies are essential for job requirements. These competencies include empathy, time management, creative and critical thinking, active listening, and stakeholder management. The results also quantify the frequency of all the mentioned competencies, allowing for the possibility of assigning weights to them to understand better their relative importance to organisations in their recruitment processes for software product managers. Leadership, communication, and empathy emerge as the most frequently cited competencies, mentioned in at least 70% of the advertisements, emphasising product management's interpersonal and strategic aspects.

Regarding responsibilities, there is considerable alignment between the descriptions in the literature and the empirical findings. However, while the core and supporting responsibilities outlined in the theoretical framework primarily focus on internal (organisational) activities (from vision creation to product launch), the empirical results also encompass external responsibilities (such as customer research and defining go-to-market strategy). The significance of UX relevance, as explained in the theory, is affirmed by empirical findings. This is due to the inclusion of feedback collection (specifically related to product performance), usability testing, and customer research as essential responsibilities.

In addition, organisations seeking product managers often use a wide range of job titles, which reflect the diverse nature of product management roles within different organisations and industries. This outcome demonstrates

that the product development company's characteristics, internal procedures, and organisational values can influence the scope of responsibilities of a product manager.

The hypothesis tests conducted on companies of varying sizes revealed significant differences in the frequency of competencies and responsibilities within the current sample. For instance, more giant corporations prioritise leadership and active listening competencies, highlighting the importance of efficient management and communication in bigger teams and projects. Similarly, within responsibilities, cooperation plays a more crucial role in micro and small enterprises, where product managers are expected to ensure that the entire organisation works closely together, ensuring effective teamwork and a strong focus on agile operation.

Consequently, software product managers must possess an all-encompassing understanding of the domain areas where a given organisation's business requirements, user preferences, and technological capabilities intersect to meet the varied expectations that can be placed upon them.

Conclusion

Job seekers in the product management field should be aware of the diverse titles, responsibilities, and qualifications associated with different roles and industries. Understanding potential employers' specific requirements and expectations can help candidates tailor their resumes and applications accordingly, increasing their chances of success in the competitive job market.

Leadership, communication, and empathy are, in general, essential for the success of product managers in the IT industry. The top five responsibilities that a product manager must handle at any company size include roadmap management, development lifecycle monitoring, product strategy development, stakeholder management, and development task prioritisation. Future product managers must also anticipate the need to monitor the product's complete life cycle consistently. Product managers in the software market oversee all UX aspects of product development. Their work begins before creating the product idea and continues even after launching it. The empirical findings demonstrate that software product managers are actively anticipated to acquire and understand user requirements, conduct usability testing, and gather feedback following the release of the product. While the basic principles of the user-centred approach may be readily acquired and are widely embraced by numerous universities in Hungary and worldwide, it is crucial to acknowledge that there are no universally applicable UX research methods for all software products. Therefore, it is vital to thoroughly comprehend the fundamental nature and practicality of different UX research methodologies and to consistently stay informed about the latest technical advancements in the field through resources such as books and online publications. This ensures that one's expertise remains current and relevant.

Given the nature of this career, which involves creativity and problem-solving, software product managers can contribute to the project success of different digital products. As a result, the practical knowledge gained becomes more valuable. Thus, employability may be more time-consuming for those without relevant professional experience. Most companies prefer applicants with at least three years of experience. Hence, while pursuing academic studies, it is advantageous to attempt to gain practical experience at a software market organisation.

To summarise, software product management provides a fulfilling and dynamic career opportunity for individuals with a strong interest in technology, innovation, and creating a meaningful impact. Software product management combines strategic thinking, creative problem-solving, and collaborative teamwork to enable individuals to bring about positive change and influence the future of technology.

The profession of product manager is a beneficial long-term investment, as skilled product managers leverage their extensive expertise and capacity to move between companies and apply their diverse knowledge gained from various industries to ensure the market success of their current product.

Limitations

The job advertisements analysed in this research share a common characteristic: they primarily focus on developing suitable products in response to business and customer requirements in collaboration with various departments, either at a strategic or operational level. This definition excluded similar yet related positions of product manager expertise, such as project manager and agile coach.

Given that our analysis solely focused on LinkedIn ads, it is possible that there were further job advertisements on other Hungarian job portals or technology companies' websites during the reviewed period that were not considered in our analysis.

Further research

Since the content analysis is limited to a shorter time frame and only considers advertisements on LinkedIn, we intend to extend the research using a comparable approach throughout 2023 to expand the dataset. We also seek to investigate the specific practical expectations placed upon IT product managers through qualitative interviews conducted with professionals in this field. Conducting qualitative research on a sample of 20 individuals allows for a comprehensive examination of the topic. This research will compare the competencies and responsibilities mentioned in job advertisements for product managers and the actual expectations in industrial practice.

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MÁTÉ MOLNÁR

SPORT SEASONS THROUGH THE LENSES OF PROJECT MANAGEMENT – IDENTIFYING THE COMMON KEY CHARACTERISTICS OF SPORT SEASONS AND PROJECTS

SPORTSZEZONOK A PROJEKTMENEDZSMENT SZEMÜVEGÉN KERESZTÜL – A SPORTSZEZONOK ÉS -PROJEKTEK KÖZÖS FŐ JELLEMZŐINEK AZONOSÍTÁSA

There is a large amount of research on both successful project management and the management of professional sports organisations, but the relationship between these two phenomena remains to be analysed. Therefore, the aim of this article is to identify the similarities between sports seasons and projects by examining the characteristics of these two domains, as well as to lay the foundations for defining the potential management practices that can improve the efficiency of seasons using tools and techniques derived from project management. The results will be obtained through a narrative literature review of relevant books and articles on projects and sports seasons. The outcome of this research will contribute to a better understanding of how sport organisations can streamline their operations, optimise performance and ensure successful sport seasons by potentially implementing a project management approach.

Keywords: **project, project management, sport project, sport season, life cycle**

Számos kutatás született már mind a sikeres projektmenedzsmentről, mind a professzionális sportszervezetek vezetéséről, azonban a kettő kapcsolatát elemző kutatások száma alacsony. Ebből fakadóan a cikk célja, hogy e két terület jellemzőinek vizsgálatával azonosítsa a sportszezonok és a projektek, illetve azok menedzsmentje közötti hasonlóságokat, valamint megalapozzon olyan kutatásokat, melyek a lehetséges projektmenedzsmentből származó eszközök és technikák sportklubok menedzsmentjébe való átültetésével javíthatják az csapatok szezonban mutatott hatékonyságát. Az eredményeket a projektekről és a sportszezonokról szóló releváns könyvek és cikkek narratív szakirodalmi áttekintésével mutatja be a szerző. A kutatás eredménye hozzájárul annak jobb és szélesebb körű megértéséhez, hogy a sportszervezetek hogyan tudják racionalizálni működésüket, optimalizálni teljesítményüket és biztosítani a sikeres szereplést egy szezonban a projektmenedzsment-megközelítés lehetséges alkalmazásával.

Kulcsszavak: **projekt, projektmenedzsment, sportprojektek, sportszezon, életciklus**

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While project management has been extensively researched across various industries including construction, engineering, and information technology (see e.g. Kerzner, 2022), the application of project management principles in managing professional sport clubs remains underexplored. Existing studies tend to focus on broader topics such as team performance (see e.g. Prapavessis, Carron & Spink, 1996), leadership (see e.g. Cotterill & Fransen, 2016), and organizational behavior within the realm of professional sports (see e.g. Wagstaff & Burton-Wylie, 2018). In the case of the connection of project management and sport, most research focuses on event organizations, large infrastructural investments, and health care and injuries, moreover, in the field of sport,

business or project management studies are commonly related to the development of players or humans in general, leadership and events (Lis & Tomanek, 2020).

However, a comprehensive examination of how project management concepts and methodologies can be effectively employed in sports clubs in terms of managing seasons is lacking.

The need for effective management of professional sport clubs in today's highly competitive landscape highlights the opportunity for the adoption of project management principles and methodologies (Ratten & Jones, 2020). The existing research gap surrounding the use of project management in this context sheds light on the lack of comprehensive studies addressing the unique challenges and strategies faced by sports clubs. Project management is often paired in research of practice with sport, however, this connection is mainly regarding sport event organization (Fotiadis, 2020) and infrastructural development (Francis, Webb, Desha, Rundle-Thiele & Caldera, 2023), but not paired or compared to managing seasons.

A research gap lies in the examination of performance metrics and factors that contribute to success in projects as well gain field and appreciation regarding professional team sports during seasons. Professional sport teams tend to use various metrics to evaluate individual and team performance, such as scoring statistics, player efficiency ratings, and win-loss records (Sarlis & Tjortjis 2020; Severini, 2020). In contrast, project success is often assessed using project completion rates, budget adherence, and client satisfaction metrics (Kerzner, 2022). Exploring the potential transferability of performance evaluation techniques and metrics between these two contexts could enhance project management approaches and possibly even sports performance analysis.

To lay down the foundation for the aforementioned study options, conducting research regarding the similarities of project and professional sport seasons is essential. Foremost, there is a need to establish a common understanding regarding these two management areas, which is based on the literature, since the number of research papers addressing the potential similarities, overlaps, and congruencies between these two management areas can be considered to be limited. Thus, there is a need to summarize the project management literature with special regard to those constraints which mean the fundamentals of projects (triple constraint, life cycle).

Project definitions and approaches

The definitions of projects have been evolving significantly over the past decades for numerous reasons. First, authors highlighted – based on Cleland (1994) – that projects were inevitable for achieving sustainable competitive advantage for firms, and this perceived importance should be reflected in the definitions as well (see e.g. Görög, 2013; Pinto, 2020). On the other hand, the complexity of projects and their surroundings environment have increased to a great extent (see e.g. Judgev & Müller, 2005) and enforced not only practitioners but also academics to analyze and understand them. In line with this, Bredillet (2007) emphasized that project management ought to get highlights to a greater extent as part of the academic discussion of business and management and at the same time the Project Management Institute (2021, from now on: PMI) drew attention to that projects have cost and time constraint, and Verzuh (2021) revealed that projects are carried out in the course of temporary organization managed by a specialized (project) manager. Görög (2013) also identified that projects have two immanent characteristics: uncertainty and interdependence. This is partly due to the unique and result-oriented nature of projects.

In accordance with these, Project Management Institute (2017, p. 4) defines a project as „a temporary endeavor undertaken to create a unique product, service, or result", while Görög's (2013, p. 9) description of the same phenomenon is the following: '... an activity which is a unique and complex task to an organization in which the duration and cost are limited, having a definite aim to create a certain result and carried out in the course of a project organization'. These approaches, together, with other relevant papers (Blaskovics et al., 2023; are intricately linked to the concept of the project triangle, also known as the Iron Triangle, where 'Time', 'Cost', and 'Scope' or 'Quality' are universally recognized as fundamental dimensions within project management literature (Kwak & Anbari, 2009; PMI, 2017). This triplet of constraints constitutes the primary criteria by which project performance and success are evaluated (Atkinson, 1999).

As articulated by Kerzner (2022), interdependent relationships exist among these constraints, whereby any alteration to one aspect necessitates concurrent adjustments in the others, leading to actions from the project team. For instance, a modification in project scope typically triggers changes in both time and cost parameters, resulting in potential schedule extensions and budgetary adjustments (Pollack, Helm, & Adler, 2018). Similarly, endeavors to reduce project costs often entail trade-offs in scope or necessitate extensions in project duration. By acknowledging and effectively managing these interdependencies, project stakeholders are empowered to make informed decisions and maintain project alignment with predefined objectives (Görög, 2013).

Based on Atkinson (1999), managing these triple constraints is crucial for project management, as balancing and prioritizing these factors are required to ensure the project's success. Meredith & Zwiakel (2020) pointed out, that managing to meet the criteria of time, cost, and scope have gotten better, but changes and adjustments to the constraints still must be carefully assessed and evaluated to identify the potential impact of other factors.

Fundamental elements, triple constraints of projects

Based on the definition of a project by PMI (2021), Görög (2013) and Verzuh (2021) projects share the attribute of being temporary endeavors. In parallel with this, one of the three dimensions of the aforementioned Iron Triangle,

'Time' is one of the critical and closely monitored constraints in project management, and Hazar (2014) and Oburu (2020) refer to multiple time-based factors as durations and deadlines of achieving tasks and milestones, but ultimately to the overall time frame in which the project must be completed (Babu & Suresh, 1996). Time constraint is influenced by numerous factors such as the client's requirements, deadlines (Chin & Hamid, 2015) goals of the parent organization, market demands, legal obligations or corporate guidelines, delivery times, and other critical in-project or cross-project dependencies (Martens & Vanhoucke, 2020; Thesing, Feldmann & Burchardt, 2021).

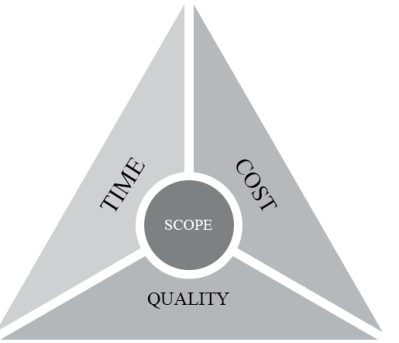
Numerous researchers (see e.g. Cooke-Davies, 2002; Martens & Vanhoucke, 2019) emphasize the need for proper planning, preparing, scheduling, and monitoring during the life cycle of a project. These activities involve responsibilities like aligning tasks based on logical connections, estimating durations, managing resource needs, and establishing realistic deadlines for every block and phase. (PMI, 2021; Ribeiro, Amaral & Barros, 2021). Also, in order to manage project time in an effective way, project managers are required to identify and mitigate potential time-connected uncertainties and risks (Strelicz, 2016). Raykar and Ghadge (2016) found that risks such as scope changes, resource problems, or unexpected external events like weather conditions must be detected and monitored, so late completion can be avoided.

Venkataraman & Pinto (2023) emphasized that cost constraint is also a key feature of the project, and effective cost management both on the project and company level is a crucial aspect of project management, which involves planning and monitoring throughout the life cycle of the project. This was reinforced by numerous authors (see e.g. Berényi & Deutsch, 2022; Varga & Csiszárik-Kocsir, 2016), while PMI (2017; 2021) revealed that one of the key tasks of managers is to estimate and allocate costs to different tasks, track and control individual and overall expenses and ensure that the project stays within the approved limitations of the budget. Verzuh (2021) also added that evaluating cost performance enables the project managers to identify weaknesses in project implementation and also helps them to identify potential cost-saving opportunities during completion.

The third and final constraint of the project triangle is the scope. According to Shenhar and Dvir (1996), these are specific objectives, deliverables – such as products and services – of the project, and requirements of the project result in case of system development projects. PMI (2017) highlighted that a proper scope management could increase the understanding of the given project by its stakeholders, and the project team stay focused on the objectives and avoid unnecessary activities. Görög (2013) underlines that the proper definition of project scope can increase the potential for project success, and any unplanned or unprepared deviations (for example scope creep) can increase the chance for failure. Both Ajmal, Khan, & Al-Yafei (2020) and Urbinati, Landoni, Cococcioni & De Giudici (2020) pointed out, stakeholders have a key role in scope management, therefore project managers must understand their expectations regarding the project and ensure that the results are also aligned with their needs (Figure 1).

Figure 1

Project management triangle of constraints



Source: own compilation based on Gido, Clements & Baker (2018, p. 14)

Project Life Cycle

Project life cycle is a concept that covers the full duration of the project. It can be divided into separate phases, each phase contributing to the project completion with its own logically related processes, tasks, and deliverables, and required project manager approach (PMI, 2017). Individual attributes can be assigned to every phase such as name, number, duration, and other specifics based on what managers and project members can follow along the processes with the logic of completion. Blaskovics (2014) highlighted that three general phases that appear in each model are planning, implementation, and closing. At the same time, numerous authors (Cleland, 1994; PMI, 2017; PMI, 2021; Verzuh, 2021) provided a framework for defining concepts of the life cycle and the phases of which it consists. Most of them agreed upon projects should go through the following phases:

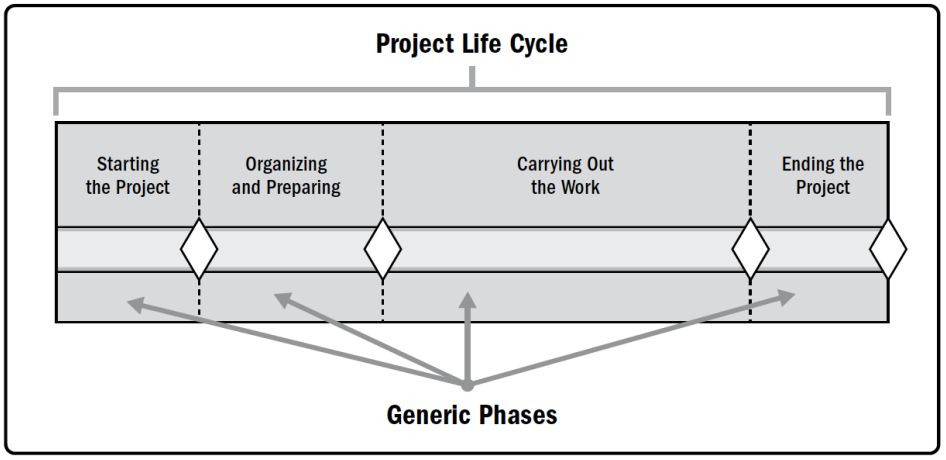
- Initiation or conceptualization: in this process, the most important constraints and the goal will be defined (for example milestones, deliverables, risks and expectations in general, budget).
- Planning: where the detailed plans will be prepared which will be the base for completing the project result, the project process, or define those internal processes that support the aforementioned two factors (like cost or time plan, or the communication strategy).
- Implementation: where the project result and the associated deliverables are created, and the progress or the project results are created.
- Closing: where the project result is taken over by the customer, and the internal resources will be integrated back into the organization.

Görög (2013) highlighted that finding the most appropriate external contributors could bear of extreme importance, thus he identified awarding as a separate phase. PMI (2017), and Verzuh (2021), argued for separating

the implementation and control since the responsible for the given phase can be different. Labuschagne and Brent (2005) considered product lifecycles instead of project life cycles and argued for adding pre-project and post-project phases. PMI (2017) in accordance with Goleman & Boyazits (2002) revealed that each phase should focus on the project team management also, since they contribute to the project success to a great extent (Figure 2).

Figure 2

Generic Depiction of a Project Life Cycle



Source: PMI (2017, p. 548)

Research Methodology

The literature on both sports and projects can be considered to be abundant, however, a lack can be identified in terms of matching these two together on club level, i.e. considering sport seasons as projects. Thus, the research aim of this paper is to delve into the intricate relationship between managing professional sport seasons and project management to provide a comprehensive analysis of the similarities these areas have. As a result of this, the following research questions are formulated:

- What are the similarities between a project and a sport season?
- What are the similarities between managing projects and managing sport seasons?

By conducting exploration and examination of recent, relevant literature, studies, and empirical evidence, this research intends to shed light on the possibilities and limitations of comparing season to project and their management approach.

In order to define projects and to investigate the possible similarities sport seasons have with projects, a narrative literature review has been conducted with the goal of studying of researching the studies of academics and researchers of the given topic. Such literature review will be conducted by predetermined parameters, therefore following the same logic the research is transparent and reproducible.

Since the literature on the common intersection of sport and project is lacking (except for the infrastructural projects which are out of the scope of the paper), the author followed an extrapolation approach based on the narrative review. Three potential steps could have been followed, which are as follows (Ferrari, 2015; Juntunen & Lehenkari, 2019):

- Option 1: Considering the literature on sport seasons as the base for the comparison and extrapolating the most important elements of this to the projects.
- Option 2: Considering the literature on projects as the base for comparison and extrapolating the most important elements of this to sport seasons.
- Option 3: Analyzing both the literature on sport season and projects, and finding the common elements based on case studies or other primary data collection techniques.

The author adopted the second option since the aim of the paper is to reveal whether a sport season can be considered as a project, and not the other way round, so the characteristics of the projects should be conducted on sport season level. At the same time, the literature that analyzes sport seasons from project perspective is limited, thus, a case study or another primary data collecting technique could only be applied only together with one of the first two options, and this exceeds both the word count limit of the journal and the scope of the paper. In order to achieve the aforementioned aim, the research had two phases. The first phase encapsulated the literature review on projects, and the second phase contained the narrative research and the comparison of the two phenomena.

Thus, in the literature review, the cornerstone elements of project management were examined in a detailed manner which could serve as a solid basis for finding the direct relationship between sport and project. This encompassed the following:

- Project definitions,
- Triple constraint (time, cost, scope),
- Project life cycle.

Approach towards the narrative research and data gathering

To synthesize the many existing definitions and characteristics of projects, the literature to review was narrowed down to handbooks and guides published in the last 20 years. This can be done due to these international and national publications contain the conclusions and definitions of the most important or most popular papers in

the discipline, including those areas that were highlighted before. Based on the popularity and widespreadness (c.f. Blaskovics, 2014), the following handbooks were selected:

- Gido, J., Clements, J. & Baker, R. (2018). Successful Project Management,
- Görög, M. (2013). Projektvezetés a szervezetekben,
- Pinto, J. K. (2020): Project Management – Achieving Competitive Advantage,
- Project Management Institute. (2017). A Guide to the Project Management Body of Knowledge (PMBOK®) – 6th edition,
- Project Management Institute. (2021). A Guide to the Project Management Body of Knowledge (PMBOK®) – 7th edition.

These papers served as a base for comparing the conclusions of the narrative research to the main characteristics of the project.

To review the broad literature on sport management and other articles related to the topic of handling problems throughout a sport season, a narrative literature review was conducted. To start the general overview of sport season characteristics 20 articles were reviewed from SCOPUS, which consisted of the 10 most cited articles all-time and 10 most cited articles between 2021 and 2024 for the keyword "sport season".

The detailed review was conducted in the database of Google Scholar. The keyword for searchings are encapsulated in Table 1.

Table 1

Keywords for research in Google Scholar regarding sport season characteristics

Research Area	Search phrase
Project triangle – Sport season	Sport season cost Sport season cost management Sport season time Sport season time management Sport season schedule Sport season goal Sport season goal setting
Project life cycle – Sport season	Sport season initiation Sport season planning Sport season execution Sport season completion
Project stakeholder management – Sport season stakeholders	Sport season stakeholder Sport season stakeholder management

Source: own compilation

In case of these searches, the author has leaned on the algorithm of the database to list the 5 most relevant articles based on the number of citations and readings, and the criterion for inclusion was to be written in English, should satisfy every scientific criterion (containing literature review, if there is empirical data collection, it should be planned, the paper should have been peer-reviewed), and paper from the field of health and medicine were excluded in this case, therefore 61 articles were reviewed from the searches in the database of Google Scholar and 44 articles contributed to the analysis of this paper, 17 were excluded due to lack of contribution.

Limitations

The research has several crucial limitations, which the author wants to improve in the future. First, the number of papers could be increased, and a topic could have been investigated in a deeper manner. At the same time, in order to find congruency between a sport season and a project, other topics should have also been analyzed, such as the similarities of organizations utilizing project and working in a season-based sport field. Furthermore, the role of sport managers and project managers should also be researched – preferably by means of a primary research – in a comprehensive comparison to see if their roles, responsibilities, and competencies could be matched or developed built on their similarities.

Additionally, a detailed semantic analysis of the definition of sport seasons should be conducted or adapted, to further deepen the understanding of the phenomenon.

Results and discussion

The presence of the triple constraint in sport seasons

In accordance with the aim of the paper identifying the similarities between sport seasons and projects, the common characteristics of the hard constraints should be analyzed. As PMI (2017) highlighted, the most important hard constraints are the elements of the project triangle, which can also be considered as the fundamental success criterion. This criterion encompasses the time (deadline), cost (budget), and scope (the decomposition of organizational goals on project level). Based on the narrative literature review, from 10 out of the 20 papers – found in SCOPUS – at least one or more constraints could be identified, and highlighted sport seasons should also consider these features. Additionally, the Google Scholar searches contributed 9 articles, from which the goal constraint could be deducted, and another 5 articles mentioned directly or indirectly the importance and effects of costs and the appropriate cost planning. Moreover, 4 papers highlighted that scheduling could be important not just on season, but interseason level as well (in accordance with the scheduling of the activities).

Looking for the key characteristics of sport seasons which can be related to the constraints of time, cost and goal, the first feature that can be derived from the literature is the importance of the time parameter. Numerous authors highlighted that there is a fixed duration for the season with a defined start and end date and within that time, teams must plan and execute their training sessions, perform at games, and participate in other related activities (Coppalle et al., 2019; Guild, Lininger & Warren, 2020; Knapik, Bauman, Jones, Harris & Vaughan, 1991; Pinto 2020; PMI, 2017).

Time management plays a crucial role in ensuring that all tasks are completed within the allocated time frame in a manner that supports a sport team's goals (Robertson & Joyce, 2018). The lack of appropriate time management can lead to rushed preparation, player fatigue, and potentially lower performance levels. Also, according to Vlahoyiannis et al. (2021) successful teams, carefully plan their schedules, allowing for sufficient rest periods and they schedule in structured practice sessions in between games to improve performance throughout the season. Moreover, goals are extremely time-bound, as their result – wins and other achievements – can not be transferred to the next season, new goals will be set (Jeong, Healy & McEwan, 2023) and personal contracts of members of the organization might expire (Borghesi, 2009), therefore the season deadline can be considered as a hard project deadline.

Another key element of professional sport seasons – as of the project management triangle – is finance, including different costs and incomes. In professional sports, financial management is pivotal, as teams must consider various expenses such as player salaries, travel costs, marketing, and equipment. From these costs, player salaries can be connected directly to the season (see e.g. NBPA,2023; NFLPA, 2020), and others could be managed as operational costs. Just like project teams, sport clubs also operate with a limited budget and must make strategic decisions to balance their expenditures while still remaining competitive. In some cases, these expenses are regulated by the parent organization or league. For example, in case of the National Basketball Association – North American professional basketball organization – or other US major sport leagues (Keefer, 2021) by applying the principles of cost management, teams can make informed choices on where to invest their resources and where to cut back. Based on the works of Késenne (2006) and Garcia-del-Barrio & Szymanski (2009) a team might decide to invest heavily in acquiring a player for a key role or they might opt for cost-effective salary distribution and lesser goals.

Although time is a stricter constraint and is easier to realize as such, cost is more difficult to manage, because of multi-year deals for players and coaches, which obviously exceed the limits of the season. However, based on the Collective Agreements of NBPA (2023) and NFLPA (2020), the best examples are provided by North American major sport leagues, revealing the cost constraint of managing a professional sport team during a season. Each of these associations has their collective agreements with their clubs and players, which includes the yearly salary cap determined for the upcoming seasons, where the salary cap is accounted for the total amount of money a sport franchise can spend as payroll for the marked season. Considering that these parent organizations of sport franchises are the project owners, this is a similar budget limiting mechanism, which is faced by project teams during implementation (PMI, 2017).

Also, a sport season has a predefined scope as projects, since sport seasons are paired with a team's goal achievement. Like any project, a sport season involves setting clear goals and objectives. Kingston & Wilson (2009) revealed that sport clubs share the aspect of having such objectives for their season – and their sub-blocks such as games or deliverables. Whether it is collecting wins, delivering a championship, or completing a project and delivering a service, defining specific goals and breaking them down motivate the individuals involved (Kingston & Hardy, 1997). As Durdubas, Martin & Koruc (2019) noted, these targets can range from winning a certain number of games to significant strategic milestones such as reaching the playoffs or championship games to personal development or injury rehabilitation of player (Croft, Paulson, Stokowski, Berri & Mondello, 2023; Knapik et al., 1991). However, the finite duration of the season means the team must effectively plan and execute their strategies to achieve these goals within the given timeframe. Time becomes a key factor in determining the team's success and adds pressure to deliver results. (Weinberg & Butt, 2014; Senécal, Loughead & Bloom, 2008).

Comprehensive planning is essential to achieve any of these goals, to outline strategies and tactics that dictate the steps necessary for success. These goals provide focus and direction, enabling teams to align their efforts with the desired outcomes and achieve better cohesion (Sarkar & Page, 2022). Careful preparation, planning, and strategic thinking are required to realize the outcome determined by owners and different stakeholders. Setting realistic, measurable, and achievable targets is quite challenging and not trivial (Healy, Tincknell-Smith & Ntoumanis, 2018). As Gillham & Weiler (2013) put it, different techniques are applied by practitioners to support reaching the goals of their temporary cooperation and goals of players as individuals to align efforts and make team performance optimal for their objectives (Ward & Carnes, 2002).

