The Evolution of Original ERP Customization: A Systematic Literature Review of Technical Possibilities

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Keywords: Enterprise Resource Planning (ERP) Systems, Customization, Modification, Tailoring, Literature Review.

Abstract: Enterprise Resource Planning (ERP) system customization is often necessary because companies have unique processes that provide their competitive advantage. Despite new technological advances such as cloud computing or model-driven development, technical ERP customization options are either outdated or ambiguously formulated in the scientific literature. Using a systematic literature review (SLR) that analyzes 137 definitions from 26 papers, the result is an analysis and aggregation of technical customization types by providing clearance and aligning with future organizational needs. The results show a shift from ERP code modification in on-premises systems to interface and integration customization in cloud ERP systems, as well as emerging technological opportunities as a way for customers and key users to perform system customization. The study contributes by providing a clear understanding of given customization types and assisting ERP users and vendors in making customization decisions.

1 INTRODUCTION

According to (Davenport, 1998), an ERP system is an IT system that enables organizations to map their business processes holistically and integrate and automate them with the aid of uniform data management. The capability of an ERP system is that best practices of industries are mapped in the form of a software package with different modules satisfying different industries. ERP systems, when designed and implemented well, can improve productivity, provide reliable information, reduce costs and improve global reach (Ziani and AlShehri, 2015). Additionally, they can enable companies to be more agile, flexible and better equipped to meet market demands, leading to a competitive advantage (Koh and Simpson, 2007). Furthermore, they can deliver improved decision support (Utecht et al., 2004), optimized inventory management (Goeke and Faley, 2009), and better information and knowledge management such as staff education and training (Ram et al., 2014).

Despite extensive research, the successful implementation of ERP systems remains a challenge (Mahmood et al., 2020). For these complex projects to be successful, critical design issues as well as project execution are critical (Ngai et al., 2008). The advantage of packaged enterprise systems is that they have a wide range of out-of-the-box functionality available. The challenge of implementation begins at the selection stage. Given the variety of systems available, selecting an ERP system that best suits the needs of the company is known to be a critical success factor (Haddara, 2018). Once the right system has been selected, the level and approach of customisation is critical to the success of the implementation.

From a project perspective, adapting business processes to the ERP standard is the simplest approach. However, companies are not willing or able to fully adopt system functionality as they strive to maintain their competitive advantage through differentiation (Hansen et al., 2023). Adapting the system to the needs and practices of the business is therefore an important part of implementation projects.

To address the gap between ERP systems functionalities and companies requirements, two approaches of customization can be distinguished. Companies need to find the right balance between the approaches (Luo and Strong, 2004; Rothenberger and Srite, 2009; Davis, 2005).

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Abendroth, A., Bender, B. and Gronau, N.
The Evolution of Original ERP Customization: A Systematic Literature Review of Technical Possibilities.
DOI: 10.5220/0012305500003690

In *Proceedings of the 26th International Conference on Enterprise Information Systems (ICEIS 2024) - Volume 1*, pages 17-27
ISBN: 978-989-758-692-7; ISSN: 2184-4992

(i) Process Customization. The company adapts its procedures to the processes specified in the system and thus uses the standard software intended by the vendor. Often, other technical forms of customization are not encouraged.

(ii) Technical Ccustomization. Refers to alterations encompassing both technical adjustments and configuration changes to the underlying aspects of the system. These customizations can vary in their nature, complexity, and associated expenses.

Extensive research is conducted on process customization, treating it as a complex multi-criteria decision-making problem, with the aim of identifying the 'right' ERP system (Singh and Pekkola, 2021). Moreover, ERP research focuses on success factors and how to mitigating organisational ERP 'misfits' (Hustad et al., 2016).

On the other site, heavy technical modification to the ERP system are often advocated against (Davenport, 1998; Holland and Light, 1999), leading to increased cost during implementation and post-implementation (maintenance) phase, software quality issues (Parthasarathy and Sharma, 2017) business operations continuity and long-term ownership risk (Davenport, 1998; Koch and Mitteregger, 2016; Khadrouf et al., 2018). Notwithstanding, companies are using technical customization to gain a competitive advantage over other companies using a similar ERP system by implementing technical customizations based on the companies individual processes, which are not part of ERP vendors intended processes (Balint, 2017). Other potential reasons are change resistance, ownership type and ERP maturity (Khadrouf et al., 2018; Zach and Munkvold, 2012).

