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Process-Aware Information Systems: Towards a Checklist to Support the Implementation Process

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Wien, 14. Oktober 2024

Julius Messner

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Kurzfassung

Geschäftsprozesse sind das Kernstück von Unternehmen, da sie sich direkt auf den Erfolg ihrer Produkte und Dienstleistungen auswirken. Um die Optimierung von Geschäftsprozessen im Rahmen der Managementdisziplin Geschäftsprozessmanagement effizienter zu gestalten, können Unternehmen sogenannte prozessgestützte Informationssysteme einführen, um den menschlichen Aufwand zu verringern und die Produktivität, Konsistenz und Effizienz zu steigern. Da Unternehmen häufig bei der erfolgreichen Einführung von solchen prozessgestützten Informationssystemen scheitern, werden in dieser Arbeit kritische Erfolgsfaktoren, Herausforderungen und Implementierungsstrategien im Kontext des Einführungsprozesses von solchen Informationssystemen untersucht.

Durch eine umfassende Analyse konsolidiert diese Arbeit relevante Faktoren und Herausforderungen, die das Ergebnis von Einführungsprojekten von prozessgestützten Informationssystemen beeinflussen. Zusätzlich wird eine Checkliste entwickelt, welche den Einführungsprozess von solchen Informationssystemen in Unternehmen unterstützen soll. Die Checkliste umfasst das Zusammenspiel zwischen identifizierten relevanten Faktoren und sequenziellen Schritten, die während des Einführungsprozesses durchgeführt werden, und hebt somit die relevanten Faktoren in jeder Phase der Implementierung hervor. Damit zielt die entwickelte Checkliste darauf ab, die Wahrscheinlichkeit einer erfolgreichen Einführung von prozessgestützten Informationssystemen zu erhöhen, indem sie sich auf kritische Bereiche wie das Change Management, die Prozessoptimierung, die Einbeziehung von Interessengruppen und die technologische Integration konzentriert.

Die Ergebnisse dieser Arbeit bieten Einblicke in den Adoptionsprozess von prozessgestützten Informationssystemen und bieten Potenziale für zukünftige Forschung, um die Implikationen für praktische Adoptionsprojekte weiter zu untersuchen. Gleichzeitig eröffnet die Arbeit Potentiale, die abgeleitete Checkliste weiter zu verfeinern.

Abstract

Business process are core assets of organisations as they directly affect the success of their products and services. To streamline the optimisation of business processes within the management discipline of Business Process Management (BPM), companies can implement a Process-Aware Information System (PAIS) to reduce human effort, and increase productivity, consistency, and efficiency. As organisations often fail in the successful adoption of Process-Aware Information Systems (PAISs), this thesis explores critical success factors, challenges, and implementation strategies associated with the adoption process of PAISs.

Through a Systematic Literature Review (SLR), this research consolidates relevant factors, and challenges that influence the outcome of PAIS adoption projects. Additionally, a multipurpose checklist foundation is developed to support the adoption process of PAIS within companies. The checklist foundation encompasses the interplay between the identified relevant factors and the sequential steps carried out during the adoption process, and as such, the checklist foundation highlights relevant factors at each stage of implementation. With that, the developed checklist foundation aims at enhancing the likelihood of successful deployment of PAISs by focusing on critical areas such as change management, process optimisation, stakeholder involvement, and technological integration.

The findings of this thesis offer profound insights into the adoption process of PAISs and provide potentials for future research to further investigate the implications for practical adoption projects, and at the same time offers potentials to further refine the derived checklist foundation.

Contents

CHAPTER 1

Introduction

1.1 Motivation & Problem Statement

Business processes are core assets of organisations, as they directly affect the success of their products and services [1]. Business processes consist of activities which are executed collectively to realise a pre-defined business goal [2]. Business Process Management (BPM) does not only entail overseeing how all those business processes perform and ensuring their consistent performance, but also improving their efficiency and continuously refining the processes themselves [3]. Companies can incorporate PAISs into their existing BPM to reduce human effort and increase productivity, consistency, and efficiency [2]. Apart from these apparent benefits, PAISs can also aid flexibility and make it easier to adapt workflows to necessary changes [4]. Workflow Management System (WfMS), which are a subcategory of PAISs can achieve these goals by automatically allocating work to human or application resources in accordance with the underlying business process model [5], in order to automate the interaction between people and Information Systems (ISs) [6].

Given that roughly only half of the organisations trying to implement a WfMS succeed [5], the implementation of such a system, even within a company having an already established fundamental BPM, can be considered rather challenging. The reason for that being not only technical challenges when implementing the actual system itself, but also organisational challenges concerning changes in business processes, including, but not limited to data and process sharing, governance, interoperability, as well as clarification and understanding [7].

Currently, there are no publicly available general guidelines, frameworks, or similar to help companies implement a PAIS and avoid common problems and misconceptions [8, 9]. Thus, it is not uncommon for such projects to fail during the implementation phase [5], since companies do not know how to expediently incorporate success factors and simultaneously successfully overcome the entailed challenges arising during or even before the actual implementation process itself.

Therefore, the main goal of this thesis is to analyse the implementation process of a PAIS within companies that already have an existing and functioning BPM. This goal should be achieved by analysing critical success factors for, as well as, challenges faced during the adoption process of a PAIS. Furthermore, the different steps and stages crucial for the adoption process will be analysed. In particular, the following research questions will be investigated:

1. What are the success factors and challenges when adopting PAISs in companies?
2. Which steps do adoption guides for PAISs have in common, how do they differ, and why?

By addressing these research questions, a more profound understanding of the relevant risks when implementing a PAIS and how to mitigate them is to be acquired.

1.2 State of the Art

According to Moullin *et al.* [10], the usage of conceptual and theoretical frameworks and checklists to support implementation processes has yet to become the norm, despite the benefits and value added when used. To support the general usage of such frameworks by researchers as well as practitioners, Moullin *et al.* [10] provided recommendations on how to use implementation-aiding frameworks and checklists reasonably.

As such frameworks and checklists build upon previously gathered information, Parkes [11] investigated critical success factors regarding the implementation of WfMSs. Similarly, Reijers *et al.* [5] studied success as well as fail factors when implementing a WfMS.

Ravesteyn [9] engaged with the development of an implementation-aiding framework for Business Process Management Systems (BPMSs), which is the another subcategory of PAIS. They studied and analysed critical success factors when implementing a BPMSs, and proposed a framework incorporating those in the implementation process. Similarly, Javidroozi *et al.* [7] identified critical success factors for Business Process Change (BPC) during Enterprise Systems Integration (ESI). They also developed a framework to act as a basis for BPC and overcoming the entailed challenges.

Wewerka [12] developed a checklist-based approach, assisting the implementation of Robotic Process Automation (RPA) solutions. Vishvakarma *et al.* [13] investigated the impact and influence of organisational strategies on critical success factors of Business Process Reengineering (BPR), and Vu *et al.* [6] studied the capabilities of today's general business process automation solutions.

The results of this thesis will contribute to this state of the art by deriving a multipurpose checklist aiding the implementation process of generic as well specific PAISs. This checklist will contain the results of this thesis regarding the relevant factors and the steps necessary for the implementation process.

1.3 Aim of the Thesis

The aim of this thesis is to help in achieving a more profound understanding of why adoptions of PAISs fail and is expected to shed light on a potential way to overcome these implementation challenges and thus decreasing the likelihood of failure for such projects. Furthermore, this thesis aims at contributing to the state of the art by providing a versatile checklist aiding the implementation process, adaptable for different types of PAISs. This checklist aims at helping companies adopt a PAIS, with the precondition that an existing BPM is already present and acting as a foundation. To ensure the practical relevance of the derived checklist, a comparative analysis with implementation guides of prominent providers of PAISs will be conducted. Finally, this work aims at centralising the success factors, reasons for failed projects, challenges, and providing insights on how to overcome those when implementing PAISs.

1.4 Contribution

The main contributions of this work are as follows:

1. Critical success factors for and challenges faced during the adoption process of different Process-Aware Information Systems are consolidated, and overarching groups of relevant factors needing attention during the adoption process are derived. Furthermore, this generic set of relevant factors is designed to be tailored to the corresponding PAIS adopted.

2. Steps necessary for the adoption process of different types of PAISs are consolidated and abstracted into a more manageable set. Moreover, a generic list of necessary steps is derived, which is designed to be tailored to the corresponding PAIS as well.

3. Comprising the preceding two contributions, an adaptable checklist aimed at aiding the adoption process of different types of PAISs is derived. This checklist is designed to be tailored to the specific PAIS adopted. Finally, this checklist contains a recommendation of which relevant factors are of particular importance within each step of the adoption process.

The derived checklist has been evaluated in form of a comparative analysis with four guidelines of representative providers of four different types of PAISs.

1.5 Thesis Outline

The remainder of the thesis is structured as follows: chapter 2 provides the background on Business Process Management (BPM), Process-Aware Information System (PAIS), and Enterprise Systems Integration (ESI) necessary for the further progress of the thesis. Chapter 3 presents the methodology applied for the conducted Systematic Literature

Review (SLR), including the employed review protocol, and data synthesisation process. The findings of the conducted SLR will be addressed in chapter 4 focusing on the relevant factors and adoption steps extracted, the derived checklist, and the subsequent comparative analysis. The discussion of the findings, their implications as well as the limitations of this thesis, and possible future research directions will be addressed in chapter 5. Finally, chapter 6 concludes this thesis by summarising the conducted work and its findings.

CHAPTER 2

Preliminaries

This chapter addresses the core concepts necessary for the further progression of this thesis. Section 2.1 elucidates the foundational concepts of Business Process Management, and it's related disciplines. Section 2.2 elaborates on the topic of Process-Aware Information System, and its subcategories. Finally, section 2.3 concludes this chapter by addressing relevant aspects for successful Enterprise Systems Integration.

2.1 Business Process Management

Business processes are considered core assets of organisations, as they directly affect the efficiency and efficacy of reaching their business goals [1, 2]. The way business processes are designed and managed has a significant impact on the success of their products and services offered to their customers [1, 2]. This holds true for internal as well as customer-facing processes [1, 2].

Business processes comprise a collection of tasks or activities that are performed in a predefined order, to achieve a certain goal [1, 14]. They can involve multiple actors and objects (e.g. employees, software systems or external entities) within their activities [1]. Business processes are present in various aspects of an organisation, including, but not limited to, production, administration, sales, and marketing [1, 15]. Business processes can be classified into three main categories: [1, 14, 15]

- **Core Processes:** Capabilities enabling companies to achieve sustainable competitive advantages are classified as core competences [1]. Core processes are processes that enable companies to create value by implementing core competencies or contributing to their development and expansion [1, 15]. Such processes can include, among others, development, manufacturing, and sales processes, depending on the industry [15].

- **Supporting Processes:** Supporting processes do not create value directly, but are crucial for the execution of core processes [1]. Procurement, human resource management, information technology management, and many more are essential to enable core value adding processes [1, 15].

- **Management Processes.** To align core and supporting processes with the overall strategy of the company, management processes are used [1]. Such processes include strategic planning, controlling and risk management, and budgeting [15].

The management of business processes can be considered a process itself [15]. An efficient BPM can allow companies to outperform their competitors by having a more streamlined internal organisational structure, thus keeping their quality, and productivity up while keeping costs down [1, 14, 16].

Organisations focusing on managing and improving their processes as well as their outcomes can be classified as process-oriented [3]. This entails that they incorporate a horizontal process-oriented organisation within their vertical functional hierarchies or follow a purely process-centred horizontal hierarchy to improve their overall performance by orienting their organisation aligned to their internal value-chain [3].

BPM is an effective methodology, process-oriented organisations can use, to improve the performance and efficiency of their business processes [3, 16]. BPM stems from a combination of disciplines, incorporating process thinking, automation, as well as a high regard for quality [3, 16]. It is a management discipline that regards business processes as the main contributor to organisational success, and thus focuses on optimising them to achieve organisational goals [3]. However, BPM does not only entail overseeing how all those business processes perform and ensuring their consistent performance, but also improving their efficiency and continuously refining the processes themselves [3, 16].

2.1.1 BPM Lifecycle

Dumas *et al.* [1] introduced the so-called BPM lifecycle, visible in figure 2.1. This lifecycle represents a structural framework aiming at providing a standardised approach to designing, implementing, and managing business processes within an organisation [1]. It consists of six phases: (1) process identification, (2) process discovery, (3) process analysis, (4) process redesign, (5) process implementation, and (6) process monitoring [1]. The goal hereby is to continuously improve and streamline the organisation's core, supporting, and management processes [1].

Process Identification. The first phase, outside the loop, initiates the lifecycle with the identification of relevant processes for a (new) business problem [1]. Here all relevant processes are delimited, meaning their input and output borders defined, and put in relation to another to acquire a new or updated process map representing the overall picture of the relevant processes and their inter-connections [1].

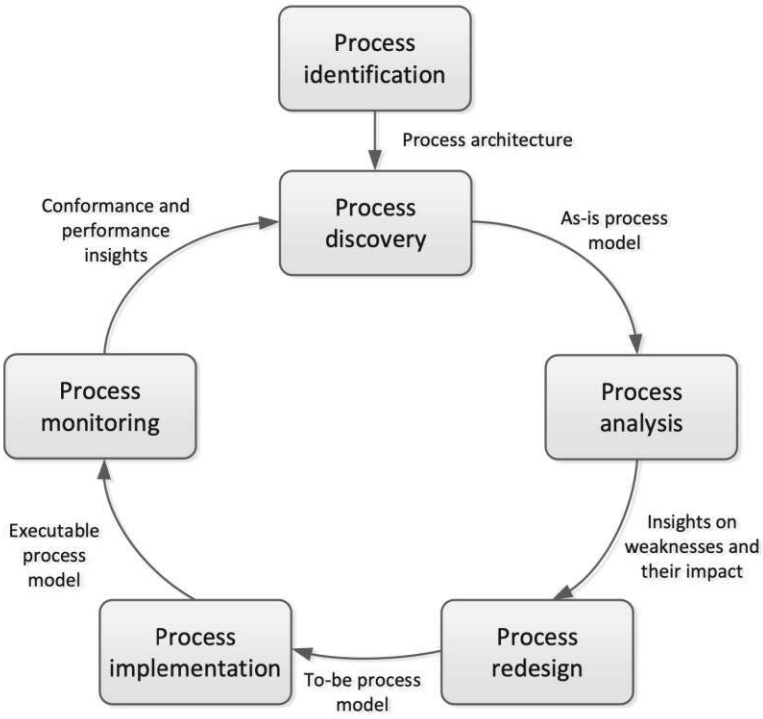


Figure 2.1: BPM Lifecycle

Process Discovery. The second phase, representing the first stage within the loop, aims at capturing the current state of the previously identified processes and documenting that [1]. This results in one or more as-is process models belonging to the previously defined process map [1].

Process Analysis. The process analysis phase, as the name already suggests, aims at analysing the as-is processes for potential issues and improvement possibilities [1]. Whenever possible, quantifiable performance metrics should be incorporated when documenting identified issues [1].

Process Redesign. In the fourth phase, potential process changes should be identified to address the previously identified issues [1]. Here the quantifiable performance metrics again come into play as they help in finding the best redesign of the process [1]. This phase should end with an improved process in the form of a to-be process model [1].

Process Implementation. The penultimate phase within the loop aims at implementing the required changes to move from the as-is to the to-be process [1]. At this stage, potential process automation steps can be implemented as well [1]. Here, the usage of organisational change management, to help employees adapt to changed working conditions, is crucial, to ensure efficiency and performance within operations [1].

Process Monitoring. The final phase of the BPM lifecycle addresses the performance monitoring of the redesigned process [1]. Here, bottlenecks, errors, or unintended behaviour within the process are identified and counteractions initiated [1]. After this phase, the BPM lifecycle continues with the process discovery phase of the next process potentially affected due to the changes made in the redesigned process [1].

2.2 Process-Aware Information Systems

To support Business Process Management, and streamline the incorporation of the BPM lifecycle, Enterprise Information Systems (EISs), that are aware of business processes in an organisational context, can be employed [5, 6, 17]. These systems are called PAISs. [17]
Being ISs, PAISs exhibit the same foundational properties, meaning that they are systems that collect, manipulate, store, and disseminate information and provide a feedback mechanism to help organisations achieve their goals [18]. In the early 2000s, there has been a shift from so-called Data-Aware Information Systems (DAISs) towards PAISs as BPM became formalised and established on a larger basis [19]. According to Dumas *et al.* [19], a PAIS can be defined as *"a software system that manages and executes operational processes involving people, applications, and/or information sources on the basis of process models"*.

ISs are classified as process-aware independent if their processes are hard-coded or only used implicitly [17]. PAIS aim at streamlining the phases of the BPM lifecycle addressed in section 2.1.1 [17]. They achieve this by involving various human actors, and often work with large underlying datasets to support the automation of activities and processes. [20].

2.2.1 Types of PAIS

Classical examples of PAISs are WfMSs, and BPMSs, which support the operational business processes, and are guided by explicit process models [17]. Apart from that, Enterprise Ressource Planning (ERP) systems, and RPA solutions can also be classified as this category of ISs, even if their processes are hard-coded or only used implicitly [12, 17].

Workflow Management System A Workflow Management System is an early example of a PAIS [17]. It ensures that tasks are automatically allocated to humans or applications based on an underlying process, and predefined available resources [5]. A WfMS can be considered the foundation of the successive BPMSs [1, 21].