Project life cycle in sport seasons

The literature review aimed to highlight the similarities between the project life cycle and sport season schedules. According to PMI (2017), a project's life cycle has four stages: initiation, planning, execution, and closing. Each of these stages includes specific tasks and processes, but there are also two important responsibilities that must be managed throughout the entire life cycle: risk management and stakeholder management. Scheduling problems, milestones, and task management responsibilities for a sport season were deductible from 7 articles out of the 20 results in the SCOPUS search. From the extended search with life cycle-specific keywords, an additional 4 articles further supported the similarities between the two phenomena.

Before the sport season begins, teams initiate the team goals during the off-season (see e.g. Salvador, Suay, González-Bono & Serrano, 2003; Pires & Ugrinowitsch, 2021) and pre-season based on team values and start the preparation with planning, recruiting, and goal setting for the latter phases of the season with a similar manner to project initiation before a kickoff. As Font et al. (2021) implied, like any well-organized project (Görög, 2013; Pinto, 2020), a sport season requires careful scheduling,

and planning of tasks ahead of execution. They plan the way they will practice, and how individuals will perform specific activities. The game plans are formulated by coaches before the season, and these plans are reiterated during competition as well as an agile implementation (Gilbert & Trudel, 2001).

After the preliminary stages, sport teams start the season and compete game by game with scheduling in practices and other related activities to optimize performance. In parallel, project teams carry out tasks to progress with the project plan towards delivery.

During a season – as during projects (Görög, 2013) – teams carry out tasks in order to succeed. Each sport team has a specific number of fixtures (see e.g. Pires & Ugrinowitsch, 2021), typically spread out over several weeks or months, and in between teams' schedules other, additional activities (Pankow, McHugh, Mosewich & Holt,, 2021; Gilbert & Trudel, 2001). These tasks are scheduled and are repetitive building blocks of the season completion (Gilbert & Trudel, 2001; Pankow et al., 2021). Coaches formulate plans for practices and games, which suit the team's competencies and let them develop their performance (Reinboth & Duda, 2006), which is in parallel with project managers having plans to carry out tasks and processes in order to finish their project with success (Görög, 2013). Sport seasons require constant monitoring and evaluation to recognize progress (Torres-Ronda, Bealand, Whitehead, Sweeting & Clubb, 2022) and with the development of technology, even more opportunities are given to the managers (Li, Wang & Li, 2021). Coaches observe their players' performance, provide feedback, and make necessary adjustments to increase efficiency (Kinnerk et al., 2023), managers track milestones, analyze metrics, identify risks, and adopt corrective measures to ensure project success. Managers of teams bear other skills of leadership to make their players perform at their best and their teams succeed (Chu et al., 2021).

Managing the team and the stakeholders

As a result of this, there is a need for a review of how team and stakeholder management appear in sport seasons.

As projects being the strategic building blocks of business organizations (Görög, 2013; PMI, 2017), seasons are the fundamental way sport teams carry out their main activity – providing experience and generating revenue (Li et al.,2021; Ratten & Jones, 2020) –, therefore stakeholders can be connected not only to the organization but their activities as well. Both Görög (2013) and PMI (2017) highlighted that stakeholder management and team management are considered to be constant and play crucial role during all or almost all phases of the project life cycle – besides risk management.

Reviewing the articles for 'sport season' keyword the responsibility of managing a team and managers or coaches being leaders was deductible from 9 out of the 20 core articles. Augmenting the search for specific articles related to sport seasons and stakeholders provided 6 additional articles highlighting various stakeholders of sport clubs.

As a sport season is completed by players and staff, managing the team is a key element as it is of project completion as well (Hicks et al., 2023; Higham & Hinch, 2002). Similarly to projects (PMI, 2017), seasons are also complex endeavors where many things are factoring in the completion.

Professional sport teams consist of a diverse group of skilled players and a supporting staff each with unique strengths and responsibilities, assembled for competing and achieving team success. As the team competes through the season facing uncertainties such as injuries, physical, psychological, and other adversaries risking the achievement of goals of the year (see e.g. Pankow et al., 2021; Moore, Petrie & Slavin, 2022). These situations need careful consideration of team dynamics, ensuring the right combination of skills and capabilities to maximize performance, furthermore, resource allocation becomes crucial in these activities, as player assignment is the greatest cost, related to the season of professional teams.

Sport clubs compete in their field with their temporary teams assembled for the season, therefore professional clubs place a strong emphasis on teamwork and performance of theirs in order to compete at games and satisfy the needs of viewers, sponsors, and other stakeholders (Borland, 2006; Sullivan, 2004). In sports, athletes with different attributes and skill sets collaborate to achieve organizational and team objectives (Frick, Prinz & Winkelmann, 2003). The success of the group depends on how they utilize individual sets of skills and competencies, and how they cooperate as teammates, therefore the way they communicate, work together and ultimately, the way they are managed determines team performance (Frick & Simmons, 2008; Tian, Li, Li & Bodla, 2015).

Leadership plays a pivotal role in the case of managing projects and running professional sport clubs, and as sports managers and coaches – sometimes being the same individual – bear this responsible role to lead and inspire their team to perform on the court (Ferkins, Skinner & Swanson., 2018). Considering this, the leader of a sport team establishes leadership structures and styles in order to guide members of their organization. As Lee & Chelladurai (2017) mentioned, the character of being a leader of a sport organization involves a broad set of skills such as acquiring the required players and personnel (Hill & Sotiriadou, 2016; Lath, Koopmann, Faber, Baker & Schorer, 2021), making critical decisions such as changes in the structure of the team (Collins & Collins, 2020), also motivating team members, resolving conflicts (Wachsmuth, Jowett & Harwood, 2020) and modifying the plans if vitally needed.

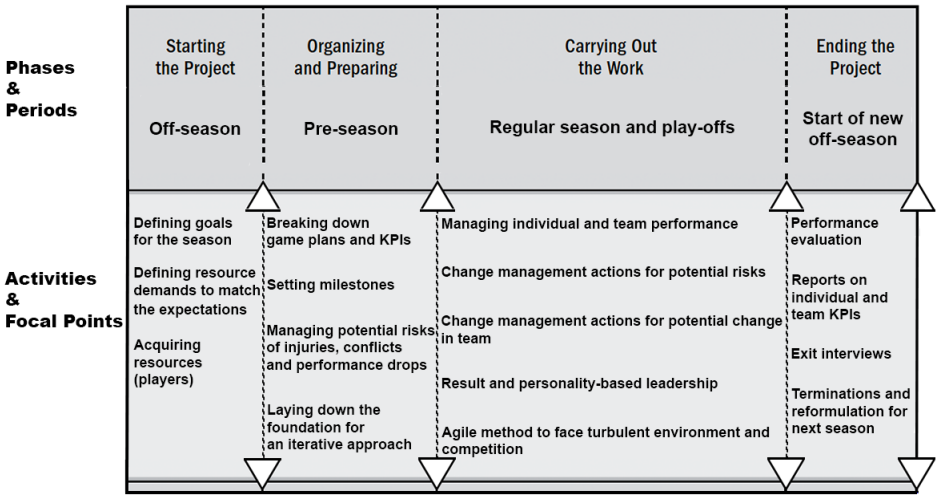
Sport teams end their collaboration by the end of the season with the evaluation of their achievements in a distinct way. Sport teams, if winning a championship or achieving team success in the predetermined way, bring collaborative success to their organization (Kreiner-Phillips & Orlick, 1993). After the competition, teams

are evaluated and terminated or reassembled for another season (Carron, Spink & Prapavessis, 1997).

For the successful completion of a sport season, team staff regularly monitor individual and team performance and also evaluate the metrics. Sport teams identify areas of improvement and assess the effectiveness of training and strategies, also analyze their performance to make adjustments, and implement changes swiftly (Font et al., 2021; Myer et al., 2015). Effective feedback and evaluation mechanisms become crucial for continuous improvement within the limited timeframe.

Figure 3

Focal points built on similarities between project and sport season life cycles



Source: own compilation based on PMI (2017, p. 548)

The Table 2 presents the characteristics of projects and sports seasons based on the reviewed literature focusing on the overlapping areas, as well as connects the characteristics with a common ground. Furthermore, it also includes how project management tools and techniques could be utilized for the management of sports seasons in case of similarities, in order to support successful performance.

Table 2

Implications based on similarities of constraints

Project Characterization	Sport Season Attributes	Project Management Implications
Time constraint	Predefined length	Task planning and scheduling methods Setting and monitoring milestones
Cost constraint	Salary caps	Loose cost control Cost register
Scope constraint	Club goals for the season	Goal definition Breaking down goals to tasks and KPIs

Source: own compilation

As there are numerous tasks to manage and complete throughout a sport season, applying task scheduling and planning methods could be transferred from project management to sport management, just like a milestone-setting approach, which would mark these events to different phases or episodes of the sport season. By applying these sport managers could improve the visibility and transparency of team progress regarding time and goals.

Cost is also a major constraint to manage. A wide range of different costs are involved in the operation of a sport club, however, sport managers mostly take care of personal finances, player salaries, and transfer fees. In varsity leagues or semi-professional sport leagues teams a loose cost control is a fitting option for project (sport season) management, but a more precise and accurate method for professional teams e.g. US major sport teams cost planning and visualizing methods such as a cost register or project-like budgeting need to be adopted. This not only provides the base for more advanced control mechanisms on cost level but also gives the opportunity for post-season planning.

Exercising a project management attitude in goal setting could serve the purpose of the team's success in the season. Visualizing and deploying KPIs to different sub-goals or deliverables of a season and breaking them down with a goal or work breakdown structure would help the player and staff understand, how goals can be achieved and what work should be executed in order to succeed.

Engaging in risk management of the season with a project management mindset and utilizing risk probability calculations and preventive methods could also have advantages for sport managers. A possible deployment might influence how practices of different members of the team roster should be executed, such as putting limitations on play time minutes or carrying out extra injury prevention activities such as conditioning.

In accordance with the aim of the paper, the congruencies between the project life cycle and the scheduling of sport seasons are also revealed based on the literature. The concept of project life cycle is based on the PMI's life cycle and the schedule of a season is based on the literature. At the same time, the potential focal point and management actions are also identified relying on the professional sources of project management (Figure 3).

Conclusions

There are numerous popular topics both in the literature of sport management and project management, however, their connection on club level is rarely researched. Based on this, the aim of this paper was to find congruency between these two areas. As the result of the narrative literature review, crucial overlaps between project and sport can be directly or indirectly identified among the attributes of sport seasons. The time constraints for completion, such as defined start and end of implementation, season fixtures being in parallel with project tasks or milestones, and also time planning and scheduling are common phenomena in the reviewed literature.

Not only time is predefined, but also goals of the season are determined, therefore just like in projects, the sport team and staff perform in order to achieve the required result, whether it is winning championships, developing players, or rehabilitating players. Leaders of the sport teams – coaches and managers – and of projects – project managers push their teams to give their best efforts and to help their teams carefully set up a plan or game plan. Besides planning, leadership is also the responsibility of the respectable leaders of teams.

During the execution of the team plans, cooperative and individual performance plays a great role in progress and overall success, and it can be monitored during seasons and also during projects to keep track of progress, look for an opportunity for development, or finish off tasks.

Not only timely manner, but also a cyclical order is realizable in sport seasons, which consist of initiation and preparation phases such as off-seasons and pre-seasons, phases for execution in regular seasons and postseasons, and just like projects for project-oriented organizations, sport seasons are the repetitive – and annual – building blocks of operation for sport teams. In between seasons, off-seasons exist, when teams and individuals evaluate past performance and based on their experience focus on preparation and planning.

Although some elements of project definition could not be identified among a seasons' attributes based on the reviewed literature, they share many key characteristics to build on. This provides an opportunity for future research to study additional similarities, for example, whether seasons have a cost constraint as projects have. Another option to continue this research is to study how sport organizations operate building on the assumption of this article that seasons can be identified as projects. Is it possible for sport clubs to adopt the processes of project-based or project-oriented organizations to increase their efficiencies? And if yes, then in what ways?

Based on the review and the similarities identified implications have been made, on how sport managers could use some project management techniques to handle the constraints and tasks during the course of a season. Such implications are that active risk management, performance, and schedule management could be useful for leaders of sport organizations.

There are some limitations of this research as the data for the literature review have been gathered only from the most cited articles of the keyphrases, and the articles touched on not only business focus but came from different fields such as Health Sciences, Sport Psychology or Medicine. Even so, the defining characteristics of sport seasons provided enough foundation to carry out this comparison.

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NÓRA FAZEKAS

UNDERSTANDING CRISIS PERCEPTION AND ORGANIZATIONAL LEARNING – A CASE STUDY OF SCHOOL ORGANIZATIONS IN THE COVID-19 PANDEMIC

A KRÍZISÉSZLELÉS ÉS A SZERVEZETI TANULÁS MEGÉRTÉSE – ESETTANULMÁNY ISKOLASZERVEZETEKRŐL A COVID-19 VILÁGJÁRVÁNY IDŐSZAKÁBAN

The research investigates the organizational dynamics of learning-in-crisis (LiC) in five Hungarian education institutions in the light of the COVID-19 pandemic with a focus on digital competence building, and the influence of organizational perception of contextual factors. The path of organisation-level learning that takes place as a result of the crisis event was analysed along two factors: the extent of perceived impact and the relevance of the rare event. Results of the qualitative, interview- and observation-based research show that learning willingness is different in the face of an identical external impact, influenced by organizational and financial capacity, as well as autonomy and stakeholder maturity for change. The depth of learning is related to the strategic and cultural fit with the sought-after competence, as well as field of knowledge and the presence of parallel crises.

Keywords: **crisis, organizational learning, COVID-19, education, learning in crisis, school**

A kutatás a COVID-19 járvány kontextusában öt magyar oktatási intézményben vizsgálja a szervezeti krízishelyzet során való tanulás (Learning-in-Crisis – LiC) dinamikáját a digitális kompetenciafejlesztéssel összefüggésben, valamint a kontextuális tényezők szervezeti észlelésének függvényében. Az átélt krízis hatására bekövetkező szervezeti szintű tanulás útját két tényező mentén elemzi a szerző: a hatás észlelt mértéke és észlelt relevanciája. A kvalitatív, interjú- és megfigyelésalapú kutatás eredményei azt mutatják, hogy a tanulási hajlandóság különbözik azonos külső hatások esetén, amit befolyásolnak a szervezeti és pénzügyi kapacitások, valamint az autonómia és a stakeholderek érettsége a változásra. A tanulás mélysége összefügg a szükséges kompetenciának a szervezeti stratégiával és kultúrával való összeegyeztethetőségével, valamint a szakterületi tudással és a párhuzamos válságok jelenlétével.

Kulcsszavak: **krízis, szervezeti tanulás, COVID-19, oktatás, krízistanulás, iskola**

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The education system worldwide was severely impacted by the coronavirus. With concerns about health and safety rising, schools and teachers had little time to implement remote-controlled home learning. They self-reported being unprepared for this challenge. Teachers quickly adapted to new digital tools, learning from each other online and within school communities. Meanwhile, school leaders coordinated staff preparation to meet the needs of students, families, and society. This external shock triggered an ongoing learning process in digital competence, leading to a complete reorganization of the education system and individual schools.

In this research, the author investigates how a specific competence, digital competence is developed within the crisis. The research follows five cases of Hungarian school organizations and observes the pandemic-crisis-induced organizational learning in the field of digital competence, caused by the necessity of remote-controlled home learn-

ing, which was mostly managed with online tools. The author aims to answer the following research question*: What factors influence the learning paths of the observed organizations within the crisis, and how?*

In this paper, to address the form of teaching and learning during the pandemic, the expression "*online education*" is used, knowing that it does not cover the realities of the phenomenon fully. The forms of remote-controlled home learning have been diverse, often applying offline solutions to bridge digital gaps in society. However, it cannot be labelled as distance education either, as *distance education* is a different professional term (Gunawardena & McIsaac, 2013). As this paper investigates the development of digital competence in the pandemic crisis, to put the focus on the online and digitally supported nature of education, the above term has been chosen.

Digital competence can be broadly defined as the confident, critical, and creative use of ICT to achieve goals related to work, employability, learning, leisure, inclusion, and/or participation in society, while a "digitally competent educational organization" refers to a school in which digital technology is used effectively by the staff to provide a compelling student experience and to realize a good return on investment in digital technology (Kampylis et al., 2015). Consequently, the paper understands organisation-level digital competence as the competence to leverage on individual and organisational digital features to support core and supportive processes within the organisation.

In the second section, the prominent crisis-learning literature is introduced, followed by recent empirical research results in education and the context of the research. In the third section, crisis understanding is displayed together with how the following learning can be interpreted along the identified factors. In section four results are summarised and finally the learnings are concluded in section five.

Theoretical background

Crisis learning

Crisis-like events are labelled differently across academia, such as *crises* (Rerup, 2009), *rare events* (Starbuck, 2009), and *disasters* (Birkland, 2009; Birkmann et al., 2010). In this study, the term crisis is defined as the state of an organization when the current situation challenges the organization's basic assumptions and goals, threatens its operation, and even survival. Crisis brings time pressure without any tried and tested coping mechanisms available in a very ambiguous environment (Antonacopoulou & Sheaffer, 2014).

Learning in chaotic contexts changes the nature of organisational learning (Hámori, 2012). Analysing crisis literature through the lens of organizational learning, the most characteristic related terms are *learning from crisis* (Elliott, 2009; Elliott & Macpherson, 2010; Smith & Elliott, 2007), *crisis learning* (Broekema et al., 2019; Lee et al., 2020), *learning in crisis* (Antonacopoulou & Sheaffer, 2014), *learning through or from rare or unusual events* (Beck & Plowman, 2009; Lampel et al., 2009), and *crisis-induced learning* (Deverell, 2009) and even *intercrisis and intracrisis learning* (Moynihan, 2009).

We can differentiate between a modernist and a postmodernist stream of thought. When we look at learning from crisis from a modernist view, we can talk about learning as crisis-induced learning ("lesson-drawing processes" triggered by the crisis) (Deverell, 2009, p. 180), or can be categorized as intercrisis ("learning from one crisis to prepare for another") or intracrisis ("learning that seeks to improve response during a single crisis episode") learning (Moynihan, 2009, p. 189). This approach perceives crisis as an external impact affecting the organizational equilibrium. From a postmodernist view, Antonacopoulou and Sheaffer (2014) defy the separating approach and promote a dynamic view of learning. This view describes *learning within the crisis*. This approach embraces crisis and sees it as a natural event of continuous change. Thus, learning *from* a crisis or a failure is not as clear-cut as assumed. Authors even suggest that "understanding the dynamics of learning and crisis may reveal *why* critical incidents may be perceived as crises in the first place" (p. 6).

Both learnings blocking and fostering aspects of crisis have been observed in empirical studies (Deverell, 2009). According to Christianson and colleagues (2009), rare events trigger learning in three ways: 1) rare events act as audits of existing response repertoires, 2) disrupt and foster the reorganization of routines, and 3) redirect organizational identity. Similarly, it is suggested that crisis experience is helpful in new crisis encounters (Moynihan, 2008) by improving understanding of latent, previously hidden flaws (Robin et al., 2019); consequently, it "broadens the scope of action and builds confidence in experimenting with new ways of thinking, acting, and learning" (Antonacopoulou & Sheaffer, 2014, p. 16). The crisis also creates a *learning space* that cultivates networks and trans-sectorial partnerships (Robin et al., 2019) and the involvement of external experts (Broekema et al., 2018), enabling the procurement of significant outside-organization knowledge and the creation of knowledge synergies.

According to Moynihan (2008), several factors hinder or block learning: the high consequentiality of crises makes trial and error learning prohibitive, there is a lack of relevant experience or existing tools, the organization misses to meet the needed scope of learning, faulty lessons are drawn, the narrowed focus limits information processing, actors recycle old solutions to new problems. There might be a lack of inter-organizational contribution to organizational learning, furthermore, political dynamics, defensive postures, denial of the problem or responsibility and opportunism can also block organizational learning in crises (Moynihan, 2008).

Besides learning and not learning in crisis, we can also talk about *unlearning* in a crisis, as first, prior routines have to be unlearned to give way for practices adequate in the crisis (Starbuck, 2017). Then, however, a great part of these new practices, knowledge, network relationships, etc., get unlearned as well once the crisis is over (Robin et

al., 2019), and the previously cultivated attributes of creativity, openness, and ability to change lose significance in the eyes of organisations (Pogácsás & Szepesi, 2023).

According to the model of Lampel and colleagues (2009) in Figure 1, learning that takes in an organization as a result of the crisis is fundamentally influenced by two factors: the extent of the perceived impact and the perceived potential relevance of the phenomenon. Perception of the possible impact determines the willingness to learn, while the perceived relevance of the crisis decides the type or depth of the learning that happens. *Transformative* learning, which we can view as double-loop learning, can occur when both levels are high.

Figure 1

Types of Learning in Crisis

POTENTIAL IMPACT		
POTENTIAL RELEVANCE	**High**	**Low**
High	Transformative	Reinterpretative
Low	Focusing	Transitory

Source: Lampel et al. (2009, p. 839)

Based on the above literature, we can conclude that even though macro-level crises have common characteristics that can be generalized throughout the demography it affects, based on local characteristics, the effects themselves or the magnitude of the effects can be different, as well as the learning that entails. In this paper the author focuses on local, organizational learning mechanisms during the general humanitarian crisis of the COVID-19 pandemic, analysing specifically the digital technological learning of school organizations.

To frame our research accordingly the observed crisis impact is defined in the following way: *The crisis is an outcome of the COVID-19 pandemic, causing schools to operate an online-technology-based education system and additional social and sanitarian services, for which they did not have sufficient level of competence*. The definition reflects Antonacopoulou and Sheaffer's (2014) approach, considering the crisis as a natural event resulting from competence gaps in organizations. This understanding suggests that the competence gap existed before the crisis but was revealed by the urgent need for a higher level of digital competence; this statement was reinforced throughout the research interviews. Thus, Lampel and colleagues' model, which focuses on perception, is suitable. While acknowledging the severe health-related crisis effects on individuals, this article adopts an organizational perspective, viewing the pandemic as the context rather than the crisis itself.

Empirical results from schools in the COVID-19 pandemic

Several studies have been conducted recently in the education sector to assess the learnings of the online education period (Scopus search terms: ("digital*" OR "technolog*" AND "learning") AND ("covid*" AND "school")). Main themes of these research projects focus on leadership capacity and practices (eg. Beckmann & Klein, 2022; Lien et al., 2022; Weiner et al., 2021), organizational learning practices (eg. Kopp & Pesti, 2022; Zaalouk et al., 2021), policy effects (eg. Zancajo et al., 2022), success factors and effects of transition (eg. Delcker & Ifenthaler, 2021) in connection with the crisis.

The meaning of crisis for schools was understood similarly in the empirical results of the above papers. The health danger our society was exposed to, left students isolated from education, connected social functions and services, and put immense pressure, often both physically and mentally, on schoolteachers and the school management. School organizations had to find solutions to mitigate the possible damages. According to the reviewed literature these solutions are mostly explained by leadership, organizational learning in the context of transitioning to online education, and technological factors in the reviewed literature.

It has been shown that success in handling the crisis depended on the ability of school leaders to apply a flexible leadership style, address issues directly, provide clear instructions and expectations, and leverage their autonomy to fittingly adapt governmental instructions for their local situations (Lien et al., 2022; McLeod & Dulsky, 2021) while leveraging on distributed forms of leadership (Beauchamp et al., 2021) at the same time. These leadership characteristics not only afforded schools to switch quicker to online teaching (Delcker & Ifenthaler, 2021) but helped to conquer uncertainty and anxiety better as well (Lien et al., 2022). Schools with high leadership capacity could even maintain promoting academic learning during the pandemic (Beckmann & Klein, 2022).

Experts argue that pre-crisis learning and knowledge-sharing practices (Kopp & Pesti, 2022) next to sufficient technology (Navaridas-Nalda et al., 2020) have been key to showing resilience in the current crisis (Delcker & Ifenthaler, 2021). Weiner and colleagues (2021) highlight organizational features in the pandemic, such as culture, autonomy, infrastructure for collaboration, and organizational learning as significant influencers of psychological safety in the organization. Internal and external organizational trust as well as building on and working together with stakeholders was shown to have an important supporting effect on successful crisis management (Ahlström et al., 2020; Lien et al., 2022).

Delcker and Ifenthaler (2021) also emphasize that the involvement of external ICT professionals would be necessary for building the digital resilience of schools, as the inner stakeholders don't have the know-how and/or the capacity to develop and maintain ICT systems. Navaridas-Nalda and colleagues (2020) showed that school principals' digital competence, which increases their perceived usefulness of technology, significantly influences the integration of technological solutions.

The long-term organizational effects of learning due to the crisis are still in question. Kopp and Pesti (2022) note that even though initially there seemed to be a tendency

or wish to formalise and institutionalise newly introduced processes, schools were keen on preserving their organisational traditions too. Therefore, even if there was an opportunity to reimagine organizational and pedagogical practices as a result of the crisis event, development steps and macro-level innovations are uncertain, furthermore, other preventive learning practices typically stopped during the pandemic period. Pató and colleagues report a reactive approach resulting in operational decisions in a wider economic context too (Pató Gáborné Szűcs et al., 2021).

The Hungarian context for schools' online learning in the pandemic

Hungary can be viewed as a highly centralized, conservative education system with relatively low local autonomy of schools (Radó, 2022). The public school system is maintained by the 60 school districts supported by a central organization, the Klebelsberg Centre (KC) and by the Educational Authority (EA), responsible for professional assistance and governance. Although historically centralized, after 1990 Hungarian schools became highly decentralized, and maintained by local municipalities, until 2011, the foundation of KC (Radó, 2019).

Major ICT development projects in Hungarian schools have been carried out for the past ca. 20 years. Between 2016 and 2020 the country had a legitimate digital strategy, the Digital Education Strategy of Hungary (Magyarország Digitális Oktatási Stratégiája, 2016), later, another proposal document, DigiNOIR (Halász et al., 2019) got prepared and was taken as a base for policies. In the lifespan of the above-mentioned strategy, several steps were taken: the National Public Education Portal (nkp.hu), a portal for digital textbooks and learning tools created between 2016-2022, laptops distributed for professional use, accompanied by training, installation of faster internet, the introduction of the digital education management systems eChalk (eKRÉTA) in the 2018/2019 school year, the Public Education Information System (KIR), the Secondary School Enrolment Information System (KIFIR), among others.

Regarding digital competence, in Hungary ca. 20% of the teachers assess themselves as beginners, 40% as independent users, and 40% as advanced users of technology in education (I. Fekete, 2022). In all these segments teachers are reported to be generally motivated in preparing for online lessons, however, they don't fully believe in their effectiveness, and they feel students are not motivated by them.

According to Monostori's research (2021) on the pandemic's impact, teachers gained more classroom freedom, leading to various school-level solutions. These solutions included unified digital systems, improved teacher digital literacy, and regulations for online lessons, fostering teacher collaboration and innovation. These changes also benefited students and parents, making educational frameworks more organized. However, differences between schools persisted and, in some cases, grew wider. Schools experienced with digital technologies and innovative pedagogy recognized the advantages of their previous efforts in skill development and creativity.

Methodology

For the purposes of the research the qualitative approach has been chosen, as it allows one "to make sense of or interpret phenomena in terms of the meanings people bring to them" (Denzin & Lincoln, 2011, p. 3). The research explores meaning-making through the cases of five schools as a part of the learning organization research and development project (2015, 2020) of KÖVI (Hungarian-Netherlands School of Educational Management) in the South Great Plain region of Hungary, and as the of the doctoral research of the author.