Despite extensive research on process customization, the field of technical customization is still a vibrant one. For this reason, a systematization and clear understanding of technical customization is crucial, but still lacking. Technical customization is fueled by an increasing variety of new technologies such as low-code programming (Picek, 2023)), on-premise as well as cloud ERP systems (Uppström et al., 2015; Al-Shardan and Ziani, 2015; Nowak and Kurbel, 2017). There are numerous different interpretations of technical customization types in research and practice. Definitions have evolved over time and are not consistent.

The goal is to provide a comprehensive understanding of technical customization types, focusing on the evolving definitions and interpretations. Additionally, the study provides practitioners with a decision-making aid into the evolving landscape of technical customization types hat align with future organizational needs. Thus, our contributions comprise (I) an overview about current technical customizations, and (II) gives concrete guidance for further, missing technical customization research.

To harmonize these definitions, an aggregation is conducted to give an overview of common ERP customization types in the scientific literature. Taken together, different understandings and definitions of ERP customization options exist within the scientific community, revealing a research gap to aggregate an overview of the scientific definitions and graduations of the ERP customization options. To fill this research gap, the following research questions are formulated, which will be answered in this study:

RQ1. Which ERP customization options in the scientific community do exist?

RQ2. How do the ERP customization options change over time?

This paper first introduces and classifies technical ERP customization types showcasing the existing diversity. The paper then explains the methodology used, which includes defining the scope of the study, describing the process of searching relevant databases, selecting the appropriate literature, and analyzing the selected sources. The paper then presents the findings in the form of aggregated ERP customization types and describes the evolution of these. Finally, the results are discussed and possible limitations of the research are identified and concluded.

2 PREVIOUS RESEARCH OF TECHNICAL CUSTOMIZATION

Previous research shows, that a distinction can be made in ERP customization types dealing with technological advances. In the 2000s, the focus lay on on-premise ERP system customization in the 2000s. (Davenport, 1998) is one of the first publications describing and defining three types of technical customization (modules, configuration of tables and codemodification). The author argues that business goals are driving the need for customization. (Glass, 1998) defines similar types, adding extensions such as user exits and bolt-ons. The author raises the question that customization is maintenance heavy and that ERP clients will undergo changes in the future. (Brehm et al., 2001) employ the term 'tailoring' to encompass both configuration (setting parameters without altering underlying technical aspects) and modification (changing package code and technical elements). They delineate 7 tailoring types adding extended reporting, workflow programming and interfaces by

categorizing each type to its layer involved and the given effort for system maintenance and post implementation. Further publication adapted customization types to show level of support (Haines, 2003), customization options (Luo and Strong, 2004), strategic alignment (Davis, 2005), likelihood of redoing customization after upgrade (Rothenberger and Srite, 2009). Moreover, publications combined technical customization with AHP-techniques to structure customization types based on hierarchy levels to show efforts for used customizations (Sarfaraz et al., 2012; Parhizkar and Comuzzi, 2015). In the mid 2010s, technical customization options are adapted to the rise of cloud ERP systems. One study of (Uppström et al., 2015) modified the technical customization types of (Brehm et al., 2001) accordingly to changes to the rise of cloud ERP systems and suggested the 3 new customization options packaged customization, conversion and mobile platforms for on-premise and cloud ERP. SaaS ERP finding are added by (Al-Shardan and Ziani, 2015) showing configuration boundaries in SaaS ERP as well as by (Nowak and Kurbel, 2017) describing customization approaches adopted by vendors and the resulting level of flexibility for adapting specific system elements. (Picek, 2023) is describing the areas where low-code platforms can be used to create extensions or small apps for improving ERP systems. It shows the possibilities of low-code extensions in ERP systems through new technical advancements, rising business needs, and digital transformation-based shifts.

3 METHODOLOGY

In order to address the research question at hand, we conducted a SLR using the methodology proposed by (vom Brocke et al., 2009). Additionally, we employed the taxonomy framework developed by (Cooper, 1988) to provide a comprehensive context for our study. This framework is depicted in Figure 1, which aids in delineating the scope of our work.

