Development of a Performance Management System Artifact Based on Business Intelligence for SMEs - A Design Science Research Methodology Approach

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Abstract

Although interest in Performance Measurement and Management Systems (PMMS) and their application in various organizations has grown substantially, they are mainly developed for larger companies, and practitioners find it challenging to implement these systems in Small and Medium-sized Enterprises (SMEs). SME characteristics such as limited budget, lack of experience and knowledge, and pace of change usually make it difficult for managers to adopt and use traditional PMMS. One of the solutions to the lack of applicability of PMMS in the SME context is provided by integrating traditional PMMS with Business Intelligence (BI) and Business Analytics (BA) tools and technologies.

The main goal of this thesis is to design and evaluate a Performance Management System based on Business Intelligence (PMS-BI) artifact that contains frameworks, architectures, tools and guidelines to help SMEs evaluate their current Performance Management System (PMS), select the most suitable PMS-BI system components, and design their own PMS based on BI. This artifact also guides them throughout the year by providing tools to assess their PMS-BI and maintain it.

For this thesis, I applied a Design Science Research (DSR) methodology to collect the relevant information needed in the design step, design and develop the artifact, and evaluate it. I used the case study approach in the design's information collection and artifact evaluation phases. The final artifact consists of an executive document that guides the SME managers to design their own PMS-BI and helps them have a perception of its efficiency.

In the data collection phase, I systematically reviewed the relevant literature to understand best practices, then interviewed eleven participants from seven SMEs to find out the gaps and requirements regarding PMS in SMEs. These participants are directly responsible for the PMS in their organization. Then by combining this information, I extracted the PMS-BI features. In the creative process of system design, I used these features to develop the artifact. Then, I presented the results to the same participants in the form of an executive summary. Finally, I used a “usability questionnaire” to understand participants' opinions about the artifact and document their feedback.

My research fills the gap in the application of DSR in the PMS artifact development. This thesis helps researchers understand the application of DSR in designing and developing PMS artifacts for SMEs. In addition, the final artifact can be used by SMEs to develop and apply their own PMS-BI.

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List of Abbreviations

B
BA: Business Analytics
BI: Business Intelligence
BPA: Business Performance Analytics

D
DDD: Data-Driven Decision-making
DSR: Design Science Research

I
IS: Information Science

P
PMMS: Performance Measurement and Management System
PMS: Performance Measurement System or (in this thesis) Performance Measurement and Management System
PMS-BI: Performance Measurement system (based on) Business Intelligence

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Chapter 1 Introduction

Performance Measurement and Management System is a field in management science where practitioners use measures and indicators to set performance targets and measure the extent of misalignment or distance from the strategic goals and manage the performance of the company based on these measurements (Melnyk et al., 2014). Moreover, Business Intelligence (BI) is the method organizations use to develop helpful information or intelligence to help organizations survive and thrive (Jourdan et al., 2008). While the business intelligence and performance management concepts share some common objectives, they are developed in different fields of study and interested in solving the problem with other solutions. PMS is mainly grown in operations management, management control systems, and financial studies. At the same time, BI is mainly developed in computer science, decision support systems, and analytics. While these two fields have been developed significantly, research in integrating them is in its infancy. Extant research mainly focuses on the potential macro-level benefits of adopting such systems (Raffoni et al., 2018). For example, Raffoni (2018) designed a PMS based on BI and Business Analytics (BA) and called it BPA. Business Performance Analytics (BPA) refers to the management and control of the firm's strategic dynamism and performance through the systematic use of internal and external data and analytical methods (Silvi, Moeller, & Schläfke, 2010). However, PMS based on BI is a relatively new subject and the literature in this field is immature (Vallurupalli & Bose, 2018). The primary goal of this thesis is to create frameworks, tools, and architectures to help SMEs design and develop their own PMS-BI by integrating the PMs and BI tools and techniques. I call these framework, tools, and architectures as the PMS-BI artifact and the system that SMEs develop as the PMS-BI, in this thesis. An SME is considered any company with 5 to 499 paid employees.

This integration is useful because BI can fill up the gaps SMEs face when implementing PMS. Developments in information technologies and rapidly increasing processing power are associated with an explosion in the volume of available data. This improvement generated significant interest in business analytics (BA) and Business Intelligence (BI), which are often referred to as "the techniques, technologies, systems, practices, methodologies, and applications that analyze critical business data. Advancements such as business intelligence dashboard, and cloud-based applications help organizations better understand business and make timely strategic decisions" (Chen, Chiang, & Storey, 2012). Although academics and practitioners have widely acknowledged this potential, organizations face significant difficulties extracting information from data (Raffoni, Visani, Bartolini, & Silvi, 2018). While the focus is on collecting, cleansing, and analyzing data, less attention is paid to understanding what actual values data can bring to companies (Klatt, Schläfke, & Moeller, 2011). Lack of analytical knowledge and unclear strategic focus are the most critical problems in using data in companies (LaValle, Lesser, Shockley, Hopkins, & Kruschwitz, 2011). Therefore, companies usually do not use BI to its full potential in organization management,

specifically for PMS purposes. However, my literature review (see section 2.2) and interviews with participants (see Chapter 4) show that BI has a great potential to solve the SMEs' issue when they implement and use PMS.