The schools were selected *intensity-based* with *stratified purposeful* sampling (Huberman & Miles, 1994). The

Table 1

Summary of the participating schools

Name	S1	S2	S3	S4	S5
Owner*[4]	Ministry of Human Resources	Ministry of Human Resources	Ministry of Human Resources	Organization of a Christian church	Ministry of Innovation and Technology
Level*[1]	primary and lower secondary	primary and lower secondary	primary and lower secondary	(early childhood), primary, lower, and upper secondary	upper secondary, (adult)
Type	general	general	general	general	vocational
No. of students*[2]	643	271	402	852	n.d. ~1200-1300*[3]
Location	county capital	small town in the agglomeration of a county capital	midsize town	county capital	county capital

**1 Educational levels in brackets were not involved in the research*

**2 Student number includes only the educational levels that were involved in the research based on 2022 data from https://dari.oktatas.hu/kirpub/index*

**3 Estimate based on 2019 data from https://dari.oktatas.hu/kirpub/index*

**4 Names of the responsible ministries as of the time of the research, 2021-2022*

Source: own compilation

intensity criteria demanded schools be able to show some examples of involvement in organizational digitalization initiatives in the past two years. For the *stratifying* criteria, the varying attribute "school owner" was chosen. As a result, state schools providing general and vocational education, as well as church-owned schools are also part of the sample, as domestic debate suggests that these schools have different opportunities regarding funding and autonomy (Jordán, 2019; Péteri & Szilágyi, 2022). The participation was invitation-based. As the project demanded serious engagement from the schools, the most significant criterion for selection and invitation was their readiness to cooperate in the different stages of the research project. In the first round 5 schools got invited; as all of them agreed to participate, a second round of invitations was not issued. A summary of the main characteristics of the schools can be found in Table 1.

In the initial research phase document analysis was conducted, collecting school documents, and reviewing past digital-competence-related reports where it was available. These didn't directly contribute data to the research, instead, they informed data collection.

Data collection was carried out in individual and focus group interviews extended with on-site observation of classes, and if possible, meetings, and workshops. The sampling of interview participants happened purposively, inviting three different groups: school leaders, administrative staff members, and teachers. Individual interviews in the research served the understanding of school management perspectives; these involved school principals and vice-principals extended by administrative staff representatives. Teachers participated in the focus group interviews to provide space for discussion and debate. Teachers were selected by school principals along the following pre-determined attributes: (1) diverse levels of digital competence (based on the principals' professional judgement), different (2) hierarchic positions, (3) age, (4) duration of school affiliation, and (5) subject backgrounds to avoid biased or wishful images about the organizations. The prepared field notes include a description of the setting, participants, interviews, class and meeting observations, and critical reflection, and were used as supporting research material for triangulation.

The main interview topics were 1) the characteristics of the school's organizational learning, 2) technology usage, and 3) experiences and learnings of the online education period of the pandemic. Altogether 24 interviews were carried out between 11th June and 31st August 2021, 14 individual, 2 in-pair, and 8 focus group interviews. In-pair interviews were designed as individual, but in two cases school leaders insisted on taking the interview together for efficiency purposes. The longest interview took 2 hours and 5 minutes, and the shortest was 46 minutes. 23 interviews have been recorded, transcribed, and coded in the NVivo software. One group interview, where the participants rejected the recording, was taken notes of and then similarly transcribed and coded in NVivo. In the text the interview codes can be understood as follows: the first part of the code refers to the school (S1, S2,…), the second part to the interview subject (L=leadership, T=teacher group, A=administrative staff), and the third part provides further specifications (A=administrative staff, P=principal, VP=vice principal, GNo=number of the group within the school). Summary of the interviews can be found in Appendix I. (online).

The first round of coding was theory-driven, based on Lampel and colleagues' model, and applied the codes (1) potential impact and (2) potential relevance. Items coded under the two main codes were (1) perceptions about the possibility and the capacity for future change based on experiences of the online education period and (2) perceptions, of whether the experiences fall into the organizational "attention". After a sample coding of all interviews of one research case, the theory-driven codes were accepted. Sub-codes were assigned using the pattern coding method (Saldaña, 2013). All data collection and analysis tasks were completed by the author of the paper.

The research's validity was ensured through triangulation (Denzin, 2012), involving multiple viewpoints (leadership, teachers, administrative staff), multiple cases (five in total), and various methodologies (individual and group interviews, observation). Peer-cross-validation was applied too in different stages of the research project. Reliability is supported by the detailed methodology explanation and project documentation. However, due to the very nature of qualitative research, full and objective generalizability and universality cannot be fully enforced (Gaudet & Robert, 2018). Ethical considerations were addressed, ensuring anonymity through assigned codes for school organizations and participants. Informed consent was obtained from respondents before interviews, following the study's purpose and data collection and analysis procedures (Kvale, 2007). Digital data was stored on personal drive. The research project followed the British Educational Research Association [BERA] Ethical Guidelines (2018) and was approved by the doctoral school of the author.

Results

Crisis learning paths

Our interpretation of the chosen model looks at schools and their learning paths during the COVID-19 pandemic. For instance, the day-to-day operation of a school can be seen completely transformed by the need to provide education online that might have a long-lasting impact (perceived impact), but the learning can be strengthened by recognizing the lack of digital competence and knowledge about digital tools supporting school operation as a development point independently from the crisis as well (perceived relevance). We could assume a high level of both factors; however, we may find that it is not evident.

Based on the interview data factors of the main axels of the model were identified that explain the willingness and the depth of learning in the crisis. Table 2 includes the influencing factors, that emerged from the coding process referred to in the method section. Definitions were worded by the author based on the whole methodological scope of the research.

Table 2

The analytical framework for learning path analysis

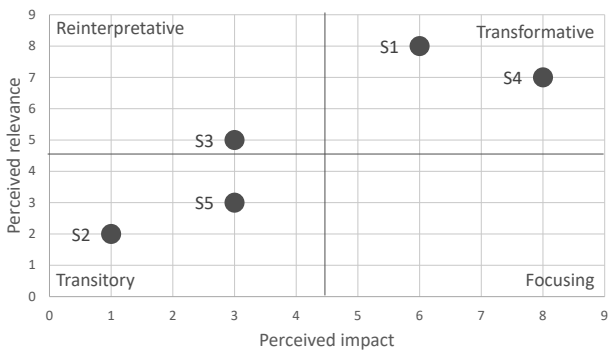
	Factors	Definition
Potential impact (willingness to learn)	Organizational capacity for change	The school has the necessary capacity (including HR and learning practices) to implement change.
	Financial capability for change	The school has the resources to financially support the necessary changes, including infrastructure.
	Autonomy for change	The school has the autonomy to make strategic decisions about issues connected to digitalization.
	Stakeholder maturity for change	Stakeholders, mostly students and parents, are capable and willing to handle tools and services that are outputs of the digital innovations in the school.
Potential relevance (type/depth of learning)	Strategy match	The organizational strategy includes digital innovation as a key element.
	Cultural match	The school's organizational and pedagogical culture and values are supported by digitalization.
	Field knowledge	The school has the professional knowledge to understand and leverage the opportunities provided by digitalization.
	Parallel crisis	The school has no parallelly ongoing crisis affecting its foundational operations.

Source: own compilation

These factors enabled the allocation of points to organizations, establishing scores along both axes and positioning schools within a matrix for comparative analysis (Figure 2). Points were assigned based on the interview data by the author on a 0 to 2 scale, where 0 indicated the absence of a characteristic, 1 denoted partial presence, and 2 represented full presence, based on research participants' statements (in the case of "parallel crisis", 0 referred to a severe parallel crisis, and 2 indicated no parallel crisis) (for scoring see Appendix II. online). While some statements were grounded in objective facts, they inherently represented the local understandings and perceptions of the participants. In the following discussion, it is explored, how these diverse factors influenced individual schools' learning and its implications for crisis management.

Figure 2

Different learning paths of the participating schools



Source: own edit based on Lampel et al. (2009, p. 839)

Perceived potential impact

Here factors are assessed that would influence the belief in schools, that the pandemic can truly bring a change, a lasting impact in the organization. This perspective was chosen, as viewing short-term impacts would less likely allow us to differentiate beyond transitory learning.

Organizational capacity for change

Here learning and HR capacity are in focus. We can observe that the learning capacity of the organization, and the learning practices, that the school had in place, not specifically from previous crisis experiences, but in general, were very decisive in how effectively schools could adapt to challenges.

S1 and S4 had organizational-level learning practices in place and were conscious of the learnings of the online education period that can bring in the regular practices of education and organizational operation. These organizations realized the positive outcomes they could leverage, and they managed to locate areas of shortcomings in online education they will have to address later. Proof of this in S1 is a report of the pandemic period's experiences that a team of the school prepared and was presented in the school and shared among other schools in the school district. S4 created a new segment in the official house rules specified for online education. In other schools either there were no effective systems in place (S2), or for different reasons, the system was fragmented (S3, S5) which led to weaker visions of change.

> *The situation at our school is very fortunate, as the internal transfer of knowledge works in an extremely advanced way. […] If we take this [online education] as a new thing that got introduced, a new thing that had to be organized: This was actually not very unlike us because we have already led and organized countless innovations. (S1-L-VP)*

The availability of the necessary human resources influences the perception of impact as well. In the case of S2, the perceived impact is minimal, as the school, especially on the lower secondary level, is quite overwhelmed because of HR shortages, as is the vice principal, responsible for this field. The cases also show that it is important to have a specialized person (e.g. S4) or team (e.g. S1, S5), who are empowered to support the changes in the long run; without this structural change, a lasting impact is not possible.

Financial and infrastructural capability for change

In all government-maintained institutions (all but S4), the impact is expected to be small, as the budget for digital investments and especially for maintenance is extremely low in comparison to the needs of the schools. A common example in state-run general education schools (S1, S2, S3) is the issue of changing the expired bulbs in the beamers, which are viewed as basic teaching equipment, but schools have to wait to get them fixed, sometimes up to 2 years. In S5 the main topic of lacking infrastructure was the missing Wi-Fi availability for all school citizens, that got resolved just before the interviews. In S2 especially, school infrastructure is heavily criticized by the staff who do not feel that they have the necessary system or local support to improve digital competence at the school. S1 and S5 were somewhat more optimistic, seemingly as a result of higher-level district management support, but also as a result of higher organizational capacities that could compensate for some of the financial disadvantages.

> *But like this, it doesn't really make much sense... Even though we learn something in a course or training, it sounds very good, and it's not that people aren't open to it or something like that, but it's simply not feasible. When you really struggle with the fact that the projector doesn't work, the children can't see it, the computer doesn't even load, and the program doesn't run. (S2-T-G2)*

Autonomy for change

In S2 regulations of the ministry and the school district are taken very seriously by the school management. They find it risky to experiment and innovate within the boundaries of the pandemic, and digital competence building is held back. A teacher has even received a written warning from the school principal for using unsanctioned digital tools as online education started, as they threatened to overwhelm students. Moreover, the school has been "sitting" on tablets without ever using them, because they were forbidden to, due to a missing central training event that fell out in the lockdown. Accordingly, any progressive action in this field seemed fake to some of the teachers in this school.

> *[…] we were given tablets and the tablets have been here for four years and we can't use them. Because they did not provide it with the necessary program. Here, the system administrator could do it, [one of the teachers] could do it, but it is not allowed. So, as I see it, somehow these things that we want to improve, and what KC gives us, somehow, should be brought closer together […]. (S2-T-G2)*

S5 and S4 point to the political, structural, and social issues that will spoil the opportunities of digitalization, namely governmental misuse of educational channels. Some teachers were rather sceptical about where digitalization can take schools and envision the replacement of onsite teachers, to solve teacher shortages, but they also fear surveillance and growing exploitation through digital spaces.

S1 and S3 experienced an average level of autonomy within their jurisdiction and power. Even though both schools have been subject to forced school mergers, the professional staff within the school is strong and empowered by the local leadership.

Stakeholder maturity for change

In S3 and S5 especially, students' social background has a very serious influence on the perception of possible change. During the pandemic class teachers had more frequent contact with parents and they had to experience their lack of capability or willingness to handle digital tools. Although students had been thought to be digitally more mature nowadays, it turned out that their knowledge and attitude towards these tools vary a lot too. Moreover, teachers were struggling to find pedagogically right solutions to work with primary school students and vocational students especially. The experiences, therefore, showed that for change to happen, they have a lot of educational tasks with students, parents, and other stakeholders, even before they get to use modern technology in education, making a quick change unattainable.

> *So far, I actually feel that this digital education, distance education, can be implemented quite difficult from the student's point of view, as long as they live in this structure, where usually there are networks, and service providers, that provide internet like in a fairy tale: "once upon a time there was internet". And the other thing is the devices for the students [lack of] ... […] A simple logging-in caused a problem, how they can enter eChalk. Username, password. So even something like this causes an issue. (S5-T-G2)*

On the perceived potential impact axis, we can observe that in a crisis organizational learning routines and available resources (HR and financial) are key for engaging in transformative learning. Organizational autonomy and stakeholder maturity can enhance the learning progress to improve digital competence, however, these factors in themselves do not guarantee change, and the lack of these factors might block learning. In a crisis, these factors are usually moderately modifiable under time pressure but can be targeted to be adapted to the situation to remove blocks from learning's way, for example by forming ICT support teams, handing out devices, educating students and parents and delegating decision rights to lower hierarchical levels (e.g., from principal to ICT responsible level).

Perceived potential relevance

Here factors are assessed that would influence the understanding of the relation between the competence gap revealed by the crisis and the organization's identity.

Strategy match

In the interviews, we can see that it is decisive in the approach to learning whether the school had a digitalization strategy in place. For example, S1 and S4 perceived the high

relevance of online education as both schools supported digital development. S1, as a talent-nurturing institution with a focus on natural sciences, saw its duty to keep up with the changes this new situation could bring. S4 was planning to start a class with a specialization on IT skill development and digitalized pedagogical methods; they even have a vice principal dedicated to this strategic action. These specific goals focused their attention on a deeper learning process.

> *Actually, we were also thinking about a "digital class". […] It's [digital competence] not something you won't use later in life. We believe that this could be provided, and smart usage of digital tools could be made a part of the learning process even in non-pandemic times. We still have to learn a lot and invest a lot in this, although I think we have come closer to this with the pandemic period by light years. (S4-L-P&VP)*

In S2, there were no clear strategic goals. Thus, it was hard to connect the opportunity of the crisis to any development paths. The school's philosophy also disfavours certain digital solutions, arguing that they would exclude students and families and that they must provide education equally to all. The school principal encourages steps in this direction (e.g., digital planning workshop, knowledge sharing workshop), but teachers don't believe in the sincerity of these measures. S5's school strategy focuses more on supporting students who struggle at school and on providing them with international opportunities through Erasmus+ programs. Digitalization is seen as important but is not put in focus at the time of the research. It seems, that schools learned not to pursue local strategic goals that are not financially supported on the system level.

S3 has an IT focus in its pedagogical portfolio, and as such, there is a very active and highly skilled team innovating in this field. However, the pandemic and the forced digital tool usage made them realize, that they might be much less prepared on the organizational level than they thought and that there is a gap between the level of perceived and real digital competence.

Cultural match

Crisis learnings related to digitalization closer to the organizational culture were shown to be easier to adopt. In S3 IT education has a long-lasting history, it is part of the school's identity. The leadership of the school, therefore, feels that they must adapt not only on the pedagogical but also on the organizational level.

S4's case is quite special, as this is the most well-equipped and most digitally competent school among the participating institutions, with the strategic plan to start a digital specialization. However, as a religious school, its pedagogical philosophy, emphasizing spiritual, emotional, and social education, is very strong, and digitalization comes forth as an enemy of this ethos in the interviews. The motivation for greater learning in digital solutions arises from a professional standpoint, seeing them as useful tools for their objectives.

> *[…] our institution considers upbringing to be very important in addition to education. And this upbringing is damaged. We can... we can also educate them in an online system that "this is how it is appropriate", "this is how you act", "this is how you speak", "this is how you dress", I don't know, but somehow, this was damaged. This is part of our education. And that's important to us. We can't let that get damaged. Because that's what makes us [the school's name], that's what makes us special. (S4-T-G)*

S5 demonstrates a strong leadership body and an innovative school culture, recognizing the potential of technology to empower students in their learning. They have utilized various ICT solutions for organizational purposes for a longer duration compared to most schools. However, students themselves are studying manual professions there, and digitalization seems to crawl slower into the school's pedagogical life. In contrast, S1 embraces digitalization as it aligns with its vision of innovation and progressiveness, with a commitment to remaining relevant and excellent as an institution. On the other hand, S2 lacks a clearly defined cultural focus that could facilitate or hinder the adaptation process. The school's leadership culture tends to be more autocratic, with decision-making primarily vested in the principal. As the principal is not actively engaged with technology, the school culture leans towards being reactive as well.

Field knowledge

What we can see in the case of S2 is that perceived relevance was lower also due to the lack of knowledge about their possibilities, the missing digital competence in the teacher community and especially in the management team, which has difficulties setting directions. In the digital planning workshop organized for the teachers, challenges were noted in establishing digitalisation goals. The difficulty stemmed from the lack of a clear understanding of potential objectives. Furthermore, these actions were pointed mostly outside of the organization.

> *But based on the model of this [other innovation], even in this area, in the digital area [we have to be] accountable, yes. Me too, because I am mostly digitally illiterate. We have to formulate it [the strategy], and then there shall be no parrying. (S2-L-P)*

> *They forced it [eChalk] on many schools where the management was not, wasn't… [thinks as if (s) he wanted to phrase it carefully]… "up-to-date", or its digital competence was not that advanced, you could put the eChalk on them, and then they forced those members of the teaching staff who could otherwise have been able to teach effectively with more modern tools. So, it was a setback for me, a very big setback, and such a pointless fight. So how... So, it was quite unpleasant to receive a written warning because I tried to use modern tools. (S2-T-G2)*

The principals of the schools did not possess comprehensive field knowledge themselves. Therefore, leveraging the knowledge of colleagues becomes crucial for decision-making. In S4, a vice principal specializing in digital development takes responsibility for the entire institution in this domain. S3 benefits from a highly dedicated group of teachers, forming an informal collective that includes the principal, enthusiastic about exploring digital pedagogical possibilities and organizational solutions. S1 benefits from three IT teachers who are eager to improve themselves and coordinate learning within the organization, backed by the support of the principal. In S5, some digital knowledge exists at the management level but lacks systematization within the organization in everyday practice. S2 appointed relevant colleagues to coordinate efforts in the school in this field. Although S1 and S4 achieved the most efficient outcomes, it is noteworthy that the appropriate solution may vary across organizations. Notably, there was no explicit involvement of external experts, which could have been a viable method for building competence.

Parallel crisis

Parallel crises can impede organizational learning, leading to shallower learning from the less relevantly perceived one. In the cases of S3 and S5, the level of perceived relevance was significantly lower due to concurrent challenges. S3 faces a transformation from a previously high-performing institution to a more segregated and low-performing school, necessitating a complete cultural change that emotionally impacts the teacher community, causing grief-like symptoms within the organization, and deflecting attention from crisis learning. Notably, in S3, one teacher group objected to a voice recording of the interview due to their intense emotions of fury and critique, indicating the gravity of the situation.

> *Our school is going through a crazy period of trouble right now. […] Yes, it is constantly changing, circumstances change, external conditions change, and perhaps this is the worst. Everyone has to learn to adapt to these external conditions, which is not an easy task. We were a school 10 years ago that could be said to have been the elite school of the city. […] The point is that now we are practically a – and this must be accepted - a comprehensive school. And of course, we are holding on, and I think there are a lot of good innovative ideas within the school, but we have to understand that it is no longer just about reaching the sky with everyone […]. (S3-T-G2)*

In S5, students come from disadvantaged social backgrounds, leading to a persistent risk of large-scale dropout even in regular periods. During the transition to online education, the primary objective was to retain students in the system, despite their limited access to adequate tools and internet connectivity, even though the teachers were prepared for more advanced digital tasks. Additionally, the school confronts continuous, extensive policy changes, while the emergence of new religious vocational schools with competing programs creates concerns among vocational educators regarding job security.

> *Because the children are functionally illiterate, 90 per cent of them, with some honourable exceptions. And even high school graduates [who complete final exams next to their vocational exams]. And they struggle with social and other identity disorders, literally. Lacking love, with all kinds of "isms" and other [personal] stories. We are trying to bring them back to life and try to help them somehow to learn, how to learn. But in truth, we don't have the time, the energy, the number of hours, the opportunity, or any other conditions. (S5-T-G2)*

We can also observe, that in those cases where there were some parallel crisis effects, it was more difficult even to keep the interview participants on the interview topics because they kept slipping back into discussing the more painful topics and into ventilating.

In short, both schools were struggling with parallel crises that made the digital development aspect of the pandemic appear transitory in comparison. In S2 conflicts between teachers and the principal stirred some emotions and deflected focus from learning at least for a part of the teachers. The other schools struggle with hardships too naturally, however, they were less engaged in them parallelly.

The perceived potential impact axis revealed that during a crisis, the organization's inherent strategic and cultural characteristics play a pivotal role in shaping its learning actions. Organizations lacking alignment between strategy and culture perceived the crisis as a threat that necessitates adaptation. Conversely, those in line with strategy and culture viewed the crisis as an opportunity for inspiration and change. The depth of learning is contingent upon field knowledge; organizations without experts can empower employees to become in-house experts or seek external expertise. Further research on expert involvement, prerequisites of openness, and success factors is advisable based on these cases. Parallel crises can impede learning opportunities, even when the learning is relevantly perceived in the crisis. This emerged as the most restrictive factor of transformative learning in the observed cases.

Discussion

Within the cases diverse crisis perceptions can be observed, which lead to varying paths of organizational learning. As an answer to the research question the results pointed to the following: willingness to learn depends on capacities, autonomy, and stakeholder readiness; learning depth is influenced by the crisis's relation to strategy, values, culture, expertise, and organizational attention. The analysis reveals different orientations in all framework factors, supporting our findings.

Results reflect and support several findings of related research reviewed above. The need for firm leadership

(McLeod & Dulsky, 2021), efficacy and psychological safety (Weiner et al., 2021), the trust in leadership, teaching staff and the education system in general (Ahlström et al., 2020), showed to be truly important factors of learning ability in a crisis, while preserving traditions as a part of organisational culture (Kopp & Pesti, 2022) was also pivotal in choosing learning paths.

An important contribution of this research is the observation that learning routine, stable learning practices, a "fitness" for change, and practising habits of a learning organization seemed to be the greatest accelerator for action. Results prove the necessity of organizational excellence besides upholding professional excellence in organizations, so much so, that a "Matheus effect" was characteristic, where the schools who have been exercising innovation the most previously could profit the most from the crisis as well, similar to Monostori's (2021) findings. The level of subject-matter expertise on hand allowed organizations to understand relevance in greater complexity, enabling deeper learning as well.

This finding also shows that previous learning experiences do not have to stem from handling previous crises, but well-oiled learning mechanisms and well-trained muscle memory for handling change can be sufficient, which of course can be supported by contingency plans designed for crises.

However, high learning capacity (like in the case of S5) showed not to be enough for deep-reaching learning, if the subject of learning (digitalization) was not in line with the organization's culture and/or strategy, even though, building digital competence was their key to survival at the time. On the other hand, a weaker cultural fit with digitalization did not stop learning if the strategic focus and necessary structural prerequisites were in place (S4).

Learning was supported well by structural coordination measures, such as appointed or voluntary teams or responsible(s), who channelled the subject matter expertise in the organization, as well as became the conveyors of a firm management practice needed under time pressure. In this aspect, the empowerment of those responsible, and coordinators were key in handling the arising issues quickly and with the necessary knowledge, supporting Beauchamp and colleagues' (2021) finding connected to distributed leadership.

Another important contribution of the research is the recognition of parallel crises in organizations drawing away attention and impeding transformative learning. There were tangible signs of organizational grief in at least two of the school cases, and this phenomenon was the most intense negative force influencing organisational learning observed during the research. Weiner and colleagues' (2021) findings on psychological safety and organizational features are in line with our research findings connected to learning, suggesting that the lack of parallel crisis, as a form of psychological safety, can be coupled with the basic requirements of transformative organizational learning.

Interestingly, network learning effects, which are typical characteristics of crisis action (Robin et al., 2019) did not appear in treating the challenges, especially not in an interdisciplinary manner as discussed by Broekema and colleagues (2018) (e.g., working with IT specialists from the for-profit sector). In cases it did happen, it happened within the formal education system (e.g., with social workers, fellow principals), or on the individual level (e.g., Facebook groups, family members). Reasons for this can be the pressing timeframe or the characteristic closedness of the sector, or that the necessary level of competence to solve the issue at hand short-term was present. In any case, this seems to be a learning gap worth exploring further.

Conclusions

This paper's approach to contributing to organizational crisis-learning literature is special in a sense, as the research analyses crisis not as an external force, but as an internal gap revealed by external or internal crisis events. The analysis also proposes that learning results from the organizational perception of this gap. The results of this research show that the same crisis can be perceived differently in various organizational and management contexts, resulting in different learning paths. Accordingly, crisis and learning management must focus on the understanding of the organization as a cumulation of their past and current, internal, and external context, paying attention to the factors influencing crisis perception.

What we can learn from the displayed cases is that strategic focus is key to steering development actions, however, the external crisis might be overshadowed by inner crises paralysing the organization to manage transformative learning. Understanding this can help us determine what direction an organization's learning can take, and what pressure points there are to eliminate or handle to steer the organization towards transformative learning. A higher level of learning organizational capacity, however, doesn't only provide the ability for continuous improvement but keeps organizations prepared in crises as well. A firm but empowering leadership style, well-designed organizational learning support, as well as being aware of the organization's knowledge, are essential for being able to find solutions for previously unknown challenges.

Infrastructure and systems are also key elements in digital competence, and our research showed that school stakeholders' social and financial backgrounds matter and represent direct influencing factors for an organization's digital learning. This learning, however, must be supported by an adequate level of organizational autonomy too, to reach a sense of self-efficacy and inspire action.

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Appendix I.

Summary table of interviews

School	IndividuAL/ Group /Pair	Type	Interview code	No. of participants	Duration	Online	Without recording
S1	Individual	Administrative staff	S1-A	1	0:55:05	x	
S1	Individual	Leadership	S1-L-P	1	1:36:40	x	
S1	Individual	Leadership	S1-L-VP	1	1:20:30	x	
S1	Group	Teacher	S1-T-G	8	1:38:15		
S2	Individual	Administrative staff	S2-A	1	1:08:01		
S2	Individual	Leadership	S2-L-P	1	1:39:43		
S2	Pair	Leadership	S2-L-VP&VP	2	1:20:50		
S2	Group	Teacher	S2-T-G1	7	1:19:16		
S2	Group	Teacher	S2-T-G2	8	1:25:20		
S3	Individual	Leadership	S3-L-P	1	2:05:04		
S3	Individual	Leadership	S3-L-VP1	1	1:21:47	x	
S3	Individual	Leadership	S3-L-VP2	1	1:37:18	x	
S3	Group	Teacher	S3-T-G1	7	-		x
S3	Group	Teacher	S3-T-G2	7	1:58:47		
S3	Individual	Administrative staff	S3-A	1	0:45:48	x	
S4	Individual	Administrative staff	S4-A	1	1:38:14		
S4	Pair	Leadership	S4-L-P&VP	2	1:58:05		
S4	Group	Teacher	S4-T-G	6	1:41:29		
S5	Individual	Administrative staff	S5-A	1	1:12:34		
S5	Individual	Leadership	S5-L-P	1	1:39:18		
S5	Individual	Leadership	S5-L-VP1	1	1:21:01		
S5	Individual	Leadership	S5-L-VP2	1	1:25:05		
S5	Group	Teacher	S5-T-G1	6	1:38:22		
S5	Group	Teacher	S5-T-G2	6	1:31:36		

Summary	
No. of interviews	24
No. of participants	73
Sum duration	34:12:08
Min. duration	0:45:48
Max. duration	2:05:04
No. of individual	14
No. of group	8
No. of pair	2

Source: own compilation

Appendix II.