Characteristic		Categories			
(1)	Focus	Research outcome	Research methods	Theories	Application
(2)	Goal	Integration	Criticism	Identification of central issues	
(3)	Perspective	Neutral representation	Espousal of position		
(4)	Coverage	Exhaustive	Exhaustive and selective	Representative	Central/Pivotal
(5)	Organization	Historical	Conceptual	Methodological	
(6)	Audience	Specialized scholars	General scholars	Practitioners	General public

Figure 1: Taxonomy according to (Cooper, 1988).

The focus of this SLR hereby lies in the identification of ERP customization types. The goal of this SLR is to aggregate the various definitions. This involves organizing this SLR conceptually and from a neutral perspective. We address specialized scholars as well as practitioners in the ERP context. In this SLR, definitions and descriptions of ERP customization types are systematically retrieved from the literature and presented to answer the research question. An up to date SLR is necessary to explore potentially new approaches for technical customization as there seem a lack of up to date general customization options.

3.1 Keyword and Database Definition

To capture a broad spectrum of the literature, a systematic search of the following 7 bibliographic databases was conducted: ACM digital library, AIS electronic library, Ieeeexplore, ProQuest, Sciencedirect, Web of Science and Wiley online library. To query these databases a search string was developed and, as required, tailored for each database:

(ERP OR 'Enterprise Resource Planning') AND (customization OR modification OR configuration OR parametrization OR individualization)

The search string was performed at the abstract level only to find relevant paper dealing with defining of customization types.

3.2 Inclusion Criteria

Studies were included if they (i) developed or extended an original definition of ERP customization types (ii) are reported in English; and (iii) are published in a peer-reviewed outlet or conference proceedings.

3.3 Exclusion Criteria

Studies were excluded when (i) they solely referenced a prior original ERP customization type definition without extension and elaboration and (ii) lacked a clear, detailed description of the customization type in question.

3.4 Conducting the Search Process

The search was carried over a three-week period beginning at start of 2023. A total of 1542 relevant papers were obtained from the search process. In this context, each obtained paper is referred to as a 'hit'. The final selection consists of hits that met the criteria for inclusion in the study.

Initially, the database search yielded a set of hits, where each hit represents a publication found during

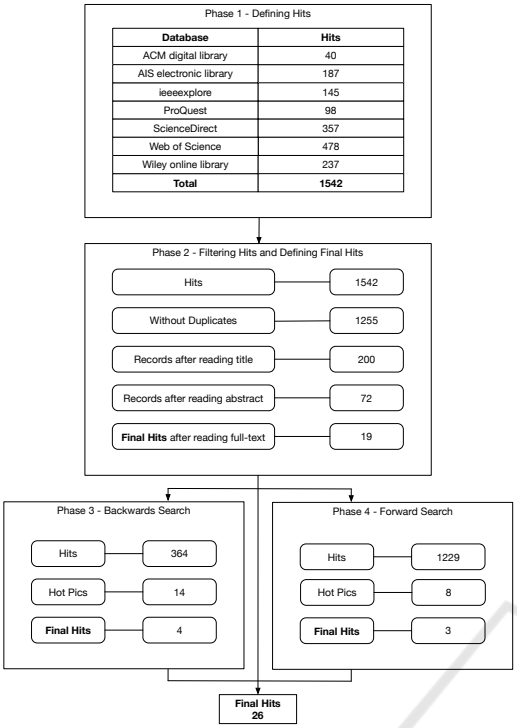

Figure 2: Search process.

the search process across multiple databases. As a result, the final collection of literature consisted of 1542 hits. After removing duplicates, the remaining records title (n=1255) were scanned, and ineligible records (n=1055) were removed not dealing with the topic of ERP systems. After reviewing the abstracts of the remaining records (n=200), ineligible records (n=128) were removed. This was due to other adjoining topics dealing with ERP systems such as success factors or process mining. After reviewing the full-texts of the remaining reports (n=73), 19 initial final hits were found. To identify the final selection of 19 relevant studies, a backwards search was conducted utilizing the tool citationchaser (Haddaway et al., 2021). The backwards search yielded 364 after eliminating duplicate entries and excluding papers written in languages other than English. a comparative analysis was undertaken to assess the remaining papers in relation to the articles screened during the initial search phase. The abstracts of the remaining 364 search results were thoroughly reviewed, leading to the identification of 14 'Hot Pics'. After reading the full-texts, 4 additional papers were included.