In this context, the main goal of this thesis is to investigate the integration of these two fields and design and evaluate the PMS-BI artifact for the selected cases. This artifact can be used by companies sharing similar characteristics with the cases studied in this thesis. These cases are SMEs in industries with medium to high level of digitalization. This artifact consists of a framework and the required methods (processes, roles, deliverables, and instances of tools and platforms). This thesis also contains guidelines for companies in testable procedures and publishable reports. From a systematic perspective, this solution connects the sub-systems and routine actions such as strategy mapping, goal definition, data collection and analytics, reporting and feedback loop and other required procedures to complement the performance management practices. Another capability provided by this artifact is procedures and required tools to understand the gap between the current state and the desired state of the performance measurement in the organization. The designed artifact fills this recognized gap by addressing the issues and requirements of the cases and ultimately providing solutions based on IS and management theories and best practices.

In practice, this thesis contributes to understanding how this integration can shape the PMS-BI and how it can be adopted into the performance management context. This artifact makes this integration more effective using BI tools and techniques by providing a general framework and detailed description of the processes underlying the measurement and management of the performance. The findings of this thesis and the designed artifact can be used by SMEs in medium to high-tech industries. Medium-sized enterprises can benefit more due to their better capabilities and structures; however, smaller companies can partially adapt and implement the artifact. The modular design of the artifact makes it possible for a range of both small and medium-sized companies to pick and use modules that fit their needs.

In the remainder of this chapter, I focus on discussing business analytics, business intelligence, and performance measurement and management systems, their usage and issues related to integrating them as the thesis topic. I present the background of the thesis and introduce the problem, the motivations, and the objectives of the thesis.

1.1 Background

The rapid increase in computers and intelligent systems applications is changing how we work today. No aspect of the business remains untouched by new technologies. These technologies change how we gather data, store them in fast and accurate data warehouses, make descriptive and predictive analyses, and ultimately alter the classical business models and management practices into unprecedented ones. Business intelligence has revolutionized how managers make decisions,

set objectives, develop strategies, and measure organizational performance. Performance measurement and management systems have been revolutionized by introducing these systems.

One of the essential applications of BI in organizations is supporting decision-making (Davenport, 2014). Business intelligence adds value by helping practitioners make better decisions based on facts and not only on intuition. Scientists coined the term Data-Driven Decision-making (DDD) and pointed out the importance of data in decision-making processes. Data-driven decision-making refers to basing decisions on the analysis of data rather than purely on intuition (Provost & Fawcett, 2013). For example, a hotel manager can decide on the number of upcoming guests based on her intuition and previous experience or based on the indicators provided by an analytical system; or make informed decisions based on both intuition and data.

Business analytics and DDD are effective in the overall performance of organizations. Brynjolfsson, Hitt, & Kim (2011) studied the effect of DDD on firm performance in a large sample of firms and emphasized that firms that adopt DDD have output and productivity that is 5- 6% higher than what would be expected given their other investments and information technology usage. They also found a significant relationship between analytics and business performance and emphasized that most high-performing businesses strategically apply analytics in their daily operations. (Brynjolfsson et al., 2011)

Business intelligence impacts the overall performance of companies, and it can be used to measure it more effectively. A wide range of literature in the performance measurement and management field demonstrated a vast potential for business intelligence and its capabilities to transform management practices (Raffoni et al., 2018; Schläfke, et al., 2013). This body of literature is concerned with using business intelligence for performance measurement and management.

In recent years, practitioners have developed more sophisticated performance measurement and management systems to help decision-makers provide relevant information. These systems evaluate the performance by capturing and analyzing data to identify the success factors and deviations from strategic goals (Bititci, Garengo, Dörfler, & Nudurupati, 2012; Bourne, Mills, Wilcox, Neely, & Platts, 2000; Franco-Santos, Kennerley, Micheli, Martinez, Mason, Marr, & Neely, 2007; Garengo, Biazzo, & Bititci, 2005; Neely, 2005).

Historically, performance measurement and management is extended from merely financial indicators into a more balanced view of the business (Kaplan & Norton, 1992). Furthermore, the shift toward new performance dimensions, such as quality, time, flexibility, and customer satisfaction, has led to a multidimensional and integrated approach to performance management (Bititci et al., 2012; Hudson, Smart, & Bourne, 2001). These changes motivated new approaches toward performance measurement and management.

While classic performance measurement and management systems use data and analytics to some extent, new business models and applications of advanced technologies, as well as the need to provide fast and effective service, require more sophisticated and analytical decision-making tools at both the operational and strategic levels (Schläfke et al., 2013). Business intelligence is

supporting the field by providing novel tools and techniques. Recent advancements in analytical tools and techniques have provided performance management with promising capabilities for dealing with the current challenges. These instruments gather data, analyze information, and provide timely and accurate knowledge to support the managers with their strategic and operational decisions.

The advancement of new BI tools and practices such as cloud-based dashboards, collaborating environments, and integrated cloud-based software makes it easier and cheaper to develop holistic performance measurement and management systems for small and medium-sized enterprises (SMEs). Traditionally, PMS was more suitable and feasible for large organizations with access to resources and financial capacities. Due to their characteristics and limited resources, SMEs were reluctant to adopt and implement PMS systems in their organization. Another issue that makes applying PMS in SMEs less attractive is the characteristics and architects of such systems designed chiefly based on the needs and requirements of large organizations. Cloud technologies and modular architecture of modern BI applications make it promising to use them in performance measurement and management practices and design systems more suitable for SMEs.