Business Process Management System A Business Process Management System is a more recent example of a PAIS. It has a wider scope of operation than a WfMS as it provides a wider set of functionalities [17]. A BPMS is more closely aligned with the

BPM lifecycle, thus supports the design, analysis, execution, and monitoring of business processes [1].

Enterprise Resource Planning An Enterprise Ressource Planning system is an PAIS more focused on the resource perspective of a business [22]. It can allow a company to more efficiently manage its use of resources by providing a process-oriented view on a company's resource usage [22].

Robotic Process Automation Robotic Process Automation is a software solution for automating business processes by mimicking user behaviour [12]. As a result, RPA can therefore only be used to automate processes on a user level, and is mostly used to automate repetitive, rule-based tasks that a human can perform within digital systems [12].

2.3 Enterprise Systems Integration

When implementing an IS into an existing Information Technology (IT) landscape, the concept of Enterprise Systems Integration is a crucial component for the successful integration of the IS [7]. The core concept of Enterprise Systems Integration has been around since the 1940s [7], and has become more relevant ever since, as IT and ISs become increasingly complex [23]. However, the goal of ESI has been constant in enhancing the organisation's overall performance by ensuring the efficient communication and interaction between different ISs [7, 24].

To ensure a successful integration of different IS, ESI encompasses organisational as well as technical elements. involves not only technical challenges, but also organisational and administrative considerations that ensure the smooth functioning of integrated systems [7]. The following four components can be classified as key elements of ESI: (1) process integration, (2) people and organisational integration, (3) technology integration, and (4) data integration [7, 24].

Process Integration: The integration of processes understands the alignment of processes and workflows of different organisational units to integrate seamlessly with one another [7, 24]. In the context of the topic of this master's thesis, this understands the seamless integration of a PAIS and its underlying processes with other existing ISs in the company's Enterprise Architecture (EA). To achieve this, companies are often required to incorporate BPR [7], where the BPM lifecycle, mentioned in section 2.1 comes into play.

People and Organisational Integration: Adapting the interaction between organisational units to the introduction of the new IS is essential in achieving sustainable business change [7]. For this, change management strategies, training programs, and clear

communication are crucial in minimising resistance to change and maximising acceptance of the new IS and adapted processes [24].

Technology Integration: Besides process and organisational integration, technological integration is of paramount importance when aiming at integrating an additional IS into the existing EA [7]. This includes the integration of necessary legacy systems to ensure that the process integration can build upon a reliable technological base [7].

Data Integration: Finally, integrating and consolidating data from various IS presents a critical aspect as the goal herby is to ensure consistent, and accurate data across the different IS [7]. This can present a rather complex undertaking, especially dealing with legacy systems offering limited interfaces and operating with different data formats [23].

Enterprise Systems Integration is an essential aspect when integrating a Process-Aware Information System into an organisation's existing Enterprise Architecture.

CHAPTER 3

Research Methodology

This chapter presents the methodology employed in the research process of this thesis. A Systematic Literature Review was conducted to identify the relevant literature, enhance the understanding, as well as to enhance the understanding of challenges, critical success factors accompanying the adoption process, and steps necessary for the adoption of a Process-Aware Information System. This SLR was conducted adhering to the guidelines of Kitchenham and Charters [25] to ensure methodological rigour, transparency, and reproducibility.

To specify the methods that were used, in advance, a pre-defined review protocol was developed. Its goal was to ensure transparency and reproducibility of the conducted SLR. The contents of this protocol were based on the guidelines of Kitchenham and Charters [25] and thus consisted of seven main components: (1) background and objectives, (2) research questions, (3) search strategy, (4) inclusion and exclusion criteria, (5) selection process, (6) data collection, and (7) data synthesisation.

It has to be mentioned that, since this SLR was conducted in the context of a master's thesis, some components mentioned by Kitchenham and Charters [25] were not present. This particularly pertains to the study quality assessment by accompanying researchers, the dissemination strategy, as well as the project timetable. Additionally, the limitations further comprise the absence of a second researcher to ensure peer-reviewed results. Section 5.3 addresses the limitations of this SLR in more detail.

To reduce potential errors, the review protocol was piloted in advance. Subsequently, digital libraries including IEEE Xplore Library, Scopus, ACM Digital Library, and Engineering Village were systematically searched based on the defined keywords and relevant publications have been selected manually in a multistage process.

Relevant data, such as mentioned challenges and success factors as well as phases and steps of such an adoption process within a company were extracted from the selected publications, and subsequently synthesised qualitatively. Based on this synthesised

data, the foundation for a checklist was derived, incorporating relevant steps during adoption combined with relevant factors for these steps. Finally, this underlying basis was compared to different guidelines provided by prominent system providers in the form of a comparative analysis.

The remainder of this chapter elaborates on each component of the review protocol in more detail and is organised as follows: section 3.1 provides detailed documentation of the SLR-process, with the focus lying on the review protocol. Section 3.2 provides the underlying scope of the SLR by listing the research questions addressed. Section 3.3 describes the search strategy, followed by section 3.4 presenting the inclusion and exclusion criteria employed. The selection process of relevant literature is described in section 3.5. Which data was collected from the selected relevant literature is described in section 3.6, and section 3.7 describes the qualitative data synthesisation process. Finally, section 3.8 concludes the chapter with an elucidation of the comparative analysis process.

3.1 Background and Objectives

PAISs are essential for companies relying heavily on the efficiency of their internal business processes [2, 7]. The successful adoption of such PAIS can be rather complex and challenging for companies [2, 7]. Thus, it is necessary to identify best practices and critical success factors through a systematic approach [2, 7]. This Systematic Literature Review aimed at establishing the foundation for a checklist to serve as a guideline for organisations adopting a PAIS [2, 7].

The objective of this SLR was to identify critical success factors, known challenges, and steps within such an adoption project. Furthermore, relevant factors affecting the adoption as well as the extracted steps and phases were synthesised. As a result, the foundation for a comprehensive implementation-aiding checklist that can be used by practitioners to ensure a successful PAIS deployment was established.

3.2 Research Questions

The research questions addressed in this SLR were as follows:

1. What are the success factors and challenges when adopting PAISs in companies?
2. Which steps do adoption guides for PAISs have in common, how do they differ, and why?

3.3 Search Strategy

The search strategy consisted of three steps:

1. A comprehensive list of synonyms and related expressions for the three main terms searched for was generated.

2. A search string containing all combinations of the identified terms across the three groups was derived.

3. The generated search string was used in digital libraries to receive a comprehensive result of potentially relevant publications for the data collection.

IEEE Xplore, ACM Digital Library, Scopus, and Engineering Village were searched with the search terms presented in table 3.1. The left column of table 3.1 lists the three main terms searched for, and the right column lists the identified synonyms and related terms as part of the already merged search string. The search string employed "or"-joins for connecting the synonyms and related terms, and "and"-joins to connect the three groups for the major terms. Table 3.2 depicts the search constraints that were applied, including the subject area, document type, language, publication stage, search fields, and timeframe. The search was conducted on three dates: the 21st of November, the 26th of November, and the 6th of December in the year 2023.

3.4 Inclusion and Exclusion Criteria

Books, book chapters, conference articles, conference papers, journals, journal articles, and research articles on the following topics, published since January 1st 2000, were included:

- Publications mentioning critical success factors regarding the adoption of a PAIS in general or regarding a specific type of PAIS.
- Publications mentioning challenges regarding the adoption of a PAIS in general or regarding a specific type of PAIS.
- Publications mentioning steps or phases relevant for the adoption process of a PAIS in general or regarding a specific type of PAIS.

The following types of publications were excluded:

- Publications representing pure opinion pieces.
- Publications not available in full text.
- Publications, where the topic of PAIS was mentioned only as a general introductory term in the paper's abstract / introduction.
- Publications representing a summary of a workshop.

Table 3.1: Literature Review Search Terms

Major Term	Search Terms
Process-Aware Information Systems	(“Process-Aware Information System” OR “Process Aware Information System” OR “PAIS” OR “Workflow Management System” OR “WMS” OR “Business Process Management System” OR “BPMS” OR “Process Automation System” OR “PAS” OR “Business Process Automation” OR “BPA” OR “Workflow Automation” OR “Intelligent Process Automation” OR “IPA” OR “Robotic Process Automation” OR “RPA”) **AND**
Implementation	(“Implementation” OR “Deployment” OR “Integration” OR “Rollout” OR “Change Management” OR “Challenges” OR “Success Factors” OR “Risks” OR “Opportunities”) **AND**
Checklist	(“Checklist” OR “Guideline” OR “Standard Operating Procedure” OR “SOP” OR “Procedure” OR “Guide” OR “List” OR “Manifest” OR “Outline” OR “Task List” OR “Protocol” OR “Workflow”)

- Publications not available in English or German.

Additionally, when a publication has been published in more than one journal / conference / digital library, the most complete version of the publication was used for further processing.

3.5 Selection Process

The study selection process should ideally involve multiple researchers to minimise bias. However, due to the fact that this SLR was conducted in the context of a master’s thesis, the potentially relevant studies were selected by a single researcher only. However, to ensure methodological rigour, clear inclusion and exclusion criteria have been defined in advance. Additionally, periodic feedback from the thesis supervisor was incorporated to mitigate potential bias and errors.

The study selection process consisted of the following steps, visible in figure 3.1:

Table 3.2: Literature Review Search Constraints

Attribute	Value
Subject Area	Computer Science Business, Management, and Accounting
Document Type	Book, Book Chapter Conference Article, Conference Paper Journal, Journal Article Research Article
Language	English, German
Publication Stage	Final
Search Fields	Title, Abstract, Keywords
Timeframe	Since 2000

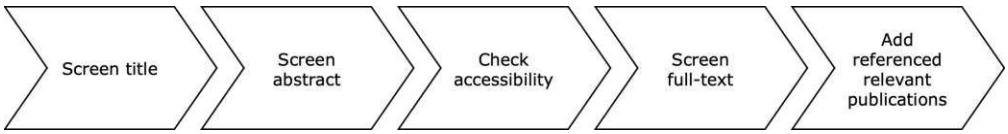


Figure 3.1: Study Selection Process

1. The title of each publication was screened for relevance, and potentially relevant publications were selected.
2. The abstract of each remaining publication was screened for relevance, and potentially relevant publications were selected.
3. Inaccessible publications were excluded.
4. The full-text of the remaining publications was screened for relevance, and relevant publications were selected.
5. Relevant publications referenced by other potentially relevant publications were added.

3.6 Data Collection

The following data attributes were extracted from each selected relevant publication:

- Year of publication
- Type of study
- Type of PAIS addressed
- Success factors
- Challenges
- Steps for adoption

3.7 Data Synthesisation

For the data synthesisation of the extracted qualitative data, the line of argument synthesisation according to Noblit and Hare [26] was followed. This method suited the gathered data as the data consisted of various aspects, e.g. technical challenges, and organisational aspects. The line of argument synthesisation involved a two-stage process:

1. The individual publications were analysed and the relevant data was extracted.
2. The extracted data was integrated to infer more general insights into the topic as a whole.

Using this approach, a comprehensive understanding and identification of patterns and best practices was attained [26], [25].

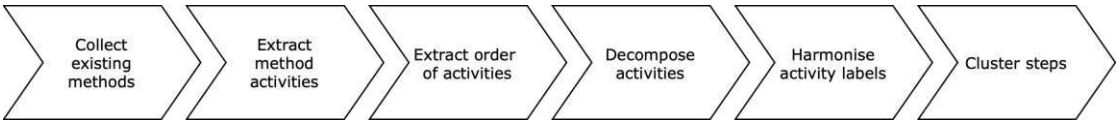
Furthermore, to synthesise the extracted critical success factors, challenges, and implementation steps an adaptation of the method mining procedure approach presented by Malinova Mandelburger *et al.* [27] was employed. Figure 3.2 depicts this adapted procedure.

Figure 3.2a shows the four steps conducted for the synthesisation of the relevant factors: (1) the critical success factors and challenges were collected from the literature, (2) the two sets were joined, (3) items describing the same semantic meaning were merged, and (4) the consolidated items were clustered into overarching categories of relevant factors.

Figure 3.2b displays the steps conducted for the synthesisation of the implementation steps: (1) the existing methods were collected from the literature, (2) the method activities were extracted, (3) the order of the actives was extracted, (4) the extracted activities were decomposed into atomic activities, (5) the labels of the decomposed activities were harmonised, and (6) the decomposed, and harmonised activities were clustered into overarching categories of necessary implementation steps.

Based on the resulting clusters of relevant factors and necessary implementation steps, the foundation for a checklist was derived by integrating them into a matrix displaying the necessary steps as rows, and the relevant factors as columns. This was done once for

(a) Relevant Factors



(b) Implementation Steps

Figure 3.2: Data Synthesisation Methodology

each type of PAIS identified, and once on a generic level to infer more general insights into the topic as a whole.

3.8 Comparative Analysis

To assess the comprehensiveness as well as the applicability for different types of PAISs, and relevance of the derived foundation for a generic checklist, this foundation was compared to guidelines of four selected prominent PAIS providers: (1) Camunda, (2) Appian, (3) SAP, and (4) UiPath. Within this comparative analysis, the addressed implementation steps and relevant factors of the different guidelines were compared to the ones addressed by the derived foundation for a generic checklist.

To ensure a meaningful comparison, implementation guidelines from representative software providers within each system category were chosen. For the selection process of representative providers, market analyses by Gartner and others were used to select the providers. Moreover, since not every company provides a publicly accessible online guide, the selected providers were chosen out of the identified leaders in the respective market analyses based on the availability of a guideline.

Camunda: According to the Gartner "Market Guide for Business Process Automation Tools" from 2023, Camunda was listed as one of the main representatives of BPMS providers [28]. Additionally, they provided a publicly accessible checklist aimed at a successful process automation rollout [29].

Appian: According to the Gartner "Critical Capabilities for Enterprise Low-Code Application Platforms" from 2023, Appian was identified as a leader of workflow automation providers [30]. Furthermore, they also provide a publicly accessible guide aimed at process automation and achieving process excellence [31].

SAP: According to Sarferaz [32], who conducted an ERP market analysis in 2022, System Analysis Program Development (SAP) has the world-wide leading market share.

SAP provides an online guide based on their Accelerated Implementation Program (AIP) [33].

UiPath: According to the Gartner "Magic Quadrant for Robotic Process Automation" from 2023, UiPath was identified as a market leader for the 5th year running [34]. They provide an online guide addressing the adoption of RPA within a company [35].

CHAPTER 4

Findings

This chapter presents the findings of the conducted Systematic Literature Review according to the methodology described in chapter 3. The data extracted from the results of the SLR was synthesised via the line of argument synthesisation according to Noblit and Hare [26]. Based on the synthesised data, the foundation for a checklist was established. The data synthesisation process was divided into three areas: (1) regarding the critical success factors and challenges, (2) regarding the implementation phases, and (3) regarding the established foundation. This established checklist foundation then was compared to guidelines published by prominent Process-Aware Information System providers in each system category.

This chapter is organised as follows: Section 4.1 presents the overall results of the conducted SLR. Section 4.2 goes into detail on the data synthesisation of the extracted data regarding the relevant factors. Section 4.3 elaborates on a similar procedure conducted for the extracted implementation phases. Finally, section 4.4 describes the development of the checklist foundation based on these two attribute groups, and section 4.5 concludes this chapter by presenting the findings from the comparative analysis of the derived checklist foundation to guidelines published by prominent system providers.

4.1 Systematic Literature Review

The methodology, according to which the SLR was conducted, is presented in chapter 3. This section aims at presenting a comprehensive overview of the gathered data of the SLR. The succeeding sections will address the individual findings in more detail.

Figure 4.1 presents the sequential steps taken within the literature selection process, elaborated in section 3.5. After the initial literature search, incorporating the search constraints mentioned in section 3.6, 4672 potentially relevant publications were found. Subsequently, those publications were filtered based on the relevance to the research

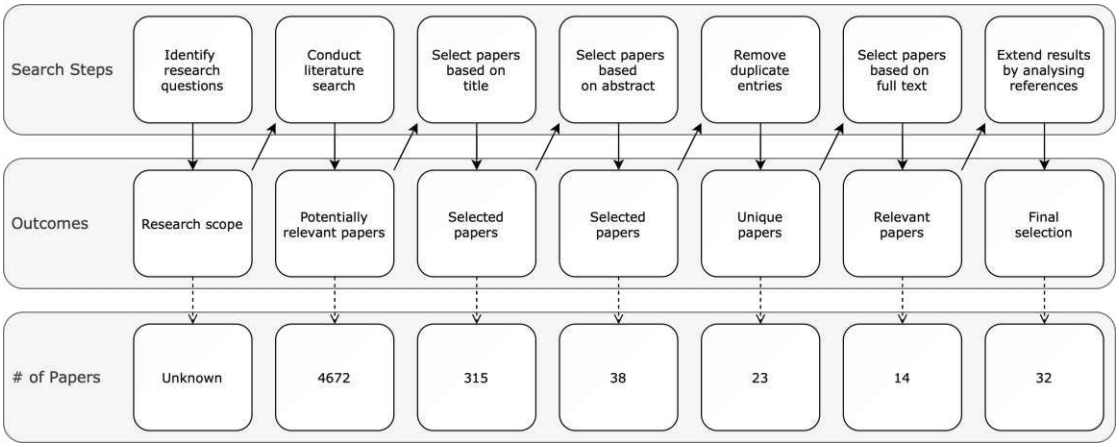


Figure 4.1: SLR Search Log

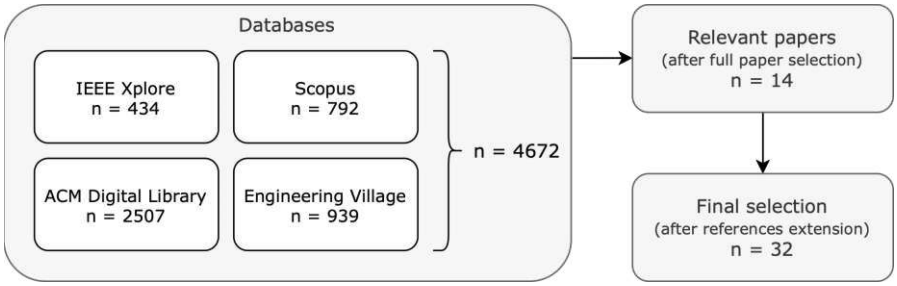


Figure 4.2: SLR Database Statistics

questions addressed in this thesis. This was first done based on the title, which led to 315 publications remaining. Next, 38 of those were selected based on their abstract and, following that, 15 duplicates were removed. Based on the remaining 23, 14 relevant publications were chosen as relevant based on their full content. During this last step, 18 publications were additionally identified through reference analysis, leading to a final selection of 32 publications.