Scoring of the schools along the determined factors

	Factors	Definition	Scale	S1 score	S2 score	S3 score	S4 score	S5 score
Potential impact (willingness to learn)	Organizational capacity for change	The school has the necessary capacity (including HR and learning practices) to implement change.	0- no 1- partly 2- fully	2	0	1	2	1
	Financial capability for change	The school has the resources to financially support the necessary changes, including infrastructure.	0- no 1- partly 2- fully	1	0	0	2	1
	Autonomy for change	The school has the autonomy to make strategic decisions about issues connected to digitalization.	0- no 1- partly 2- fully	1	0	1	2	1
	Stakeholder maturity for change	Stakeholders, mostly students and parents, are capable and willing to handle tools and services that are outputs of the digital innovations in the school.	0- no 1- partly 2- fully	2	1	1	2	0
Potential relevance (type/ depth of learning)	Strategy match	The organizational strategy includes digital innovation as a key element.	0- no 1- partly 2- fully	2	0	1	2	1
	Cultural match	The school's organizational and pedagogical culture and values are supported by digitalization.	0- no 1- partly 2- fully	2	0	2	1	1
	Field knowledge	The school has the professional knowledge to understand and leverage the opportunities provided by digitalization.	0- no 1- partly 2- fully	2	1	2	2	1
	Parallel crisis	The school has no parallelly ongoing crisis affecting its foundational operations.	0- severe parallel crisis 1- neutral 2- no parallel crisis	2	1	0	2	0
Impact score				6	1	3	8	3
Relevance score				8	2	5	7	3

Source: own compilation

GÁBOR RÓNAFÖLDI-SZÉLL

SUCCESSION AND GENDER DYNAMICS IN FAMILY FIRMS – A SYSTEMATIC LITERATURE REVIEW AND FUTURE RESEARCH AGENDA

UTÓDLÁS ÉS NEMI DINAMIKÁK A CSALÁDI VÁLLALKOZÁSOKBAN – SZISZTEMATIKUS SZAKIRODALMI ÁTTEKINTÉS ÉS KUTATÁSI JAVASLATOK

The influences of gender relations and gender dynamics within family firm succession have been widely studied in recent decades. However, there have been few attempts to synthesise existing results in the field. Thus, this article aims to provide a systematic literature review focusing exclusively on the gendered issues related to family firm succession processes. A comprehensive analysis of 57 journal articles extracted from the Scopus database was conducted. As a result, (1) the topics of gendered influences on daughter's succession in family firms, (2) gender and succession processes in family firms, and (3) gender and intra-family relationships in family firm succession are identified as the central areas. Based on these findings, a future research agenda is outlined. The paper contributes to the field of family firm research by highlighting the research trends in the gendered analysis of family firm succession, and by pointing out under-researched areas that merit further exploration.

Keywords: **family firm, family business, gender roles, succession, gender dynamics, succession planning, gender**

A nemek közötti kapcsolatok és a nemi dinamik**ák** hatását a családi vállalkozások utódlásán belül az elmúlt évtizedekben széles körben vizsgálták. Kevés kísérlet történt azonban arra, hogy a területen meglévő eredményekről összefoglalás készüljön. Ezért e cikk célja, hogy olyan szisztematikus szakirodalmi áttekintést végezzen, amely kizárólag a családi vállalkozások utódlási folyamataihoz kapcsolódó nemi kérdésekre összpontosít. Ez a Scopus adatbázisából kinyert 57 folyóiratcikk átfogó elemzése által valósul meg. Az elemzés eredményeképpen az alábbi központi témákat azonosítja a szerző: (1) nemek által a családi cégek női utódlására gyakorolt hatások, (2) a nemek és az utódlási folyamatok a családi cégekben, valamint (3) a nemek és a családon belüli kapcsolatok a családi cégek utódlásában. Az elemzés eredményei alapján jövőbeli kutatási lehetőségeket **vázol** fel a cikk. A tanulmány azáltal járul hozzá a családi vállalkozások kutatásának területéhez, hogy rávilágít a családi vállalkozások utódlásának nemek szerinti elemzésével kapcsolatos kutatási trendekre, és rámutat azokra a kevéssé kutatott területekre, amelyek további feltárást érdemelnek.

Kulcsszavak: **családi vállalkozás, családi cég, nemi szerepek, utódlás, nemi dinamikák, utódlástervezés, gender**

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The topic of relationships between gender and family firms has been researched since the late 80s (Dumas, 1989; Hollander & Bukowitz, 1990; Kaslow, 1998). The relationship between gender and family firm succession was discussed from multiple angles over the years, examining several aspects of family firm succession where the gender of one or more of the stakeholders could have an effect on some part of the succession processes (Smythe & Sardeshmukh, 2013; Humphreys, 2013; Nelson & Constantinidis, 2017; Wieszt, Martos,

Sallay, Varga & Vékás, 2021). Likewise, literature reviews on the topic of family firms and gender have been written since the late 90s (Aronoff, 1998; Martinez Jimenez, 2009; Campopiano, De Massis, Riana & Sciascia, 2017; Nelson & Constantinidis, 2017). More recently, multiple bibliometric literature reviews have been published regarding women's involvement and entrepreneurship in family businesses (Bagis, Kryeziu, Kurutkan & Ramadani, 2022; Maseda, Iturralde, Cooper & Aparicio, 2022). However, these aforementioned literature reviews take a more holistic approach to gendered discourse in family businesses, covering a variety of themes related to the topic. Martinez Jimenez (2009) discusses the contributions of women in family firms, with a partial emphasis on succession and primogeniture, while also covering issues related to other obstacles preventing women from involvement, as well as positive aspects such as professional career development. Meanwhile, Campopiano et al. (2017), discussing women's involvement in family business, briefly review literature related to succession processes as well (n=16), while splitting their focus among other important issues such as women's entrepreneurial entry, career dynamics and presence in family business. Nelson & Constantinidis (2017) focus their research on how gender is theorized in family business succession research – while their results are hugely relevant and of great importance, the emergence of newer, more recent empirical studies provides a need for another review of the subject of gender in family business succession. As such, in previous literature reviews there has mostly been only a partial focus on the specific gendered issues related to family firm succession or was approached through a focus on how the issue is theorised, rather than what is being discussed. The author believes that a systematic literature review is thus necessitated, in order to bring the insofar fragmented reviews on the gendered processes of family business succession. With this in mind, the following research question was outlined: *What are the central themes of discourse related to gender dynamics in the succession processes of family firms, and what is being said in that discourse?*

Thus, the contributions of this article to the field are threefold: first of all, the article contributes to the growing field of literature on the gendered issues related to family firm succession by providing a comprehensive systematic literature review of empirical and conceptual articles discussing the different ways in which gender affects family firm succession, published up to 2023, and by doing so providing a starting point for scholars building their own research; second, by interpreting the results, highlighting contradictions, and seeking to provide an answer to them; and third, outlining further research opportunities, suggesting research propositions and questions, and providing a guide for future research agenda.

The main findings of the paper are as follows: As a result of the systematic literature review, (1) the topics of gendered influences on daughter's succession in family firms; (2) gender and succession processes in family firms; and (3) gender and intra-family relationships in family firm succession are identified as the central areas of the field. While research is mostly congruent on these topics, disagreements arise regarding the role gender actually plays in determining succession, which disagreement is further explored, along with highlighting notable gaps in existing research, and recommending propositions for empirical research.

Methodology

In this article, a systematic literature review methodology is applied to analyse existing literature in relation to the above outlined research questions, as suggested by multiple authors (Tranfield, Denyer & Smart, 2003; Snyder, 2019; Anand, Muskat, Creed, Zutshi & Csepregi, 2021). To extract the articles used in this review, Elsevier's Scopus database was utilised. As per Mongeon and Paul-Hus (2016), Scopus is a reliable, widely utilised, and strong database, comparable to Web of Science (WoS) and Google Scholar, with including approximately 97% of all journals that are indexed by WoS (Bosman, Mourik, Rasch, Sieverts & Verhoeff, 2006; Thürer, Tomašević, Stevenson, Blome, Melnyk, Chan & Huang, 2020). Therefore, Scopus represents the most suitable database to conduct the literature review (Centobelli &Ndou, 2019).

First, Scopus was utilised to perform multiple searches based on keyword selections deemed relevant to the research questions by the author. The final keyword selection can be seen in Table 1.

Table 1

Keyword string utilised in Literature Review

Keywords and Search String utilised to identify and extract articles from Scopus Database
(TITLE-ABS-KEY („Family Business*" OR „Family Firm*" OR „Family Enterprise*" OR „Family Corporation" OR „Family Compan*" OR „Family Organi?ation*" OR „Family Leadership" OR „Family Manage*" OR „Family Ownership" OR „Family-owned" OR „Family-managed" OR „Family-led")) AND (TITLE-ABS-KEY („Succession" OR „Successor" OR „Heir" OR „Generation Change" OR „Inherit*" OR „Next Generation*" OR „Next-gen*")) AND (TITLE-ABS-KEY („Gender" OR „Gender Role*" OR „Gender Dynamics" OR „Gender Difference*" OR „Female" OR „Woman" OR „Daughter")) AND (LIMIT-TO (SRCTYPE, „j")) AND (LIMIT-TO (SUBJAREA, „BUSI")) AND (LIMIT-TO (DOCTYPE , „ar")) AND (LIMIT-TO (LANGUAGE, „English"))

Source: own compilation

The keywords were created and utilised in a way to focus on the gendered discourse around family firm succession, by including a large variety of potential synonyms that may be used to refer to concepts related to the research question. Applying the keyword selection (Table 1) to Scopus' Title, Abstracts and Keywords search function yielded an initial result of 254 documents. To these initial results, inclusion/exclusion criteria were applied by the author. The criteria did not include a timeframe, as the aim was to provide a comprehensive overview of the field – thus, papers from the earliest available date of publica-

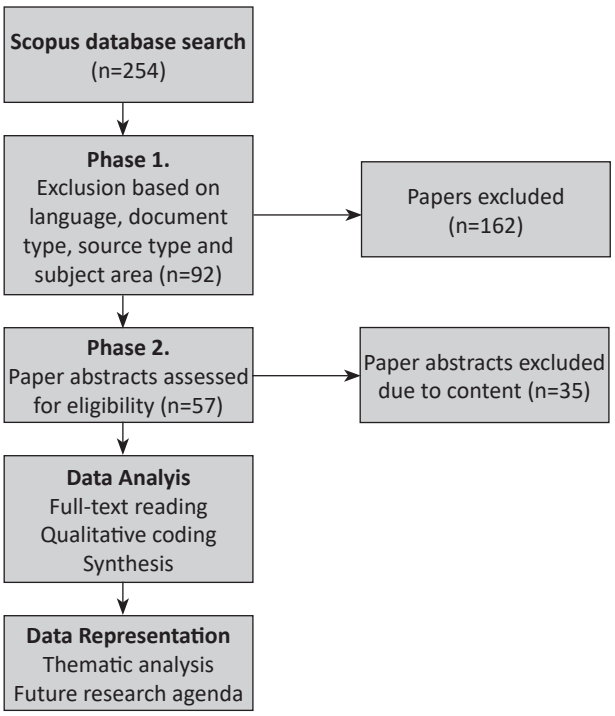
tion, 1989, all the way up to the present day at the time of writing this review (2023) were considered. In terms of the criteria included, firstly, the dataset was limited to documents published in English language, due to the author's own linguistic limitations – while this resulted in certain potentially relevant articles being excluded, this exclusion criteria lowered the total document count only to 241 articles. Secondly, as this study approaches the issues related to family firm succession and gender dynamics from a Business Management point of view, the decision was made to limit the dataset only to documents in the subject area of "Business, Management and Accounting", as defined by Scopus' search function, lowering the total document count to 162. Following the suggestions of Adams et al. (2017), the author decided to further limit search results to articles published in journals, as other types of documents – such as books, book chapters or conference papers can be considered to be less reliable, due to potentially not having undergone a serious peer review process (Adams, Smart & Huff, 2017). This resulted in a final pool of 92 individual articles extracted from the Scopus database.

In the following step, after the recommendations of Hiebl (2022), the author screened the remaining papers by reading and analysing the abstracts of each of the 92 articles, making further selections on whether the subject matter of the article is relevant to the research questions, or not. In this phase, articles deemed relevant to the research question were selected to be included if both (i) a focus on succession processes within family firms was present in the article, and (ii), if family firm succession was approached from a gender-oriented perspective. Papers that failed to meet one or both of the above outlined screening criteria were not considered in the literature review. As a result of this stage of selection, a total of 57 articles were identified as the final dataset to be used for the systematic literature review. These 57 articles were then read in their full extent by the author, and coded according to the main themes and topics they present (Figure 1). The results were interpreted utilising the process of synthesis (Snilstveit, Oliver & Vojtkova, 2012; Schick-Makaroff, MacDonald, Plummer, Burgess & Neander, 2016). Synthesis is a methodical process for synthesizing narratives and summaries from a variety of literature (Schick-Makaroff et al., 2016). According to the results of the coding process, a thematic analysis of the articles will be performed. A brief summary of all reviewed papers can be seen in the appendices of the online version of this article.

For the thematic analysis, the reviewed articles were categorised based on common parameters such as research methods, theoretical frameworks, research questions posed and discussed and topics analysed. These initially created categories were then reviewed and screened for overlapping themes and topics, and when necessary, combined with each other.

As a result, the following themes were identified: (1) the impact of gender on succession planning processes and succession outcomes in family firms, (2) gender-related individual successor characteristics in family firm succession, and (3) gender and intra-family relationships in family firm succession. Certain papers included in the literature review touched upon multiple of these themes, and as such were included in the analysis of all the topics they discussed. In the following sections, the three identified main themes will be presented and analysed one-by-one.

Figure 1
Methodological Process of the Systematic Literature Review



Source: own compilation

The impact of gender on succession planning processes and succession outcomes in family firms

When discussing the gendered topics related to succession processes, we can consider both the planning of the succession, and the outcome of it as relevant for this paper. The succession planning processes in family firms are not exempt from the influence of gender dynamics within the family, or society as a whole (Galiano & Vinturella, 1995; Ramadani, Hisrich, Anggadwita & Alamanda, 2017; Mustafa, Elliot & Zhou, 2019).

The impact of incumbent leader's gender on succession planning processes

The gender of the owner/incumbent leader can be a highly influential factor (Koffi, Guihur, Morris & Fillion, 2014; Harveston, Davis & Lynden, 1997; Ahrens, Landmann & Woywode, 2015; Maciel, Reyna, de la Garza Ramos & Aguilar, 2021; Umans, Lybaert, Steijvers & Voordeckers, 2021). Maciel et al. (2021) highlight that the gender of the CEO influences female succession in that if the current CEO is a woman, the probability of choosing a female successor is increased. Furthermore, male and female busi-

ness owners utilise different behavioural strategies in their efforts to ensure the credibility of their successors (Koffi et al., 2014). Likewise, the determinants of succession planning (including variables such as organizational size, structure, source of financial capital, but also the human capital of the owner) also differ between firms headed by male or female owners (Harveston et al., 1997). The founding CEO's inability to let go of control can hinder succession processes, and this negative effect is more influential in cases of male founders, with female founders showing better ability in disconnecting their emotions from their decision-making (Umans et al., 2021). However, Cadieux, Lorrain & Hugron (2002) point out that in the cases of their study on female owners, one can observe a tendency to delay succession planning until a potentially suitable successor is identified, with the early stages of succession planning being lacking.

The impact of successor gender on succession planning processes

Owners and incumbent leaders may have preferences for the gender of their successor, which can significantly impact succession planning (Galiano & Vinturella, 1995; Ahrens et al., 2015; Mustafa et al., 2019). As traditionally, it was the firstborn sons, or male children in general who were considered for succession – a phenomenon which is also referred to as the "rule" of primogeniture – incumbents may still plan succession processes with the male heirs in mind (Ahrens et al., 2015; Chang, Mubarik & Naghavi, 2020; Chen, Ying, Wu & You, 2021). The characteristics and attitudes of the owners can strengthen certain negative gender stereotypes and prejudices, leading to limited opportunities for female family members to establish their legitimacy in leadership and successor roles (Mustafa et al., 2019). In fact, Chen et al. (2021) report that family firms with at least one male potential successor exhibit more innovative behaviour, and more long-term planning and orientation. Examining succession planning processes in which the gender of the successor is female, Urban & Nonkvelo (2020) highlight the importance of the business context, intra-family cohesion and adaptability, and the parent-daughter relationship as key components, with positive circumstances leading to a more fruitful succession process.

The impact of successor gender on succession process outcomes

The outcomes of family firm succession can also be influenced by gender characteristics (Remery, Matser & Flören, 2014; Soost & Moog, 2019; Sardo, Vieira & Serrasqueiro, 2022). Successor generations in family firms positively influence the speed of adjustment towards the firm's target debt level, an effect which is also influenced by the gender of the owner – with female ownership resulting in a higher speed of adjustment (Sardo et al., 2022). Soost & Moog (2019) point out that the firm's performance after succession processes is impacted by the gender of the successor in various ways, including the number of employees hired, or the productivity index of the firm – however, the notion that either gender is more, or less capable than the other in managing the family firm is rejected. The firm's ownership structure can also be affected by the gender of the successor, as male successors seek full ownership of the firm after succession, whilst female successors are more likely to opt for shared ownership (Remery et al., 2014). As a further possible outcome of succession processes, family firms that do not include female family members during their succession planning may find the lifespan of the firm drastically shortened (Chang et al., 2020). As such, the importance of involving female family members in the management and succession processes of family firms, when possible, due to the unique skills and characteristics they can provide, cannot be overstated (Ramadani et al., 2017).

Further considerations

Despite the previous contents of the chapter, there is some disagreement on the question of whether gender is really considered important during succession planning processes (Chrisman, 1998; Hossain, Islam & Haque, 2022; Aldamíz-Echevarria, Idígoras & Vicente-Molina, 2017). According to Chrisman (1998), both gender and birth order are considered to be among the least important factors during succession planning. Aldamíz-Echevarria et al. (2017) argue that gender is not considered to be an obstacle when it comes to becoming a successor, despite there being more male than female successors in general – likewise, birth order is more influential in the cases where the firstborn child is male. Furthermore, Hossain et al. (2022) find that gender had no impact on succession processes in their study. Potential reasons for differing results regarding the question of whether successor gender effects succession planning processes may be found in the characteristics of the samples examined in the respective studies, or the way research methodologies were designed. It is safe to say that gender biases, such as primogeniture, have existed and continue to exist, but they do not affect all family firms equally. However, this disagreement merits further examination.

In the reviewed literature, succession planning and outcomes are discussed only in terms of the gender of the incumbent and the successor at an individual level. Gender dynamics, however, could be present on other levels of the firm as well – such as the board, the owners, or the family itself, for example. Further studies into how the gender diversity and gender dynamics of these larger units within family firms impact the succession planning and outcome of the firm could provide further contributions to the field.

The impact of gender-related successor characteristics on family firm succession

Succession processes within family firms, and their relations to successor gender have been examined by existing literature through a variety of different lenses (Bagis et al., 2022; Maseda et al., 2022). Most examinations of succession processes that take successor gender into view focus on succession involving female successors, specifically daughters (Curimbaba, 2002; Vera & Dean, 2005;

Cater & Young, 2022), but other possibilities, such as the succession of widows (Almlöf & Sjörgen, 2022) are also discussed. As such, in this section, this article provides an overview of the main factors that influence the succession of daughters inside family businesses, including obstacles and different successor characteristics.

Several studies have highlighted that when it comes to succession, daughters face a multitude of obstacles and/or difficulties that are not present in the cases of male successors (Akhmedova, Cavallotti, Marimon & Campopiano, 2020; Overbeke, Bilimoria & Perelli, 2013; Vera & Dean, 2005; Martinez Jimenez, 2009). These barriers to succession include invisibility (Curimbaba, 2002; Martinez Jimenez, 2009; Karatas-Özkan, Erdogan & Nicolopoulou, 2011), blindness to the possibility of succession (Overbeke et al., 2013), primogeniture (Ahrens et al., 2015; Vera & Dean, 2005; Ramadani & Gërguri-Rashiti, 2017), work-family conflict (Campopiano, De Massis, Rinaldi & Sciascia, 2017) and other gendered inequalities impacting women (Gherardi & Perrotta, 2016). Invisibility refers to the phenomenon of women's work within family firms – including both emotional labour, as well as labour directly linked to the operation of the firm – being overlooked or ignored by peers, often going unvalued and unappreciated (Curimbaba, 2002; Martinez Jimenez, 2009). This links directly to the obstacle identified by Overbeke et al. (2013), namely that daughters are often blind to the possibility of succession, due to gender norms and beliefs that might cause the daughters to consider themselves invisible to others as a possible successor. Campopiano et al. (2017) highlight work-family conflict as another recurring obstacle present in literature, wherein fulfilling family obligations of raising a family and future generations, and working on advancing the family business often create conflicting priorities. Another obstacle outlined in the literature is the concept of primogeniture, which refers to the tradition of the first-born male child succeeding the incumbent leader of the family firm (Vera & Dean, 2005; Ahrens et al., 2015). It is even pointed out by Ahrens et al. (2015) that male descendants must face lower expectations related to their performance as a precondition for succession than female descendants, and thus that even lower-performing male members of the next generation may be preferred over more qualified female members of thereof.

Identity construction, gendered identities

While most succession literature considers gender as an objective and stable condition of women (Nelson & Constantinidis, 2017), there are some articles that discuss the construction of gender identity as a more subjective process. According to those papers, the family business succession of daughters is influenced by the way they construct their identities as successors and leaders, which is in turn influenced by the way they navigate "masculine" and "feminine" gender identities (Hytti, Alsos, Heinonen & Ljunggren, 2016; Byrne, Fattoum & Thébaud, 2019; Byrne, Radu-Lefebvre, Fattoum & Balachandra, 2021; Feldmann, Lukes, & Uhlaner, 2022). Gender identity is linked to the career path of the individual in such a way that women are more likely to be employees of family firms, rather than successors of it (Feldmann et al., 2022). Daughters' gender and leadership identities are constructed through interactions by opposing, expanding, and utilising gendered scripts available to the female successor (Hytti et al., 2016). The process of identity construction for female successors involves the negotiation of two different roles, that is, daughter, and business leader, with both of these identities being influenced by societal gender norms and expectations (Xian, Jiang & McAdam, 2020). Female successors find themselves having to adopt masculine identities of ownership and leadership in order to legitimize their claim to running the family business (Hytti et al., 2016; Bryne et al., 2021). Fernandes and Mota-Ribeiro (2017) also highlight the need of female leaders in family business settings to adopt masculine identities in order to gain "respect" in a male-dominated world. This is necessitated due to the successor role itself being socially constructed as a masculine role, collectively by family business members (Bryne et al., 2019). Further attention is drawn to the importance of the phenomenon of 'self-positioning', whereby female heirs are forced to define their own roles and positions within the family business in a way that conforms to expected masculine norms (Mussolino, Cicellin, Pezzillo Iacono, Consiglio & Martinez, 2019). Meanwhile, male successors whose masculine identities are different from that of the incumbent are also at a disadvantage in terms of succession – such as fathers who value family over work commitments, and thus are deemed to be unfit leaders (Bryne et al., 2021).

Motivation and Commitment

The role of motivation in determining the career outcomes of daughters in family businesses cannot be ignored (Akhmedova & Cavallotti, 2021). Female successors' motivation centers largely on internal factors, such as independence, self-actualization or a desire to apply their skills and knowledge (Li, Sun, Wang & Ke, 2020). Meanwhile Karatas-Özkan et al. (2011) highlight a sense of responsibility and belongingness as crucial motivating factors. Ethical motivations, such as helping the family and its stakeholders, are also of paramount importance in engaging daughters in the family business (Akhmedova et al., 2020). According to Akhmedova and Cavallotti (2021), these motivational synergies between internal and ethical motivation are especially important in the context of family businesses.

Discussing the types of commitment that female successors feel towards the family firm, Otten-Pappas (2013) highlights that normative commitment (a sense of obligation to join the firm) is present only in cases of emergency, while most female successors display a combination of affective (emotional) and calculative commitment. The findings of Gimenez-Jimenez et al. (2021) point out that the development of affective commitment towards the firm leads to succession intentions, however, this commitment is higher in sons than daughters, potentially due to expectations of primogeniture in succession.

Further considerations

The above reviewed literature, when discussing gender-related successor characteristics, focuses exclusively on the gender-related characteristics of family successors, specifically daughters. Discussion on sons' gender characteristics are notably absent. The specific reasons for this are multifaceted and are out of the scope of this review to fully explore – however, further research projects could be focused on investigating the exact causes of this phenomena. Likewise, research focusing on the gender-specific characteristics of male successors, and their influences on succession could be warranted in the future.

Gender and intra-family relationships in family firm succession

The effect of the relationship between family members on succession processes has been studied since the early 90s (Dumas, 1990; Swogger, 1991; Kaslow, 1998). Most of the research focuses on the relationships between the incumbent leader and the successor, specifically on father-daughter, (Dumas, 1990; Deng, 2015; Smythe & Sardeshmukh, 2013; McAdam, Brophy & Harrison, 2020; Cicellin, Mussolino & Viganó, 2021) mother-daughter (Vera & Dean, 2005; Ferrari, 2019; Cesaroni, Erro-Garcés & Sentuti, 2021), and mother-son (Kaslow, 1998; Cadieux et al., 2002) relationships. However, other intra-family relationships, such as that between the members of the successor generation (Swogger, 1991), or the role that wives play in succession processes, (Cosson & Gilding, 2021) are also discussed. As such, contents of this chapter were organised based on whether the relationship dynamics discussed exist on the level of the duo that is the incumbent and the successor, or on the level of the wider family, which include non-incumbent parents and siblings in relation to the successor.

Gender and intra-family relationships in succession on the incumbent-successor level

In general, it can be said that the role that the incumbent generation (the parents) play in succession processes is significant (Schröder, Schmitt-Rodermund & Arnaud, 2011; Cater & Young, 2022; Humphreys, 2013; Feldmann et al., 2022). The career choices of the successor generation are significantly influenced by their perception of their parents' work, and the examples they provide (Schröder et al., 2011; Feldmann et al., 2022). While daughters report an overall lower likelihood of succession as compared to founding their own business (Schröder et al., 2011), family influence can be a mitigating factor (Feldmann et al., 2022). The incumbent generation's support and mentoring is a key factor of the success of the transfer of the firm's leadership (Humphreys, 2013). However, there exist differences between the mentoring done by fathers, and the mentoring done by mothers (Cater & Young, 2022).

Father-daughter relationships

The most researched type of intra-family relationship in terms of succession processes is the relationship between the incumbent father and the successor daughter. Cicellin et al. (2021) point out that the paternalistic leadership style of the father heavily influences the outcomes of the succession processes. However, if the father is not the incumbent leader, but the spouse instead, his role in the succession processes is greatly diminished (Cesaroni et al., 2021). First examined by Dumas (1990), she states that the relationship between father and daughter is key in developing the daughter's successor identity, contrasting it with the identity construction of sons, who instead seek to separate from their fathers. More recently, McAdam et al. (2021) agree that daughters need certain elements (such as preparation, endorsement, or credibility) of the father-daughter relationship in order to construct their own identities – however, they also need to develop independently from their fathers as well. For the father-daughter succession to be fruitful, the daughter's early socialisation into the family firm (Smythe & Sardeshmukh, 2013; Deng, 2015), open communication between father and daughter, and the successful negotiation of the father's continued involvement post-retirement are key factors (Smythe & Sardeshmukh, 2013). Deng (2015) also points to out the importance of the successful transfer of the father's social capital to the daughter.

Mother-child relationships

Gendered discussion can also enter family firm succession in the cases of female founders or incumbent leaders, and the unique aspects of their relationships with sons and daughters. Female managers spend significantly more time raising children than male managers in addition to running their businesses (Cadieux et al., 2002). Consequently, female managers feel more responsibility for nurturing and preparing the succeeding generation than male managers (Kaslow, 1998). Cadieux et al. (2002) argue that this has a significant impact on succession processes, as the increased attention results in different relationship dynamics between incumbent and successor than in more traditional male leadership. However, in a mother-to-daughter succession process, difficulties may arise that are not present in a mixed-gender incumbent-successor situation (Vera & Dean, 2005; Cadieux et al., 2002; Ferrari, 2019). Vera and Dean (2005) suggest that there are "underlying issues" involved in relationship dynamics where mothers manage their own daughters, and that female incumbent leaders often have trouble relinquishing control of the firm to their daughters. Ferrari (2019) likewise points out that mother-daughter succession has its own share of unique difficulties, such as the boycotting of the next generation by the incumbent, the power-asymmetry between mother and daughter, or the gender-specific relationship issues between the two parties. On the other hand, mother-daughter relationships can also positively influence female succession, as having a self-employed mother as a positive role model can offset traditional gender norms that would otherwise hinder the daughter in succession (Feldmann et al., 2022).

Gender and intra-family relationships in succession on the family level

Mother-child relationships also factor into cases of succession processes where the incumbent is the father (Cesaroni et al., 2021; Vera & Dean, 2005; Cosson & Gilding, 2021). In the case of father-child succession, the role of the mother is often characterised as a mediator between the incumbent and the successor (Cesaroni et al., 2021). The effect of the wives (who are also the mothers, in most cases) on family firm successions is characterised both by their influence on the family's socialisation dynamics, – such as raising the children, being the "emotional manager" of the family, or setting examples of autonomy and choice for the future generation – as well as their influence on the career path choices of the next generation (Cosson & Gilding, 2021).