1.2 Problem statement

The first and the utmost problem highlighted in this thesis is that small and medium-sized enterprises have characteristics that make it challenging to adopt a conventional PMS. These characteristics also make it challenging to use conventional PMS to measure and manage performance. By reviewing the literature published before 2010, Taticchi (2010) showed that, despite the maturity of literature in performance measurement and management for large companies, PMS studies in SMEs are still in their infancy. They stated that while literature related to large companies is more focused on the “effectiveness of the PMS”, literature related to small and medium-sized enterprises appears immature, and models identified often fail while implemented. They also identified the study gap in efficiency, effectiveness, and adaptability of PMS in the literature related to small and medium-sized companies compared to large organizations. They ultimately concluded that traditional PMS is designed for large companies.

On the other hand, despite the promising potential benefits of BI in performance management and decision making, Ittner & Larcker (2005) and Raffoni (2018) explained that organizational and technical barriers limiting the use of data analytics and business intelligence. Organizational barriers, such as lack of information sharing, uncoordinated analyses, fear of incorrect results, organizational beliefs, and technical barriers, such as inadequate measures, information system problems, and data inconsistencies, hinder data analytics and business intelligence as a part of performance management life cycle.

Therefore, there is a need to investigate the integration of BI in PMS and find a solution to develop an integrated system that uses BI's potential in performance measurement and

management in SMEs. This system needs to address the requirements for the performance measurement and management in the selected company (companies) and effectively use the business intelligence tools and techniques. This system also needs to address the specific needs and requirements of SMEs.

1.3 Objectives and Contributions

This thesis aims to design and evaluate a PMS-BI artifact based on the current performance measurement and management practices and the business intelligence instruments, tools, techniques, and methods. This thesis aims not to develop a specific measurement system but a framework and related methods, processes, roles, and guidelines.

For this reason, a four-step Information System (IS) design research methodology (Hevner, March, Park, & Ram, 2004) is used to guide the development of this artifact. The developed artifact is based on the knowledge gathered through the interviews and literature review to capture the best practices for developing and using similar systems. The recommended PMS-BI framework provides clues to dynamically redesign the conventional performance measurement and management system to use BI in the PMS system more effectively.

A performance measurement and management system as a complex social structure must be rigorously studied and carefully implemented. The preliminary features for an SME PMS (Bourne et al., 2000; Garengo et al., 2005; Hudson et al., 2001) and the BPA framework developed by Raffoni et al. (2018) guide us through the theorization and developing stages. These guiding frameworks and theories are explained in section 2.3.2.

Literature review showed a clear gap between classic performance measurement and management studies and business intelligence application in such systems, specifically for SMEs. Also, the few studies trying to define the PMS based on BI do not provide a comprehensive framework that can be effectively used in both medium and small enterprises. Another problem with PMS-BI frameworks is their inadequate explanation of the rule of these artifacts in the performance management life cycle. This imprecision raises questions such as how BI will improve the quality of performance measurement and management activities, who owns the system, and which departments develop and adopt such systems. What are the routines and leading activities for the design and development of such systems in SMEs, the primary performance measurement and management control activities, and the overall shape and structure of such systems in an SME?

This thesis contributes to the knowledge by analyzing the conventional constructs and frameworks, integrating the two broad fields of PMS and BI, and finally proposing an artifact by conducting case research and evaluating the artifact. Furthermore, this thesis provides a general framework and specific practical guidelines and tools to help organizations understand how integrating BI and performance measurement and management tools could be operationalized

more effectively in an SME context. I interviewed respondents from multiple cases to develop the artifact and then used a standard "usability testing" method (Davis, 1989) to evaluate the system. These cases represent the Canadian small and medium-sized enterprises with medium to high PMS and BI implementation levels. Other companies can use the designed artifact in a similar context.

I used interview data to study the performance measurement and management practices and the level of business intelligence tools and infrastructure implementation. Data for this thesis is gathered by semi-structured interviews with top managers and responsible persons in the companies. These respondents are responsible for implementing and using the PMS and BI in the companies or directly managing the performance measurement and strategic management decisions. After designing the artifact using the data gathered from literature and the interviews, the artifact is evaluated using a standard "Usability Questionnaire."

This thesis tries to develop the artifact by finding answers to the following questions.

Main question:

- *What are the main components and activities of the PMS-BI in an SME?*

Sub-questions:

- *What are the main components and activities of the PMS in an SME?*
- *What are the components and activities related to BI in SMEs?*

Answers to these questions have shed light on the performance measurement and management practices, activities, and mechanisms and helped me design and develop a PMS-BI artifact.

The designed PMS-BI artifact helps SMEs to design Plan, Execute, and Control subsystem and their components. Also, it provides guidelines for activities such as annual, quarterly, and ongoing activities necessary for the PMS use, control, and maintenance. Multiple tools and guidelines as well as an execution summary is provided to facilitate the adoption, use and maintenance of the PM-BI.

1.4 Outline

The rest of this thesis is structured as follows:

Chapter 2: This chapter presents the systematic literature review strategy and explain the philosophical and theoretical foundation. In the end I summarize the review result and represent the research gap.

Chapter 3: I then highlight the research methodology I follow in this thesis. I explain the Design Science Research (DSR), then I present the problems identification process. I end this chapter with artifact development and artifact evaluation description.

Chapter 4: In this chapter, I describe the case study approach I use in the information collection and artifact evaluation stages of the DSR. After describing the interview process and introducing the selected cases, I describe the themes and identified problems and solutions in the literature. I apply the results of this chapter in the artifact development and design.

Chapter 5: In this chapter, I highlight the design, development, and evaluation of the artifact by introducing the background and foundation of the design, artifact development process, and artifact component. I also include the artifact evaluation strategy and results.

Chapter 6: The last chapter presents the conclusions of my research work, its limitations and threats to validity, summary of the contribution.