Figure 4.2 presents the composition of the initial 4672 potentially relevant publications, broken down onto the four digital libraries searched. 434 publications resulted from IEEE Xplore Library, 792 publications were obtained through Scopus, 2507 originated in the ACM Digital Library, and 939 publications resulted from Engineering Village.

Together, figure 4.1 and 4.2 illustrate the rigorous and system approach taken to ensure a thorough and comprehensible literature review.

Table 4.1 shows which type of data was extracted from which publication. The table shows the final selection of publications grouped per type of PAIS. The three columns “SF”, “C”, and “IM” represent the three different types of data focused on: “Success Factors”, “Challenges”, and “Implementation Methodology”. These columns mark whether data of this category was extracted from the publication or not. A checkmark in the

column “SF” or “C” in this context understands that the publication mentioned any success factors or challenges relevant for the implementation process of a PAIS within a company. A checkmark in the column “IM” means that the publication addresses the methodology of adopting a PAIS within a company by listing specific steps necessary for the implementation process. In total, 23 publications mentioned success factors, 16 mentioned challenges, and 12 mentioned steps necessary for the implementation of a PAIS within a company. The full data extraction log can be found in appendix A.

4.1.1 Excluded Entries

In total, nine publications were excluded from the results, after the evaluation of their full text for relevance to the research questions. Eight publications were excluded as they did not mention any challenges, success factors or steps regarding the adoption process of a PAIS in general or regarding a specific type of PAIS: [5, 63–69]. One publication was excluded since the challenges addressed by this publication were focused on the security aspect in PAIS, and not on the adoption process: [20].

4.2 Relevant Factors

The data synthesisation of the extracted critical success factors and challenges involved the following two steps to achieve a set of relevant factors: (1) conjunction and consolidation of relevant factors, and (2) clustering of relevant factors.
Both steps were conducted in the context of each type of system identified during the data extraction phase of SLR, and will be explained in more detail in the following subsections.

4.2.1 Conjunction and Consolidation

All collected critical success factors and challenges were pooled together into the overarching category “Relevant Factors” for a better overview and easier subsequent manipulation. Here, identical duplicates were also removed to reduce the overall set of factors. Following that, the next step involved the consolidation of entries that understood the same underlying relevant factor but differed in their textual description.

To illustrate this, the former critical success factor “effective communication with employees” and the former challenge “insufficient communication towards employees” were merged into the relevant factor “effective communication” as both address the topic of communication but differ in their perspective. The same holds true for “selection of the right tool” and “deciding on the best application” which were consolidated in the relevant factor “tool selection”.

By carrying out this process for all conjuncted critical success factors and challenges, the total number of remaining relevant factors was reduced significantly from 302 to 166 unique factors. In detail, the set of relevant factors was brought down to 48 factors regarding BPMSs, 62 factors for WfMSs, 100 factors for ERP systems, and 92 factors

Table 4.1: Type of Data extracted per Publication

PAIS	Publication	SF	C	IM
BPMS	Reijers [36]	✓		
	Ma *et al.* [37]		✓	
	Ravesteyn [9]	✓		✓
	Holzmuller-Laue *et al.* [38]	✓	✓	
	Dumas *et al.* [1]	✓	✓	
	Bartlett *et al.* [39]		✓	✓
WfMS	Murray [40]	✓		
	Parkes [41]	✓		
	Cheung [42]	✓	✓	
	Rojo Abollado *et al.* [43]	✓	✓	
ERP	Markus and Tanis [44]			✓
	Hong and Kim [45]	✓	✓	
	Esteves and Pastor [46]	✓		✓
	Kumar *et al.* [47]	✓	✓	✓
	Kim *et al.* [48]		✓	
	Kamhawi [49]	✓		
	Finney and Corbett [50]	✓		
	Françoise *et al.* [51]	✓		
	Dezdar and Sulaiman [22]	✓		
	Shaul and Tauber [52]	✓	✓	
	Elezabeth and Velan [53]	✓		
	Javidroozi *et al.* [7]		✓	
RPA	Syed *et al.* [54]	✓	✓	
	Koch and Fedtke [55]	✓		✓
	Herm *et al.* [56]			✓
	Turcu and Turcu [57]	✓	✓	
	Choi *et al.* [58]		✓	
	Krakau *et al.* [59]	✓		✓
	Flechsig *et al.* [60]	✓	✓	✓
	Plattfaut *et al.* [61]	✓		✓
	Wewerka [12]		✓	✓
	Brandstatter *et al.* [62]			✓
		23	16	12

with regard to RPA solutions. In total, 29 publications mentioned either critical success factors or challenges relevant for the implementation process of PAISs. The consolidated relevant factors for each type of PAISs can be found in appendix B.

4.2.2 Clustering

Now, having a unique set of relevant factors for each type of system identified in the literature, these items were clustered manually to further reduce the number of data points and complexity for further processing. The clustering of multiple relevant factors into a single cluster was determined based on their semantic interrelationship. For example, the relevant factors "change management" and "resistance to change" were put in the same cluster, as they both address the overarching topic of change management.

This process was done for all relevant factors, spanning across all identified systems, and resulted in a total of 18 clusters. Subsequently, these clusters were labelled as categories and a textual description was derived depending on their content.

Best Practices Usage. Best practices are identified and adopted. Modelling standards and techniques are utilised. A unified language for modelling notation and process execution is used.

Business Culture and Politics. The organisation's culture and political landscape are considered. Strategies are developed to align the adoption with the existing culture to ensure that political dynamics are effectively handled.

Business Integration. Existing central identity management solutions and automation islands are assimilated. Processes and data are integrated seamlessly.

Business Structure and Accountability. Decision-makers are empowered, and responsibilities are (re)defined. Accountability and control are established.

Business Vision and Strategy Alignment. Goals are aligned with the business plan and vision, ensuring a strategic fit.

Change Management. Stakeholder concerns are addressed and mitigated. Trust towards the change is built. Resistance to change is reduced. Potential role changes are enacted, and job redesign implications are realised.

Continuous Optimisation. Areas for improvement are continually re-assessed. Functionality and efficiency is ensured.

Data Integration. Lossless data migration is ensured. Data integrity and accuracy is prioritised. Information flow through the system(s) is ensured.

Gradual Introduction. The system is implemented/adopted gradually, focusing first on fully understood processes.

Infrastructure Assessment. The IT infrastructure foundation, readiness, and compatibility for the system is assessed and ensured.

Knowledge Management. In-depth system and usage documentation is created. A comprehensive knowledge base for long-term knowledge management is established, shared, and continuously updated.

Maintenance Implications. Maintenance requirements are identified, and mature technology is considered. Resources for ongoing support are allocated.

Management Support. Active management support and commitment are secured. Resources and focus are provided by top management. Organisational leadership is engaged, ensuring financial resources and capabilities for the implementation/adoption process.

Process Awareness and Orientation. Organisational understanding of BPM concepts is enhanced. Processes are prioritised for automation. Policies and procedures for managing workflow changes are established.

Project Management. Project team composition, scope, and objectives are managed. Cross-functional coordination and teamwork are promoted. Trust between partners and the use of consultants are facilitated.

Quality Assurance. Quality standards are defined and maintained. System security and testing are ensured. Reliability, performance, and ease of use are monitored. Governance is established.

Stakeholder Involvement and Communication. Stakeholders are identified and engaged throughout the implementation/adoption process. Effective communication strategies are used. User training, participation, and clarification are ensured.

System Configuration and Customisation. The system is configured to meet business needs. Flexibility, scalability, and modifiability of the system is ensured.

Since each type of PAIS had different relevant factors mentioned in their respective relevant literature, not every group was present as a relevant factor category for each type of system. The resulting categorisation of relevant factors for each type of system identified will be addressed in the following.

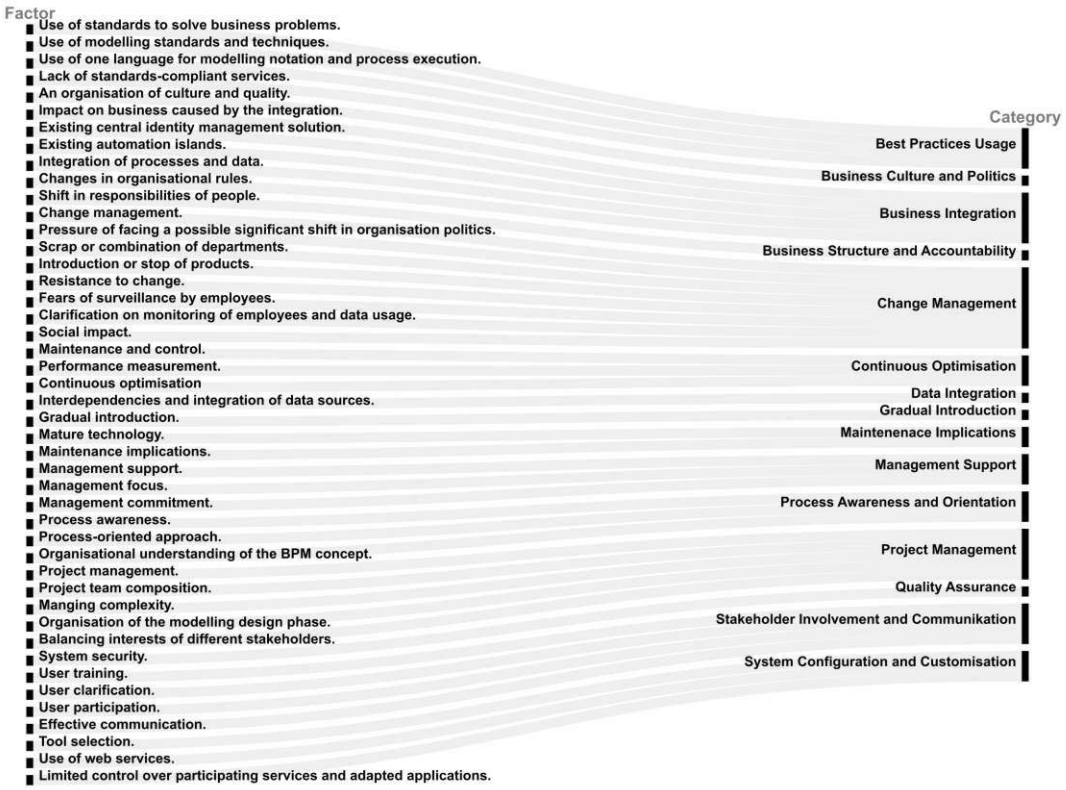


Figure 4.3: BPMS Relevant Factors Categorisation

4.2.2.1 Business Process Management System

Figure 4.3 depicts the categorisation of the relevant factors applicable for the adoption process of a BPMS. The left side of the graphic contains all identified relevant factors, and the right side the corresponding categories.

Based on relevant factors gathered through the publications visible in the first group of table 4.1, the following 15 categories are present within this categorisation:

(1) Best Practices Usage, (2) Business Culture and Politics, (3) Business Integration, (4) Business Structure and Accountability, (5) Change Management, (6) Continuous Optimisation, (7) Data Integration, (8) Gradual Introduction, (9) Maintenance Implications, (10) Management Support, (11) Process Awareness and Orientation, (12) Project Management (13) Quality Assurance, (14) Stakeholder Involvement and Communication, and (15) System Configuration and Customisation.

The categories “Business Vision and Strategy Alignment”, “Infrastructure Assessment”, and “Knowledge Management” are not present since no relevant factor matching the context of these groups was mentioned in the gathered literature.

4.2.2.2 Workflow Management System

Figure 4.4 depicts the categorisation of the relevant factors applicable for the adoption process of a WfMS. The left side of the graphic contains all identified relevant factors, and the right side the corresponding categories.

Based on relevant factors gathered through the publications visible in the second group of table 4.1, the following 15 categories are present within this categorisation:

(1) Business Culture and Politics, (2) Business Integration, (3) Business Structure and Accountability, (4) Business Vision and Strategy Alignment, (5) Change Management, (6) Continuous Optimisation, (7) Data Integration, (8) Gradual Introduction, (9) Infrastructure Assessment, (10) Management Support, (11) Process Awareness and Orientation, (12) Project Management, (13) Quality Assurance, (14) Stakeholder Involvement and Communication, and (15) System Configuration and Customisation.

The categories “Best Practices Usage”, “Knowledge Management”, and “Maintenance Implications” are not present because no relevant factor matching the context of these groups was mentioned in the gathered literature.

4.2.2.3 Enterprise Resource Management System

Figure 4.5 depicts the categorisation of the relevant factors applicable for the adoption process of an ERP System. The left side of the graphic contains all identified relevant factors, and the right side the corresponding categories.

Based on relevant factors gathered through the publications visible in the second to last group of table 4.1, the following 17 categories are present within this categorisation:

(1) Business Culture and Politics, (2) Business Integration, (3) Business Structure and Accountability, (4) Business Vision and Strategy Alignment, (5) Change Management, (6) Continuous Optimisation, (7) Data Integration, (8) Gradual Introduction, (9) Infrastructure Assessment, (10) Knowledge Management, (11) Maintenance Implications, (12) Management Support, (13) Process Awareness and Orientation, (14) Project Management, (15) Quality Assurance, (16) Stakeholder Involvement and Communication, and (17) System Configuration and Customisation.

The category “Best Practices Usage” is not present, since no relevant factor matching the context of this group was mentioned in the gathered literature.

4.2.2.4 Robot Process Automation

Figure 4.6 depicts the categorisation of the relevant factors applicable for the adoption process of RPA. The left side of the graphic contains all identified relevant factors, and the right side the corresponding categories.

Based on relevant factors gathered through the publications visible in the last group of table 4.1, the following 15 categories are present within this categorisation:

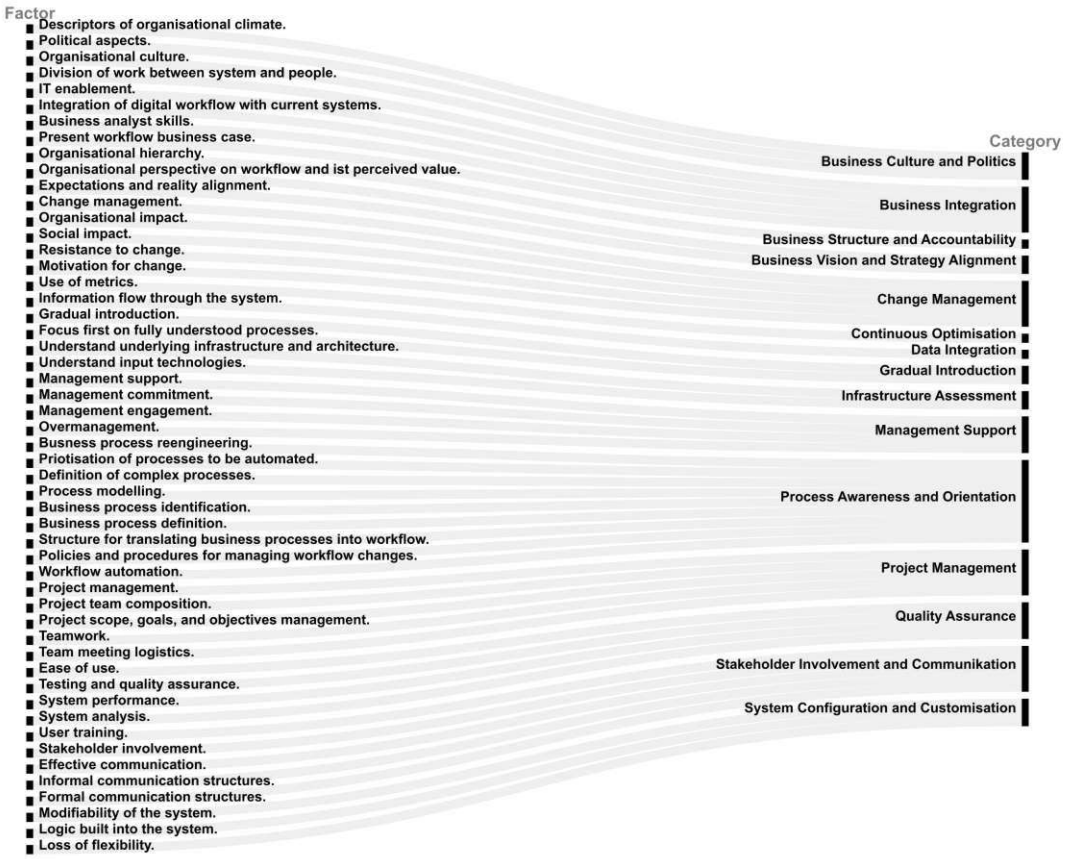


Figure 4.4: WfMS Relevant Factors Categorisation

(1) Best Practices Usage, (2) Business Integration, (3) Business Structure and Accountability, (4) Business Vision and Strategy Alignment, (5) Change Management, (6) Continuous Optimisation, (7) Gradual Introduction, (8) Infrastructure Assessment, (9) Knowledge Management, (10) Management Support, (11) Process Awareness and Orientation, (12) Project Management, (13) Quality Assurance, (14) Stakeholder Involvement and Communication, and (15) System Configuration and Customisation.