Employing the same methodology, a forward search in Google Scholar with initial 1649 hits was conducted. After eliminating duplicates (n=420), the remaining 1229 articles title were screened and 1190 paper eliminated. The remaining 39 articles full-texts were screened leading to 3 added final hits. The overall SLR resulted in 26 final articles.

4 ANALYSIS PROCEDURE AND SEARCH RESULTS

For the analysis, a table was created with the name of technical customization type, the given category and its description. After that, the descriptions of each ERP customization type was read. If no concrete description for the customization type was made, the customization type name was used as a description. Each description was read, and categories were formed according to (Mayring, 2014). It was possible, that a given customization type of a hit was given more than one tagged customization type. The reason is that the descriptions were not distinctly specified, so that a description could have more than one category.

The distribution of years of final hits indicate two phases, in which ERP customization types were defined (Figure 3). Firstly, the phase in the 2000s, where ERP systems where research in this areas was growing and topics in on-premise ERP systems were discussed; and secondly in the 2015-present, where the rise of cloud ERP systems rose questions to customizing.

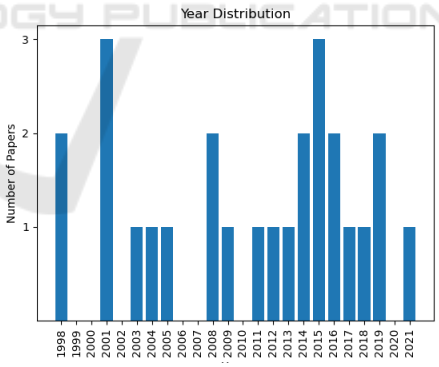

Figure 3: Yearly distribution of final hits.

Out of the 26 definitions, 137 technical customization types were identified. The minimum number of technical customization type per definition is 1, the maximum 13 and the average 5.27 (SD=2.88). Based on the technical customization types, an aggregation took place in the form of a bottom-up procedure to consolidate and eliminate redundancies. For this purpose, the individual categories of the customization types with the descriptions were considered and assigned to the respective references. A total of 13 technical customization types (tct) in the area of ERP were

aggregated.

(tct01) Module selection. Selection of a suitable module from the ERP provider.

(tct02) Parametrization (table). Setting parameters in tables.

(tct03) Screen masks. Creating screen masks for input and output of data.

(tct04) Reporting. Programming advanced data output and reporting options.

(tct05) Bolt-ons. Extensions in the form of third-party packages.

(tct06) User exits. A user exit is a subroutine called by a software package for a predefined event when the package is executed.

(tct07) Workflow programming. Creation of non-standard workflows.

(tct08) ERP-internal programming language. Programming additional applications without changing the source code (in the vendor's computer language, e.g. ABAP from SAP).

(tct09) Code generation. Automatic generation of program code and/or database schemas based on an information model.

(tct10) Interfaces. Development of code extensions that use pre-built system components.

(tct11) ERP-code modification. Modification of the ERP source code to program additional functionalities.

(tct12) Query customization. Direct modification of ERP database entities and relationships.

(tct13) Other. Other categories not fitting the previous mentioned.

Table 1 presents the identified and aggregated customization types, along with references that mention non-unique instances, contrasted with references that mention uniquely identified references. When looking at the distribution of the aggregated customization types, parametrization was tagged the most with 32 times of the 137 identified customization types, followed by ERP code modification (n=25) and interfaces (n=13). Interestingly, ERP code modification was mentioned more when accounting only unique references (m=22) compared to parametrization (m=19). The least tagged customization types were code generation (n=2), query customization (n=3), followed by the category other (n=6).

Subsequently, the aggregated technical types of customization were categorized into 3 categories. Three categories were adapted to (Hansen et al., 2019, pp.171-172) and (Leimeister, 2021, p. 332) and than matched to the tcts.

(a) Modularization. Incorporating the vendor's program modules without altering the underlying technical aspects.

(b) Parametrization. Configuring functions through standard software parameters, also known as configuration, without impacting the underlying technical aspects.

(c) Complementary Programming. Adapting or replacing components with programming code that affects the technical aspect of ERP.

Table 1: Count of tagged ERP customization types and unique references.