Chapter 2 Literature Review

In this chapter, first, I present a brief explanation of the philosophical and theoretical foundation of the thesis. This explanation is followed by a literature review on business intelligence and SME performance measurement and management. Finally, the research gaps are outlined.

2.1 Literature Review Strategy

Relevant research papers are reviewed for this thesis, and the findings are summarized. First, literature on PMS-BI and BPA is systematically reviewed, and the preliminary findings are analyzed and summarized. Related literature in PMS and BI is also reviewed and reported to support the findings from a systematic review, and findings are discussed.

2.1.1 Systematic Literature Review Methodology

This review illustrates existing research on performance measurement, management, and business intelligence and analytics, then synthesize the findings. For this reason, the systematic approach of Kitchenham (2009) is used, which consists of four phases:

- Searching for relevant studies using automatic and manual procedures
- Evaluating the retrieved publications against the validated inclusion and exclusion criteria
- Extracting the relevant information from selected studies
- Synthesizing the findings to draw conclusions and interpret findings

2.1.2 Systematic Literature Review Strategy

In this chapter, I systematically review “performance measurement,” or “performance management,” and “business analytics,” or “business intelligence.” For this reason, I followed these steps:

1) All relevant articles were gathered using an automated keyword search of databases.

2) Another relevant research was added by doing a manual search.

3) A list of potential articles is saved in Mendeley®.

4) First screening stage: To find and remove duplicated articles, I used the duplicate removal function on Mendeley®.

5) Second screening stage: Other articles are excluded based on inclusion/exclusion criteria.

6) Articles assessed against quality criteria,

7) Results are saved for the data extraction and synthesis stage. (See Figure 2-2 Literature review strategy steps and selection process)

Steps 1-3 are related to searching for potentially relevant articles. Steps 4-7 cover evaluating relevant articles to this thesis.

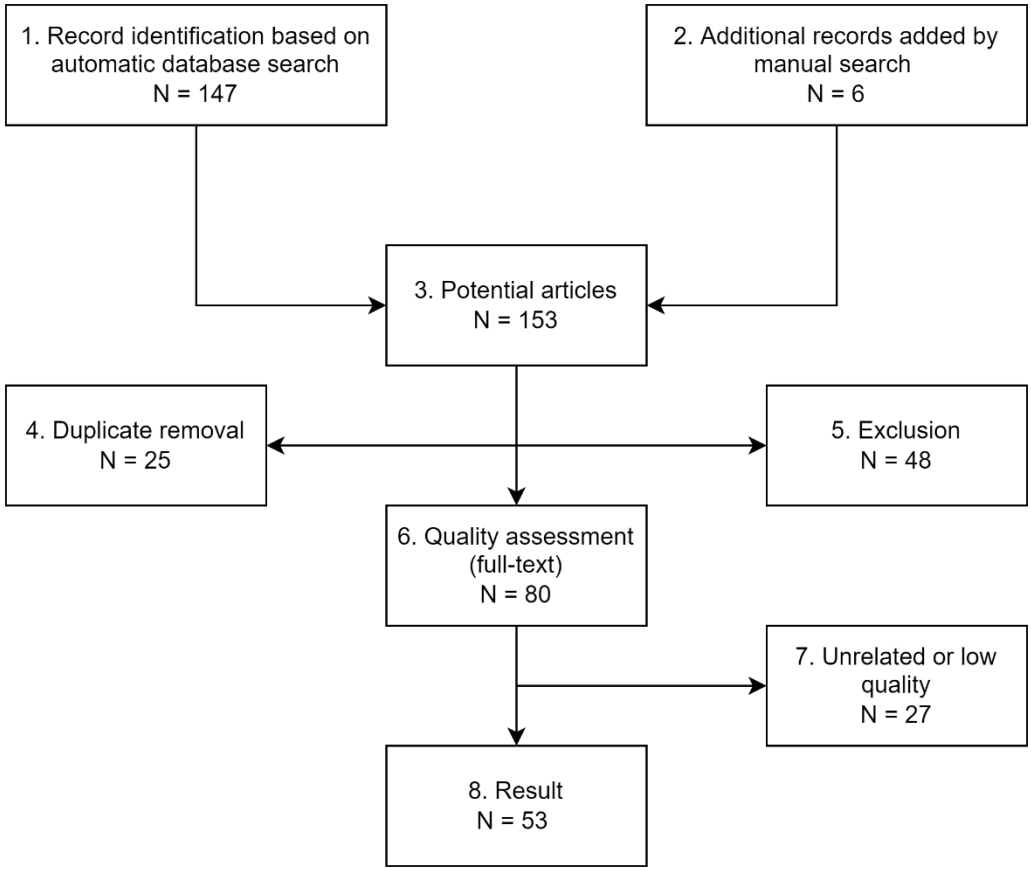


Figure 2-1: Literature review strategy steps and selection process

2.1.2.1 Automatic Records Identification

An automated keyword search of databases was used to identify relevant articles. “Performance measurement and management” and “Business intelligence and analytics” are inclusive terms that resulted in numerous records separately. However, combining these terms has resulted in a manageable number of articles. I tested several other word combinations to select the query with the highest number of relevant findings.

Search Query

The search query is a combination of keywords representing the research objectives in a specific order to use in search engines. As my research is mainly about "Performance Measurement and Performance Management," the first part of the query consists of "Performance measurement*" or "Performance Management*." Then it follows with "Business Analytic*" or "Business Intellige*." After conducting preliminary searches and experimenting with different queries, I finalized the queries.

Other parts of the query are limiting the retrieved records to only articles and "Business" as the subject area (see Table 2-1).