The categories “Business Culture and Politics”, “Data Integration”, and “Maintenance Implications” are not present because no relevant factor matching the context of these groups was mentioned in the gathered literature.

4.3 Implementation Phases

The data synthesisation of the extracted steps and phases relevant for the adoption process for the different PAISs consisted of two steps: (1) decomposition of the extracted steps, and (2) clustering and allocation of steps to stages.

Figure 4.5: ERP Relevant Factors Categorisation

Figure 4.6: RPA Relevant Factors Categorisation

Figure 4.7: BPMS Step Decomposition

Both steps were conducted in the context of each type of system identified during the data extraction phase of the systematic literature review, and will be explained in more detail in the following subsections. However, it has to be noted in advance that this section only addresses BPMSs, ERP systems, and RPA solutions, since none of the acquired literature provided any steps or phases relevant for the adoption of a WfMS.

4.3.1 Decomposition

As a first step, the extracted phases and steps from the gathered literature were preprocessed in form of (1) splitting the steps into atomic activities, and (2) labelling them consistently, consisting of a verb followed by an object.

The following subsections will illustrate this process in more detail for the three types of PAISs.

4.3.1.1 Business Process Management System

For the system type “BPMS”, there were two publications mentioning a total of 12 unique steps necessary for the implementation process, as shown in table 4.1 in the first group in the last column. Figure 4.7 illustrates that these 12 steps were transformed to 16 atomised steps during the decomposition process.

To illustrate the process in form of an example, the step “Management of Organisation and Processes” extracted from Ravesteyn [9] was split up into two atomised steps: (1) “Manage Organisation”, and (2) “Manage Processes”.

The first column of the graphic shows the publication, the second column shows which steps were extracted, and the third column shows the atomised step. In this case, neither of the two publications mentioned any phases within the implementation process. Hence, figure 4.7 does not show such a column.

4.3.1.2 Enterprise Resource Management System

For the system type “ERP”, there were three publications mentioning a total of 65 unique steps necessary for the implementation process, as shown in table 4.1 in the second to last group in the last column. Figure 4.9 illustrates that these 65 steps were transformed to 75 atomised steps during the decomposition process.

Again, the first column of the graphic shows the publication, however, the second column now shows the phases extracted and following that, the third column shows which steps were extracted and belong to which phase. The last column again shows the atomised step.

In this case, the mentioned phases by each publication differed in number. Esteves and Pastor [46] mentioned five phases: (1) "Preparation", (2) "Business Blueprint", (3) "Realisation", (4) "Final Preparation", and (5) "Go-Live" comprising 27 steps. Kumar *et al.* [47], on the other hand, mentioned only one phase: "Project — Configuration, Integration, and Rollout" consisting of 11 steps. Markus and Tanis [44] mentioned four phases: (1) "Project — Configuration, Integration, and Rollout", (2) "Chartering", (3) "Shakedown", and (4) "Onward and Upward" containing 37 unique steps. As visible in the first and second column of figure 4.8 the one phase mentioned by Kumar *et al.* [47] has the same name as the first phase mentioned by Markus and Tanis [44]. However, the third column of the graphic shows that these phases only share a portion of their steps and that the phase by Markus and Tanis [44] contains additional steps like "Ongoing Project Management", and "Current and/or Future Business Process Modelling and Reengineering".

4.3.1.3 Robotic Process Automation

For the system type "RPA", there were seven publications mentioning a total of 70 unique steps necessary for the implementation process, as shown in table 4.1 in the last group in the last column. Figure 4.9 illustrates that these 70 steps were transformed to 72 atomised steps during the decomposition process.

Similar to figure 4.8, figure 4.9 also contains extracted phases in the second column. Here, three publications mention three phases. Krakau *et al.* [59] differ between (1) "Initiation", (2) "Piloting", and (3) "Deployment" , Flechsig *et al.* [60] differ between (1) "Pre-Implementation", (2) "Implementation", and (3) "Post-Implementation" , and Herm *et al.* [56] mention (1) "Initialisation", (2) "Implementation", and (3) "Scaling" as the three phases. Koch and Fedtke [55] mention four phases: (1) "Build Understanding of RPA", (2) "Lay the Foundations", (3) "Carry out Lighthouse Project", and (4) "Prepare and Carry out Nationwide Rollout". Finally, Wewerka [12] differs between five phases: (1) "Analysis", (2) "Product Design", (3) "Coding", (4) "Testing", and (5) "Operation" , and Plattfaut *et al.* [61] and Brandstatter *et al.* [62] do not mention any phases at all.

4.3.2 Clustering and Allocation

Now, having a unique set of atomised steps relevant for the adoption process for each type of system, these were now clustered manually to again further reduce the number of data points and complexity for further processing. The clustering of multiple relevant implementation steps into a single cluster was determined based on their semantic interrelationship. For example, the relevant factors "Adjust Control", "Monitor Perfor-

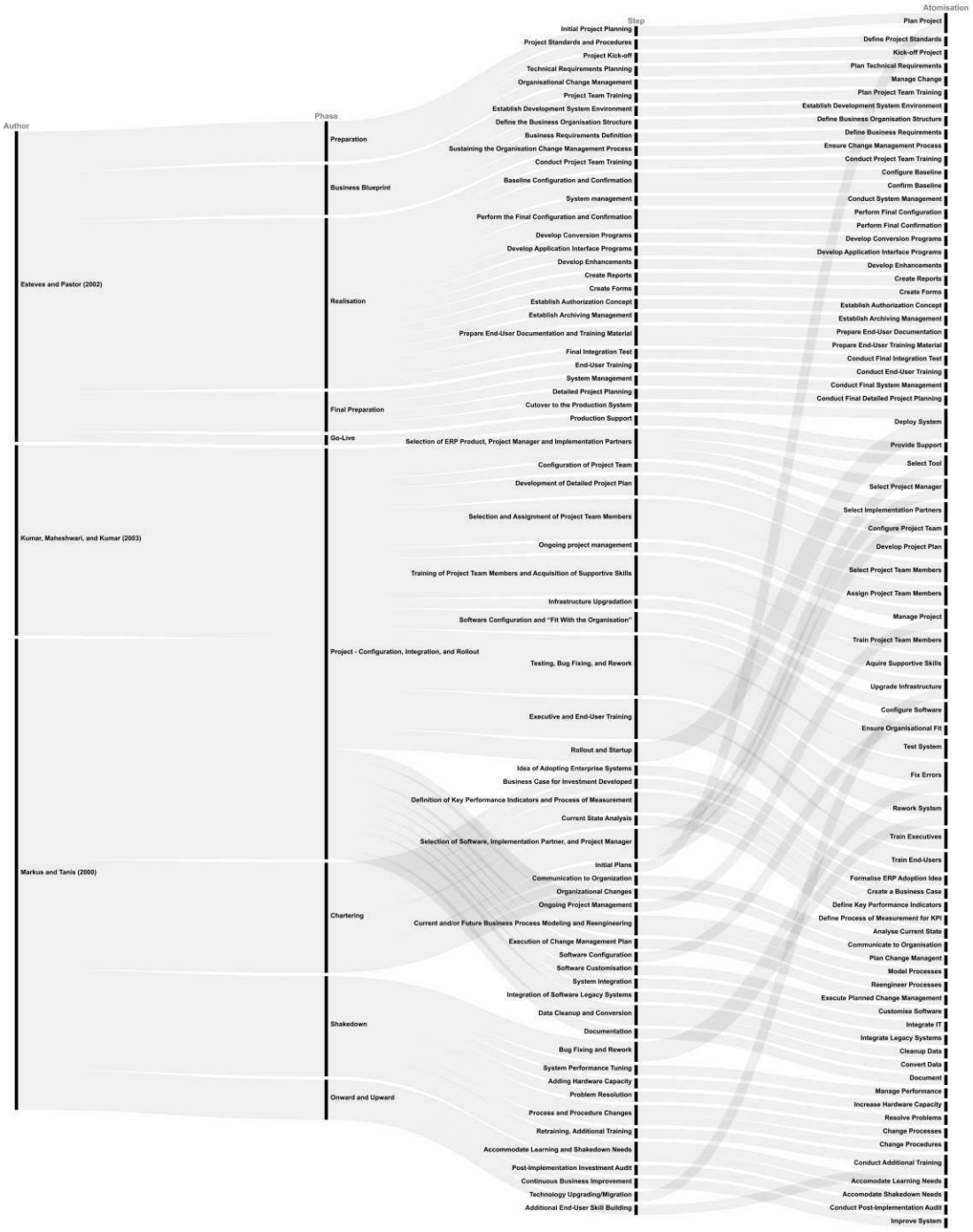


Figure 4.8: ERP Step Decomposition

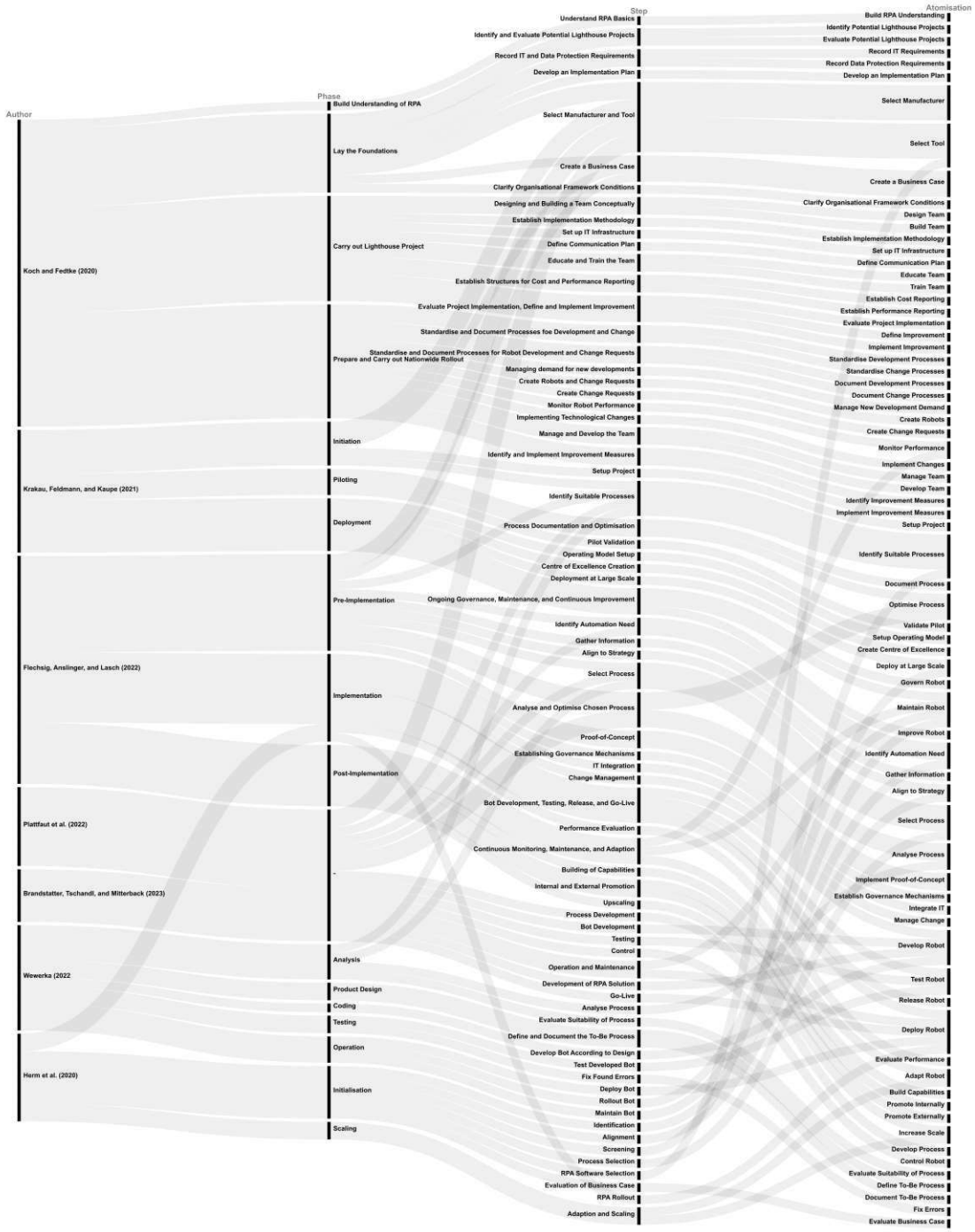


Figure 4.9: RPA Step Decomposition

mance", and "Manage Performance" were put in the same cluster, as they all address the overarching topic of monitoring and managing the performance of the system.

This process was done for all mentioned implementation steps, spanning across all identified systems, and resulted in a total of 15 clusters. Subsequently, these clusters were labelled as categories and a textual description was derived depending on their content. The distinction between the stages of the implementation process is made between "Pre-Implementation", "Implementation", and "Post-Implementation" and subsequently the clusters were allocated to a stage based on their semantic meaning.

Pre-Implementation

Assess Organisational Needs. Understand and assess organisational requirements. Identify automation needs and key areas of automation potential. Derive automation needs from overall organisational goals.

Assess Organisational Readiness. Assess the organisation's preparedness for automation. Identify and evaluate suitable processes. Analyse current state of organisational readiness.

Define Objectives and Goals. Set clear objectives and goals for the project and align them to the organisation's overall vision and strategy. Define project standards as well as technical and business requirements.

Evaluate Business Case. Implement a proof-of-concept to test feasibility and create and evaluate a business case. Ensure that the project delivers value to the organisation.

Select Software. Evaluate and select the appropriate software provider and tool to meet the organisation's requirements.

Assess and Prepare Processes. Select, evaluate, document, and optimise suitable existing processes. Ensure preparedness of the processes for the adoption of the system and integration into the organisation's workflow.

Formulate Adoption Strategy. Develop a strategy for adopting the new system by designing the organisational architecture, managing upcoming change, planning trainings, and establishing development environments.

Plan Implementation. Plan and prepare for the implementation of the new system. Clarify communication, governance, and implementation methodology on an organisational level.

Implementation

Implement Solution. Conduct the actual implementation process of the planned solution, including development, testing, and final system management. Ensure the system's fit within the organisational structure.

Train Users. Educate and train all user groups, including end-users, executives, and development staff, and provide comprehensive training programs.

Ensure Documentation and Reporting. Ensure comprehensive documentation throughout the implementation stage. Set up and establish performance reporting, prepare user documentation, and training material.

Go-live. Conduct the final deployment and release of the developed solution into the live environment. Verify that the systems are fully operational and integrated into the organisation's architecture.

Post-Implementation

Monitor and Manage Performance. Continuously monitor the deployed system, analyse its performance, and implement performance improvement measurements.

Transfer Knowledge. Facilitate the transfer of knowledge from the project team towards the line organisation.

Expand and Scale. Increase operational scale, upgrade infrastructure, and conduct post-implementation audits.

Since each type of PAIS had different implementation steps mentioned in their respective relevant literature, not every group of steps was present as a relevant category for each type of system. The resulting categorisation of implementation steps for the three types of system identified will be addressed in the following.

4.3.2.1 Business Process Management System

There were 16 atomised steps relevant for the implementation process of a BPMS. Figure 4.10 illustrates how these 16 steps were clustered into eight categories. The first column of the graphic shows the atomised step, the second column shows to which group each atomised step was assigned, and the third column displays the allocation of the group to one of the three adoption stages.

Based on the steps gathered through the publications, the following eight steps necessary for implementing a BPMS are present within this categorisation:

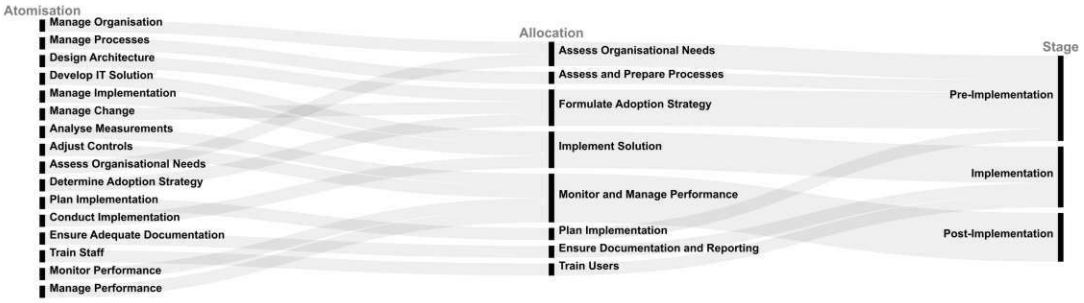


Figure 4.10: BPMS Step Clustering and Allocation

(1) Assess Organisational Needs, (2) Define Objectives and Goals, (3) Formulate Adoption Strategy, (4) Plan Implementation, (5) Implement Solution, (6) Train Users, (7) Ensure Documentation and Reporting, and (8) Monitor and Manage Performance.