The relationships between siblings also influence family firm succession processes (Vera & Dean, 2005; Swogger, 1991). According to Swogger (1991), sibling relationships are paramount to the positive outcome of family firm succession processes, with the successor generation requiring strong bonds between each other, being able to separate themselves from the incumbent generation, and being able to step into the leadership roles together for the best possible outcome. When it comes to multiple siblings in the successor generation, clearly defined roles, and expectations, as well as previous experience of working together prior to succession can ensure the most qualified sibling being chosen for the successor role, as well as avoid conflicts or rivalry between the siblings (Vera & Dean, 2005).

Further considerations

The body of research analysed in this chapter does not reflect on any other family members who may be involved in succession – however, the role that wider family members (such as aunts/uncles, grandparents, cousins, etc.) or spouses may be significant in certain cases, depending on family firm composition.

Father-son relationships are also not explicitly discussed in the reviewed literature. As before, the causes of this specific relationship dynamics not receiving focused attention from a gender research perspective are multifaceted, and it is not the goal of this paper to uncover them – but further research into these causes is certainly warranted. Likewise, the examination of father-son relationships and their gender dynamics could provide valuable contributions to both family firm and gender research.

Discussion

Building upon previous literature reviews discussing the field of gendered issues within family businesses (Martinez-Jimenez, 2009; Campopiano et al., 2017; Nelson & Constantinidis, 2017), this article provides a comprehensive review of prior literature discussing gendered topics within family firm succession. It does so by analysing the three themes identified in existing literature, namely (1) the impact of gender on succession planning processes and succession outcomes in family firms, (2) the impact of gender-related successor characteristics on family firm succession, and (3) gender and intra-family relationships in family firm succession. On the first theme, it highlights both the influence of the incumbent's gender, as well as the influence of the incumbent's gender preferences for the successor on succession planning. The gendered differences in the outcomes of succession processes are also described. Regarding the impact of gender-related successor characteristics on family firm succession, the paper highlights the literature's focus on female, specifically daughter succession when discussing gender-related characteristics. It finds that the main

Table 2

Identified research gaps and proposed research questions

Identified research gap	Suggested research questions
#1: Examining the gendered dynamics of father-son relationships in family business.	#1A: How are father-son relationships gendered during a family firm succession process? #1B: How does the gendering of father-son relationships differ from that father-daughter relationships, or mother-child relationships during family business succession?
#2: Investigating the way gender dynamics manifest through the interactions of the extended family (siblings, spouses, etc.) and how those dynamics might influence succession.	#2A: How are the roles of spouses gendered during a family firm succession process? How do the gendered roles and expectations differ between husbands of incumbents and wives of incumbents? #2B: How are roles, interactions and relationships of wider family members (aunts/uncles, cousins, siblings) gendered during a family firm succession?
#3: Examining identity construction of sons and male successors in a family business succession context, construction of masculine leadership identities.	#3A: How do male successors construct masculine leadership identities for family business succession? #3B: How does the identity construction of female and male successors differ during succession processes?
#4: Analysing whether gender is considered relevant during succession planning or not.	#4: To what extent is gender considered relevant by incumbent family business leaders during succession planning?
#5: Studying the effects gender dynamics and gender diversity on a board level has on family firm succession processes.	#5: How does board gender diversity impact family firm succession planning processes and succession outcomes?

Source: own compilation

gender-related factors influencing daughter's family firm successions are the various obstacles stemming from gendered norms and stereotypes that they have to face, as well as their own internal characteristics, including attributes, motivation, commitment to the firm, and their construction of gendered identities around the leadership of the firm. Finally, the review summarises the effect that different intra-family relationships, such as father-daughter; mother-daughter; mother-son; or sibling relationships have on family firm succession. Notably, the effects of father-son relationships are mostly absent from existing literature (Table 2).

Over the course of the literature review, several significant research gaps were identified by the author, which are presented below, together with research propositions that may be utilized by future research to fill such gaps:

As a first research gap, the lack of research on certain gender dynamics in intra-family relationships is highlighted. Whilst examples can be seen for father-daughter (Dumas, 1990; McAdam et al., 2020), and mother-child (Kaslow, 1998; Vera & Dean, 2005; Ferrari, 2019), there is very little research on father-son relationships, and the succession of sons as a whole (Cheng et al., 2021). Future research could examine the gendered relationship dynamics that are specific to fathers and sons in a family business setting. Based on this, a potential research proposition to be examined could be that father-son relationships are not seen as "gendered" the same way that parent-child dyads involving a woman are.

Following up on the first gap, a lack of research into the role that wider family members (such as aunts/uncles, grandparents, cousins, etc.) or spouses play in succession processes, and the gendered relationship dynamics that stem from them are also not covered in the reviewed literature. Further research projects could investigate the way gender dynamics manifest through the interactions of the extended family, and how those dynamics might influence succession. Likewise, a research gap was identified around the sibling relationships, and how they affect succession processes. While there has been previous research into the topic (Swogger, 1991; Vera & Dean, 2005), more recently, there have been very few publications on the topic as per the author's knowledge. New research into the topic could bring further contributions to the field of intra-family relationships in family firm succession.

Third, similarly to the first research gap, there exists numerous literature on the gendered identity construction of daughters around leadership and management roles (Hytti et al., 2016; Fernandes & Mota-Ribeiro, 2017; Bryne et al., 2019; Bryne et al., 2021). While Bryne et al. (2021) highlight the fact that male successors also face issues related to the construction of masculine leadership identities, the field of gender identity research in succession is lacking in terms of men's identity construction as a topic. More research would be necessary to examine how sons construct their identities around the hypermasculine expectations of management roles (Bryne et al., 2021), as well as more comparisons between the experiences of sons and daughters could prove interesting for the field. The examination of other gender-related characteristics of male successors in relation to family firm succession could also be warranted.

Fourth, a disagreement in whether gender is relevant (Galiano & Vinturella, 1995; Ahrens et al., 2015; Umans et al., 2021) or not (Chrisman, 1998; Hossain et al., 2022) in the context of succession planning has been noted in previous literature. Further studies into the issue could contribute to either point of view, and help in creating a clearer picture of the importance of gender in succession planning. A potential research area into the question could be the examination of whether gender is a relevant factor for incumbent leaders when deciding on their successor in family businesses.

Finally, in the previously reviewed literature, discussion concerning succession planning and outcomes focused solely on the gender of the incumbent and the successor at an individual level. However, gender dynamics may also be evident at other levels of the family business, such as the board, the owners, or even the family itself. Additional research into the effects of gender dynamics and gender diversity in these bigger family business units on succession planning and outcomes could offer further contributions to the field.

Conclusions and limitations

The review provides a future research agenda for scholars wishing to research family firm succession, as well a starting point for those seeking to deepen their understanding of the discussed topics.

This study is limited in its scope by several factors stemming from the selection criteria applied to the included literature. By sourcing the articles included in this literature review from Scopus, it is possible that certain articles, published in journals not contained in Scopus' database were missed by the author. Likewise, by excluding documents not written in English, or published in a format other that journal articles, some pieces of information may have been missed. While this literature review focuses on the topics of Business Management, the issues of gender dynamics could be approached from a variety of other perspectives, for example from that of Social Sciences. Future research could focus on providing literature reviews with the inclusion of those above-mentioned criteria, as well as on approaching the gendered discourse on family firm succession through the lens of other fields.

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Appendix I.

Summary table of the articles

Author and year	Sample and method	Aim of Study	Results
Ahrens et al. (2015)	n=804	Investigate labor market constraints in CEO succession contests in family firms with concentrated ownership	Males are still preferred choice for succession; Succession more likely to occur if heir is male; Preference for male family heirs limits labor market selectivity; Successors are not chosen based on qualifications or human capital, but by predecessors' gender preferences
Akhmedova & Cavallotti (2020)	n=3, multiple case study method	Explore the psychological link between daughters and family, and the psychological processes behind a daughter's acquisition of a high position in the family firm; analyse patterns of daughter's motivation in family businesses	Important differences in terms of extrinsic, intrinsic and ethical motivation among daughters that occupy different positions; These differences affect the way daughters interact with business environment, and how they justify themselves as leaders and viable successors
Akhmedova et al. (2020)	n=66	Examine daughter's motivations and perceptions of barriers in taking high-management positions in family business	Three pathways highlighted: „no barriers", „challengers", „rational", based on theconfiguration of present motivation and barriers; Ethical motivation especially important
Aldamiz-Echevarría et al. (2017)	n=60, qualitative analysis	Investigate the succession process in SME family businesses, how gender could influence the selection of the successor; Focusing on specific factors that may influence women entering the family business	Despite gender not being considered an obstacle to become successor, there are more male successors than females; Birth order influences the succession process more often if the first child is male than if it is female; This is not only a predecessor's decision as many women also decide not to join the family business.
Almlöf & Sjörgen (2022)	n=3, qualitative approach	Examine the roles widows can take in the family business in case of unexpected death of owner-manager spouse, when having played no salient role before said death	Four main roles: „exiteur", „understudy", „entrepreneur", „bridge-builder"; roles are dynamic, a widow can take more than one, or move between them
Bagis et al. (2022)	n=160; Bibliometric literature review	Examine which journals, authors and countries are the most productive on women's entrepreneurship in family business literature; Discover the dominant research topics on woman entrepreneurship in family business literature	Bibliometric data of dominant countries, journals and authors revealed; topics gathered into three clusters: (1) family succession and women's roles, (2) gender bias and leadership and entrepreneurship, and (3) indentity construction
Bryne et al. (2019)	n=4; Family SMEs, case studies	Investigate how gender structures successor selection	Successor role is construed as masculine; Daughter's chance of succession restricted; being male is not sufficient - most masculine or „hypermasculine" son becomes successor
Bryne et al. (2019b)	n=7, qualitative analysis	Examine how CEOs 'do gender' in management succession and how this impacts their legitimacy as successor CEOs	Successor CEOs enact entrepreneurial, authoritarian and paternalist masculinity; Relational femininity emerges as important tool for legitimacy; women CEOs need to adopt and combine various masculine and feminine identities to become legitimate
Cadieux et al. (2002)	n=4, case studies	Explore the succession processes of family businesses ran by women	Female owners reluctant to begin succession-planning until necessitated by circumstances; Points of resistance include characteristics and traits of owner-manager; poor communication between incumbent and successor; lack of trust between incumbent and successor
Campopiano et al. (2017)	n=87, systematic literature review	Map literature on women's involvement in family business	Drivers and outcomes of women's involvement in family firms outlined; research gaps identified and research questions proposed
Cater & Young (2022)	n=18, qualitative case studies	Examine the preparation process for daughters as successors in family firms in the United States	Reciprocal social exchange process between parent mentors and daughter successors; Significant elements in the preparation process: positive childhood experiences, choosing and earning relevant college degree, daughter's autonomous decision to enter family firm, guided on-the-job training, counsel and advice to overcome crucial issues of male gender bias and childcare responsibility; Difference between mothers and fathers as mentors in understanding daughter's position in firm
Cesaroni et al. (2021)	n=2, longitudinal case studies	Understand how women entrepreneurs involved in a succession process as incumbent manage their double identities of entrepreneur and mother, and the interplay of the two identities	In succession processes with father as incumbent, mothers act as mediators, but in case of mothers as incumbents, fathers are not involved, mediator role not required
Chang et al. (2020)	n=9, narrative inquiry	Explore the aspects of succession planning in family business, especially the role of female family members in succession and conflicts	Lack of consideration for female family members in succession planning; lack of involving female family members shortens lifespan of business
Chen et al. (2021)	n=247	Examine whether the gender of entrepreneurs' children affects corporate innovation and long-term decision making	Entrepreneurs with male heirs exhibit more long-term orientation and innovativeness in decision-making than those without, due to preference for sons succeeding them
Chrisman et al. (1998)	n=485	Investigate the most important successor attributes in family business succession	Integrity and commitment to the business rated as most important attributes; birth order and gender found to be least important
Cicellin et al. (2015)	Theoretical paper	Examine the impact of paternalistic leadership on the gender diversity of family firm succession	Proposed model of how benevolent, authoritarian or moral paretnalistic leadership styles of the predecessor affect male and female successors: a benevoltent style favours female successors, an authoritarian style favours male successor, and a moral style provides equal chances for the success of succession regardless of gender

Author and year	Sample and method	Aim of Study	Results
Cosson & Gilding (2021)	n=34	Examine wives' influence on family business succession	Wives influence succession through normative (child-raising), interactive (emotional management) and experiential (reconfigured marital dynamics and gender roles) socialization; Wives influence children's vocational choices, either encouraging or discouraging them from joining the family business
Curimbaba (2002)	n=12; Multiple case study	Analyze how the family and business structures affect the daughters' visibility in managerial positions, and the resulting gender relations	Dynamic Triangular Model of heiresses (Professional, Anchor, Invisible)
Deng (2015)	n=4, case study approach	Explore factors facilitating and impeding father-daughter succession in chinese family businesses	Daughters in study were encouraged from a young age to become successors; Importance of good relationship with father highlighted; Taking over father's social capital seen as a challenge; Successor daughters may have difficulty in establishing authority
Dumas (1989)	n=20	Examine father-daughter relationships in relation to family business succession processes, and daughter's identity construction	„Caretaker of the king's gold" as daughter's identity: Caring for the father and the business alike; Five steps of managing the father-daughter relationship: Consider daughters as viable resources; Assess and discuss the daughter's potential; understand female developmental issues; Uncover assumptions about the process; Provide crucial training
Feldmann et al. (2022)	n=2897	Predict the career status of the sample of young Europeans (aged 18–35) from 11 countries, with at least one self-employed parent	Gender identity is associated with career status; Women more likely than men to be employees vs. successors to a family firm; However, women no less likely to be a founder than either being an employee or successor
Fernandes et al. (2017)	n=12; Two focus groups of 5 (inherited family business) and 7 (started own business); Discourse analysis of data collected	Compare how businesswomen with different initial bounds to their businesses resort to gender discourses to construct a shared business identity in group interaction	The identities of businesswomen are constrained and produced by different masculinities (authority, professionalism and self-determination) and femininities (restrictive and emancipatory)
Ferrari (2019)	n=11, italian family SMEs	Investigate the power dynamics of mother-daughter succession in family business	Power assymmetry remains in mother's favour even after succession; legitimacy of daughter successors challenged even by woman predecessors; power is important in itself, regardless of the gender of who excercises it
Galiano & Vinturella (1995)	n=10	Explore biases and underlying perceptions toward females in a family business context	While traditionally successor gender impacted succession planning, positive examples of female successors show changing attitudes
Gherardi & Perrotta (2016)	n=2, qualitative analysis	Explore the interplay between gender and legitimacy in family business succession; Family business conceptualised as locus where two regimes of engagement are present, generating the copresence of two orders of worth: the domestic and the industrial	The daughters' perceived gender inequality in the succession process is justified; the dual regime of engagement is what justifies the reproduction of a specific gender regime
Gimenez-Jimenez et al. (2020)	n=18576	Explore the role of affective commitment in the relationship between family business exposure and succession intentions in the context of enterprising families; Investigate the moderating role of gender and birth order in the relationship between family business exposure and affective commitment in the context of enterprising families	Affective commitment partially mediates the relationship between family business exposure and offspring's succession intentions; This relationship is stronger for sons than for daughters, primogeniture an influenching factor; Birth order has no effect on relationship between family business exposure and affective commitment.
Halkias et al. (2010)	n=63	Investigate the trend for daughters in Asian family businesses to succeed their fathers, and factors that impede or support succession intentions of daughters	Men more likely to stay in family business than women, who often seek employment elsewhere; family business environments in Asia still male-dominated, restrictive for women, who choose to „run away"
Harveston et al. (1997)	n=983	Examine the extent to which differences are evident between male- and female-led family businesses in succession planning processes	Significant differences in succession-planning process between male- and female-led family businesses; Explanations could be differences in characteristics or human capital of owners, or differences in firm size/ formalization
Hossain et al. (2022)	n=287	Examine the impact of the factors such as governance board, gender and business strategies on the succession planning in Bangladeshi family-owned businesses	No impact of gender on succession processes of family-owned businesses
Humphreys (2013)	n=14, qualitative thematic analysis	Examine how daughters take the lead in their family businesses; Investigate relevant issues that characterize the succession process for daughters, the attributes of daughter successors, and what, if any, features distinguish their leadership style	Skill and commitment override gender in successor selection; successor-incumbent relationship key; mentoring by incumbent tthe principal vehicle for transfer of business leadership; Emotional competence a key successor quality
Hytti et al. (2017)	n=4, narrative analysis & case study research	gendered analysis of how daughters navigate family businesses and construct identities as family business leaders	Daughters construct gender and leadership identities in interactions with others by opposing, expanding and making use of the gendered scripts available to them; they produce masculinized identities as strong owners; daughters have to navigate unspoken attitudes, hidden assumptions, stereotypes, power relations and expectations from external and internal stakeholders

Author and year	Sample and method	Aim of Study	Results
Karataş-Özkan et al. (2011)	n=8	Examine the key drivers for active involvement, contributions and challenges of women in family businesses	Drivers behind active involvement: independence, a sense of responsibility, flexibility in work arrangements, high income, career opportunities, a sense of belongingness; Contributions: Growing & Restructuring business, improving processes and communication; Challenges: work-home conflict, invisibility, lack of female peers
Kaslow (1998)	n=2, case study approach	Examine mother-son family business succession dynamics and interactions	Female incumbents take more responsibility for the preparation of their successor than male incumbents; Mother-daughter-in-law rivalry must be taken into account
Koffi et al. (2014)	n=7, case studies	Examine how credibility of successor is achieved in family business succession	Male and female incumbent leaders adopt different behavioral strategies in order to bring credibility to their successors.
Li et al. (2020)	n=5, qualitative analysis	Understand the experiences, motivations, challenges and opportunities of second-generation female entrepreneurs in chinese family businesses	Motivations of women entrepreneurs centered more on internal "pull" factors (e.g., self-actualization, independence, achievement) rather than external "push" factors (e.g., economic pressures); Major challenges include tense relationships with parents, gender-role conflicts, and alignment issues with the family businesses' established culture.
Maciel et al. (2020)	n=652	Identify the factors that influence the decision of the selection of a woman successor in the family business	Female owner/manager increases likelihood of female successor - likewise, male ownership decreases likelihood; larger businesses less likely to have female successors; industry sector also influential
Martinez Jimenez (2009)	n=74, systematic literature review	Analyse obstacles to and positive aspects of involvement of women in family business	Obstacles involve invisibility, emotional leadership, and primogeniture
Maseda et al. (2022)	n= 225, Bibliographic literature review	Map literature on women's involvement in family business	Five thematic clusters: (1) female entrepreneurs and family firms; (2) women in family-firm governance; (3) family–business dynamics; (4) women in business succession; and (5) temporal and spatial dimensions of women's involvement; Research questions proposed by authors
McAdam et al. (2020)	n=14	Explore daughter's identity construction in father-daughter succession, and the role of gendered relations in identity work	Legitimate successor identity co-constructed with incumbent father; Factors enabling co-construction: Support and preparation from father; partnership between father and daughter, or „osmotic credibility"; father's endorsement of daughter; Factors constraining co-construction: lack of shared vision; father's generational shadow
Mussolino et al. (2019)	n=4, narrative analysis	Analyze how female successors describe their self-positioning in male-dominated family businesses, once the succession process has occurred	To be accepted within dominant social norms, daughters use particular trajectories for self-positioning to reflect masculine norms
Mustafa et al. (2019)	n=2, qualitative analysis	Investigate how do gender perceptions/ attitudes influence successors' learning and development in family businesses	Gendered perceptions of incumbent influence learning strategies of the successor; knowledge provided or withheld based on gender of the successor; Female successors adopt experimental and observational learning methods as alternative
Nelson & Constantinidis (2017)	n=157, literature review	With what meaning and to what degree does the family business succession literature historically consider gender and/or sex as a theoretical construct and variable of interest?; How can a social construction of gender lens be conceptualized to add value to family business succession research moving forward?	The family business succession literature undertheorizes gender; When the succession literature considers gender, it regards it as a stable and objective condition of women; The succession literature demonstrates a deep tension between patriarchal and egalitarian gender norm system viewpoints; The succession literature embeds the gendered lens of its researchers, largely unspoken.
Otten-Pappas (2013)	n=6, multiple case study design	examine to what extent female successor commitment displays particular characteristics and which insights this sheds on successor commitment theory.	Imperative commitment was not observed; normative commitment was only observed when the female successor was the oldest sibling and when a crisis/emergency occurred; : the occurrence of a crisis/emergency (e.g. death of the incumbent or business crisis) is proposed as an additional antecedent for normative commitment; successor commitment among female successors was found to change over time; all female successors either kept or developed affective commitment; personal opportunity costs are an important component of calculative commitment for female successors; female successors showed a particular combination of affective and calculative commitment
Overbeke et al. (2013)	n=21	Examine how implicit and explicit factors such as gendered cognitions, contextual factors, and daughters' deliberative thought processes contribute to their decisions to seek family firm succession	Daughters are often blind to the possibility of succession; Succession only considered when motivated by critical event; Key role of parental support and mentoring

Author and year	Sample and method	Aim of Study	Results
Phikiso & Tengeh (2021)	n=120	Investigate the qualities and attributes that family-owned businesses desire in a potential successor	Characteristics preferred by incumbent: management skills; leadership skills; ability to relate well with members of the family; show interest in becoming successor, possess greater aptitude than other family members; understand the business vision; trustworthiness; commitment to the business; management experience; related by blood or law; able to harmonise the interests of the family with those of the business.
Ramadani & Gërguri-Rashiti (2017)	n=97, systematic literature review	Explore the recent trends in global marketing, gender and family entrepreneurship in Asia; Provide an overview about research on global marketing, gender and family entrepreneurship in Asian countries and future directions	Motivating factors for female entrepreneurs include the desire for autonomy, freedom, and flexibility; succession in larger asian family businesses still focuses on male successors
Ramadani et al. (2017)	n=10, multiple case study approach	Identify opportunities for women to become corporate leaders in family businesses through succession planning, in an Indonesian context	Benefits of involving women in the management of family businesses include their personal traits of patience, fastidiousness, tenacity and thriftiness; wider access for Indonesian women to corporate management positions, and broader participation for them is required
Remery et al. (2014)	n=232	Investigate gender differences among (potential) successors of Dutch family firms regarding education, self-perceived capabilities and ownership ambition	Clear gender difference regarding ownership; men strive more often for full ownership, while women opt for shared ownership instead
Sardo et al. (2022)	n=7135	Analyze the effects of gender and succession on the financing behavior of SME family businesses	Speed of adjustment towards target debt ratio is lower in family firms under female ownership; second and further generations positively influence speed of adjustment, this effect is stronger under female ownership
Schröder et al. (2011)	n=106	Investigate the determinants of career choice intentions of adolescents with family business background	Personality traits, gender, adolescent identification with the family business, perceived parental job rewards, parental succession preference and preparation all significantly differentiate adolescents' career choice intentions.
Smythe & Sardeshmukh (2013)	n=7	Examine relationship quality in father-daughter successions in family business	Early socialisation within the family business, good communication between father–daughter, and deep understanding of the father's shadow helps daughters during the succession process; Daughters use business as a way of bonding with their fathers
Soost & Moog (2019)	n=633	Examine gender differences in organizational performance after succession in family firms, considering social and liberal feminist theories	Succession is gendered, men and women manage their business differently; Female successors realize equal revenues to male successors, but employ more people on average, leading to lower productivity of sales/employee; However, female and male successors have equal satisfaction and growth prospects
Swogger (1991)	n=4, case analysis	Explore the dynamics of intergenerational succession, with emphasis on relationships between members of successor generation	Bond between siblings, autonomy regarding role in family business, leadership skills key for successor generation
Umans et al. (2021)	n=259	Investigate antecedents of succession planning in family firms such as: founder status, family CEO's inability to let go, and the family CEO's gender.	Family firms led by founders show lower succession planning levels than family firms led by descendant family CEOs - linked to founders' inability to let go. Male CEOs affected more than female CEOs - suggesting women find it easier to let go
Urban & Nonkwelo (2020)	n=210	Investigate intra-family dynamics with regard to daughters as potential successors in family businesses	Business context, intra-family cohesion, intra-family adaptability and the parent-daughter relationship are key factors in successful daughter succession planning
Vera & Dean (2005)	n=10	Determine the extent of challenges daughter successors face in a family business context	Challenges include employee rivalry, work-life balance difficulties, blindness to the possibility of succession, harsh comparisons to predecessor in case of mother-daughter succession (but not father-daughter)
Xian et al. (2021)	n=20, qualitative interpretivist approach	Understand daughters' views on gender, family business leadership and succession; Examine the approaches adopted to negotiate the role of female successor/leader in the Chinese family business	Identity construction is a negotiation between simultaneous roles of daughter and future leader; Three strategies identified: (1) follow traditional gender norms and act as temporary leader, (2) act as „second leader", (3) challenge gender norms and act as independent leader

Source: own compilation

VANDA HARMAT

CHATBOTS FROM THE USERS' PERSPECTIVE – A SYSTEMATIC LITERATURE REVIEW

CHATBOTOK A FELHASZNÁLÓK SZEMSZÖGÉBŐL – SZISZTEMATIKUS IRODALMI ÁTTEKINTÉS

The application of chatbots in business organizations is becoming ever more widespread. When developing an interface, besides the aspects of efficiency, human values, and users' social and emotional needs also should be respected. From this perspective, understanding the impact of human-chatbot interaction (HCI) on individuals' behavior is paramount. This article aims to contribute to the exploration of users' perspectives on chatbots through a systematic literature review of 31 papers examined with content analysis. The results show that besides functionality, entertainment is also important for users during HCI. The growing magnitude of humanlike attributes that could support this need does however not provide users with the feeling of satisfaction but can evoke feelings of anxiety instead.

Keywords: **chatbot, human-chatbot interaction, HCI**

A chatbotok alkalmazása az üzleti szervezetekben egyre elterjedtebbé válik. A felhasználói interfész kialakításánál a hatékonyság mellett az emberi értékeket, a felhasználók szociális és érzelmi igényeit is figyelembe kell venni. Éppen ezért kiemelten fontos megérteni az ember-chatbot interakció (HCI) hatását az egyének viselkedésére. Jelen cikk célja, hogy hozzájáruljon a felhasználók chatbotokkal kapcsolatos perspektívájának a feltárásához egy szisztematikus irodalmi áttekintésen keresztül. Az eredmények alapján láthatóvá vált, hogy a funkcionalitás mellett a szórakoztatás is fontos a felhasználók számára a chatbotokkal folytatott interakció során. Az ezt az igényt kielégítő emberi tulajdonságok megléte a chatbotok esetében azonban nem feltétlen nyújtja a felhasználóknak az elégedettség érzését, sokkal inkább a szorongás érzését válthatja ki.

Kulcsszavak: **chatbot, humán-chatbot interakció, HCI**

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Several studies examined the effectiveness of tools used to automate organizational processes (Willcocks, Lacity & Craig, 2015; Marciniak, Móricz & Baksa, 2020) and communication (Rossmann, Zimmermann & Hertweck, 2020). However, the consideration of social aspects is also becoming more common in technology-related research (Rapp, Curti & Boldi 2021), starting from the theory of social interface, according to which people react to technology-mediated communication as if it were their partner (Mehra, 2021). Such artificial interactions can also be carried out by chatbots, which are able to imitate the feeling of a social situation (Szűcs & Jinil, 2018), through their communication with the users without human intervention based on pre-written scenarios and rules (Harmat, 2023). Chatbots can perform several tasks, therefore more and more companies decide to implement them to make business processes more effective (Luo, Lau, Li & Si, 2021). However, users' willingness to regularly communicate with them may generate some challenges. Dautenhahn (2013) stated that besides technological features, developers should create chatbots that also respect humans' social and emotional needs.