Scopus and Web of Science databases are selected. These databases cover the most of important scientific journals and conferences. These two databases also have a very comprehensive list of publications in the business and management fields which are the main focus of this literature review.

Table 2-1: Search queries

Database	**Query**	**Results**
Scopus	TITLE-ABS-KEY (("Performance measur*" OR "performance manag*") AND ("business analy*" OR "business intelligen*")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp")) AND (LIMIT-TO (SUBJAREA , "BUSI"))	98
Web of Science	(TS=("performance measu*") OR TS=("performance manag*")) AND (TS=("business analy*") OR TS=("business intellige*"))	49

Validation of Automatic Search

During the preliminary stage of the thesis, several articles were identified as particularly important to the thesis. These articles address "Performance Measurement and Management" and "Business Intelligence" and are related to "design" and "framework" or "system." By conducting a manual search in the databases and experimenting with different criteria, I distinguished two streams of literature related to the subject; one is from the production and operations management and another from information science and systems. A concise list of related articles was selected to check the validity and inclusiveness of the queries.

Then, the search was done on the databases using the defined query. Since the result contained these studies, I validated the inclusiveness of the search query.

2.1.2.2 Manual Search

In addition to the keyword-based automated search and to avoid missing some relevant articles, two methods of manual searches have been conducted: A review of the essential relevant journals and a backward/forward search using a concise list of articles.

Creating a list of journals and conferences for a manual search

After an initial search using the query on Scopus and limiting the results to business and management fields, the built-in analysis tool shows the journals with the number of articles, citations, CiteScore, H-Index, and SJR index. Table 2 lists the leading journals based on the H-index criterion (see Table 2-2).

Table 2-2: Selected journals and their H-index

Journal	H index
MIS Quarterly: Management Information Systems	195
Expert Systems with Applications	166
International Journal of Production Economics	155
Decision Support Systems	127
International Journal of Operations and Production Management	120
International Journal of Production Research	115
Computers and Industrial Engineering	111
Journal of the Operational Research Society	94
International Journal of Information Management	91
Industrial Management and Data Systems	88
Management Decision	82

These journals contain the most cited relevant articles in BPA, PMS and BI, which I used in the manual search phase. I searched these journals manually, and I added six related articles which have not appeared in the automatic search to the list of articles.

This list of journals will also help find the most valuable journals to publish the results of this thesis.

2.1.2.3 Screening Stage

In this stage, after listing all the potential articles from automatic and manual searches, in the first screening stage, all the duplicate research or broken links are removed automatically using Mendeley software. I selected one hundred fifty-three articles after conducting the first screening stage. Then in the second screening stage, some articles are excluded manually based on inclusion and exclusion criteria (see Table 2-3. Inclusion and Exclusion criteria). By conducting these

screening stages, the resulted list of articles contains 80 peer-reviewed studies related to performance measurement and business analytics.

Table 2-3: Inclusion and Exclusion criteria

Inclusion Criteria	**Exclusion Criteria**
Related to performance measurement or performance measurement management Related to business analytics or business analytics	Books, theses
Related to one of the business or management practices	Articles on other fields
Peer-reviewed (journals and conferences)	Results not in English

Finally, the selected papers were downloaded and stored in a database. A library contains all the records was stored in Mendeley®.

2.1.2.4 Literature Quality Assessment

I used study quality assessment to include valid and credible studies in the systematic literature review. The quality of this synthesis is primarily related to the inclusion of relevant studies with acceptable quality based on both internal and external validity.

Relevance

This thesis is focused on performance management and business intelligence, so articles not mentioning any business analytics or business intelligence approaches or applications or not related to performance measurement and management are removed.

Internal Validity

This criterion answers the question: “How well does the study under review reduce its systematic error within the circumstances of the experiment being performed?” (Keele, 2007). Therefore, I removed studies with unsatisfactory internal validity.

External Validity

This criterion represents the ability to follow the procedure of study repeatedly. It could be referred to as the type and strategy of study and the logic behind the procedures (Keele, 2007). Concerning external validity, I removed articles lacking the ability to follow the procedure of the studies repeatedly.

2.1.3 Complementary Literature Review

Systematic literature reviews for PMS and BI articles showed a lack of studies using design science research methodology. Therefore, I manually searched for Design Science Research (DSR) papers in the IS field to implement the design science research into the PMS-BI artifact development study. I continued this manual search to reach saturation in the subject. A list of methodological papers as references to this thesis is in Table 2-5.

Table 2-4: Methodology Reference Papers

Title	Author	Year
A Paradigmatic Analysis Contrasting Information Systems Development Approaches and Methodologies	Livari et.al.	1998
Twelve Theses on Design Science Research in Information Systems	Livari et.al.	2010
Design Science Research	Dresch et.al.	2015
Positioning and Presenting Design Science Research for Maximum Impact	Gregor et.al.	2013
A Design Science Research Methodology for Information Systems Research	Peffers et.al.	2014
Design Science in Information Systems Research	Hevner et.al.	2004
A Three Cycle View of Design Science Research	Hevner, A.	2007
Building an Information System Design Theory for Vigilant EIS	Walls et.al.	1992

2.2 Threats to Validity and Reliability of the Systematic Literature Review

There are some potential threats to the validity of the study and results. First, the search strategy may be not completely inclusive. PMS and BI and BA are broad subjects which may not be exclusively identified by using “PMS”, “BI” or “BA” keywords. For instance, articles in data mining, data analytics or big data could be considered as a potential “Business Analytics” research but not included in our search result. To partially mitigate this limitation, some records added to the list by conducting manual research.