The steps "Assess Organisational Readiness", "Evaluate Business Case", and "Maintenance Implications" are not present because no steps matching the context of these groups were mentioned in the gathered literature.

4.3.2.2 Enterprise Resource Management System

There were 75 atomised steps relevant for the implementation process of an ERP system. Figure 4.11 illustrates how these were clustered into all 15 categories mentioned in section 4.3.2. The first column of the graphic again shows the atomised step, the second to which group each step was assigned, and the third the allocation to the adoption stages.

4.3.2.3 Robotic Process Automation

There were 72 atomised steps relevant for the adoption process of an RPA solution. Figure 4.12 illustrates how these 72 steps were clustered into 13 categories. The first column of the graphic shows the atomised step, the second column shows to which group each atomised step was assigned, and the third column displays the allocation of the group to one of the three adoption stages.

Based on the steps gathered through the publications, the following 13 steps necessary for adopting RPA are present within this categorisation:

(1) Assess Organisational Needs, (2) Assess Organisational Readiness, (3) Define Objectives and Goals, (4) Evaluate Business Case, (5) Select Software, (6) Assess and Prepare Processes, (7) Plan Implementation, (8) Implement Solution, (9) Train Users, (10) Ensure Adequate Documentation and Reporting, (11) Go-live, (12) Monitor and Manage Performance, and (13) Expand and Scale.

The steps "Formulate Adoption Strategy", and "Transfer Knowledge" are not present because no steps matching the context of these groups were mentioned in the gathered

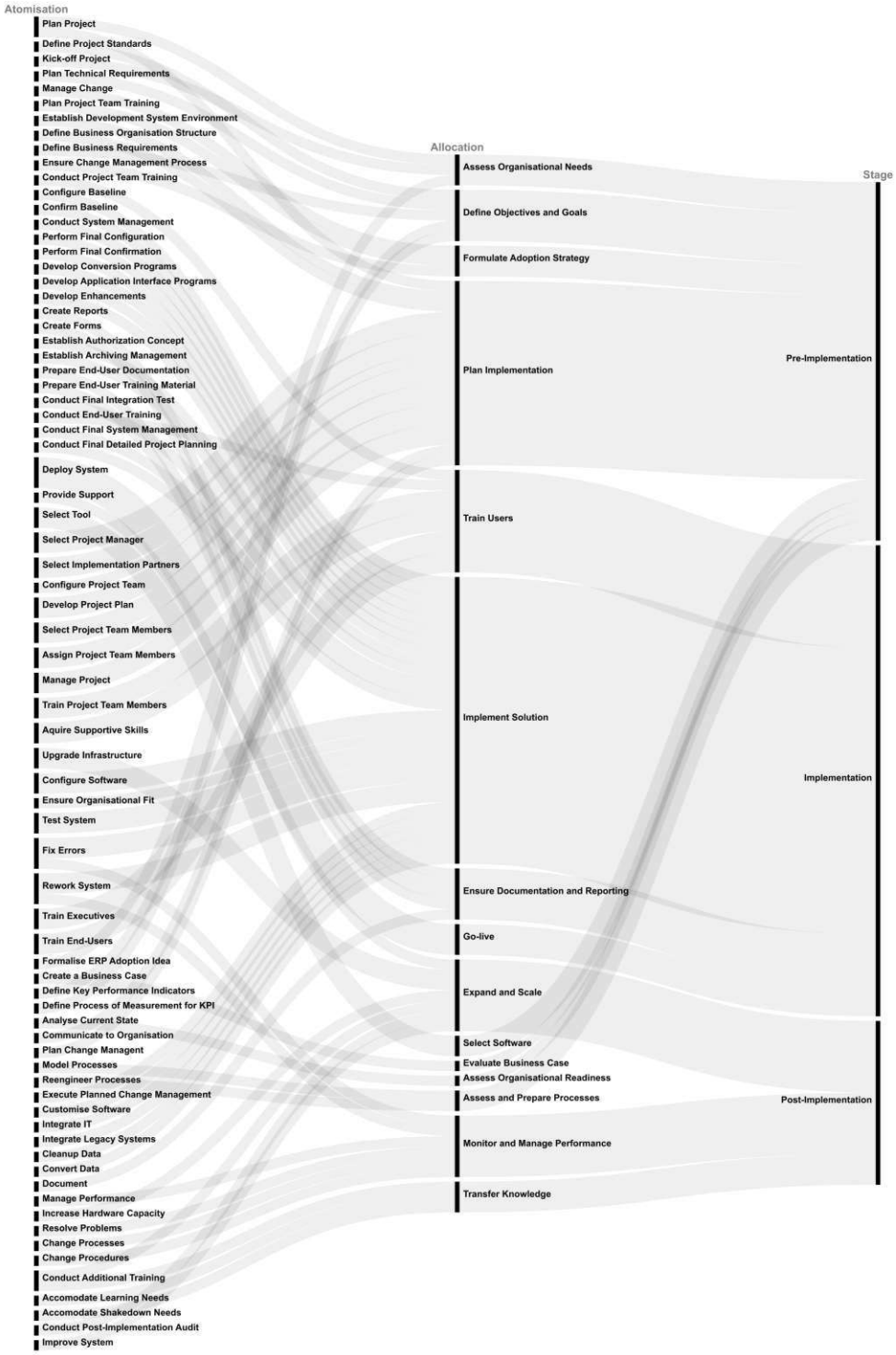


Figure 4.11: ERP Step Clustering and Allocation

literature.

4.4 Checklist Foundation

After the extracted data for the relevant factors as well as the necessary implementation steps for the adoption of a PAIS was synthesised, the foundation for a checklist comprising these two properties was derived. For this, the in section 4.3 synthesised implementation steps were brought face to face with the relevant factors synthesised in section 4.2 in the form of a matrix. Figure 4.13 depicts the resulting foundation. The checklist foundation consists of the 15 necessary steps for the adoption of a PAIS listed on the left-hand side, grouped into their respective stages of the adoption process. The 18 categories of relevant factors are listed above the central grid. The resulting grid in the middle additionally contains checkmarks marking the particular importance of factors for the specific steps.

Moreover, figure 4.13 depicts the foundation for a generic checklist (figure 4.13a), incorporating all 15 steps and all 18 relevant factors alongside the foundations for four specific checklists for BPMSs (figure 4.13b), ERP systems (figure 4.13c), RPA solutions (figure 4.13d), and WfMSs (figure 4.13e), each incorporating only a relevant selection of steps and factors. This selection is inherited from the findings of sections 4.2 and 4.3 presenting the different relevant steps and factors for the different types of PAISs.

It is important to note that the emphasis on specific factors for each step of the adoption process, displayed in the centre grid, reflects the author's expertise and professional opinion. This emphasis has not been validated through a scientific methodology or empirical study. Section 5.3 addresses this limitation in more detail.

4.4.1 Generic Checklist Foundation

Figure 4.13a depicts the derived foundation for a generic checklist adaptable for all types of PAISs. In the following, the importance of the emphasised factors for each step, marked with a checkmark, will be elaborated.

Assess Organisational Needs. To understand and assess organisational requirements, the business culture must be considered to align automation needs with the organisation's cultural and policy landscape. Considering the current systems and processes helps to determine the automation needs of the organisation. Aligning these needs with the overall vision and strategy ensures that they are strategically sound and contribute to long-term goals. Finally, engaging stakeholders early on ensures that their needs and concerns are addressed from the start to gain their support.

Assess Organisational Readiness. Assessing the organisational readiness requires an understanding of the business culture and politics to evaluate feasibility and reasonability. Business integration ensures that processes identified for automation can be integrated without disrupting existing workflows. Assessing the current infrastructure is necessary

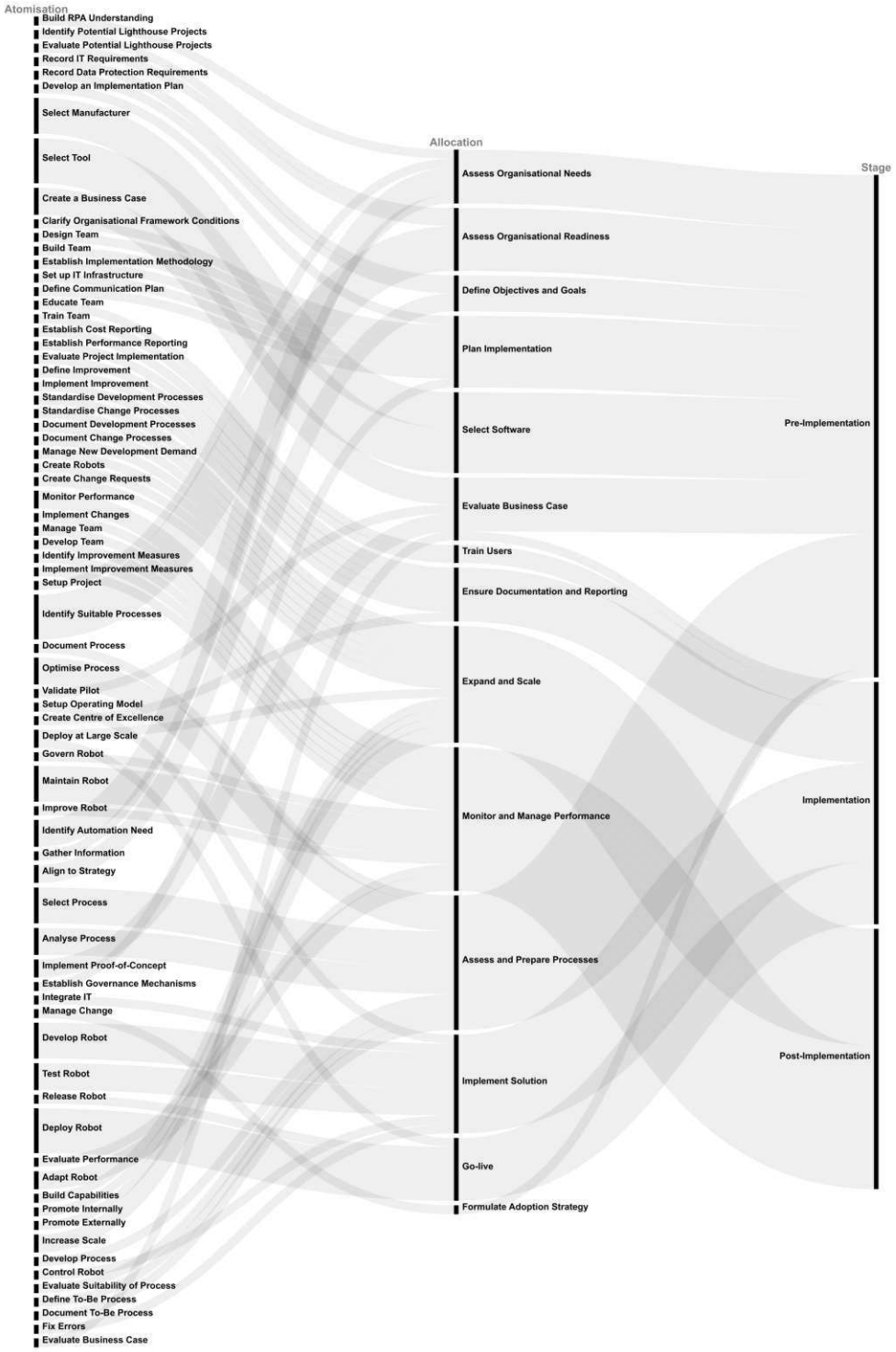


Figure 4.12: RPA Step Clustering and Allocation

to determine the technical readiness of the organisation. To identify potentially suitable processes, process awareness and orientation is necessary on an organisational level. Finally, keeping stakeholders informed promotes transparency and reduces potential resistance.

Define Objectives and Goals. Defining clear goals and objectives aligned with the company's overall strategy and vision increases support and commitment of top management. Additionally, these goals need to align with the business culture and politics to reduce potential resistance. Furthermore, the objectives need to include seamless integration of processes. The definition of objectives and goals needs to be derived from the preceding infrastructure assessment and should be in relation to the company's overall process orientation. Continuous engagement and communication with stakeholders ensures that the defined objectives are set with broad consensus and clear understanding.

Evaluate Business Case. The creation and evaluation of a business case aims at increasing management support and providing clear justification of the project and its contribution towards the fulfilment of strategic business goals. Ongoing stakeholder engagement increases the likelihood of approval and success.

Select Software. When selecting suitable software, its integration into the company's business processes and system must be ensured. When selecting specific tools, the preceding infrastructure assessment is necessary to verify that the current IT infrastructure can support the new software. To reduce long-term costs of the software, maintenance implications need to be taken into account during the selection process. Additionally, configuration and customisation possibilities to meet specific business requirements and provide the necessary flexibility and scalability need to be evaluated.

Assess and Prepare Processes. Evaluating, optimising, and preparing processes should adhere to best practices and standards to ensure proficient knowledge management and seamless integration with existing systems and data. Additionally, this requires profound process understanding on an organisational level. To address stakeholder concerns and manage resistance, the topic of change management needs to be addressed early in the adoption process by ensuring transparent communication and involvement of stakeholders.

Formulate Adoption Strategy. Formulating an adoption strategy for the new system involves the clear definition of roles and responsibilities. Change management needs to be an essential part of the adoption strategy to ensure user acceptance by keeping communication transparent and users involved. A phased introduction of the new system allows to reduce resistance to change and prompt adjustments. Management support is essential to ensure top-down commitment and the allocation of resources for effective project management.

Plan Implementation. The plan for the actual implementation needs to address the phased integration into ongoing business, including system and data integration, knowledge management, and change management. Clear roles and responsibilities need to be established within the project team. It is important to maintain management support and confirm their consensus with the implementation strategy.

Implement Solution. During the actual implementation process, it is important to adhere to standards and use best practices to active successful business and data integration. Change management aspects should not fall short during this first part of the gradual introduction of the new system. Project management during this step should aim at making sure the system is configured correctly, integration quality is ensured, and relevant stakeholders are informed on a regular basis.

Train Users. For a successful introduction of a new system, training and involving stakeholders is crucial to promote user and management understanding and support. This can help in overcoming concerns and resistance and to promote acceptance for the new system, and at the same time increases process awareness and orientation within the company. An established knowledge management ensures that comprehensive training materials and documentation are created and shared to support long-term utilisation.

Ensure Documentation and Reporting. Ensuring comprehensive documentation throughout the implementation process is essential for long-term success and quality assurance. Best practices and standards should be used for documentation practices. Proper documentation and training materials can support change management by providing stakeholders with necessary information. Data integration procedures and maintenance implications need to be documented properly to mitigate loss of knowledge during the system handover into the line organisation. Ongoing stakeholder engagement and communication ensures management and user support.

Go-live. During the deployment of the new system into the production environment, business integration must be ensured so that the system can be seamlessly integrated. A phased rollout allows for reduced risk during deployment. Effective project management needs to coordinate the rollout, assure quality, and inform stakeholders regularly.

Monitor and Manage Performance. After successful deployment into the production environment, performance needs to be continuously monitored and optimised. The reliability of the new system needs to be ensured, and the system configuration adapted as necessary.

Transfer Knowledge. Acquired knowledge during the adoption process needs to be transferred from the project organisation into the line organisation. During the changeover, concerns and resistance from the line organisation need to be addressed. By

transferring the built-up knowledge into the line organisation, the process awareness on organisational level increases.

Expand and Scale. Increasing the operational scope requires a functional and efficient business integration. Roles and responsibilities in the organisation must be clearly defined for the system to be expanded. With an expansion, the topic of change management cannot be left unattended, and support of management must be secured. If necessary, the system needs to be adapted and scaled to meet the business requirements. Engagement of and communication with management stakeholders ensures that the defined objectives of the expansion are set clearly.

4.4.2 Specific Checklist Foundations

Figures 4.13b, 4.13c, 4.13d, and 4.13e show the derived foundations for checklists specific for four PAIS types (BPMS, ERP, RPA, and WfMS). These checklist foundations stem from the foundation for a generic checklist in figure 4.13a and are adapted based on the relevant factors and implementation steps addressed in their respective literature.

For example, figure 4.13b depicts the derived foundation for a checklist for a BPMS. Here, the factors “Business Vision and Strategy Alignment”, “Infrastructure Assessment”, and “Knowledge Management” are marked red as they have not been mentioned by the gathered literature. Additionally, the steps “Assess Organisational Readiness”, “Define Objectives and Goals”, “Evaluate Business Case”, “Select Software”, “Go-live”, “Transfer Knowledge”, and “Expand and Scale” are not present in this checklist foundation for the same reason.