Technical customization type		Count of tagged customization types (n)	Count unique reference (m)
Modularization	tct01	13	13
Parametrization	tct02	32	19
	tct03	5	3
	tct04	7	6
Complementary Programming	tct05	12	12
	tct06	5	5
	tct07	7	6
	tct08	7	7
	tct09	2	2
	tct10	13	10
	tct11	25	22
	tct12	3	3
	tct13	6	3
Total		137	26

tct01 corresponds to 'Modularization', tct02 to tct04 fall under the 'Parametrization' category, and tct05 to tct12 are categorized as 'Complementary Programming' with detailed explanations provided in the accompanying table 2. The distribution of the tcts according to the final hits can be found at Table 3 in the Appendix.

5 DISCUSSION

To contribute to the further development of technical ERP customization, an overview and systematization is provided. The interplay between customization needs and the possibilities offered by technological advances brings hope to customization. Especially for heavy efforts, dependence on system experts and inflexibility of customization's.

Table 2: ERP customization options matched to tcts.

tct	Explanation for Categorization
tct01	Selecting a suitable module from the ERP provider, which fits the idea of organizing or modularizing the ERP system by choosing specific modules.
tct02	Setting parameters in tables, which are configurations that can alter the behavior of the ERP system.
tct03	Creating screen masks for input and output of data typically involves configuring how data is displayed and entered, which can be considered a form of parameterization.
tct04	It involves programming advanced dataoutput and reporting options, which are often configurable settings within an ERP system.
tct05	Bolt-ons refer to adding external third-party packages to extend ERP functionality, which is a form of complementary customization.
tct06	User exits are used to inject custom code into predefined events in the ERP system, extending its functionality without modifying the core code.
tct07	Workflow programming involves creating non-standard workflows, which is a form of customizing the ERP system's behavior.
tct08	It involves programming additional applications using the ERP system's internal language without changing the core code.
tct09	Automatic generation of program code can be a way to enhance the ERP system's capabilities without direct manual coding.
tct10	It involves developing code extensions that use pre-built system components (interfaces) to integrate with other systems.
tct11	Directly modifying the ERP source code to add additional functionalities is complementary programming.
tct12	Directly modifying ERP database entities and relationships can involve modifying the code or using custom queries.

5.1 The Start: On-Premise Customization

In the early days (first half of the period), on-premise ERP systems played an important role, and customisation was mainly achieved through parameterisation, ERP-internal programming languages or direct modifications to the ERP code. These methods allow organisations to tailor the ERP system to their specific needs, but they often require extensive technical expertise and are time consuming (Uppström et al., 2015; Rothenberger and Srite, 2009).

5.2 ERP Customization in the Cloud Era

The second half of the period witnessed the rise of cloud ERP systems, which brought about transformative changes in the ERP landscape. With cloud-based implementations, organizations could leverage the flexibility and scalability of the cloud, enabling access to ERP functionalities through responsive designs that support mobile devices. This shift in focus towards mobile use opened up new opportunities for increased productivity, real-time decision-making, and improved user experience (Hansen et al., 2023; Nowak and Kurbel, 2017).

As the adoption of cloud ERP systems has grown, so has the need for customization. Cloud infrastructures, especially in newer forms of SaaS architectures, require different forms of customization, as vendors are interested in running similar client instances within an infrastructure to achieve efficiency gains. As a result, parameterization has taken on a new importance, levelling the configuration possibilities of ERPs. More individual customization has been done by using interfaces for seamless integration of external applications. These approaches allowed organizations to connect their ERP systems with other systems, portals, or cloud functions through well-designed APIs (Uppström et al., 2015; Hustad et al., 2016). Moreover, customization of reporting often requires integration with business intelligence systems,

as these systems require data from external sources to generate meaningful insights. Moreover, workflow programming utilizes microservices to reconfigure processes, requiring integration capabilities (Bender et al., 2021). The integration aspect becomes crucial in achieving seamless interoperability and enabling efficient reporting customization and workflow programming. This shift not only facilitated data exchange but also enabled the integration of specialized systems, forming an interoperable ecosystem. The ERP system acts as the central focal point for orchestrating and synchronizing processes, ensuring seamless collaboration between the ERP system and its specialized counterparts (Bender et al., 2022; Vyawahare et al., 2018; Arulraj et al., 2016).

5.3 Empowerment of (Key) Users

To address the reliance on vendor experts to perform customizations, there was a growing interest in enabling customers to perform customizations. The availability of pre-defined application components simplifies the development process by providing a library of ready-to-use functionalities. Users can leverage these components to assemble and configure applications according to their specific requirements, significantly reducing the need for custom programming (Ali et al., 2019).