Another threat to validity and reliability of the systematic review is that although the procedure of conducting the systematic literature review is controlled and thoroughly documented in detail, it may not be fully replicable due to my intervention on selection criteria and synthesis section.

Finally, since I was the sole reviewer of the documents, the obtained results and the proposed discussions could be biased. To mitigate this threat, my supervisors reviewed the results and confirmed their validity.

2.3 Results

After reviewing the articles, I reported the preliminary results in this section. First, I discussed the philosophical foundation of the research. Then, I explained the theoretical foundation. In the theoretical foundation section, I reviewed PMS in SMEs, BI and BA in SMEs; then, I explained the PMS-BI frameworks and models and design challenges in SMEs. In the end, I reviewed the kernel theories I used in the DSR methodology.

2.3.1 Philosophical Foundations

I investigated the design science research methodology as a proper methodology for this study. Moreover, I explored the case study research methodology as a viable method in the information gathering and artifact evaluation processes of the DSR methodology.

As argued by Van Aken (2005), the core mission of design science is "to develop valid knowledge that can be used by professionals in the field in question to design solutions to their field problems" (p. 22). Carlsson (2011) stated that we could identify two significant streams of design science research in the IS field. One stream, being the dominant view, mainly focused on the development of new Information Technology (IT) artifacts (e.g., Hevner et al., 2004) and IT artifact design theory (e.g., Walls et al., 1992). The more recent second stream is based on the argument that IS design science research should not only be concerned with the prescriptions for designing technological products and applications but also for designing methodologies and interventions. Thus, Carlsson (2011) believes that DSR is a socio-technical approach.

The main goal of this thesis is to design and develop an artifact that is more relevant to the second, more recent stream in IS design science. This artifact is concerned with designing PMS-BI methodologies and interventions rather than technical IT software and application. The first step in my study is to investigate companies' performance measurement and management practices and use the constructivist approach to build the artifact. In the following paragraph, I explain the philosophical reasons behind selecting the constructivist approach for the first stage of the thesis.

Studies characterized the information systems and business intelligence areas by dynamic technological change and innovation. Performance measurement and management systems based on these technologies also share similar characteristics. Researchers in these fields often follow practitioners in proposing changes or assessing methods and tools for developing new systems (Baxter & Sommerville, 2011). In rapidly altering fields, researchers usually formulate and theorize the practices accepted in companies; therefore, a proper research design must capture practitioners' knowledge and develop theories from it. A case study is a method researchers use in both the exploration and exploitation stages of knowledge creation (Brix, 2017). This methodology embraces both deductive and inductive approaches to theory. An integrated approach can also be

followed where researchers are constantly moving from inductive to deductive and vice versa to either adapt an existing theory or present an alternative theoretical framework. A case study can be used in the knowledge creation, exploration, and exploitation stages (Holmström et al., 2009).

The case study research methodology can embrace different epistemological orientations, as well. For example, it can take a realist orientation where an absolute reality is assumed to exist independent of the observer. It also accommodates a relativist perspective assuming multiple realities and having multiple meanings. In this manner, a case study researcher pursues a constructivist approach, attempting to understand the different perspectives of participants and focusing on how these understandings shape the phenomenon under the study (Yin, 2017).

Benbasat et al. (1987) suggested three reasons a case study is a viable information science research strategy. First, the researchers can study the phenomena in a natural context to generate theories from the practice. Second, the case study allows researchers to understand the nature and complexity of the process deeply. Third, the case study is an appropriate method where researchers conducted a few previous studies. Therefore, case study research can most favourably pursue investigating the development of a PMS-BI in selected small and medium-sized companies.

Case study research is an idiographic social science research method where the investigator intensely examines a single entity or a particular event in its context (Benbasat et al., 1987). It is appropriate for types of problems in which research and theory are at their early, formative stages, and the problem is based on the practical situations; therefore, the experiences of the actors are essential, and the context of action is critical (Benbasat et al., 1987).

For the data gathering stage of this thesis and evaluation stage, I used an integrated (deductive-inductive) case study approach.

2.3.2 Theoretical Foundation

Designing a PMS-BI artifact by integrating the PMS and BI tools and techniques requires a theoretical foundation that addresses the evolutionary process of integration and proposes a framework for the final PMS-BI artifact. The main framework that I used for the study is Raffoni et al.'s (2018) preliminary BPA framework (see Figure 2-1: Preliminary BPA framework by Raffoni et al. (2018)). This framework originated from studies in performance measurement and Simons's (1995) framework of levers of control. They hypothesized their framework regarding diagnostic or interactive control use in an organization. This framework also highlights the procedural development of measures from assessing the company's strategies and performance measurement model and integrating the analytical process in the data collection and analysis phases. Through this process, Raffoni suggested that data analysis can support the development and use of PMS. Their framework is overcoming a limit of analytical measurement (lack of strategic focus). One of the main issues of PMS is the limited ability to quantify the cause-effect relationships between value drivers and firm performance. By implementing the BI, their model

can improve the understanding of what is happening (descriptive analytics), what will reasonably happen in the future (prescriptive analytics), and what should happen in the future (prescriptive analytics). This integration is also improving the capability of PMSs by adding a target setting and reporting (diagnostic control) and disseminating information across the company, enabling discussion between hierarchical levels and reassessing the business strategy (interactive control) using business analytics.