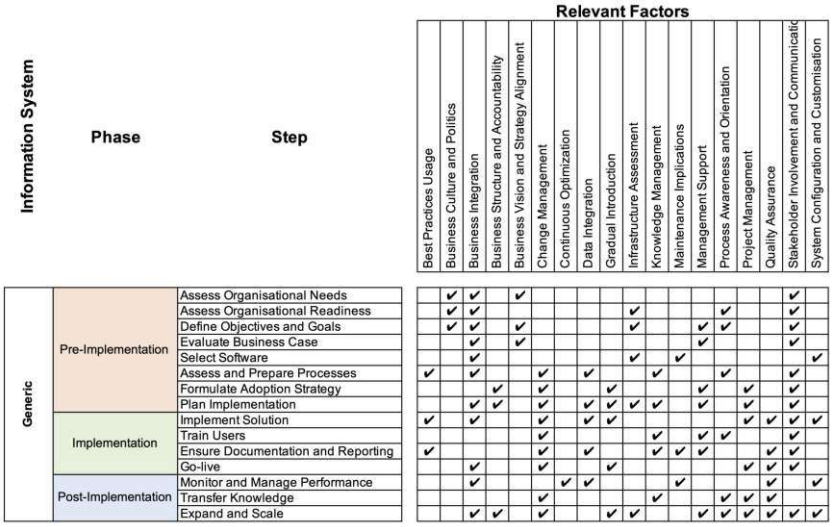
Figure 4.13c shows the foundation for a checklist for the introduction of an ERP system. Here, the relevant factor “Best Practices Usage” is not present. However, all implementation steps mentioned in the foundation for a generic checklist are present.

Figure 4.13d presents the foundation for a checklist for the adoption of an RPA solution. The factors “Business Culture and Politics”, “Data Integration”, and “Maintenance Implications” as well as the step “Transfer Knowledge” are not present.

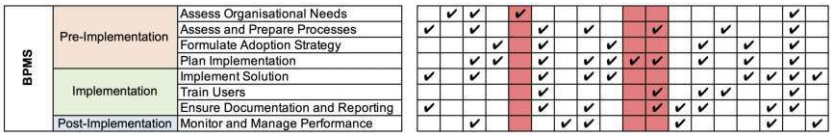
Lastly, figure 4.13e depicts the derived foundation for a checklist for a WfMS. Here, because no implementation steps were mentioned by the gathered literature, the included steps are identical to the ones from the foundation for a generic checklist. Nevertheless, the relevant factors “Best Practices Usage”, “Knowledge Management”, and “Maintenance Implications” are not present.

4.5 Comparative Analysis

Figure 4.14 presents the results of the comparative analysis of the derived foundation for a generic checklist with guidelines of the four selected representative PAISs providers. This checklist foundation, visible in figure 4.13a, is positioned at the centre of figure 4.14. The



(a) Generic



(b) BPMS

(c) ERP

(d) RPA

(e) WfMS

Figure 4.13: Generic and Specific PAISs Implementation Checklist Foundations

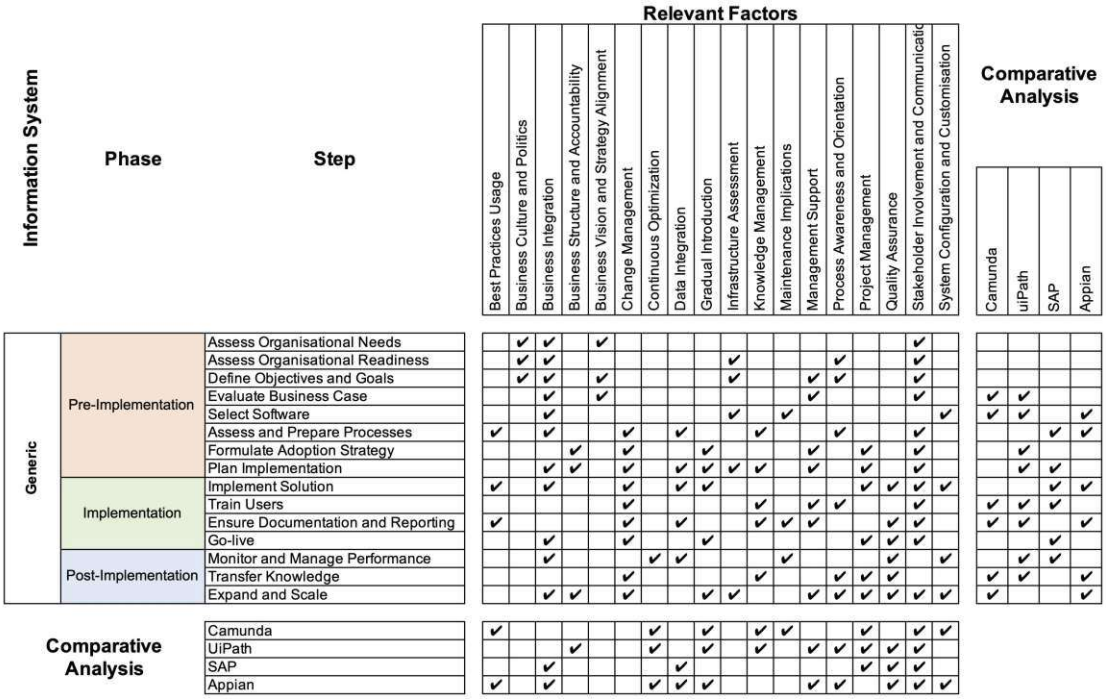


Figure 4.14: Checklist Foundation Comparative Analysis

comparison to the four guides are located in horizontal and vertical extension with respect to the centre grid. The comparison of mentioned steps regarding the implementation process is displayed in horizontal extension to the right of the grid of the checklist foundation. The comparison of mentioned factors relevant for the implementation process is displayed in vertical extension below the grid of the checklist foundation.

Looking at the relevant factors mentioned across all four guides combined, four factors are not addressed in any way by any of the guides compared to the derived foundation for a generic checklist: (1) “Business Culture and Politics”, (2) “Business Vision and Strategy Alignment”, (3) “Change Management”, and (4) “Infrastructure Assessment”.

Looking at the implementation phases mentioned across all four guides combined, three steps within those phases are not addressed in any way by any of the guides compared to the derived foundation for a generic checklist: (1) “Assess Organisational Needs”, (2) “Assess Organisational Readiness”, and (3) “Define Objectives and Goals”.

The topic of potential reasons for the absence of these relevant factors and steps is discussed in section 5.1

CHAPTER 5

Discussion

In this chapter, the findings presented in chapter 4 are discussed. Section 5.1 discusses and analyses the results and findings. The implications for research and practice will be addressed in section 5.2. Section 5.3 addresses the limitations of the conducted work. Finally, section 5.4 provides recommendations for future research.

5.1 Findings

In this section, the findings of chapter 4, specifically the derived checklist foundations, and the conducted comparative analysis are discussed in relation to the research questions:

1. What are the success factors and challenges when adopting PAISs in companies?
2. Which steps do adoption guides for PAISs have in common, how do they differ, and why?

5.1.1 Checklist Foundations

The Systematic Literature Review resulted in the limited number of 32 publications, which were classified as relevant for the context of this thesis. One reason for the limited number of publications available addressing the adoption process of different types of PAISs could be the common misconception that this process merely corresponds to an "ordinary" change management project. However, the adoption of PAISs within a company involves a more complex and specialised strategy. As presented in section 4.2, "Change Management" is just one of the 18 relevant factors identified. Such an undertaking requires a profound understanding of business processes, technological integration, and the organisational integration and adaption of workflows.

Nevertheless, the checklist foundations presented in figure 4.13 encompasses the answers to both research questions addressed in this thesis. As elucidated in section 3.7 the extracted success factors and challenges have been consolidated into the overarching category "relevant factors". These 18 categories serve as the answer to the first research questions.

More specifically, the relevant factors when adopting PAISs in companies are: (1) Best Practices Usage, (2) Business Culture and Politics, (3) Business Integration, (4) Business Structure and Accountability, (5) Business Vision and Strategy Alignment, (6) Change Management, (7) Continuous Optimisation, (8) Data Integration, (9) Gradual Introduction, (10) Infrastructure Assessment, (11) Knowledge Management, (12) Maintenance Implications, (13) Management Support, (14) Process Awareness and Orientation, (15) Project Management, (16) Quality Assurance, (17) Stakeholder Involvement and Communication, and (18) System Configuration and Customisation.

Similarly, the 15 steps presented in the foundation for a generic checklist represent the answer to the second research question. In particular, the 15 steps adoption guides for PAISs have in common are: (1) Assess Organisational Needs, (2) Assess Organisational Readiness, (3) Define Objectives and Goals, (4) Evaluate Business Case, (5) Select Software, (6) Assess and Prepare Processes, (7) Formulate Adoption Strategy, (8) Plan Implementation, (9) Implement Solution, (10) Train Users, (11) Ensure Adequate Documentation and Reporting, (12) Go-live, (13) Monitor and Manage Performance, (14) Transfer Knowledge, and (15) Expand and Scale. Additionally, the differences between the adoption guides for PAISs is visualised in detail in figure 4.13, and described in section 4.4.2. The potential reasons why specific steps are absent are discussed in the following four subsections.

5.1.1.1 Business Process Management System

The SLR found only two publications mentioning steps necessary for adopting a BPMS. This indicates a potential gap in the literature, as there are significantly more publications on establishing BPM within a company. Consequently, the derived foundation for a checklist for BPMSs may not be entirely accurate or comprehensive due to the limited number of data built upon. Therefore, it may be more practical to utilise the foundation for a generic checklist instead, as it covers a broader range of steps and factors relevant to the adoption process of a PAIS. Furthermore, the absence of the implementation steps "Assess Organisational Readiness", "Define Objectives and Goals", "Evaluate Business Case", "Select Software", "Go-live", "Transfer Knowledge", and "Expand and Scale" can be attributed to the meagre number of publications found.

However, as the limited number of relevant publications only concerns the implementation steps, the results acquired regarding the factors relevant for the adoption of a BPMS can be regarded sound. Nevertheless, the lack of occurrences of relevant factors belonging to the categories "Business Vision and Strategy Alignment", "Infrastructure Assessment", and "Knowledge Management" does seem peculiar. The alignment to the overall business vision and strategy of a company when conducting such a project does appear to be rather

essential. Comparably does the assessment of the organisations' technical infrastructure, as a BPMS — if self-hosted on premise — presents a not negligible part in the enterprises' architecture. Lastly, engaging in knowledge management during the adoption process also seems rather relevant since a BPMS can intervene in core workflows, managing crucial data and knowledge flow. Therefore, the absence of these three factors should be taken with caution and investigated further.

5.1.1.2 Workflow Management System

Unfortunately, no publication addressing steps necessary for adopting a WfMS resulted from the conducted SLR. This absence might be explained due to a combination of circumstances: (1) WfMS have been around since the late nineties, and their functionality has been widely integrated into other PAISs [70], (2) due to this fact, a lot of relevant literature may have been cut off by the employed search limitation of only including publications after the year 2000, and (3) many publications addressing the topic focus more on a technical development of a WfMS rather than an organisational adoption. Finally, this fact can also further substantiate the assumption that the search terms presented in table 3.1 are incomplete. Thus, a significant amount of literature regarding WfMSs might have been missed. Section 5.3 addresses this topic in more detail.

However, four publications were found mentioning relevant factors for the adoption of a WfMS. As shown in figure 4.13e the relevant factors "Best Practices Usage", "Knowledge Management", and "Maintenance Implications" are not present in the derived checklist foundation as they have not been mentioned by the selected literature. However, even though not explicitly mentioned, the usage of best practices might have been implicitly assumed by the authors. Apart from that, since WfMSs integrate strongly into existing processes and procedures, using best practices can definitely aid the implementation process. The absence of the relevant factors "Knowledge Management", and "Maintenance Implications" may also be a result of the incomplete search terms and thus the limited number of publications found mentioning relevant factors.

5.1.1.3 Enterprise Resource Planning

Although ERP systems have also been around for some time, there still have been three publications found mentioning an extensive number of steps necessary for the adoption of an ERP system. The implementation steps encompassed in the foundation for a checklist specific for ERP systems match the steps contained in the generic one.

Looking at the relevant factors, the fact "Best Practices Usage" has not been mentioned by the gathered literature. A reason for this absence could be that ERP systems not necessarily involve the execution of business processes, and thus it is not necessary to align the modelling language to other standards as process modelling is just used for documentation and communication purposes. However, as ERP systems like SAP for example, support the execution of workflows within their environment, this is just an unconfirmed assumption.

5.1.1.4 Robotic Process Automation

As visible by the amount of gathered publications mentioning relevant factors and steps necessary for the adoption of RPA solutions, it is clear that the topic of RPA is currently booming. The only step not mentioned by any of the seven publications mentioning adoption steps, is "Transfer Knowledge".

In terms of mentioned relevant factors, the three factors "Business Culture and Politics", "Knowledge Management", and "Maintenance Implications" are absent. As RPA solutions mostly automate existing workflows, they do not interfere too much with the organisational culture and politics, since existing processes are not changed. Thus, the resistance towards such solutions can be regarded less on a cultural level than the adoption of other types of PAISs. Additionally, since RPA solutions in most cases are implemented on top of existing systems, knowledge management can be considered less relevant as the workflows and their outputs do not change significantly. Finally, it can be argued that maintenance effort can be minimal as long as the underlying process and systems do not change. And if they do change, only the RPA bot needs to be adapted to successfully work again. However, these are all just assumptions on why the literature does not mention those relevant factors.

5.1.2 Comparative Analysis

The derived foundation for a generic checklist was compared to four guidelines of prominent PAIS providers, as shown in figure 4.14. For each of the identified four systems, a provider was chosen based on representative market analysis conducted by Gartner and others. The checklist foundation then was compared on two levels: (1) how the checklist foundation for a checklist, and other guides differed in factors considered as relevant, and (2) what implementation steps they considered necessary. It is important to note that the emphasis on specific factors for each step of the adoption process, displayed in the centre grid, reflects the author's expertise and professional opinion. This emphasis has not been validated through a scientific methodology or empirical study. Section 5.3 addresses this limitation in more detail. Additionally, section 5.4 elaborates on potentials for future research to empirically validate and further substantiate these findings.

However, upon comparing the relevant factors mentioned across all four guidelines combined, four factors were found not to be addressed by any of the guides.

Business Culture and Politics: The absence of the relevant factor aiming at aligning the adoption with the existing culture to ensure that political dynamics are effectively handled is rather peculiar. As with any change management project, organisational culture can be considered a cornerstone needing to be addressed. However, a possible reason for the omission of this factor by the four guides is that this aspect is difficult to pack into concrete suggestions, as this is unique to the business at hand.

Business Vision and Strategy Alignment: Similarly to the previous factor, the alignment of goals with the business plan and vision to ensure a strategic fit can be regarded as essential when undertaking such projects. However, it can be argued that this factor is explicitly kept out of the four guides, as they understand this as a prerequisite for undertaking such a project. This would go hand in hand with the missing three steps in all four guides, addressing the organisational assessment and definition of objectives and goals. Nevertheless, this factor is a must to be addressed in advance of the actual implementation process.

Change Management: As in any project leading to significant organisational change (in structure or processes), stakeholder concerns need to be addressed and mitigated. Moreover, trust towards the change needs to be built, and resistance to change needs to be reduced. As the adoption of a PAIS can be considered such a project, it is of crucial importance to address this relevant factor during the project. However, as change management is a complex discipline on its one, the assumption can be made that the guides provided by the four prominent system providers explicitly do not address this factor. They may have the underlying assumption that companies have separate (project) teams addressing this topic during the adoption process, and thus it is not relevant to address this factor in their guides.

Infrastructure Assessment: Assessing the IT infrastructure foundation, readiness, and ensuring compatibility for the system is inevitable when adopting any IS. However, similarly to the first to absent factors "Business Culture and Politics", and "Business Vision and Strategy Alignment", this factor is predominantly relevant in the initial steps of undertaking such a project. Therefore, the assumption that the four chosen guides simply do not address this early stage in the project substantiates.

Similar to the absent relevant factors, three steps necessary for the adoption process were not mentioned by any of the guides: (1) "Assess Organisational Needs", (2) "Assess Organisational Readiness", and (3) "Define Objectives and Goals". Both, assessing the organisational needs, and assessing the organisational readiness are crucial steps when deciding to adopt a PAIS within an organisation as the adoption of such a system entails substantial potential changes in business structure and business processes which need to be considered. Furthermore, the adequate definition of objectives and goals for the project and the post implementation stage are crucial to concretise in advance.

The absence of these three steps stands in alignment with the previous assumption that the guides provided by the four prominent system providers do not address this early phase in the project. The organisational assessment and definition of objectives and goals is missing in the guides, which explains the non-existence of the factors "Business Culture and Politics", and "Business Vision and Strategy Alignment". Additionally, the topic of managing change during the adoption is not addressed in any way, and the assessment of existing IT infrastructure of the business is absent too. These findings

suggest the conclusion that the foundation for a checklist, derived as part of this master's thesis, shown in figure 4.13, presents a more holistic view of the adoption process when compared to the four guides.

Nevertheless, while the derived foundation for a generic checklist contains several critical factors and steps that are absent in other guidelines, further empirical research is needed to validate and refine these elements. Addressing these gaps in future research could lead to a more comprehensive and effective foundation for a checklist for the adoption of PAISs.