Recent systematic literature search on chatbots focused on their application in an educational context

(Wollny et al., 2021; Pérez, Daradoumis & Puig, 2020), in tourism (Calvaresi et al., 2021), in the financial sector (Wube, Esubalew, Weldesellasie & Debelee, 2022) and healthcare (Gentner, Neitzel, Schulze & Buettner, 2020). In contrast, Rapp, Curti & Boldi (2021), Suhaili, Salim & Jambli (2021) systemized the literature on chatbots from a broader view as they did not define any special application area. Bilquise, Ibrahim & Shaalan (2022) dealt with emotionally intelligent chatbots and Rapp, Curti & Boldi (2021) examined the effects of human-chatbot interaction (HCI) on users thereby highlighting the importance of HCI's social aspects. Applying the approach of Rapp, Curti & Boldi (2021) and Bilquise, Ibrahim & Shaalan (2022) the article aims to contribute to the exploration of users' perspective on chatbots through a systematic literature review. Following Dautenhahn's (2013) statement, the study strives to understand, how HCI affects individuals' behavior to discover what social and emotional needs should be considered when developing a chatbot. To explore that, we conducted a systematic literature search. Our corpus consisted of 31 journal articles. As a result of the content analysis, we identified seven key issues, among them users' expectations, attitudes, experiences, satisfaction, perceptions, trust, and acceptance. We organized the presentation of the results under these topics.

The study is structured as follows. At first we present the methodology of literature research. The next section deals with the results of the descriptive analysis. The results of the content analysis are presented in the following section. This part is followed by the conclusions, and then we deal with the theoretical limitations and future research.

Methodology

A systematic literature search was applied to map out the publications focusing on the users' perspective on chatbots. This data collection method is "explicit, comprehensive, and repeatable" and aims to identify, evaluate, and synthesize the publications of researchers and practitioners (Fink, 2005, pp. 3-4). The research was conducted according to Okoli & Schabram's (2010) methodological recommendation. After identifying the relevant articles, the data was examined using content analysis to find the emerging topics.

Research goal

The goal of the systematic literature search is to identify the relevant articles related to users' perspectives on chatbots. The research questions are based on the distinction of the human-chatbot interaction's context: (1) *What do we know about the users' perspective on chatbots in a real real-life context (interaction between existing corporate chatbots for external communication / existing corporate chatbots for internal communication and customers/ organization members)?* (2) *What do we know about the users' perspective on chatbots in an experimental setting (interaction between experimental chatbot and research subject)?*

Search strategy

Our search strategy follows the exhaustive review with a selective citation scenario proposed by Cooper (1988). This coverage method means that the researcher reviews a manageable number of papers instead of trying to find every available research published or unpublished. This procedure allows the inclusion of only journal articles (Randolph, 2009). Thus, the search base consisted of peer-reviewed, English-language journal articles. As the literature search was conducted in August 2021 and its goal was to identify all relevant journal articles, the search base consisted of papers that were published no later than 2021. The subject areas were narrowed down to "Computer Science", "Social Sciences", "Psychology" and "Business, Management, and Accounting". The articles were searched in SCOPUS and Science Direct using the following keywords: "chatbot" AND "expectation" OR "motivation" OR "attitude" OR "experience" OR "satisfaction" OR "perception" OR "trust" OR "acceptance" and "human-chatbot interaction". *Table 1* shows the number of search results by database and keyword.

Table 1

The number of search results by database and keyword

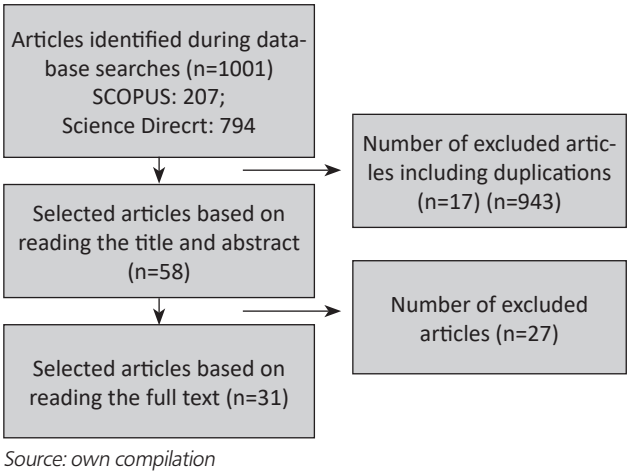
Database	Keywords	Number of results
SCOPUS	*„chatbot" AND „expectation" OR „motivation" OR „attitude" OR „experience" OR „satisfaction" OR „perception" OR „trust" OR „acceptance"*	197
	human-chatbot interaction	10
Science Direct	*„chatbot" AND „expectation" OR „motivation" OR „attitude" OR „experience" OR „satisfaction" OR „perception" OR „trust" OR „acceptance"*	778
	human-chatbot interaction	16
In total		1001

Source: own compilation

Selection process

Figure 1

Flowchart of the systematic literature search



Source: own compilation

The total number of search results in the databases was 1001 articles. Based on a review of titles and abstracts, 926 publications and 17 additional articles (duplicates) were disregarded. As a result, 58 studies remained in the analysis pool, and 27 publications were excluded after reading the full text. Thus, as a result of the systematic literature search, we found 31 relevant journal articles (*Figure 1*).

Regarding the inclusion criterion, we made a distinction between the conditions for classifying publications as closely related and partially related articles. Articles defined as closely related deal with the perspective of users on chatbots in a real-life context. The partially related articles also explore user perspectives on chatbots but in an experimental setting. It has been defined as an exclusion criterion if the article does not discuss users' perspective on chatbots or it examines the phenomenon in a non-business context (the latter includes publications examining the user experiences of interactions with chatbots used for health, education, or therapeutic purposes) (*Table 2*).

Table 3

Distribution of selected articles by date of publication

Year	2015	2018	2019	2020	2021
Number of articles	1	1	6	10	13

Source: own compilation

Chatbots' application areas

Twelve articles of the corpus used an experimental method to examine user attitudes related to human-chatbot interaction in a laboratory setting, and most cases, chatbots were developed for the research. Two publications (Croes & Antheunis, 2021; Skjuve et al., 2021) explored user experiences of interaction with existing social chatbots. The application areas of the chatbots were e-commerce (n=7), customer service (n=3), tourism (n=1), telecommunications (n=1), B2B communication (n=1), and banking services assistance (n=3). Only two articles (Brachten, Kissmer & Stieglitz, 2021; Jang, Jung & Kim, 2021) were identified that examined the attitudes of organization members towards chatbots used to automate internal communication.

Table 2

Inclusion and exclusion criteria

I/E	Criterion	Criterion description	Database	Number of publications
INCLUSION	Closely related	It discusses the perspective of the consumer/organization member towards the chatbot in a business / organizational context.	Science Direct	4
			SCOPUS	13
	Partly related	It discusses the users' perspective towards the chatbot in general.	Science Direct	5
			SCOPUS	9
EXCLUSION	Not related	It is not about users' perspective on chatbots. It is not in a business / organizational context and does not discuss users' perspectives on chatbots in general.	Science Direct	772
			SCOPUS	181

Source: own compilation

Data extraction and the presentation of results

The present review has a research outcome-oriented and theoretical focus (Cooper, 1988), as it aims to explore the results of research examining users' perspectives on chatbots and to discover the applied theories. Regarding the purpose of the literature review, it attempts to identify the central issues in the field. As a result of the content analysis, seven main issues have emerged, among them users' expectations, attitudes, experiences, satisfaction, perceptions, trust, and acceptance. We present the selected articles' results and applied theories organized under these seven topics.

Descriptive analysis

Publication date of the selected articles

Most of the studies that make up the corpus have been published in the last two years. 42% (n=13) of the articles were published in 2021 and 32% (n=10) in 2020. (*Table 3*). 16% (n=5) of the articles were published in the journal Computers in Human Behavior, while 9.6% (n=3) were in the International Journal of Human-Computer Interaction.

Content analysis

Expectations

The exploration of expectations on chatbots has great importance, as they affect users' perceptions that may define the overall satisfaction when interacting with chatbots (Rapp, Curti & Boldi, 2021).

Chaves & Gerosa (2020) identified 11 attributes that are important to equip chatbots to avoid experiencing frustration and dissatisfaction during a human-chatbot interaction. These characteristics were categorized into the following three main groups: conversational intelligence, social intelligence, and personification. Conversational intelligence includes proactivity, conscientiousness, and communication. Proactivity means that the chatbot asks follow-up questions, provides additional information, and suggests new topics, thus keeping the conversa-

tion alive and contributing to a more natural interaction. Conscientiousness refers to the attention provided by the chatbot, the meaningful answers, the continuity of the conversation, the use of visual elements, and the transparency of the chatbot's identity. Communicability means that the user's expectations are well managed through offering the next steps and providing assistance. Social intelligence covers the ability to repair damage (handling unfriendly users, identifying abusive sentences, ignoring offensive sentences), thoroughness (showing humanity, authenticity, consistency in interaction), the way of behaving (politeness, expressing gratitude, continuing small talk), morality (avoiding stereotypes, building a distortion-free database, avoiding alienation), emotional intelligence (reciprocity, use of social-emotional expressions, making the identity of the interactive agent transparent, displaying emotional reactions), and personalization (learning from the user, recommending custom services, data security). Finally, personification - which refers to the anthropomorphization of the chatbot - includes the interactive agent's identity (balance of identity and technical skills) and its personality (appropriate language use, user-adapted sense of humor, balance of personality traits).

Attitude

Attitude is an internal mental process defined by several factors and circumstances in which individuals evaluate the entities around them positively or negatively (Kohlmann, 2018). Attitude also influences an individual's actions. Examining users' attitudes towards chatbots can help in predicting their behavior during HCI.

Based on the factors of the Consumer Technology Acceptance model (CAT) and the PAD dimensions (pleasure, arousal, dominance) of the Environmental Psychology model (EPM), Zarouali et al. (2018) examined users' attitude development to a chatbot assisting in ticket reservation. The authors' model of unified technology acceptance considers not only cognitive factors (perceived usefulness, perceived ease of use, perceived helpfulness) but also the role of affective factors (joy, liveliness, dominance), through the examination of users' intention to use the chatbot technology. Zarouali et al. (2018) found a positive relationship between two cognitive factors (perceived usefulness, and perceived helpfulness), all affective elements of the unified consumer technology acceptance model (pleasure, liveliness, dominance), and attitudes about chatbots, respectively. The authors found that the acceptance of chatbots depends not only on the role of cognitive factors but also on how users feel about technology.

Kasilingam (2020) examined user attitudes and intent to use a chatbot providing online shopping assistance. The author has included seven factors (perceived usefulness, perceived ease of use, perceived entertainment, price awareness, perceived risk, trust, and personal innovation) in his research model that may influence consumer attitudes and intentions to use technology. The results of the research showed that perceived usefulness, perceived ease of use, perceived fun, price awareness, perceived risk, and personal innovation influenced attitudes toward chatbots. However, in addition to attitude, the intention to use was only directly influenced by trust and personal innovation.

Experience

User experience related to technology is often examined through the perception of usability (Denecke, Hochreutener, Pöpel & May. 2018; Denecke, Vaaheesan & Arulnathan, 2020), however, in this study, we define experience as the users' feelings and thoughts when they interact with chatbots. User experiences play an important role in technology acceptance.

Skjuve et al. (2019) investigated whether not revealing the chatbot's identity evokes the phenomenon of the uncanny valley described by Mori (1970). Their results showed that the lack of transparency did not induce the "uncanny valley" effect; however, the authors identified the long waiting time during the conversation as a factor similar to the uncanny valley phenomenon that caused discomfort to users.

Ciechanowski et al. (2019) revealed that a simple, text-based chatbot caused fewer anxious feelings in the user compared to a more advanced chatbot with an avatar. The simple chatbot also evoked less intense reactions from the subjects and received more positive reviews.

Hill, Ford & Farreras (2015) compared the evolution of interactions between people and the chatbot in terms of quality (word uniqueness, use of profanity, shorthand, and emoticons) and quantity (words per message, words per conversation, messages per conversation). The results showed that messages sent to chatbots contained on average fewer words than those sent to the human interaction partner, however, the subjects sent more than twice as many messages to the chatbot than to the human interaction partner. It was also found that individuals used vulgar and negative terms in their interactions more with the chatbot than with the human partner.

In their research, Skjuve et al. (2021) used the Social Penetration theory to examine the phases along which human-chatbot interaction evolves. The authors found that the evolution of the human-chatbot relationship bears similarities to the process of interpersonal relationship development described by the theory of social penetration. Nevertheless, it also has specific conditions, including the disclosure of the chatbot's identity to build trust, which plays a central role in establishing the human-chatbot connection. The stages of development identified by the authors are as follows:

(1) Exploratory phase: users are not yet familiar with the technology; they have not developed trust in the chatbot. At this stage, the curiosity towards the chatbot and the desire to experience the novelty keep the interaction alive.

(2) Affective phase: Trust develops at this stage. The chatbot's accepting, supportive, understanding, and non-judgmental behavior, as well as revealing its identity contributes to trust significantly.

(3) Stable phase: in this phase of relationship development, the user already shares everyday events with the chatbot and enjoys the benefits of regular interaction,

including self-reflection facilitated by conversations with the chatbot.

Croes & Antheunis (2021) also examined the human-chatbot relationship, namely, whether the longer-term use of the chatbot could lead to a social connection – more specifically, friendship – between the human and the chatbot. The authors based their research on the ABCDE Relationship Development Model (A: attraction, B: building, C: continuation, D: deterioration, E: ending). In the frame of the research, participants interacted with the social chatbot seven times, after which they completed a questionnaire about their experiences. The results showed that the sense of friendship was increasingly reduced in the users during the interactions. Although the experience of novelty appeared at the time of the first interaction, later the chatbot became predictable, and as a result, the individuals found the interactions less enjoyable. Subjects became less and less socially attracted to the chatbot over time, and for some time were reluctant to open up and found the chatbot less empathic or competent, which, according to the ABCDE model, necessarily brought about the decline or termination of the relationship. The authors concluded that the research subjects did not develop emotions towards the chatbot and the chatbot did not become their friend.

Satisfaction

The main goal in the development of HCI systems is to achieve user satisfaction that has long been based solely on usability and efficiency but has recently been supplemented with the need to experience the entertainment provided by the interaction. Satisfaction requires the coincidence of the user's expectations and experiences with chatbots (Rapp, Curti & Boldi, 2021).

Shumanov & Johnson (2021) formulated their hypothesis of satisfaction with the chatbot based on the Similarity-Attraction theory. According to the theory, similarities between the interaction partners' personality has a positive effect on satisfaction. The authors used the Big Five Personality test to examine whether the perception of similarities leads to satisfaction. The interaction style of the chatbots was adapted to the subjects' personalities. The introverted chatbot engaged in efficient, goal-oriented communication, while the communication of the extroverted chatbot was characterized by the pursuit of a user experience. The authors found that the language used by chatbots does contribute to a sense of personalization, commitment, and satisfaction.

Ashfaq et al. (2020) conducted their research based on several models to examine the determinants of user satisfaction with chatbots, including the Expectation-Confirmation model, the Information System Success model, the Technology Acceptance model, and the Need for Interaction with a Service Employee. Their results showed that the chatbot's up-to-date, reliable, fast response and the provision of personalized attention have a positive effect on user satisfaction and, through this, on their intention to continue using the technology. The results also revealed that continuance intention (CI) is positively influenced by perceived enjoyment (PE), perceived usefulness (PU), and perceived ease of use (PEOU).

Chung et al. (2020) identified two groups of factors that can affect satisfaction: the effort made by the chatbot (interaction, entertainment, trendiness, customization, problem-solving), and the quality of communication (accuracy, information credibility, communication competence). The research results show that the chatbots used to sell luxury brands can also contribute to the acquisition of a favorable shopping experience that supports the establishment of a consumer-company relationship.

Li et al. (2020) investigated the factors that determine user demand for subsequent use of chatbots used to automate the provision of information related to travel services. The authors examined user satisfaction along the following quality dimensions that determine intent for further use: understanding, reliability, responsiveness, security, and interactivity. The results of the research showed that all quality dimensions except responsiveness had an impact on user satisfaction and, through this, the intention to use it later. The authors explain the lack of a link between responsiveness and satisfaction by stating that in China (the country in which the research was conducted), consumers are accustomed to quick responses from the human workforce, so this did not play a key role in creating their need for later use.

Eren (2021) studied user satisfaction with a chatbot used in banking services based on the Expectation-Confirmation theory, which examines consumer behavior and purchasing decisions based on perceived performance. The results revealed that perceived performance, trust, and organizational reputation show a significant relationship with consumer satisfaction with chatbots.

Cheng & Jiang (2020) examined how the use of chatbots affects overall consumer satisfaction based on the Uses and Gratification theory. The authors identified four possible categories of user satisfaction with chatbot use, which are (1) utilitarian: the usefulness and accuracy of the information provided by the chatbot, (2) hedonist: the fun experienced during the interaction and emotional support, (3) technology: simplicity and speed of technology availability and (4) social: experiencing a social presence. The research results confirmed that these categories have a positive effect on consumer satisfaction and through this the intention to use them later.

Tsai, Liu & Chuan (2021) examined how the anthropomorphic nature and social presence of the chatbot contribute to the consumer's brand commitment. The authors also incorporated the concept of parasocial interaction as a factor influencing positive branding. We speak of parasocial interactions when the relationship that people build with media people resembles an interpersonal relationship for them but is one-sided (Kassing and Sanderson, 2015). Tsai, Liu, and Chuan's (2021) research revealed that the anthropomorphic nature of a chatbot positively influenced the perception of social presence through parasocial interactions, which also had a positive effect on user brand engagement.

Perception

Examining the perception of chatbots helps to define the determinants of users' satisfaction. Based on the results of the present literature search, this area proved to be one of the most significant, as seven journal articles dealt with this topic.

Mehra (2021) examined the perception of chatbots with different personalities. For the research, three chatbots were developed based on the Big Five personality model. The three chatbot personalities were the transactional, the prosocial, and the friendly ones, respectively. The transactional chatbot was characterized by efficient and focused task performance, by as little interaction as possible, and by seriousness. In contrast, the prosocial chatbot was anthropomorphic in nature and placed more emphasis on social interactions, however, this personality was also characterized by a certain degree of distance. The friendly chatbot has been developed to interact with users as if they were close friends. The results showed that the majority of the subjects preferred the friendly chatbot, as the users perceived the interaction with it as the most comfortable and the most effective.

Lee, Lee & Sah (2019) also examined user perceptions of anthropomorphic traits. These were analyzed not in relation to the personality but to the mind (mental state) of the chatbot, namely, whether the perception of the mental state of the chatbot contributes to social presence and proximity and the intention to use. The authors claim that perceiving a mental state also has cognitive and emotional benefits for the users, as it contributes to a more meaningful experience with the chatbot and to the feeling that the user is chatting with an intelligent entity. It was found that the more conscious the subjects perceived the chatbot, the stronger their sense of social presence and interpersonal closeness was.

Han (2021) examined whether the perceptions of the humanness of a chatbot affect the perception of social presence and entertainment. The results of the study revealed that the anthropomorphization of a chatbot has a positive effect on the perception of social presence and entertainment, which play an important role in purchasing decisions.

Schuetzler, Grimes & Giboney (2020) investigated how a higher level of a chatbot's ability to chat affects the perception of social presence and humanity, as well as user engagement. The study found that chatbots with higher levels of conversational ability (which communicated with the research subject in a personalized manner and used a variety of terms in the interaction) had higher perceptions of social presence and anthropomorphic character, as well as engagement.

Beattie, Edwards & Edwards (2020) also conducted a study on chatbot perception, focusing on how the chatbot's use of emojis affects the perception of social attractiveness, competence, and authenticity. The results revealed that subjects also found the human interaction partner and chatbot to be more socially attractive, competent, and authentic when using their emojis in their communication.

Go & Sundar (2019) investigated the effect of the appearance of anthropomorphic visual signals on the interface, the interactivity of the message, and the perception of identity in their research. The authors revealed that the chatbot was able to create a sense of social presence without being visible to the user or having an identity because message interactivity could compensate the users for the lack of visual character or identity of the chatbot.

Park et al. (2021) investigated how the nature of communication with a chatbot is influenced by the perceived humanity, social competence, and ideological background of the user. The results of the research showed that the ethical orientation of the subjects influences the nature of their communication with the chatbot. Idealists were more likely to communicate more kindly with the chatbot, while relativists tended to use offensive terms. Furthermore, it became apparent that the more humane individuals perceived the chatbot, the more vulgar or hurtful the terms were used.

Jang, Jung & Kim (2021) examined perceptions of chatbots from the perspective of managers. The authors used the theory of social representations (SRT) as the basis for their research to explore collective interpretations of the chatbot. The authors found that the perception of managers regarding the use of chatbots is twofold: in addition to articulating the undoubted benefits of introducing the technology, they also perceive the challenges it generates.

Trust

Trust is a cognitive assessment and a subjective sense that security as a psychological need is present (Mayer et al., 1995). Trust plays an important role in human-chatbot interaction, especially if the user shares personal information with the chatbot which is risky (Zamora, 2017). In several HCI publications, trust appears as a determinant of attitudes towards chatbots (Kasilingam, 2020).

Toader et al. (2019) examined the effects of perceived social presence, perceived competence, and anthropomorphic character on the development of trust in the chatbot and positive consumer responses. To create their research model, the authors used the Social Information Processing theory, the Media Equation theory, and the Computers Are Social Actors (CASA) paradigm as a basis. The results have shown that the gender of the chatbot plays an important role in the development of trust and positive consumer responses. Consumers' reviews of the anthropomorphic chatbot with a female identity remained positive even when the chatbot made a mistake. The results also showed that subjects who interacted with the female chatbot were more likely to share personal information about themselves and elevate patronage intention (i.e., recommending the use of the chatbot to other individuals). They also found that errors of female chatbots were more often forgiven by users compared to those of male chatbots. Finally, it was demonstrated that chatbots that work without errors are more likely to incentivize a purchase, raise patronage intention, and also tend to make customers more satisfied.

Nordheim, Følstad & Bjørkli (2019) developed an initial model of trust in chatbots. Their model included elements revealed in the literature (expertise, predictability, humanity, ease of use, risk, reputation, propensity to trust technology), and two other factors identified by them. These factors are responsiveness (the ability of chatbots to respond quickly and efficiently as an additional factor) and the perception of the brand.

Cheng et al. (2021) examined the effect of human characteristics (empathy, friendliness) attributed to the chatbot, the disclosure of the identity of the chatbot, and the complexity of the task performed by the chatbot on the development of trust in connection with an e-commerce chatbot. The results show that the perceived empathy and friendliness of the chatbot have a positive effect on the development of trust, whereas empathy plays a more significant role compared to friendliness. The complexity of the task had no significant effect on the relationship between empathy and trust, while it was moderately affected by the disclosure of the chatbot's identity.

De Cicco, Silva & Alparone (2020) examined how perceived social presence – i.e., the feeling that one is present with someone else – affects the development of trust towards the chatbot, the experience of fun during the interaction, and the general attitude towards chatbots, respectively. The authors examined the perception of social presence along two variables, namely, whether the chatbot has an avatar or not, and whether its interaction style is relationship-oriented or task-oriented. The authors have shown that a relationship-oriented style of interaction contributes to the perception of social presence. It has also become apparent from the study that a sense of social presence plays a role in perceiving the entertaining nature of trust and interaction, which in turn leads to the development of positive attitudes towards the chatbot. However, the authors found no association between the appearance of the chatbot with an avatar and the perception of social presence.

Acceptance

Acceptance is the assessment and attitude following the use of technology (Schuitema et al., 2010) and a condition for the success of an implemented system, so it is paramount to understand how technology characteristics affect users' technology acceptance (Davis, 1987).

Richad et al. (2019) studied the willingness to accept a chatbot used in a banking environment based on the Technology Acceptance Model (TAM). The authors added innovation as an exogenous factor to the variables, i.e., the subject's attitude towards novelties. Their results have shown that innovation, perceived usefulness, perceived ease of use, and attitudes toward using chatbots have increased users' intentions of use.

Rese, Ganster & Baier (2020) investigated the willingness to accept an online shopping assistant chatbot. Their research was based on the Technology Acceptance Model and Uses and Gratification theory. Research revealed that the authenticity of the conversation, its perceived usefulness, and entertainment positively influenced the willingness to accept the chatbot. At the same time, safety and the maturity of the technology had a negative effect on the intention to use and the frequency of use.

Behera, Bala & Ray (2021) examined the willingness to accept a chatbot used to automate B2B communication based on the Technology Acceptance Model and the Information Systems Success model. In addition to elements of the TAM and ISSM models, the authors also included perceived trust and perceived risk as possible determinants of the willingness to accept the chatbot. The results of the research show that perceived ease of use (PEOU), perceived usefulness (PU), and perceived trust (PT) play an important role in the formation of user attitudes and intentions to use. It was also found that perceived information quality (PIQ), perceived system quality (PSYQ), and perceived service quality (PSEQ) have an impact on user satisfaction.

Brachten, Kissmer & Stieglitz (2021) pointed out that before introducing chatbots into organizations, it is crucial to understand what factors influence employees' willingness to accept and adopt an interactive agent (without alienation from the technology). The authors used the theory of Planned Behavior as a basis for studying the phenomenon, which contributes to learning about the intention to use chatbots. The results of the research revealed that attitude played a greater role in the formation of intent to use than external factors, such as subjective norms and perceived behavioral control. It was also found that the influence of peers on the intention to use was more significant than the influence of leaders.

Conclusions

The literature review aimed to explore users' perspectives on chatbots with a research outcome-oriented and theoretical focus. As a result of the content analysis, seven topics have emerged in connection with human-chatbot interaction such as user expectations, attitude, experience, satisfaction, perception, trust, and acceptance. Most of the selected articles dealt with users' perceptions and satisfaction, while expectations, experience, and attitudes were examined only by a few publications.

Regarding users' expectations, Chaves & Gerosa (2020) identified 11 characteristics that are important for users during human-chatbot interaction. Having these attributes, a perfect entity emerges in a cognitive and affective sense that rarely appears in real human-to-human interactions. Based on this, the question arises as to whether humans need an artifact that does not have errors and owns the superintelligence and moral superiority as Gladden (2016) described it.

The studies have shown that in addition to cognitive factors, affective factors also play an important role in the development of attitudes toward chatbots. This implies that users' feelings should also be considered when developing such technology.

Regarding users' experience with chatbots, surprisingly, during the longer-term use of chatbots, individuals were less willing to interact with them because it became predictable

for them, resulting in a loss of novelty with the technology. These findings raise the question: what can create a need for multiple interactions with the chatbot? Studies examining user experience have also shown that simpler chatbots with no "uncanny valley" effect evoked less strong reactions from the users, as opposed to more complex interactive agents, which contradicts the results of Chaves & Gerosa (2020) regarding user expectations about chatbots.

Several articles focused on users' perceptions of chatbots, examining the phenomenon in terms of the anthropomorphic nature of the chatbot. One of the research findings was that individuals allowed themselves to use offensive, negative language in their communication with the chatbot much more than with a human interaction partner. Offensive communication had no negative consequences on users, which however is not true in a workplace context. Therefore, it may be an interesting question whether this use of the language is typical in the case of employees as well, given that they know the interactions could be stored by the chatbot.

Trust in the chatbot was another topic studied by the corpus articles, which is determined by several factors, including the reputation of the company's brand. This finding draws attention to the phenomenon that in an organizational context employees' trust in chatbot technology may be influenced by their commitment to the company.

Cheng & Jiang (2020) applied the User and gratification Theory to examine customer satisfaction. The author found the dimension of U&G Theory influences positively user satisfaction. It would be interesting to explore whether employees' satisfaction with chatbot technology can be positively influenced by the dimension of the model including social needs and hedonism.

The studies on acceptance showed that besides the perceived usefulness and perceived ease of use, entertainment is also an important factor for the users. Other research shows (Ciechanowski et al., 2019) that the less humanlike attributes evoke less intense reactions from the users and receive more positive feedback. Based on this one can conclude that interface developers must find the right proportion between the functional and anthropomorphic characteristics of the chatbot.