This is added by the use of model-based code generation techniques such as low-code (Picek, 2023). Instead of writing code from scratch, users can create models or visual representations of their desired applications. These models capture the desired functionalities, business logic, and data structures, which are then automatically translated into executable code. This approach reduces the reliance on manual coding, streamlines the development process, and enhances the maintainability of the ERP system (Bender et al., 2021).

5.4 Recommendations Against and for Customisation Options

Organizations must balance the potential benefits, such as return on investment (Light, 2001) and competitive advantages (Koch and Mitteregger, 2016), against the cost drivers of implementation (Brehm et al., 2001), including higher maintenance (Ng, 2001; Haines, 2003; Koch and Mitteregger, 2016) and upgrade expenses (Brehm et al., 2001). If the benefits outweigh the disadvantages, customization should be pursued (Ng, 2001). Strategic alignment should precede customization (Davenport, 1998), and thorough planning (Rothenberger and Srite, 2009) is essential to understand potential pitfalls. Customization should only be undertaken when it adds value to value-adding processes (Oseni et al., 2013). Stakeholder engagement enhances the outcomes of customization (Huang et al., 2021). Purely technical customization is discouraged (Luo and Strong, 2004; Oseni et al., 2013). (Parhizkar and Comuzzi, 2015) emphasize that making modifications to function code, data queries, and workflows typically incur higher expenses whereas configuration is least expensive. Minor adjustments in configuration typically incur lower costs compared to functional changes (Light, 2001). Therefore, configuration is often the preferred option (Davenport, 1998).

(Luo and Strong, 2004) provide nuanced recommendations regarding customization, which vary based on the organizational context They suggest moderate customization when an organization possesses high technical change capacity but limited process change capability. It is cautioned against solely technical-driven modifications that may not directly impact transformative ERP capabilities. High customization in the form of code modification is only advised for companies with both technical high change capacity and high process change capability.

(Uppström et al., 2015) advocate for configuring a cloud ERP system over modifying it, citing the lack of custom modification options and the accompanying high risk. Moreover it is recommended to use new types of customisation for cloud ERP systems such as mobile platforms.

Conversely, (Nowak and Kurbel, 2017) propose the differentiation of various cloud-based architectures and argue that these systems should be distinguished based on their maturity level or the underlying cloud architecture and maturity. Additionally, they recommend leveraging built-in customization tools. They highlight that a development platform with services surrounding the underlying ERP system enables vendors to substantially extend customization capabilities.

The structured literature review highlights the emergence of new technologies that facilitate modifications in ERP systems and their processes. These advancements generally simplify the adoption and customization of established protocols, underscoring the importance of discerning when to implement system modifications. These innovations reduce the need for specialists and external collaborators, allowing for more extensive customization. However, it emphasizes the importance of effective governance to prevent the risks associated with the easy adoption of systems and processes. These findings reveal new opportunities for organizations using standard software,

emphasizing the dependent nature of their benefits on careful implementation.

5.5 Implications for Practice

For companies that use or are considering an ERP system, new customization technologies can be a significant enabler, allowing for more precise tailoring of ERP systems to their operational needs. However, this capability requires the design and development of appropriate governance mechanisms, particularly given that adoption and customization processes were previously centrally coordinated. The rise of low-code/no-code platforms presents an opportunity and a challenge. While they simplify the customization process, they also require careful oversight to prevent uncoordinated modifications. Therefore, companies must evaluate the extent of customization capabilities within the selected ERP system, including considerations for on-premise, SaaS, or PaaS solutions. Each option provides varying levels of customization flexibility. Cloud-based ERPs, especially SaaS solutions, often have limited opportunities for deep customization. Therefore, it is crucial to thoroughly assess the need for customization upfront and have a well-defined system landscape architecture to enable seamless integration with external systems or services.

For ERP vendors, integrating customization options and shifting design capabilities to clients presents a significant challenge that must be considered in their business model and implementation approach from the outset. Providing client-side customization services, particularly in the cloud market, can improve market share. Moreover, exploring model-based programming options can enable users to customize standard processes using visual modeling tools and predefined templates, eliminating the need for direct code modifications. This approach not only facilitates customization but also requires strategic alignment between the vendor's IT infrastructure and database approach. In addition, implementing collaborative strategies can improve the customization process, making it more efficient and aligned with clients' specific needs.