5.2 Implications

This thesis' main contribution is the foundation for a checklist that can facilitate initiatives of companies to adopt PAISs by consolidating relevant factors and implementation steps needing attention during the adoption process. The checklist foundation presented in figure 4.13 can serve as a structured guide for practitioners, providing an additional tool aiding the implementation process, pillared on literature. As such, it can help inexperienced companies or business professionals to tackle this project holistically.

By listing the 18 relevant factors identified in the literature in combination with the 15 main steps identified when undergoing such a project, the checklist foundation provides a clear and comprehensible point of reference on the different aspects of adopting a Process-Aware Information System within a company. The textual description provided in section 4.4.1 provides a straightforward explanation of the interplay between the relevant factors and the respective steps.

The thesis' implications for research are multi-facetted. By consolidating the critical success factors, challenges, and implementation steps acquired by many preceding publications, and synthesising them in foundations for specific and generic checklists, this thesis provides a base for further research. Based on this work, researchers can further investigate the importance of relevant factors in specific phases of adopting a PAIS in general or tailored down to a specific type of PAIS. Furthermore, this checklist foundation can serve as a starting point to develop a comprehensive framework aimed at streamlining the adoption process of PAISs within companies. However, section 5.4 will go into more detail for potential future work.

5.3 Limitations

As many research projects, the results of this master's thesis do not come without some limitations. More specifically, four limitations were identified during the course of this project: (1) the search terms used for the Systematic Literature Review may have been incomplete, (2) no distinction was made as to whether the publications, from which the relevant information was extracted, incorporated theoretical or practical research to acquire their data, (3) the emphasis of specific relevant factors for specific steps has not

been scientifically validated, and (4) the comparative analysis of the derived checklist foundation was not conducted following a clear scientific methodology.

Incomplete Search Terms: The SLR conducted resulted in a limited number of publications classified as relevant for the scope of this thesis. Furthermore, only two publications mentioning steps relevant for the adoption process of BPMSs and none for the adoption process of WfMSs were found. One reason for this may be that the selected search-terms, presented in table 3.1, were not optimally chosen or insufficiently exhaustive. Unfortunately, this fact remained unidentified during the pilot test of the keywords when developing the review protocol for the conducted SLR. The deficiency was not recognised until the SLR had already nearly been completed, and all publications had been analysed.

It also has to be mentioned that, since this SLR was conducted in the context of a master's thesis, some components mentioned by Kitchenham and Charters [25] are missing. This particularly concerns the study quality assessment by accompanying researchers, the dissemination strategy, as well as the project timetable. Additionally, the limitations further comprise the absence of a second researcher to ensure peer-reviewed results. Due to these circumstances, the search-terms were not redefined and the SLR was not carried-out again, as this would have exceeded the scope of this master's thesis.

Differentiation of Origin of Extracted Information: The results of this master's thesis aim at having implications for research and practice. However, the implications for practice experience certain limitations. During the data synthesisation process of the conducted SLR, no distinction was made whether the publication was based on theoretical or empirical research. Hence, the derived checklist foundation also does not distinguish between relevant factors and necessary implementation steps based on theoretical deduction and empirical induction. For this reason, the implicit applicability in practice cannot be entirely ensured at present time and has to be further evaluated. However, this limitation at the same time results in potentials for future work to further investigate the applicability in practice of the derived checklist foundation.

Emphasised Factors: The derived checklist foundation presented in figure 4.13 includes checkmarks representing the emphasis on relevant factors for specific steps. This emphasis on relevant factors purely reflects the author's expertise and professional opinion. No scientific methodology or empirical study has been employed for that, as this presents a stand-alone investigation, itself, and would have exceeded the scope of this master's thesis. Thus, future research could address this topic and analyse the coherence between the identified relevant factors and the implementation steps.

Comparative Analysis: The comparative analysis of the derived foundation for a generic checklist with guides for specific PAISs provided by prominent system providers conducted in section 4.5 was not carried out following a certain scientific methodology.

The goal hereby was to provide an overview of the practical relevance of the derived checklist foundation compared to guidelines specifically addressing a certain type of PAISs. Therefore, to ensure methodological rigour, this comparative analysis should be conducted again, following a scientific methodology.

5.4 Future Directions

Based on the limitations mentioned in section 5.3, certain directions for future research can be derived. In the following, three concrete potentials for future research are presented.

In-depth Systematic Literature Review: Given the limited results found regarding the adoption steps of a BPMS and WfMS in this study, future research could investigate this issue further and conduct a dedicated SLR specifically addressing these two systems. The results of this could enhance the academic foundation and practical insights related to BPMS and WfMS implementation. Additionally, such research could identify industry-specific factors and challenges that may not have been captured in this thesis, further refining implementation strategies for different organisational contexts.

Validation of Emphasised Factors: To empirically validate the factors emphasised in the derived checklist foundation, further research is needed. For this, methodologies such as surveys or case studies analysing the relationship between the identified relevant factors and the steps necessary for the adoption of a BPMS can be employed. The scientific validation of these emphasised factors can enhance the validity and applicability of the derived checklist foundation and thus better supporting practitioners.

Evaluation of the Derived Checklist Foundation: Finally, another direction for future research is to evaluate the derived checklist foundation using a rigorous scientific methodology. This includes establishing a well-defined framework for comparison and employing systematic evaluation techniques. A method for testing the applicability of the checklist foundation in practice would be to conduct a in-depth case study with a company, planning to adopt a PAIS. This evaluation can further improve the relevance for practice, providing more credible insights.

CHAPTER 6

Conclusion

The adoption of Process-Aware Information System (PAIS) represents a major aspect for enhancing the existing Business Process Management (BPM). PAISs aim at increasing the efficiency, productivity, and flexibility of a company's business processes. Despite the benefits PAISs have on the operational excellency of businesses, companies often fail in adopting PAISs. One reason for this is the absence of guidelines, frameworks, or similar to help companies successfully adopt PAISs. This thesis addressed this problem by investigating the critical success factors for, challenges faced during, as well as crucial steps necessary for the adoption process. Additionally, the foundations for a generic, as well as four specific checklists, were derived, encompassing the findings of this investigation.

As part of this thesis, a Systematic Literature Review (SLR) was conducted, investigating critical success factors for, challenges faced during, and steps necessary for the adoption process of PAISs in companies. The results of this SLR include the consolidation of critical success factors, and challenges into the overarching category "relevant factors". Furthermore, necessary steps of the adoption process of PAISs were consolidated. Based on these findings, a checklist foundation was created, encompassing an allocation of relevant factors during the adoption process onto necessary steps of the adoption process. The implications of the contributions of this thesis impact both research and practice. The developed checklist foundation aims at serving as a guiding model for companies adopting a PAIS. The consolidation of relevant factors for, and steps necessary during, the adoption process of different types of PAISs serve as a foundation for a more profound investigation into this area. Additionally, future research can further investigate and evaluate the practical applicability of the derived checklist foundation.

However, this thesis' contributions are not without limitations. During the data synthesisation process of results of the SLR, a lack of publications addressing the adoption process of a Business Process Management System (BPMS) and a Workflow Management System (WfMS) became apparent. The reason for this can be traced back to an incomplete definition of search terms employed in the SLR. Thus, potential for improvement was

identified in this area. Moreover, due to limitation of resources, no distinction has been made regarding theoretical and practical research gathered through the SLR. This results in the circumstance that implications for practice have been drawn based on a mixture of empirical and theoretical information extracted from the literature. Furthermore, both the emphasis of relevant factors in different phases of adoption, and the comparative analysis are purely informative in nature and need to be rigorously investigated and evaluated in further research.

Nevertheless, this thesis provides a valuable resource for both practitioners and researchers. The checklist foundation developed offers practical guidance for companies embarking on the implementation of PAISs, helping to mitigate risks and enhance the likelihood of success. Future research can build upon the contributions of this thesis, or further investigate the foundations this thesis' contributions are built upon.

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Acronyms

AIP Accelerated Implementation Program. 18

BPC Business Process Change. 2

BPM Business Process Management. xi, 1–3, 5, 6, 8, 9, 24, 46, 53

BPMS Business Process Management System. 2, 8, 17, 21, 22, 25, 30, 35, 36, 38, 42, 43, 46, 47, 51–53, 55

BPR Business Process Reengineering. 2, 9

DAIS Data-Aware Information System. 8

EA Enterprise Architecture. 9, 10

EIS Enterprise Information System. 8

ERP Enterprise Ressource Planning. 8, 9, 21, 22, 26, 28, 30, 32, 36–38, 42, 43, 47, 55

ESI Enterprise Systems Integration. 2, 3, 5, 9, 10

IS Information System. 1, 8–10, 49

IT Information Technology. 9, 24, 40, 49

PAIS Process-Aware Information System. xi, 1–3, 5, 8–13, 16, 17, 19–24, 27, 30, 35, 38, 42, 43, 45–55

RPA Robotic Process Automation. 2, 8, 9, 22, 23, 26, 29–31, 33, 36, 38, 39, 42, 43, 48, 55

SAP System Analysis Program Development. 17, 18, 47

SLR Systematic Literature Review. xi, 3, 4, 11, 12, 14, 19–21, 45–47, 50–55

WfMS Workflow Management System. 1, 2, 8, 21, 22, 26, 27, 30, 38, 42, 43, 47, 51–53, 55

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Appendix

APPENDIX A

Data Extraction Log

ID	Year	Type of System	Success Factors	Challenges	Steps	Comments
Reijers, H	2006	BPMS	management support; top management focus; selection of the right tools; mature technology; effective communication with employees; deep user participation; process awareness; process oriented approach to application development; organisational understanding of process concepts;			
Ma, C., L.	2007	BPMS		The pressure of facing a possible significant shift in organization politics; The far-reaching impact on businesses caused by the integration; The limited control the developers have over the participating services and applications adapted; The lack of standards-compliant services; The limited capability of the current standards to solve a wide range of real world business problems; The maintenance implication of the integration solutions.		
Ravesteyr	2007	BPMS	Project Management; Change Management; Understanding the BPM Concept; Organization of the modelling design phase; Understanding the process; Using the 'best' modelling standards & techniques; Understanding interdependencies and integration of data sources; Maintenance and control - including quality - of the models is important; Integration of processes and data; (Use of) Web services; Change management; Involving the right people in the project; Project management; Performance measurement; Continuous optimisation; An organization and culture of quality		Management of Organization and Processes; Architecture Design; Developing an IT Solution; Management of Implementation and Change; Measurement and Control;	An overview and clustering of 55 success factors available in the appendix.
Holzmulle	2013	BPMS	Modeling notation and process execution language are the same; Existing central identity management solution	Existing automation islands		
Dumas, M	2018	BPMS	Gradual introdutction instead of a radical one; training and clarification of users; clarification for users on how the monitored data will be used and what benefits it brings; strong management commitment; change management	Lack of process awareness of traditional systems already in use, but instead work is batch processed and not handled case-wise; Balancing of different stakeholder interests; Insight into how processes work; changes in organisational rules; scrap or combination of departments; shift in responsibilites of people; introduction or stop of products; employees' fears of surveillance; poor management: poor planning, monitoring, and control, lack of resources and know-how, and incompatible corporate policies and practices;		
Harmon, F	2019	BPMS				
Bartlett, Li	2023	BPMS		Managing complexity; Ensuring system security; Overcoming resistance to change; Balancing the technological and human factors	assess the organisation's needs; determine adption strategy; implementation planning; implementation; staff training; monitor and manage performance	

Figure A.1: Data Extraction Log BPMS

ID	Year	Type of System	Success Factors	Challenges	Steps	Comments
Murray, M	2003	WMS	Descriptors of organizational climate; Organizational perspective on workflow and its perceived value Presentation of workflow to the organization; Organizational hierarchy; Outward signs of executive support; Project leadership; Commitment of resources; Team structure; Team composition; Team goals and objectives; Roles and authority of team members; Effective teamwork; Team meeting logistics; Informal communication structures; Formal communication structures; Communication facilitators; Definition of business process reengineering; Overall approach to business process reengineering; Methods for business process identification; Criteria for selection of business processes to automate; Methods for analysis and definition of business processes; Structure for translating business processes into workflow map; Policies and procedures for managing workflow changes; Expectations versus reality; Ease of use; Modifiability of the system; Off-line testing and modeling capabilities; System performance; Logic built into the system; Flow of information through the system; Division of work between system and people; Understanding the underlying infrastructure and architecture; Understanding of input technologies (document imaging system, COLD feeds, ADT feeds, etc); System analysis training; Business analyst skills;	-	-	
Parkes, A	2004	WMS	Process modelling; Change management; Political aspects; Organisational impact; Business process reengineering; IT enablement; Social impacts;	-	-	
Cheung, K	2011	WMS	management support; communication; motivations for change	Organisational culture; Choice of proceses to be automated; Re-engineer business processes; automate workflows; User training;	-	
Rojo Abol	2017	WMS	Support of senior management; Integrate the digital workflow with current systems; Get support of end users; Implement in phases; Focus first on processes that are fully understood; Use metrics;	Defining complex processes; Worker resistance; Management engagement; Overmanagement and creation of new work; Loss of flexibility; Technical implemenation costs;	-	

Figure A.2: Data Extraction Log WMS

ID	Year	Type of System	Success Factors	Challenges	Steps	Comments
Hong, Kyı	2002	ERP	organisational fit; process adaption	Organisational resistance	-	
Esteves, .	2002	ERP	Sustained management support; Effective organisational change; Good project scope management; Adequate project team composition; Meaningful business reengineering; User involvement and participation; Adequate Project champion role; Trust between partners; Dedicated staff and consultants; Strong communication; Formalize Project Plan/schedule; Adequate Training Program; Preventive Trouble Shooting; Usage of Appropriate Consultants; Empower Decision Makers; Adequate ERP Implem. Strategy; Avoid Customization	-	Project Preparation Phase (initial project planning, project standards and procedures, technical requirements); Business Blueprint Phase (organizational change management, blueprint phase, and the definition of the business organisation structure); Realization Phase (prepare end-user documentation and training material, sustaining the organisation change management process, conduct project team training, project management realization phase); Final Preparation Phase (project management of the final preparation phase, end-user training and detailed project planning)	
Kumar, Vi	2003	ERP	Product, project manager and implementation partners selection criteria; Project planning; Project team constitution; Ongoing project management; Training; Infrastructure; Software configuration and instituionalization; Testing and quality assurance;	End Customer not ready; Extent of customization;Bugs in the software; Limited extent of implementation; People could not by-pass procedures, ad-hoc activities were not possible; Confusion persisting due to changes brought about in the organization; Inconsistency of data; Hardware reliability, capacity and maintenance issues; Keeping up employee morale in tricky situations of system malfunctioning; Concurrently running with legacy systems; Distinguishing between what people thought was a problem and the real problem; Reconciliation of data between new and old was a challenge	Selection of ERP product, project manager and implementation partners; Configuration of project team; Development of detailed project plan; Selection and assignment of project team members; Ongoing project management; Training of project team members and acquisition of supportive skills; Infrastructure upgradation; Software configuration and "fit with the organization"; Testing, bug fixing, and rework; Executive and end-user training; Rollout and startup	Challenges are specific to the shakedown phase of the implementation
Kim, Yong	2005	ERP	-	Human resources and capabilities management; Cross-functional coordination; ERP software configuration and features; Systems development and project management; Change management; Organizational leadership	catering ("ideas to dollars"); project ("dollars to assets"); shakeout ("assets to impacts")	
Kamhawi,	2007	ERP	Technical Fit; Organisational Fit; Strategic Fit; Business Process Reengineering; Top-Management Support; Project Planning; Training; Ease of use; Resistance; Competitive Pressures	-	-	However, nonsignificant impact was found for some classical success factors such as top-management support, technical fi,t training, competitive pressure, and strategic fit on both project and business success.
Finney, SI	2007	ERP	Top management commitment and support; Change management; BPR and software configuration; Training and job redesign; Project team: the best and brightest; Implementation strategy and timeframe; Consultant selection and relationship; Visioning and planning; Balanced team; Project champion; Communication plan; IT infrastructure; Managing cultural change; Post-implementation evaluation; Selection of ERP; Team morale and motivation; Vanilla ERP; Project management; Troubleshooting/crises management; Legacy system consideration; Data conversion and integrity; System testing; Client consultation; Project cost planning and management; Build a business case; Empowered decision makers	-	-	
Françoise	2009	ERP	Project teamwork and composition; Organizational culture and change management; Top management support; Business plan and long-term vision; Business process reengineering (BPR) and customization; Effective communication; Project management; Software development, testing, and troubleshooting; Monitoring and evaluation of performance; Project champion; Organizational structure; End-user involvement; Knowledge management	-	-	Detailed table with factors affecting the implementation and corresponding difficulties in appendix.
Dezdar, S	2009	ERP	Top management support and commitment; Project management and evaluation; Business process reengineering and minimum customization; ERP team composition, competence and compensation; Change management program; User training and education; Business plan and vision; Enterprise-wide communication and cooperation; Organizational culture; Vendor support; Software analysis, testing and troubleshooting; Project champion; Careful selection of ERP Software; Use of consultant; Appropriate business and IT legacy systems; System quality; User involvement	-	-	
Shaul, Le	2013	ERP	Implementation strategy; Support of top management; Enterprise system; Software maintenance; Data management; Project management; Project tracking; Enterprise system selection process; Change management; Project team competence; Organisational experience of major change; Acceptance control; Education and training;Vendor; Environment; User involvement	Selection process of an ERP system; Project management; Senior leadership; Data management; Training program; User involvement	planning; implementation; stabilization of the ERP system into normal operation; enhancement	
Elezabeth	2019	ERP	Communication and change management; Training for the new system	-	-	
Javidroozi	2019	ERP	-	Managerial;Clarification and understanding BPC Monitoring Risk Governance Standardisation;Functional;Efficiency Quality assurance;Complexity;Agility and flexibility;Inter-organisational;Interoperability;Data and business process sharing Inter-dependencies Autonomy and confidentiality;Environmental;Economic conditions and cost of change Politics;Human issues;People-related challenges	-	