While this framework provides an exciting roadmap for integrating BI and PMS, it does not provide a complete structure for the final PMS-BI system. Their proposed model can also be complemented by adding more details about how companies map their strategic goals and manage the change. Thus, this model can be considered a guideline for an evolutionary roadmap, not a natural PMS-BI system. This thesis contributes to providing a more comprehensive model that incorporates both the integration procedure and the structure for the final PMS-BI by adding the required component to Raffoni's framework. Also, considering the SMEs' intrinsic characteristics, this thesis aims to modify the framework to reflect the needs and requirements of such companies.

Raffoni's framework development consists of five steps: (a) strategy and performance model assessment; (b) identifying the key questions; (c) data needs and collection; (d) designing and developing the analytical methods and tools; (e) Performance Management Cycle (PMC). These five steps ensure their design objectives: (a) integrating analytics in the PMS and (b) focusing on the strategies and objectives of the company.

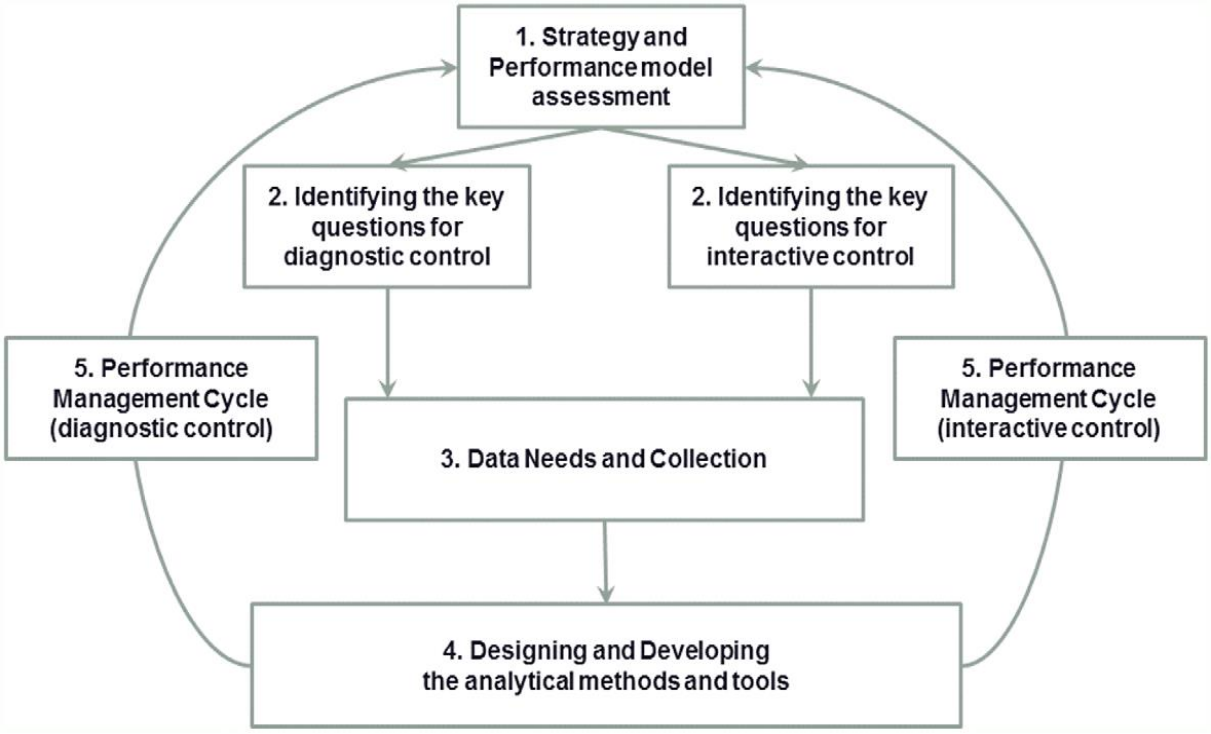


Figure 2-2: Preliminary BPA framework by Raffoni et al. (2018)

2.3.2.1 Performance Measurement and Management in SMEs

Performance Measurement and Management (PMS) is a mature research field for large companies (Taticchi, Tonelli, & Cagnazzo, 2010). However, in the context of SMEs, literature in performance measurement and management system design appears immature, and the models identified often fail while implemented (Taticchi et al., 2010). Various studies (U. Bititci et al., 2012; Božič & Knežević Cvelbar, 2016; Garengo et al., 2005; Hudson, Lean, et al., 2001; Hudson, Smart, et al., 2001) dedicated to small-medium sized firms show that further research is required to design and develop a performance measurement and management system specifically suitable for these companies. Defining relevant performance measurement, designing efficient metrics to measure those dimensions and creating consistent and applicable performance measurement and management systems are fundamental to ensuring efficient resource allocation and utilization, business development and revenue growth, and survival of SMEs (Ates et al., 2013; Jamil & Mohamed, 2011; Panno, 2019).

Although the PMS is considered a primary factor in managing and improving SME performance, there is also a gap between theory and practice in this field (Carpinetti et al., 2007; Chalmeta et al., 2012; Hudson, Smart, et al., 2001). Literature review results revealed that most of the research

on applying PMS in SMEs lacks the scientific and formalized connection to the knowledge generated. Conceptual models and frameworks such as Garengo (2005); Hudson, Smart (2001); Jamil (2011); Marchand (2018); and Rojas-Lema (2020), are rarely used in a natural context. While there is a clear gap between the theory and practice, my proposed artifact uses multiple inputs from the body of knowledge to develop and evaluate a performance measurement and management system. I further explain this linkage in section 3.4.

In the following paragraphs, based on the literature review results, I explain the main gaps in the performance measurement and management studies between the large enterprises and SMEs and the gap between the theory and practice in this field.