5.6 Prospects for Future Research

The customization of packaged enterprise systems (PES) other than ERP, such as CRM or SCM systems, should be further explored, as the research findings may be generalizable across different types of enterprise-level applications. The study by (Singh and Pekkola, 2021), which conducted a systematic literature review (SLR) on customization topics for PES, provides a solid foundation for expansion. In addition, the categorization of the identified customization technologies (tcts) should be validated in subsequent research. Emerging trends, including the adoption of low-code platforms due to technological advances, increasing business needs, and developments spurred by digital transformation, warrant closer examination (Picek, 2023). Decision-making tools for selecting the appropriate deployment type based on customization needs, options, and associated costs also merit further development, with the work of (Parhizkar and Comuzzi, 2015) serving as a potential starting point for identifying the costs associated with each tct.

Moreover, there is an urgent need for research on the management processes involved in governing system adoptions resulting from the democratization of such adoptions. This includes exploring how organizations can effectively oversee the adoption and customization of ERP systems in an environment where these processes are increasingly accessible to a broader range of stakeholders. Research on collaborative implementation strategies, specifically how companies can work with ERP vendors to facilitate customization efforts, is crucial. This should cover mechanisms for ensuring that customization efforts align with both the vendor's capabilities and the client's needs, optimizing the effectiveness and efficiency of the implementation process. This research would not only address gaps in the literature but also offer practical insights for organizations and vendors dealing with the complexities of customizing ERP systems in the digital age.

5.7 Limitations

The selected keywords are focused on customization of ERP at abstract level. It is conceivable that the identification of different types of ERP customization might have been omitted during the initial search based on the title or keyword level such as software tailoring. The proposed research aims to address this gap by conducting a comprehensive backwards and forwards search. Furthermore, it is important to acknowledge that the current search strategy, which specifically focuses on ERP customization, may not adequately capture emerging customization paradigms that target areas beyond ERP.

6 CONCLUSION

Enterprise Resource Planning (ERP) system customization is often necessary because companies have unique processes that provide their competitive ad-

vantage. A systematic literature review (SLR) is used to identify and systematize technical customizations. The study presents the aggregation of 13 unique approaches of ERP spanning over 20 years of ERP customization. The shift from on-premises to cloud systems affects customization approaches. Emerging technology capabilities enable key users to be empowered to make changes. The study contributes by providing a clear understanding of customization types and assisting ERP users and vendors in making customization decisions.

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APPENDIX

Table 3: Analysis of Final Hits and corresponding technical customization type.

Reference	tct01	tct02	tct03	tct04	tct05	tct06	tct07	tct08	tct09	tct10	tct11	tct12	tct13	Total
(Davenport, 1998)	1	1									1			3
(Glass, 1998)		1				1		1			1			4
(Brehm et al., 2001)		1	1	1	1		1	1		2	1			9
(Light, 2001)	1	1									2			4
(Ng, 2001)													1	1
(Haines, 2003)	1	1				1					1			4
(Luo and Strong, 2004)	1	1									1			3
(Davis, 2005)										1	1			2
(Dittrich and Vaucouleur, 2008)	1			1	1					1	1			5
(Sommerville, 2008)	1	1		1			2			1		1	2	9
(Rothenberger and Srite, 2009)	1	1			1			1			2			6
(Zach and Munkvold, 2011)					1			1			1			3
(Sarfaraz et al., 2012)	1	1									1			3
(Oseni et al., 2013)	1				1					1	1		3	7
(Selmeci and Orosz, 2014)		3			1			1			2			7
(Ziani, 2014)		11					1				1			13
(Al-Shardan and Ziani, 2015)		1												1
(Parhizkar and Comuzzi, 2015)		1			1	1	1	1		1	1	1		8
(Uppström et al., 2015)		1		1	1		1			2	1			7
(Hustad et al., 2016)				2	1		1			2	1			7
(Koch and Mitteregger, 2016)	1	1									1			3
(Nowak and Kurbel, 2017)	1	1	1			1			1	1	1			7
(Khadrouf et al., 2018)		1									1			2
(Ali et al., 2019)	1	1			1			1			1			5
(Pestana et al., 2019)		2	3	1	1							1		8
(Huang et al., 2021)	1				1	1			1	1	1			6
Total	13	32	5	7	12	5	7	7	2	13	25	3	6	137