As described above, the corpus articles studied human-chatbot interaction typically only from one aspect. Although, the focus on one issue helps to expand the specific knowledge of one area, for creating successful human-chatbot interaction systems, all factors and their connections should also be considered. As *Figure 2* shows, before interacting with chatbots, users already have expectations and attitudes influenced by their beliefs and previous knowledge. During human-chatbot interaction, they gain experiences and perceptions of the technology. If their experiences and perceptions coincide

Table 4

Theories used by corpus articles

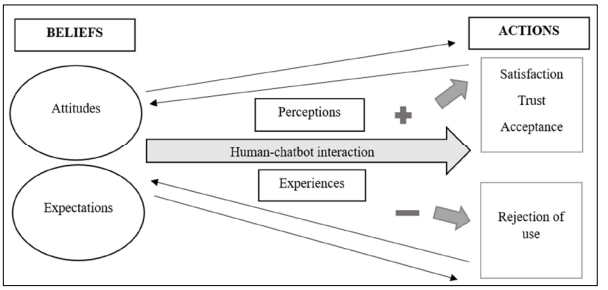
TOPIC	APPLIED MODEL	AUTHOR(S)
Attitude	Consumer Technology Acceptance Model (CAT)	Zarouali et al. (2018)
	Environmental Psychology model (EPM, PAD)	
	Technology Acceptance Model (TAM)	Zarouali et al. (2018) Kasilingam (2020)
Experience	Uncanny valley	Skjuve et al. (2019) Ciechanowski et al. (2019)
	ABCDE relationship development model	Croes & Antheunis (2021)
	Social Penetration Theory (SPT)	Skjuve et al. (2021)
Satisfaction	Similarity-attraction theory (SAT)	Shumanov & Johnson (2021)
	Big Five personality test	
	Information Systems Success model (ISSM)	Ashfaq et al. (2020)
	Technology Acceptance Model (TAM)	Ashfaq et al. (2020)
	Expectation Confirmation Model (ECM)	Ashfaq et al. (2020) Eren (2021)
	Uses & Gratification theory (U&G)	Cheng & Jiang (2020)
	Social Presence Theory (SP)	Tsai, Liu & Chuan (2021)
Perception	Big Five personality test	Mehra (2021)
	Social Presence Theory (SP)	Han (2021
	Theory of Social Attraction (SA)	Beattie, Edwards & Edwards (2020)
	Theory of Social Representations (SRT)	Jang, Jung and Kim (2021)
Trust	Social Presence Theory (SP)	Toader et al. (2019)
Willingness to accept	Uses & Gratification theory (U&G)	Rese, Ganster & Baier (2020)
	Planned Behavior theory (TPB)	Brachten, Kissmer & Stieglitz (2021)
	Technology Acceptance Model (TAM)	Richad et al. (2019) Rese, Ganster & Baier (2020) Behera, Bala & Ray (2021)
	Information Systems Success model (ISS)	Behera, Bala & Ray (2021)

Source: own compilation

with their expectations, they will be satisfied, accept the technology and they will have trust in chatbots. Due to their experiences, users' attitudes may change towards the technology, which influences their later actions.

Figure 2

The connection between the identified topics



Source: own compilation

In the databases in which we conducted the literature search, no articles have been found that overviewed the theories applied for examining human-chatbot interaction. As a result of our analysis, we identified the models by topics scholars use for examining human-chatbot interaction (*Table 4*). Some theories were used for studying more topics such as the Technology Acceptance model that appeared not only in acceptance but also in attitude and satisfaction research. Most of the publications used existing theories, and only two studies created new models. One of them was developed for measuring trust in chatbots (Nordheim, Følstad & Bjørkli, 2019), and the other one was for the exploration of the human-chatbot relationship development (Skjuve et al., 2021). Some theories were applied more often such as the Theory of Social Presence, the Big Five Personality test, the Uses & Gratification Theory, the Information Systems Success Model, and the Expectation-Confirmation model. Most of the selected articles applied quantitative methods and some of them combined the variables of more models. Consequent to the literature review, it can be seen that the use of existing models from other fields and quantitative methods is dominant in human-chatbot interaction research. However, chatbot technology has its features, therefore the development of new models may help to better understand users' perspectives on chatbots. The application of qualitative methods may contribute to the deeper analysis of the nature of human-chatbot interaction.

Limitations

Our search strategy followed the exhaustive review with a selective citation scenario which means we included only the peer-reviewed journal articles in the search base. This way, conference papers, book chapters, and other publications were excluded thus hindering the identification of all relevant research in the field.

The literature search was conducted only in two databases which means we could not discover all the suitable publications.

Another limitation of our research was that we did not overview the reference list of the selected papers which would have helped to find more relevant articles.

Future research

Only two publications of the selected articles examined the attitudes of organization members toward chatbots used to automate internal communication. The study of human-chatbot interaction in a workplace context may enrich the research field. We claim that employee-chatbot interaction may generate different results in terms of satisfaction, expectation, or acceptance because workers are not allowed to reject the use of chatbots.

As the results show, besides functionality, entertainment is also important for users when interacting with a chatbot, but the presence of too many humanlike attitudes does not necessarily lead to user satisfaction. Therefore, it would be important to research the right proportion of social and technological functions of a chatbot.

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ZOLTÁN NAGY – JÁCINT JUHÁSZ

DEMAND PLANNING FOR BUILDING ENGINEERING PRODUCTS – A CASE STUDY WITH TRANSFORMER-BASED NEURAL NETWORKS

ÉPÜLETGÉPÉSZETI TERMÉKEK KERESLETTERVEZÉSE – ESETTANULMÁNY TRANSZFORMER ALAPÚ NEURÁLIS HÁLÓZATOKKAL

Efficient demand planning holds critical significance for businesses. In this research, the authors investigate the applicability of the Temporal Fusion Transformer, a neural network-based model, to address demand planning challenges. Specifically, they explore the potential benefits of incorporating additional information related to product characteristics and sales channel types. The primary objective of this study is to assess the advantages gained by incorporating these supplementary variables. The dataset utilized in this analysis originates from a company predominantly engaged in the sale of building engineering products. The authors initially focus on static attributes such as product groupings and time-varying attributes such as sales channel variations. This paper's contribution lies in its comprehensive case study, which applies the Temporal Fusion Transformer model to a real-world demand planning problem of the company, including all its specifications and customizations.

Keywords: **time series forecasting, demand planning, neural networks**

A hatékony keresletтervezés kritikus jelentőségű a vállalkozások számára. Ebben a kutatásban a Temporal Fusion Transformer neurális hálózat alapú modell alkalmazhatóságát vizsgálják a szerzők a keresletтervezési kihívások kezelésére. Konkrétan megvizsgálják a termékjellemzőkkel és értékesítési csatornatípusokkal kapcsolatos további információk beépítésének lehetséges előnyeit. Kutatásuk elsődleges célja e kiegészítő változók beépítésével nyert előnyök felmérése. Az elemzésben felhasznált adatállomány egy túlnyomórészt épületgépészeti termékek értékesítésével foglalkozó cégtől származik. Kezdetben a statikus tulajdonságokra, például a termékcsoportokra, majd az időben változó tulajdonságokra, például az értékesítési csatornaváltozásokra összpontosítanak. A tanulmány fő hozzájárulása az átfogó esettanulmány, amely alkalmazza a Temporal Fusion Transformer modellt a vállalat keresletтervezési problémájára, az összes specifikációjával és testreszabásával együtt.

Kulcsszavak: **idősor előrejelzés, keresletтervezés, neurális hálózatok**

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Forecasting holds a central position within supply chain management due to its profound significance and the broad-ranging effects it has on various viewpoints of the supply chain. Accurate analysis and forecasting yield valuable insights into future demand, empowering companies to make well-informed decisions concerning production scheduling, inventory control, and resource allocation. By foreseeing customer requirements and market trends, organizations can optimize their operations, cut down expenses, and elevate customer satisfaction levels. The practice of forecasting empowers businesses to synchronize their supply with demand, averting situations like stockouts or excessive stockpiling. Moreover, it fosters effective collaboration with suppliers, facilitating the timely procurement of materials and components, trimming lead times, and cultivating stronger supplier relationships. Also, forecasting is a crucial risk management tool, identifying disruptions and enabling proactive responses.

The importance of forecasting accuracy is highlighted in the J.P. Morgan Working Capital Index Report 2022 (Shah et al., 2022). The report analyzed financial data from S&P 1500 companies spanning 20 industries, collectively accounting for approximately 90% of the total U.S. market capitalization.

The companies were categorized into three groups based on their working capital metrics: the top 25%, the middle 50%, and the bottom 25%. The analysis indicated that the bottom 25% needed to enhance their performance to reach the industry average. This enhancement uncovered an overinvestment in working capital amounting to $523 billion by the end of 2021. Since working capital is defined as the combination of inventory and accounts receivable, adjusted for accounts payable (which are nearly identical), this suggests a close relationship between inventory and working capital. Consequently, optimizing working capital aligns closely with optimizing inventory, underscoring the significance of effective working capital management. Additionally, PWC's report from 2021 (Windaus & Tebbett, 2021) found that global overinvestment in working capital over 5 years amounted to $1.2 trillion. U.S. companies demonstrated inventory performance indicators that were 33% better than those in Europe and 46% better than in Asia.

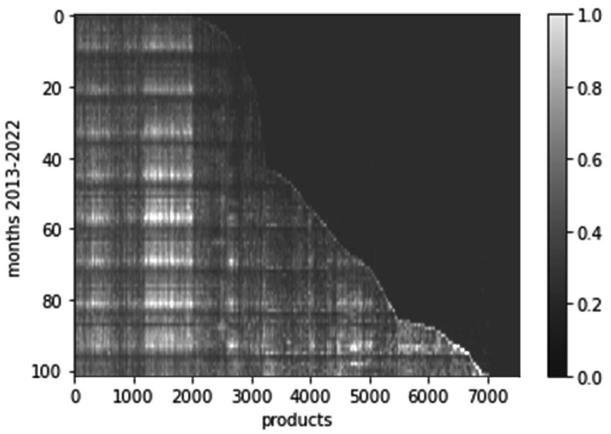
The effect of working capital on small and medium-sized companies is more pronounced, as (Nobanee, 2017) highlighted in a study of 5802 US non-financial firms. His finding reveals a negative and highly correlated relationship between the cash conversion cycle and profitability for small firms, in contrast with a weak positive relationship for medium and large firms. This relationship is the focus of much empirical research in various regions and countries all around the world. (Deloof, 2003) studied 1000 Belgian firms between 1992-1996 suggesting value creation possibility in reducing inventory and shortening receivables period. Another research paper, (Lazaridis & Tryfonidis, 2006), came to the same conclusion for companies in Greece, highlighting the value creation by optimizing the components of the cash conversion cycle. A broader study (Garcia et al., 2012) analyzed 2974 non-financial companies from 11 European countries for 12 years (1998-2009) and concluded that working capital decisions have a significant effect on profitability regardless of country, industry, and fiscal year.

On the other hand, the correlation between forecast accuracy and service level remains a topic of discussion, frequently reliant on management choices about inventory management strategies. A lot of companies opt for a fixed-cycle service level approach. In these scenarios, forecast accuracy and service level work in conjunction to establish the safety stock, consequently impacting the overall cost associated with the inventory policy.

(Barros et al., 2021) assessed nine distinct methods for calculating safety stock, each of which demonstrated an exponential relationship involving the service level and the standard deviation of the forecast error, incorporating different adjustment factors. Conversely, certain management strategies favor an optimization-based approach to service level, aiming to find an equilibrium point between inventory expenses and potential sales loss. Even when examining a limited set of variables, the connection between inventory and service level follows an exponential trend. This was also highlighted in the research conducted by (Jeffery et al., 2008) where a boost of 10% in service level resulted in a 100% increase in inventory.

Figure 1

Normalized portfolio over the months from 2013 to 2022



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Our study focuses on demand planning based on time series forecasting using historical demand data, product characteristics, and external factors. In these situations, is crucial to understand the difference between sales and demand data, as in general the company rarely possesses demand information and often there is confusion with sales data, replacing sales with demand. Such confusion leads to shifting the forecast from demand to sales target and there are significant differences between these two. Demand planning aims to predict future customer demand for a company's products or services. It provides insights into what customers are likely to purchase in terms of

quantity and timing, while sales target setting involves establishing specific, measurable sales goals or targets that a company aims to achieve within a defined period and often incorporates specific business logic. For example, a business logic might forbid decreasing trends, but demand planning could indicate such trends.

Drawing upon the previously mentioned concepts, we have emphasized the significance of accurate forecasts. In the upcoming section, we introduce the specific issue we investigated in our case study.

Problem statement

In this paper, we address the demand planning problem faced by a company specializing in building engineering products. With an inventory of approximately 8,000 critical items, maintaining their availability while avoiding overstocking is essential. Thus, accurate forecasting is crucial for the company's seamless operation. To achieve this, we conducted a thorough analysis of a dataset obtained from the company aiming to develop a tailored and precise forecasting model.

On the other hand, the company is experiencing rapid expansion, diversifying its product offerings significantly. This trend is clearly illustrated in Figure 1, which displays the normalized extension of the product portfolio from 2013 to 2022, showcasing the quantities sold. In Figure 1, the dark values represent nearly zero values, while the light values approach or reach one. This portfolio analysis reveals several noteworthy insights. Firstly, the portfolio has expanded in 2022 more than threefold from its initial state in 2013. Secondly, some products exhibit distinct seasonal patterns, repeating every twelve months.

In our specific study, we have focused on conducting an analysis exclusively on products that have remained in the portfolio for at least six years. This selection process yielded a total of 2625 products that formed the basis of our analysis.

The company places a strong emphasis on the 6-month forecast horizon, viewing it as the most critical timeframe for its operations. To ensure the accuracy of these forecasts is closely monitored, they conduct biweekly evaluations. It's worth highlighting that while long-term forecasts, such as those for 12 or 18 months, are indeed significant, they are carried out just once a year and require extensive manual adjustments and speculative analysis. In such cases, even the most advanced methods have limited usability.

This paper's primary contributions encompass three key elements: Firstly, it entails an in-depth case study conducted on the company's dataset. Secondly, it examines the company's portfolio with a neural network model. Lastly, the paper demonstrates the potential benefits achievable through the incorporation of various supplementary products and sold quantity information.

The findings of the current work hold significant relevance for both practitioners and researchers. For practitioners, both the model itself and the resultant outcomes demonstrate their utility in real-world business environments, underscoring the practical applications and opportunities they offer. Simultaneously, for researchers engaged in this field, these findings are valuable as they demonstrate the potential of incorporating covariates in the modeling process of the time series.

In the subsequent sections, we aim to conduct a literature review concerning the cutting-edge models currently employed in the creation of time series forecasting models.

Literature review

In recent years, the field of time series modeling and forecasting has gained substantial attention, owing to its increasing importance and relevance across various domains. One pioneering work in this field, (Anderson, 1977), introduced the Auto-Regressive Integrated Moving Average (ARIMA) model, revolutionizing the approach to time series analysis. ARIMA establishes a vital link between present and past data points, particularly excelling in modeling stationary time series.

Another notable contribution, (Gardner Jr, 1985), presented exponential smoothing as an alternative to the traditional ARIMA model, well-suited for handling non-stationary time series. Extensions and adaptations of these models have since evolved, such as seasonal ARIMA (Hipel et al., 1977), designed for seasonality, and Holt-Winter's model (Chatfield, 1978), extending exponential smoothing to handle seasonality.

Despite their utility, it's important to highlight that fine-tuning these models often requires expert knowledge for optimal parameter selection, a crucial consideration in practical applications.

The Generalized Additive Model (GAM) represents another valuable approach to time series modeling and forecasting, as discussed in (Hastie & Tibshirani, 1987). A GAM model decomposes a time series into its fundamental components, including elements like trend and seasonality. These models can be conceptualized as curve-fitting tools, with regression techniques employed to determine the associated parameters, as highlighted in (Hong & Wang, 2014). Although GAMs have enjoyed recognition for some time, they were recently rediscovered (Taylor & Letham, 2018) with the introduction of a novel modeling methodology known as *Prophet*. Their inherent simplicity and transparency set these models apart, as they define a time series by breaking it down into its constituent elements. Also, GAM models offer the advantage of analyzing each component individually, facilitating the identification of changes in trends and their correlation with specific events or factors.

Over the past few years, there have been new methods created that take advantage of neural networks for predicting and modeling time series. As neural networks have improved, they have become more commonly used for analyzing time series. While Long Short-Term Memory (LSTM) networks have existed for a while, they were limited by the tools available for machine learning. But now, with the development of simple and easy-to-use frameworks like TensorFlow, Keras, and PyTorch, resear-

chers can apply neural network-based solutions more efficiently to forecast and analyze time series.

Various models employing specific LSTM network architectures have been explored for time series forecasting. For instance, (Chimmula & Zhang, 2020) treated the COVID-19 transmission as a time series problem and used an LSTM network for modeling. Additionally, (Altan & Karasu, 2022) focused on crude oil prediction and employed LSTM in their model. Similarly, in the work by (Nguyen et al., 2021), both forecasting and anomaly detection were addressed within the context of supply chain management.

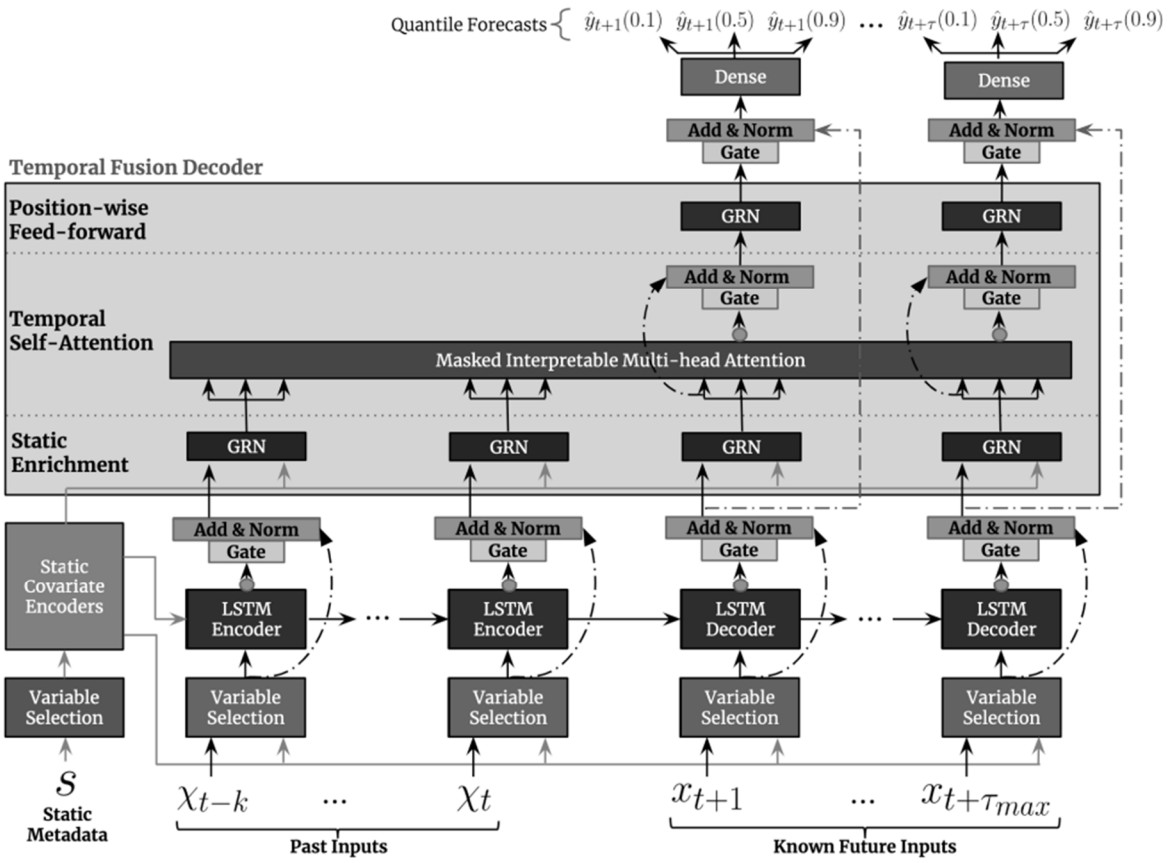
It's important to highlight that the models mentioned earlier primarily focus on univariate modeling, meaning they handle individual time series in isolation without considering their interconnections. However, a recent and intriguing model known as the Temporal Fusion Transformer (TFT) was introduced in (Lim et al., 2021). TFT is an attention-based model that employs the novel encoder-decoder strategy called the transformer, as originally presented in (Vaswani et al., 2017). One notable advantage of TFT is its ability to model multi-horizon and multi-input data, allowing it to learn from other data points beyond its own. TFT can also improve forecasting accuracy by incorporating additional covariates, such as historical and geographical information or other additional information that could help improve forecasting accuracy. With its dual capabilities of generating forecasts for datasets and effectively utilizing supplementary information, the TFT model emerges as a compelling choice for addressing demand planning challenges. For example, (Wu et al., 2023) successfully employed this approach in an application where they leveraged the benefits of covariates within the TFT to predict and model tourism demand during the COVID-19 pandemic.

Several alternatives to the TFT exist in the field of time series forecasting. One such alternative is DeepAR (Salinas et al., 2020), developed by Amazon, which employs an autoregressive model using LSTM-based neural networks. This model also integrates covariates and delivers probabilistic forecasts. However, it falls short in one important aspect when compared to TFT: it cannot provide feedback regarding the significance of covariates, a feature offered by TFT through its attention-based layers. Another similar model is N-BEATS (Oreshkin et al., 2020), which employs a deep neural architecture based on both backward and forward residual links, combined with a deep stack of fully-connected layers. A drawback of N-BEATS is its inability to handle extra covariates. The NHITS model (Challu et al., 2023) is specifically designed for forecasting time series with long forecasting horizons and can also handle covariates. However, it falls short of providing probabilistic or quintile forecasts.

Overall, when comparing these recent models, the

Figure 2

TFT architecture



Source: Lim et al. (2021, p. 1751)

TFT model stands out as the most promising option due to its comprehensive feature set. These include its capability to produce quintile forecasts, manage additional covariates, and simultaneously handle multiple time series. Our primary objective in this study is to thoroughly investigate the potential of the TFT model. Our initial hypothesis is that by using these extra covariates the forecasting accuracy could be improved.

Next, we present briefly the TFT model which is followed by the case study developed with the dataset obtained from the company. Note that, we refer to a time-stamped quantity vector as a *time series* and the term *dataset* to refer to a set of time series. Additionally, the terms *covariate* and *feature* are used interchangeably in the manuscript, referring to extra information about the time series.

Temporal Fusion Transformer (TFT) models

A recent breakthrough in this field is the introduction of a transformer-based solution, as highlighted in the study (Lim et al., 2021). The TFT model introduces an innovative attention-based structure that combines advanced multi-horizon forecasting with interpretable insights into temporal dynamics. Compared to other neural network architectures, TFT offers several unique features.

In addition to the traditional time-value vectors, this model allows for the incorporation of covariates, which are supplementary inputs that enhance its performance. These covariates fall into several categories: time-dependent or static, real or categorical, and known or unknown. Time-dependent covariates refer to variables that change with time; for instance, weather conditions can be considered time-dependent, whereas the material composition of a product remains static, such as being made of copper for example. Moreover, weather can be represented as a real value due to its numerical nature, while months can be categorized as discrete features since their possible values are predefined (e.g., January, February, etc.). Lastly, the known or unknown classification relates to whether we possess future knowledge about a covariate. Depending on a company's policies, we may or may not have information about the future price of a product, but one certainty is that we lack knowledge about future sales quantities.

Based on (Lim et al., 2021), the architecture of the TFT model can be observed in Figure 2.

Furthermore, the TFT also helps us to understand the importance of several of these covariates. The model gives feedback on which features were the most important in the generation of the forecasts. It gives a ranking with percentages based on the importance of these features. In comparison to other neural network-based methodologies, such as the example presented in (Nguyen et al., 2021), where the importance and impact of individual factors on the forecast remain undisclosed, TFT offers a distinctive advantage. With TFT, this information is available after the training, empowering us to make more informed decisions when considering the incorporation of new features. Moreover, the model also highlights the significance of the temporal vector, pinpointing precisely which segment of the historical time series played the most pivotal role in the forecast.

Another notable benefit of this model is its capacity to provide more than a mere point forecast; it also generates a quantile forecast, thereby furnishing valuable metrics that quantify the level of confidence associated with the forecast.

Before starting the model training, a series of hyperparameters can be configured regarding the model. While we won't delve into the intricate specifics here, we would like to emphasize a few of them. For an in-depth understanding, we recommend referring to (Lim et al., 2021).

Among the hyperparameters available for fine-tuning, the learning rate stands as a pivotal parameter. It plays a critical role in determining the initial pace at which the model progresses towards approaching its near-optimal parameters. To elaborate further, if the learning rate is set excessively low, the model may struggle to converge to a local optimum, potentially stalling its training progress. Conversely, if the learning rate is overly large, the model might exhibit erratic behavior, oscillating around local minima without effectively settling on an optimal solution.

Another crucial hyperparameter is the dropout rate. Dropout is a regularization technique employed to prevent overfitting in neural networks. This rate determines the proportion of randomly selected neurons that are temporarily dropped out during each training iteration. It helps enhance model generalization by introducing an element of uncertainty, preventing any single neuron from becoming overly specialized on the training data. In the case of our analysis to find the near-optimal hyperparameters we used an automatic tuning process, the *optuna* (Akiba et al., 2019).

Based on the advantages of the TFT, we consider that this model architecture represents an interesting modeling approach capable of offering valuable insights into our data. In the subsequent section, we delve into the details of the training process.

Training process

To guarantee a comprehensive and reliable evaluation of our models, we divided the dataset into three distinct segments: the training set, the validation set, and the testing set. Each of these segments plays a crucial role in ensuring the quality and effectiveness of our models. The training dataset primarily serves the purpose of deriving model parameters, while the validation dataset plays a crucial role in evaluating the model's performance and mitigating overfitting risks.

Furthermore, an epoch represents a single complete pass through the entire training dataset during the training of a neural network. It is a fundamental unit of iteration in training, helping the model update its parameters by learning from each data point.

Overfitting occurs when a model is exclusively trained on the training dataset, gradually improving its performance in each epoch without any external reference or control. To prevent this scenario, we incorporate the vali-

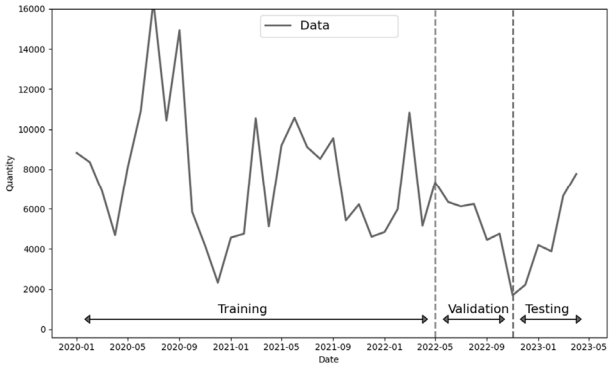
dation dataset into the process. We continuously assess the model's performance on this independent dataset, ensuring that it doesn't overly adapt to the noise present in the training data. This precaution is essential because the noise encountered in the training data may differ from that in the validation data, and by monitoring both, we aim to create a more robust and generalizable model.

Lastly, the testing dataset remains untouched during the model development phase. It serves as an objective benchmark, providing an unbiased measure of the true performance of our models. This dataset offers a critical assessment of the models' capabilities on unseen data, assuring the reliability and generalizability of the results.

It's worth noting that similar approaches to data partitioning have been employed in several studies (El Bourakadi et al., 2023; Lim et al., 2021). For a visual representation of this data partitioning strategy for a specific product, please refer to Figure 3.

Figure 3

Splitting the data to training, validation, and test



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Numerous software packages are available for constructing a TFT model. For our study, we harnessed the Python environment, leveraging the PyTorch package, more precisely, the PyTorch Lightning and PyTorch Forecasting packages.

To maintain consistency in initializing the model's parameters and eliminate randomness, we employ identical initialization with random values across all iterations. Furthermore, we ran all of our training for 50 epochs, from which we selected the best-performing parameter set with respect to the validation.

Performance measures

To evaluate the forecast's accuracy, we use the Symmetric Mean Absolute Percentage Error (SMAPE) metric (Koutsandreas et al., 2022). The SMAPE formula is as follows:

$$SMAPE = \frac{1}{N}\sum_{k=1}^{N}\frac{2|y(k)-\hat{y}(k)|}{|y(k)|+|\hat{y}(k)|}$$

$$SMAPE(\%) = \frac{1}{N}\sum_{k=1}^{N}\frac{2|y(k)-\hat{y}(k)|}{|y(k)|+|\hat{y}(k)|}100(\%)$$

In this equation, represents the true value at point , and denotes the estimated value. SMAPE provides symmetrical results, treating scenarios where the true value is, for instance, 5 and the forecasted value is 100, the same as cases where the true value is 100 and the forecasted value is 5.