Figure A.3: Data Extraction Log ERP

ID	Year	Type of System	Success Factors	Challenges	Steps	Comments
Syed, Rel	2020	RPA	managing fear of bots and potential job loss; the need for clear communication; dealing with RPA 'mistrust'; the need to set the right expectations; the critical role of leadership	Support for benefit realisation; Comprehensive metrics for benefits; Models for organisational readiness assessments; Mechanisms for infrastructure assessments; Models for organisational capabilities assessments; Maximise analytical capabilities; Methodological support for adoption; Methodological support for implementation; Critical success factors; Socio-technical implications; Techniques for task selection; Systematic design, development, and evolution; Seamless handling of exceptions; Techniques for managing scalability; Proactive monitoring and control	-	
Koch, Chr	2020	RPA	Management must present and show the vision; a good technology partner makes the start easier and helps with the methodology; include employee representative from the start; choose a appropriate process for the first bot; teamwork is essential	-	Understanding RPA basics; Identify and evaluate potential lighthouse projects; Record IT and data protection requirements; Develop an implementation plan; Select manufacturer and tool; Create business case; Clarify organizational framework conditions; Designing and building a team conceptually; Establish implementation methodology; Set up IT infrastructure; Define communication plan; Educate and train the team; Establish structures for cost and performance reporting; Evaluate project implementation, define and implement improvement measures if necessary; Standardize and document processes for robot development and change requests; Managing demand for new developments; Create robots and change requests; Monitor robot performance; Implementing technological changes; Manage and develop the team; Identify and implement improvement measures;	checklist for project lead for an rpa initiative in the appendix; phases: Build understanding of RPA; Lay the foundations; Carry out lighthouse project; Prepare and carry out nationwide rollout
Turcu, C.E	2021	RPA	Choosing the most fitting RPA platform/solution/vendor; Consider type of process to be automated; Consider type of artefacts handled in the to-be automated processes;	Choose, which workflows to automate; Priotize which workflow to automate first; Who is responsble if the RPA robot fails?; Who has the control over the intellectual property robots handle and generate?	-	
Choi, Dae	2021	RPA	-	Inability to prioritize potential RPA initiatives; Concerns about cybersecurity/data privacy; High implementation costs; Difficulty in scaling applications; Making a convincing business case; Difficulty in deciding on best applications; Regulatory constraints; Aversion to risk; Limited RPA skills/talent; Little sense of urgency	-	
Krakau, J.	2021	RPA	Early analysis if there are better-suited automation technologies; Conduct a pilot and document best practices and lessons learned; Create centre of excellence after deployment; develop stakeholder support and organisational commitment; Consider hiring an external ressource specialised in RPA implementation to acquire RPA skill-set; Approach the RPA project with a lean team; RPA has to be regarded as strategic innovation, not only by management; Early IT involvment to ensure compliance with IT security and configure infrastructure;	-	project setup; logistics use cases and processes identification; business case calculation; software provider selection; process documentation and optimization; pilot bot development; pilot validation; operating model setup; center of excellence creation; deployment at a large scale; Ongoing governance, maintenance, and continuous improvement.	Phases: Initation; Piloting; Deployment; Ongoing governance, maintenance and continuous improvement
Flechsig, I	2022	RPA	honest communication; early stakeholder involvment; illustration of training possibilities;	IT infrastructure; IT human ressources; internal communication; financial ressources; top management support; organisational structure; suppliers; government regulations;	Identification of automation need; Information gathering; Strategy alignment; Decision on RPA software and provider; Process analysis, selection, and optimization; Proof-of-concept; Business case evaluation; Establishing governance mechanisms (Center of Excellence); IT integration; Change management; Bot development, testing, release, and go-live; Performance evaluation; Continuous monitoring, maintenance, and adaptation; Building of capabilities; Internal and external promotion; Upscaling	Phases: pre-implementation, implementation, post-implementation
Plattfaut, I	2022	RPA	top management support; involve operational and IT staff early; develop skills of employees; define RPA governance in terms of technology, standards, and organisation; integrate rpa into overall process optimisation program; communicate the impact on human labour; investigate automation alternatives; ensure alignment of RPA initiatives with the overall strategy; approach RPA strategically and not only as a tool for headcount reduction; use a staged approach; be aware of the process costs as a basis for the creation of a business case; communicate the limitations; ensure sufficient process knowledge; ensure managerial engagement; involve all relevant stakeholders; train employees for changing role; ensure compliance with IT, organisation and security policies; select and strategically develop processes according to established criteria; manage internal communication and staff redeployment; ensure adequate documentation and knowledge management; create a center of excellence; design for scalable and flexible solutions; use a standardised and structured development approach; use vendors to skill up the organisation; ensure sufficient resources and priority of tasks; ensure sufficient process knowledge to monitor bots; train operative employees for maintenance tasks; ensure compliance with existing governance; plan for	-	context analysis; process analysis, process development, bot deployment, testing, control, and operation and maintenance	Good section on CSF in general (concept, idea behind etc.)
Brandstat	2023	RPA	-	-	Identification and selection of processes suitable for RPA; Selection and testing of RPA software; Development of RPA solution; Go-Live; Parallel to all stages: change management process with a corresponding communication strategy	
Wewerka,	2022	RPA	-	identify the right process or task for automation;understand the factors influencing RPA user acceptance;explain RPA;design the interaction between human and bot;how to implement RPA projects	Analysis;Product Design;Coding;Testing;Operation;Choose task to be automated;Understand task to be automated;Analyse task to be automated;Evaluate suitability of the task for the automation software;Define and document the to-be task;Translate target task into automation framework;Develop bot according to design;Test developed bot;Fix found errors;Deploy bot;Roll out bot; Maintain bot	
Herm et a	2020	RPA	-	-	Identification of Automation Need; Alignment with Business Strategy; Screening of Different (RPA) Technologies; Processes Selection; RPA Software Selection; Proof of Concept Implementation; Evaluation of Business Case; RPA Rollout; Adaptation and Scaling of RPA Services; Center of Excellence; RPA Support Processes	

Figure A.4: Data Extraction Log RPA

APPENDIX B

Consolidated Relevant Factors

Table B.1: Consolidated Relevant Factors BPMS

#	Relevant Factors
1	An organisation, and culture of quality.
2	Balancing of different stakeholder interests.
3	Balancing technological, and human factors.
4	Change management.
5	Changes in organisational rules.
6	Clarification for users on how the monitored data will be used, and what benefits it brings.
7	Continuous optimisation.
8	Deep user participation.
9	Effective communication with employees.
10	Employees' fears of surveillance.
11	Ensuring system security.
12	Existing automation islands.
13	Existing central identity management solution.
14	Gradual introduction instead of a radical one.
15	Insight into how processes work.
16	Integration of processes, and data.
17	Introduction or stop of products.
18	Involving the right people in the project.
19	Maintenance, and control — including quality — of the models is important.
20	Management support.
21	Managing complexity.
22	Mature technology.

Table B.1 continued from previous page

#	Relevant Factors
23	Modelling notation, and process execution language are the same.
24	Organisational understanding of process concepts.
25	Organisation of the modelling design phase.
26	Overcoming resistance to change.
27	Performance measurement.
28	Poor management.
29	Process awareness.
30	Process-oriented approach to application development.
31	Project management.
32	Scrap or combination of departments.
33	Selection of the right tools.
34	Shift in responsibilities of people.
35	Strong management commitment.
36	The far-reaching impact on businesses caused by the integration.
37	The lack of standards-compliant services.
38	The limited capability of the current standards to solve a wide range of real world business problems.
39	The limited control the developers have over the participating services, and applications adapted.
40	The maintenance implication of the integration solutions.
41	The pressure of facing a possible significant shift in organisation politics.
42	Top management focus.
43	Training, and clarification for users.
44	Understanding the interdependencies, and integration of data sources.
45	Understanding the BPM concept.
46	Understanding the process.
47	Use of web services.
48	Using the 'best' modelling standards, and techniques.

Table B.2: Consolidated Relevant Factors WMS

#	Relevant Factors
1	Automate workflows.
2	Business process reengineering.
3	Business analyst skills.
4	Change management.
5	Choice of processes to be automated.
6	Commitment of resources.
7	Communication.
8	Communication facilitators.
9	Criteria for selection of business processes to automate.
10	Defining complex processes.
11	Definition of business process reengineering.
12	Descriptors of organisational climate.
13	Division of work between system, and people.
14	Ease of use.
15	Effective teamwork.
16	Expectations versus reality.
17	Flow of information through the system.
18	Focus first on processes that are fully understood.
19	Formal communication structures.
20	Get support of end users.
21	Implement in phases.
22	Informal communication structures.
23	Integrate the digital workflow with current systems.
24	IT enablement.
25	Logic built into the system.
26	Loss of flexibility.
27	Managerial engagement.
28	Management support.
29	Methods for analysis„ and definition of business processes.
30	Methods for business process identification.
31	Modifiability of the system.
32	Motivation for change.
33	Offline testing, and modelling capabilities.
34	Organisational culture.
35	Organisational impact.
36	Organisational hierarchy.
37	Organisational perspective on workflow, and its perceived value.
38	Outward signs of executive support.
39	Overall approach to business process reengineering.
40	Overmanagement, and creation of new work.

Table B.2 continued from previous page

#	Relevant Factors
41	Policies, and procedures for managing workflow changes.
42	Political aspects.
43	Presentation of workflow to the organisation.
44	Process modelling.
45	Project leadership.
46	Reengineer business processes.
47	Roles, and authority of team members.
48	Social impacts.
49	Structure for translating business processes into workflow map.
50	Support of senior management.
51	System analysis training.
52	System performance.
53	Team composition.
54	Team goals, and objectives.
55	Team meeting logistics.
56	Team structure.
57	Technical implementation costs.
58	Understanding of input technologies.
59	Understanding the underlying infrastructure, and architecture.
60	Use metrics.
61	User training.
62	Worker resistance.

Table B.3: Consolidated Relevant Factors ERP

#	Relevant Factors
1	Acceptance control.
2	Adequate ERP implementation strategy.
3	Adequate project champion role.
4	Adequate project team composition.
5	Adequate training program.
6	Appropriate business, and IT legacy systems.
7	Avoid customisation.
8	Balanced team.
9	Bugs in the software.
10	Build a business case.
11	Business plan, and long-term vision.
12	Business plan, and vision.
13	Business process reengineering.
14	Careful selection of ERP software.
15	Change management.
16	Change management program.
17	Communication plan.
18	Competitive pressures.
19	Concurrently running with legacy systems.
20	Confusion persisting due to changes brought about in the organisation.
21	Consultant selection, and relationship.
22	Cross-functional coordination.
23	Customisation.
24	Data conversion, and integrity.
25	Data management.
26	Dedicated staff, and consultants.
27	Distinguishing between what people thought was the problem, and the real problem.
28	Ease of use.
29	Education, and training.
30	Effective communication.
31	Effective organisational change.
32	Empowered decision makers.
33	End customer not ready.
34	End user involvement.
35	Enterprise system.
36	Enterprise-wide communication, and cooperation.
37	ERP software configuration, and features.
38	Extent of customisation.

Table B.3 continued from previous page

#	Relevant Factors
39	Formalise project plan, and schedule.
40	Good project scope management.
41	Hardware reliability, capacity, and maintenance issues.
42	Human resources, and capabilities management.
43	Implementation strategy, and timeframe.
44	Inconsistency of data.
45	Infrastructure.
46	IT infrastructure.
47	Job redesign.
48	Keeping up employee morale in tricky situations of system malfunctioning.
49	Knowledge management.
50	Legacy system consideration.
51	Limited extent of implementation.
52	Managing cultural change.
53	Meaningful business reengineering.
54	Monitoring, and evaluation of performance.
55	Ongoing project management.
56	Organisational fit.
57	Organisational resistance.
58	Organisational culture.
59	Organisational leadership.
60	Organisational structure.
61	People could not by-pass procedures, ad-hoc activities were not possible.
62	Post-implementation evaluation.
63	Preventative troubleshooting.
64	Process adaption.
65	Product, project manager, and implementation partners selection criteria.
66	Project champion.
67	Project cost planning, and management.
68	Project management.
69	Project planning.
70	Project team constitution.
71	Project tracking.
72	Reconciliation of data between the new, and old system
73	Resistance.
74	Selection of ERP.
75	Software analysis, testing, and troubleshooting.

Table B.3 continued from previous page

#	Relevant Factors
76	Software configuration.
77	Software institutionalisation.
78	Software maintenance.
79	Strategic fit.
80	Strong communication.
81	Sustained management support.
82	System quality.
83	System testing.
84	Systems development.
85	Team morale, and motivation.
86	Technical fit.
87	Testing, and quality assurance.
88	Top management commitment.
89	Top management support.
90	Training.
91	Troubleshooting, and crisis management.
92	Trust between partners.
93	Usage of appropriate consultants.
94	Use of consultants.
95	User involvement.
96	User participation.
97	User training.
98	User education.
99	Vanilla ERP.
100	Vendor support.

Table B.4: Consolidated Relevant Factors RPA

#	Relevant Factors
1	A good technology partner makes the start easier, and helps with the methodology.
2	Adapt the organisational security framework.
3	Approach RPA strategically, and not only as a tool for headcount reduction.
4	Approach the RPA project with a lean team.
5	Aversion to risk.
6	Be aware of the process costs as a basis for the creation of a business case.
7	Choose an appropriate process for the first bot.
8	Choose, which workflows to automate.
9	Choose the most fitting RPA platform/solution/vendor.
10	Communicate the impact on human labour.
11	Communicate the limitations.
12	Comprehensive metrics for benefits.
13	Concerns about cybersecurity, and data privacy.
14	Conduct a pilot, and document best practices, and lessons learned.
15	Consider hiring an external resource specialised in RPA implementation to acquire RPA skill-set.
16	Consider types of artefacts handled in the to-be automated process.
17	Consider type of process to be automated.
18	Continuous knowledge management.
19	Create a centre of excellence after deployment.
20	Dealing with RPA mistrust.
21	Define RPA governance in terms of technology, standards, and organisation.
22	Design for scalable, and flexible solutions.
23	Design the interaction between human, and bot.
24	Develop skills of employees.
25	Develop stakeholder support, and organisational commitment.
26	Difficulty in deciding on the best applications.
27	Difficulty in scaling applications.
28	Early analysis if there are better-suited automation technologies.
29	Early IT involvement to ensure compliance with IT security, and configure infrastructure.
30	Early stakeholder involvement.
31	Ensure adequate documentation, and knowledge management.
32	Ensure alignment of RPA initiatives with overall strategy.
33	Ensure compliance with existing governance.
34	Ensure compliance with IT, organisation,, and security policies.

Table B.4 continued from previous page

#	Relevant Factors
35	Ensure managerial alignment.
36	Ensure sufficient process knowledge.
37	Ensure sufficient resources, and priority of tasks.
38	Explain RPA.
39	Financial resources.
40	High implementation costs.
41	Honest communication.
42	How to implement RPA projects.
43	Identify the right process or task for automation.
44	Illustration of training possibilities.
45	Inability to prioritise potential RPA initiatives.
46	Include employee representative from the start.
47	Integrate RPA into overall process optimisation program.
48	Internal communication.
49	Investigate automation alternatives.
50	Involve all relevant stakeholders.
51	IT human resources.
52	IT infrastructure.
53	Limited RPA skills/talent.
54	Little sense of urgency.
55	Making a convincing business case.
56	Manage internal communication.
57	Management must present, and show the vision.
58	Managing feat of bots, and potential job loss.
59	Maximise analytical capabilities.
60	Mechanisms for infrastructure assessments.
61	Methodological support for adoption.
62	Methodological support for implementation.
63	Models for organisational capabilities assessments.
64	Models for organisational readiness assessments.
65	Organisational structure.
66	Plan for continuous improvement.
67	Prioritise which workflow to automate first.
68	Proactive monitoring, and control.
69	Regulatory constraints.
70	RPA has to be regarded as strategic innovation, not only by management.
71	Seamless handling of exceptions.
72	Select, and strategically develop processes according to established criteria.

Table B.4 continued from previous page

#	Relevant Factors
73	Socio-technical implications.
74	Staff redeployment.
75	Suppliers.
76	Support for benefit realisation.
77	Systematic design, development,, and evolution.
78	Teamwork is essential.
79	Techniques for managing scalability.
80	Techniques for task selection.
81	The critical role of leadership.
82	The need for clear communication.
83	The need to set the right expectations.
84	Top management support.
85	Train employees for changing role.
86	Train operative employees for maintenance tasks.
87	Understand the factors influencing RPA user acceptance.
88	Use a staged approach.
89	Use a standardised, and structured development approach.
90	Use vendors to skill up the organisation.
91	Who has the control over the intellectual property robots handle?
92	Who is responsible if the RPA robot fails?