Moreover, SMAPE inherently yields values within the range of 0% to 200%. However, it's important to note that the SMAPE function itself is not symmetric in the sense that it assigns higher values for underestimation and lower values for overestimation. For instance, with a true value of 100 and a forecasted value of 140, the resulting SMAPE is 16%. Conversely, with a true value of 100 and a forecasted value of 60, the SMAPE becomes 25%, despite both cases having the same absolute difference between the true and forecasted values.

This distinction between underestimation and overestimation is useful from our business perspective as lost sales due to understocking do more harm than incremental costs generated by overstocking. The relation between lost sales and increased inventory cost generally has a convex form, based on (Janakiraman & Roundy, 2004), and it is difficult to express in a simple formula. In our study, we believe that by using SMAPE, we can effectively highlight the significance of preventing stockouts, thereby favoring the outcome of overstocking.

Data preprocessing

In this section, we delve into the details of the problem. Our analysis encompasses the portfolio, resulting in a dataset comprising 2,625 products. These products have been included in our analysis because they possess data spanning at least six years. The data we are examining covers the period from January 2013 to October 2022 (see Figure 1).

Predictions in the TFT model are based on a collection of input values known as encoders. The choice of encoder length is a hyperparameter, and in our case, we employed a 12-month encoder length due to the yearly periodicity of the data and its monthly granularity. Moreover, the prediction horizon is set at 6 months, as it represents the primary and frequently used forecasting timeframe of the company. In the subsequent sections, we will outline our approach to addressing missing values within the dataset and provide a comprehensive exploration of the dataset's features.

Handling missing and negative values

Given the extensive dataset, some months lack sales for certain products. Regression models handle this well, but models like TFT rely heavily on prior values. While various strategies exist in the literature for addressing this challenge, see e.g., (Bashir & Wei, 2018; Liu et al., 2020), we won't delve into these details here. We refrain from

delving into extensive details about handling missing values because it hinges on understanding the underlying reasons for those gaps, necessitating a deeper grasp of the business logic and product portfolio. To handle missing data, we set sales to 0 for dates with no recorded sales, ensuring forecasts closely align with reality.

On the other hand, in certain instances, negative data points may appear, indicating anomalies within the system. These anomalies should also be considered in the context of business logic. However, given the main topic of this manuscript, we address this issue by replacing negative values with zeros. In our future research endeavors, we intend to delve deeper into these cases and explore them more thoroughly. Nevertheless, for the current paper, this topic falls outside its scope.

Dataset

The dataset consists of three primary columns: *Date, ItemID,* and *OrderedQty*. The *ItemID* column is used for product identification, while the *OrderedQty* column records the quantity of the product sold. The *Date* column indicates the month in which the sales quantity is recorded. In addition to the aforementioned columns, we also have a set of static covariate columns, namely *MGName, GroupName, SubGroupName*, and *ReqGroupID*. *MGName* designates the primary category to which the product belongs, such as Installation products, Interior design products, Electronic products, DIY products, and more. The *GroupName* column provides details about the specific category within the main category. For instance, within the Installation products' main category, we have the *Pipes* group. *SubGroupName* further narrows down the specification within the group; for instance, it might specify *copper pipes*. Lastly, *ReqGroupID* indicates the product's priority level.

Furthermore, we also consider time-varying covariates in our analysis. Initially, the *OrderedQty* represents the aggregated quantity sold, consolidating sales across all distribution channels. To introduce additional features, we incorporate information about the specific channels through which these products were sold. In this company, three primary channels exist: *Shop* for in-store purchases accessible to any walk-in customer, *Eshop* representing sales on the company's website, and *B2B* referring to sales to other retailers who subsequently sell the products to end clients.

In our analysis, we have identified both static and time-dependent variables that we have included as covariates. Our objective is to explore the benefits derived from incorporating these additional covariates. To achieve this, we will investigate four specific scenarios in the subsequent sections:

- Case 1 - Using base information: product id, date, and quantity
- Case 2 - Using base information and static covariates
- Case 3 - Using base information and time-varying covariates
- Case 4 - Using base information with both static and time-varying covariates

Now we are ready to present the main findings of the paper.

Main results

Within this section, we will comprehensively explore each distinct scenario, commencing from Case 1 and progressing through to Case 4. Our objective is to provide a thorough account of our observations and findings for each case, ensuring a comprehensive presentation of our results.

To ensure reproducibility, we employed the following model hyperparameters, which were derived from the base information. You can find these hyperparameters outlined in Table 1.

Table 1

Hyperparameters

Max epoch	*50*
Gradient clip value	*0.8033*
Learning rate	*0.0111*
Hidden size	*70*
Attention head size	*2*
Dropout	*0.2903*
Hidden continuous size	*16*

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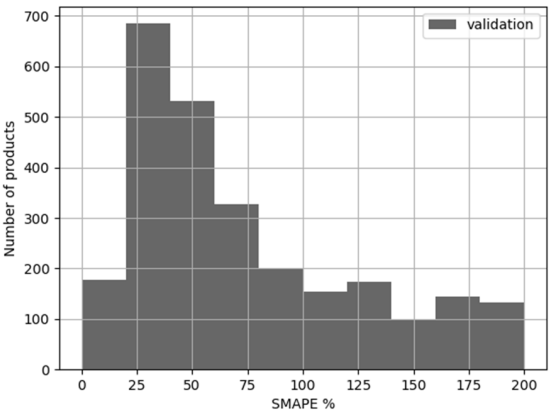
Case 1

In Case 1, we used the training data to determine the parameters while using the validation set to prevent overfitting. The model underwent 50 training epochs, during which we selected parameters from the epoch that exhibited the lowest quintile loss on the validation dataset. Our findings from this process are reflected in Figure 4, where we present a histogram of these SMAPE percentages on the validation data.

Figure 4

Histogram of SMAPE % of the products on the validation data



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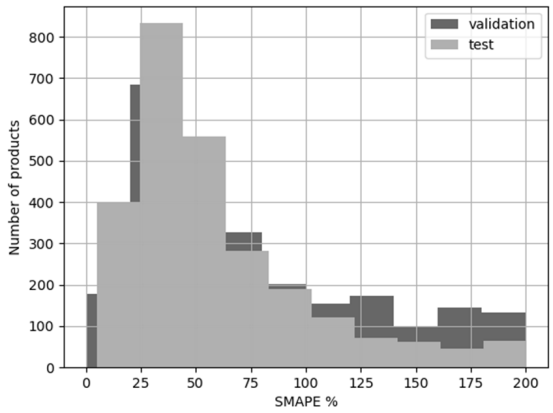
We can observe that nearly half of the products exhibit SMAPE values below 50%. The median SMAPE stands at 58.74%, while the mean SMAPE is 75.93%.

Additionally, Figure 5 illustrates the SMAPE histog-

ram for the untouched test data along with the validation data. In this scenario, the median SMAPE is 47.02%, with a mean of 60.14%. Notably, an interesting pattern emerges: the model's performance on the test data surpasses that on the validation data. This phenomenon could potentially be attributed to the selling seasonality, primarily occurring in August, September, October, and November. As the test data spans from May 2022 to October 2022, it encompasses the peak of this season, likely contributing to the improved performance.

Figure 5

Histogram of SMAPE % of the products on the validation and test data



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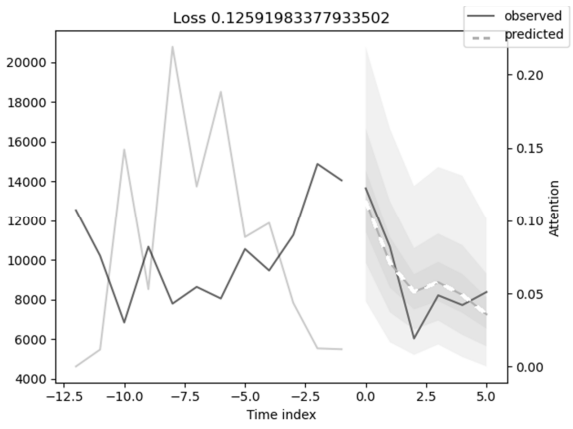
Moreover, we delve into a more detailed examination of one of the top-performing predictions, as displayed in Figure 6. In this visual representation, the true values are depicted in black, while the forecasted values are presented with dashed grey color. Notably, the plot also includes shaded regions of grey, indicating the forecast's quantiles. These quantiles serve the purpose of maintaining confidence in the forecast, proving particularly valuable in scenarios like "what if" analyses, where decision-makers, such as managers, may seek to enhance the sales of specific product types.

Figure 6

Prediction compared to validation – product id: anon101



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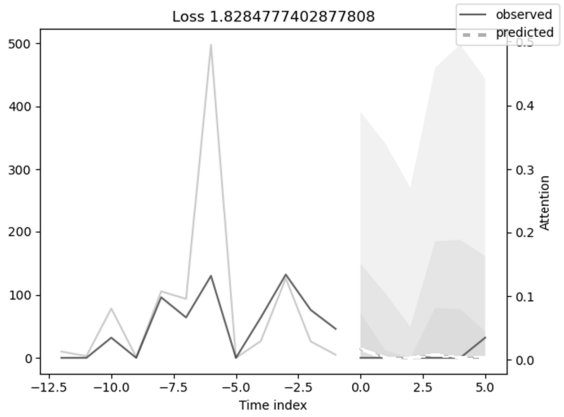
It's worth noting that the data used for generating the forecast comprises the most recent 12 months of training data, with a forward projection spanning 6 months (prediction length). Additionally, a light grey line is visible, underscoring the significance of specific data points that played a pivotal role in shaping the forecast. These significance values are presented on the y-axis of the right-hand side. Furthermore, the displayed loss corresponds to the SMAPE quantile loss, represented in decimal format. To clarify, a value such as 0.1259 should be understood as 12.59%, encompassing not only the point loss but also accounting for the level of confidence in the forecast.

Conversely, we can examine one of the least accurate forecasts, as depicted in Figure 7.

Figure 7

Base features, prediction compared to validation - product id: anon801



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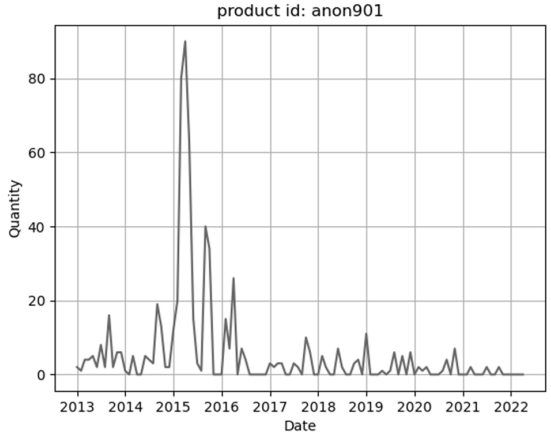
It's worth noting that the actual prediction doesn't appear significantly flawed. However, when considering the quantile loss, which accounts for the inclusion of quantiles, the outcome is notably unfavorable, reaching 182.84%, approaching the upper limit of 200% of the SMAPE.

Figure 8

Product data with no clear pattern



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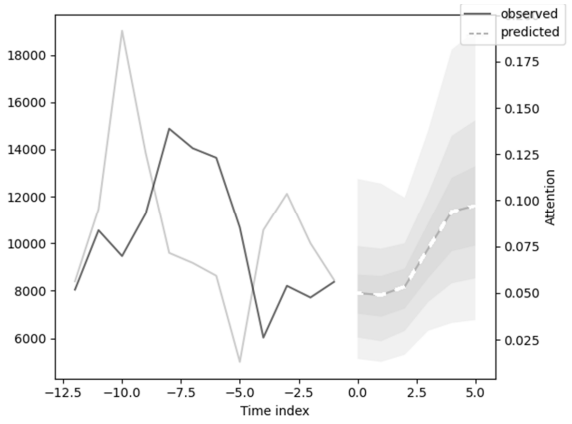
Henceforth, we categorize these products as challenging to forecast, as they do not exhibit a clearly repeatable pattern. Notably, these are the products that once had substantial sales quantities in the past but are presently less popular. This trend is evident in Figure 8. Moreover, a group of products shares this characteristic, and this pattern is also apparent in Figure 4, where we observe a significant cluster of products with forecast errors approaching 200%.

Comparable findings are evident when extending the forecast into the later stages of the test data period, as illustrated in Figure 9. Notably, the forecast closely replicates the initial behavior of the first few months, characterized by an upward trend.

Figure 9

Forecast of product anon101



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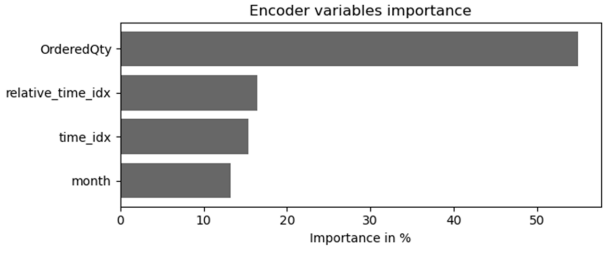
The significance of the variables can be seen in Figure 10. From this visualization, we can assert that the most influential variable is the quantity sold (OrderedQty), followed by the *relative_time_index*, which for each sampled sequence spans from -*encoder_length* (12 in our case) to *prediction_length* (6 in our case). The subsequent crucial variable is the *time_idx*, signifying the time index stretching from the initial date and time in the dataset to the final date and time. In this context, January 2013 corresponds to 0, while October 2022 corresponds to 117.

Figure 10

Encoder variables importance – Case 1.



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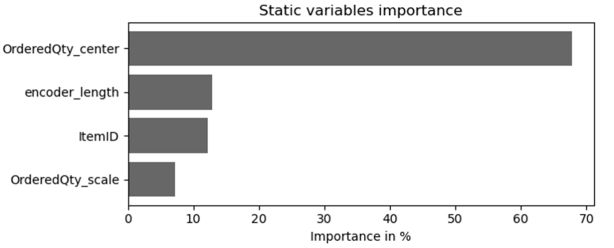
Moreover, the model produces certain static variables, as depicted in Figure 11. From this representation, we can discern that when generating forecasts, the most pivotal element is the mean value of sold quantities (*OrderedQty_center*), whereas the scale factor exerts a comparatively lesser influence.

Figure 11

Static variable importance - Case 1



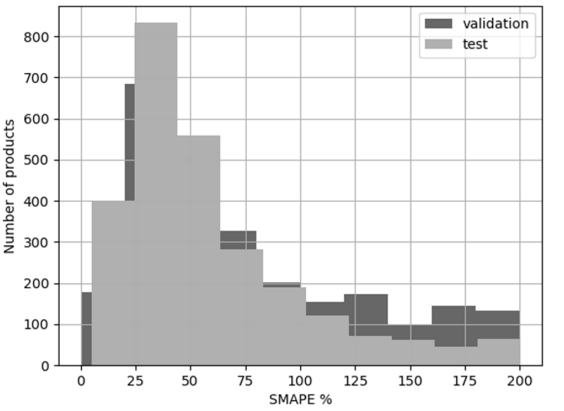
Source: own compilation

Case 2

In this scenario, we incorporated the static variables, specifically *MGName, GroupName, SubGroupName,* and *ReqGroupID*, into the training process. By introducing these additional covariates while maintaining the same setup as in *Case 1*, we observed enhancements in the validation data results, with a median improvement of 56.54% and a mean improvement of 74.18%. Similarly, there was an improvement in the test data, with the median rising to 46.49% and the mean reaching 59.46%. The histograms of the test and validation data are presented in Figure 12.

Figure 12

Histogram of the validation and test measures obtained using the base and the static covariates



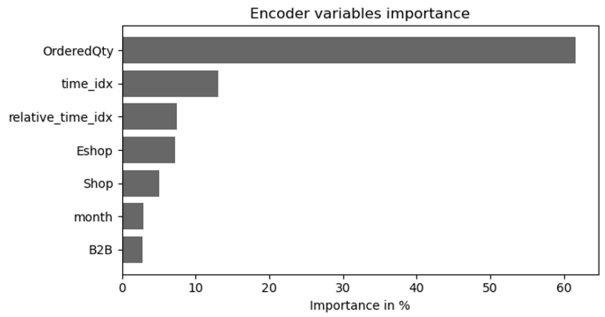
Source: own compilation

Conversely, we can delve into the importance of the static elements as depicted in Figure 13. Notably, *OrderedQty_scale* emerges as the most significant, whereas *OrderedQty_center* ranks among the least significant. Furthermore, it's worth noting that *MGgroup* is the second most significant element, although its importance in the overall context is approximately 10%. As a result of the seemingly erratic significance of these variables, we get the impression that the inclusion of static variables may not necessarily enhance the forecasting performance,

despite the improved percentages observed on both the validation and test datasets.

Figure 13

Significance of static variables including the static covariates

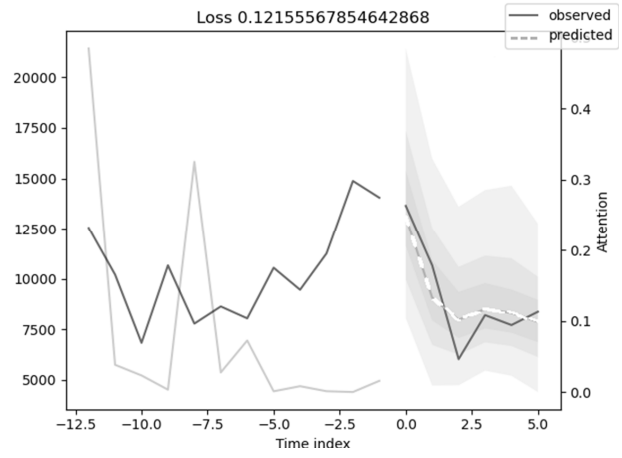


Source: own compilation

On the other hand, when we examine the good example from *Case 1*, we also observe a slight enhancement in the quintile loss, as depicted in Figure 14.

Figure 14

Base and static features, prediction compared to validation - product id: anon101



Source: own compilation

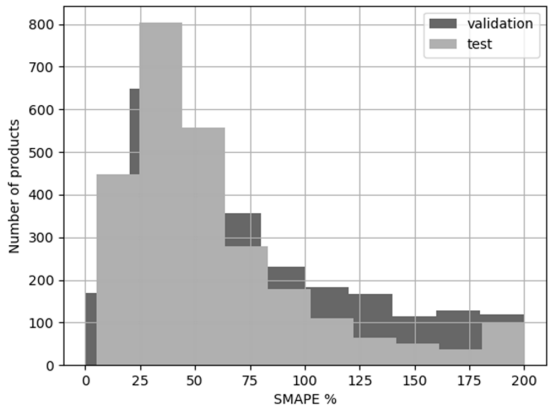
Case 3

In *Case 3*, we incorporated time-varying covariates that segment the sales quantity based on the channels of sale: *B2B, Eshop*, and *Shop*. This additional information led to an enhanced performance on the validation and the test data. We can visualize this improvement in Figure 15.

The median on the validation data is 59.46%, while the mean is 74.47%. Furthermore, the median on the test data is 46.38%, and the mean is 59.42%. The importance of the time-varying covariates can be seen in Figure 16. Unfortunately, our expectations were not met, as the newly introduced additional variables turned out to be the least significant. However, there is an improvement in the model's performance compared to both validation and test data.

Figure 15

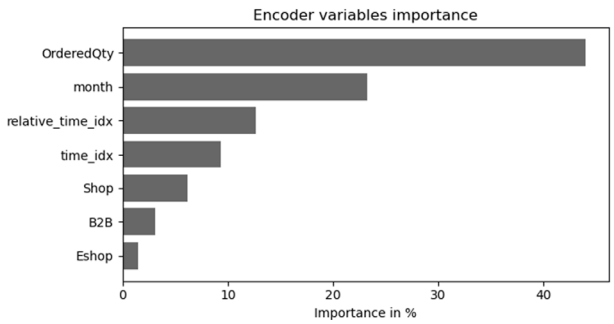
Histogram of the validation and test measures obtained using the base and the time-varying features



Source: own compilation

Figure 16

Time-varying features importance



Source: own compilation

Case 4

In this case, we incorporated both the static and the time-varying features that were examined in previous cases. The expectation was that the inclusion of these additional features would lead to improved forecasting accuracy, and to some extent, this expectation held true. On the validation dataset, we observed a median SMAPE of 53.5% and a mean of 70.06%, marking an enhancement compared to both Case 1, Case 2, and Case 3. However, the median SMAPE for the test data, at 48.66%, and the mean, at 63.42%, were somewhat higher than anticipated, indicating a less favorable outcome in this regard.

Table 2

Performance measures of Case 1-4

	Validation (median)	Validation (mean)	Test (median)	Test (mean)
Case 1	58.74%	75.93%	47.02%	60.14%
Case 2	56.54%	74.18%	46.49%	59.46%
Case 3	59.46%	74.47%	46.38%	59.42%
Case 4	53.50%	70.06%	48.66%	63.42%

Source: own compilation

According to the data in Table 2, it is apparent that the supplementary features generally lead to improvement; however, the obtained results suggest that there may still be room for further enhancements.

In this regard, we ensured comparability by maintaining a consistent set of hyperparameters across all cases. This approach was intended to facilitate a fair comparison among the various training scenarios. However, the outcomes did not align with our expectations, as the addition of extra information did not uniformly enhance forecast accuracy. To address this challenge, we once again employed the *optuna toolbox* to fine-tune the model's hyperparameters, this time considering the features from Case 4. We expect that this hyperparameter tuning, performed with the training and validation dataset of Case 4, will result in improved forecast accuracy. Next, we present this scenario.

Case 4, with improved hyperparameters

For this instance, we incorporated all available features during the model-tuning process. We can find the hyperparameters obtained for this case in Table 3, with the previously used values shown in parentheses for reference. The most notable alteration is in the *gradient_clip_value*, a hyperparameter designed to prevent exploding gradients. Gradient clipping ensures that gradient values remain within specified ranges. In the initial case, this value was substantial, whereas now it is significantly smaller. Furthermore, the *attention_head_size* has been reduced to 1, signifying that the model performs more effectively with a single attention head rather than employing multiple ones and subsequently aggregating their results.

Table 3

Hyperparameters obtained considering all covariates

Max epoch	*50*
Gradient clip value	*0.0164 (0.8033)*
Learning rate	*0.0179 (0.0111)*
Hidden size	*47 (70)*
Attention head size	*1 (2)*
Dropout	*0.1686 (0.2903)*
Hidden continuous size	*14 (16)*

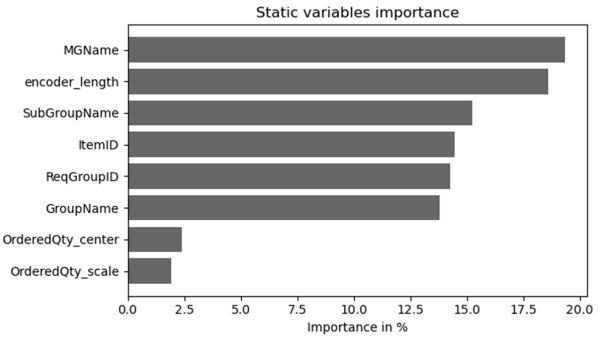
Source: own compilation

The validation dataset yielded a median SMAPE of 53.88% and a mean SMAPE of 69.66%, while the test dataset produced a median SMAPE of 45.80% and a mean SMAPE of 58.71%. To facilitate comparison, please refer to Table 4. Furthermore, in Figure 17 we can observe the importance of the static variables.

Now, we can observe that all the additional static features contribute to more than 10% of the overall importance. Interestingly, the least significant static variables are the center and scale of the ordered quantity. This suggests that the added static variables are indeed crucial, and the model recognizes their significance.

Figure 17

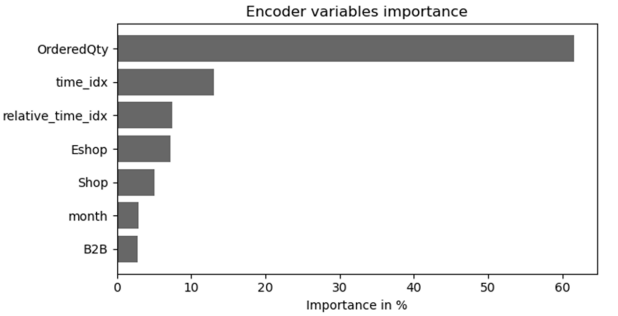
Static variables importance – Case 4 improved



Source: own compilation

Figure 18

Importance of time-varying features – Case 4 improved



Source: own compilation

In Figure 18, we explore the importance of the time-varying features. The most vital feature is *OrderedQty*, as expected, followed by time-related features: *time_idx* and *relative_time_idx*, which align with their importance for forecasting purposes. *Eshop* and Shop sales also exhibit noteworthy importance, indicating their relevance as features, while *B2B* sales are the least significant. Regarding the time-varying features, *Eshop, Shop*, and *B2B*, it's worth noting that from a business standpoint, the majority of sales (around 70-80%) occur through the *B2B* channel. Consequently, the *B2B* channel exhibits the strongest correlation with *OrderedQty*, explaining its lower importance. On the other hand, *Eshop* and Shop sales are considered somewhat less predictable, making their information valuable for enhancing the overall prediction of *OrderedQty* values.

Table 4

Performance measures with improved hyperparameters on Case 4

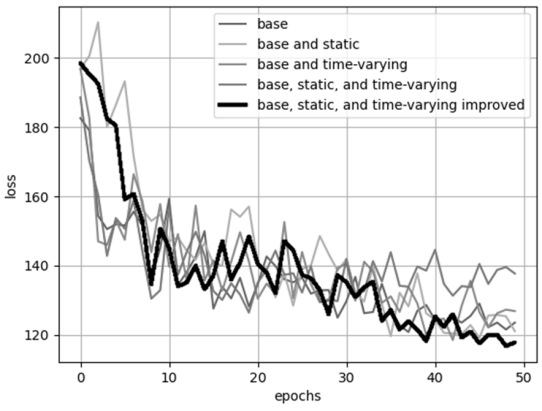
	Validation (median)	Validation (mean)	Test (median)	Test (mean)
Case 1	58.74%	75.93%	47.02%	60.14%
Case 2	56.54%	74.18%	46.49%	59.46%
Case 3	59.46%	74.47%	46.38%	59.42%
Case 4	53.50%	70.06%	48.66%	63.42%
Case 4 imp	53.88%	69.66%	45.80%	58.71%

Source: own compilation

Although the validation results closely resemble those of Case 4, there is a marked improvement in performance on the test data. To further examine the performance of the model, we present the loss function for all five cases in Figure 19. Note that the loss function employed here is the quintile loss, which means it evaluates not only point errors but also the corresponding quintile losses. It's noteworthy that the smallest loss is achieved when all features are used and the model's hyperparameters are tuned accordingly. This underscores a compelling conclusion: retraining the hyperparameters when introducing new features is essential.

Figure 19

Loss function evolution on the validation data across the epochs



Source: own compilation

Conclusions and Future Work

In this paper, the problem of demand forecasting was examined. The main objective of the paper was to present a neural network-based forecasting model. The considered model was one of the most recently developed, the Temporal Fusion Transformer (Lim et al., 2021). The problem under study was the demand forecasting problem of a company that mainly sells building engineering products. We used the available data from the company from January of 2013 to October of 2022. First, we examined the data, having several information from which we identified 4 cases. In Case 1 we used only the base data, having only the product id, the date, and the sold quantity of that product. Furthermore, in Case 2 we added static variables, and in Case 3 we added time-varying variables. Finally, in Case 4 we used both static and time-varying features. In the current study, we compared these four cases and we examined each of them in depth. We observed that in most of the cases, the model's performance was improved by using these extra features. Additionally, fine-tuning the model's hyperparameters to align with the dataset's features can lead to further enhancements in the model's performance. Therefore, the overarching conclusion is that augmenting the model with additional covariates can indeed boost its performance. This conclusion aligns with the findings of the related research as it is presented in (Lim et al., 2021; Wu et al., 2023).

There are several potential avenues for enhancing the model's performance in the future. Firstly, we can consider a more rigorous data separation, distinguishing between cases with reliable forecasts and those exhibiting random behavior, as indicated in Figure 8. Some products, for instance, may have once had high sales but now demonstrate declining quantities. Filtering out such cases can help mitigate their disruptive impact on the model's accuracy.

Another avenue for improvement involves a deeper exploration of forecast quantiles, enabling the generation of 'what if' analyses based on these forecasts. For instance, we can assess the probability that increased demand planning for certain products would meet customer needs. From a technical perspective, further enhancements can be achieved by incorporating additional features and fine-tuning hyperparameters accordingly. These represent just a few of the potential future directions stemming from our work.

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