Lack of comprehensive methodology

Taticchi (2012) stated that a considerable difference exists between the big and small companies; therefore, SME practitioners are not able to adapt the PMS models developed for big companies. One of the main reasons for this low level of implementation is the lack of a comprehensive methodology. This problem links the goals and strategies to SME performance while accounting for the particularities and characteristics of this kind of enterprise (Chalmeta, Palomero, & Matilla, 2012). To address these differences and highlight the influencing factors to be considered in future studies, Garengo (2005) indicated that the increasing complexity in SMEs and their sensitivity to differences in organizational culture and management systems are among the most critical constituents in the lack of PMS methodology.

Unsystematic performance measurement and management procedures

Previous empirical studies illustrated that only a few SMEs apply and use efficient and effective performance measurement and management models and procedures, and were applied, they are implemented in an unsystematic fashion (Heinicke, 2018; Laitinen, 2002; Rojas-Lema et al., 2020). SMEs' performance measurement and management activities usually lack logical and rational formalization, and practitioners partially use and implement these models (M. H. Smith & Smith, 2007).

Supporters of formality claim that SMEs need to formalize their structures and procedures to improve their organizational capabilities and become more efficient (Terziovski, 2010). Large companies have generally succeeded with this strategy by focusing on process improvement, which necessitates formal structures and systems to drive costs down; therefore, supporters of formality in SMEs advocated for the same practices in the small-medium-sized companies. Contrary, informality supporters, on the other hand, argue that because SMEs develop products for niche markets, they do not need to formalize their structures and systems (Bessant & Tidd, 2007, p. 285). They base their argument on the premise that SMEs' competitive advantage over large firms is mainly due to their flexible structures (Appiah-Adu & Singh, 1998; Qian & Li, 2003; Yousuf et al., 2019). Researchers need to address this in the PMS development for SMEs. While

the PMS needs to be as flexible as possible, the core structure and guidelines must be accounted for formality.

Unbalanced approach to performance measurement and management

Hudson (2001) highlighted that SMEs measure and monitor a few non-financial or financial metrics that lack reference to strategy. Garengo (2005) argues that SMEs rarely use balanced models since SMEs focus on operational and financial performance. Despite the importance of operational concerns in SMEs, these businesses must improve their strategic management approach to connect decision-making processes with strategic goals; a well-balanced PMS could be a valuable tool in this regard (Tenhunen et al., 2001). A balanced approach to performance measurement and management also facilitates the rational connection between company strategies and performance measurement and management goals (Garengo et al., 2005; Hudson, Smart, et al., 2001).

These gaps are primarily related to the defining SME characteristics. These characteristics are being reactive, having a fire-fighting mentality, growth-oriented, dealing with resource limitations, having informal strategies, and highly flexible structures (Hudson, Smart, et al., 2001; Qian & Li, 2003; Terziovski, 2010).

Therefore, there is a need to develop an artifact tailored explicitly for SMEs that can be successfully implemented. Based on the literature analysis, this artifact should specifically address a comprehensive methodology for PMS development and use; support the systematic approach to performance measurement and management and allow users to follow a balanced approach to metrics definition and selection. I consider these factors as essential inputs to the artifact development stage.

2.3.2.2 Business Intelligence and Business Analytics in SMEs

The digitization of companies provides unprecedented opportunities to analyze internal and external data with incredible accuracy and speed (Pence, 2014). Researchers coined the term Business Intelligence (BI) to reflect business data's mathematical, statistical, and econometric analyses to support operational and strategic decisions (Davenport & Harris, 2017). PMS literature also provides a consensus on the considerable potential of BI and BA in performance measurement and management (Bhimani & Willcocks, 2014; Warren Jr, Moffitt, & Byrnes, 2015). In this context, an emerging field of research aims to analyze the ways of strengthening the role of analytical approaches to performance management (Raffoni et al., 2018).

Business Performance Analytics

I categorized studies in this field into four groups. One group of studies addresses the importance and impact of business analytics (BA) and business intelligence (BI) on the overall performance management practices of the companies (e.g., Hartl et al., 2016; Jayakrishnan et al., 2018; Peters

et al., 2016; Richards et al., 2014; Richards et al., 2019; Vukšić et al., 2013). These articles mainly focus on the impact of various BA and BI tools and techniques on the performance of SMEs. The second group of articles addresses the implementation of tools and mechanisms of BA and BI in performance measurement and management systems (e.g., Abai et al., 2019; Vallurupalli & Bose, 2018). The third group of studies deals with designing and introducing an integrated business performance measurement and management system (e.g., Raffoni et al., 2018; Schläfke et al., 2012; Schläfke et al., 2013; Silvi et al., 2010). The fourth group of studies experiments on the designing and implementing of a business process monitoring and performance measurement infrastructure with integrated BI and BA structure (e.g., Stefan et al., 2010; Vallurupalli & Bose, 2018; T Xin & Wei, 2014; Tian Xin & Yu-feng, 2011; Yao & Ma, 2010). In this section, I elaborate on the following group of studies.

BI and BA tools used by SMEs for PMS

Literature mentioned different BI and BA tools and applications related to the PMS in SMEs (Peters, Wieder, Sutton, Xia, et al., 2016; Pugna et al., 2018; Vallurupalli & Bose, 2018; Vugalter & Even, 2015). These tools range from very simple software such as Microsoft Excel for accounting be financial performance analysis (Iriyadi et al., 2018; Putra, 2019), to CRM tools for customer relationship management (Marchand & Raymond, 2018a) such as Salesforce, and Oracle Netsuite, and ERP tools for enterprise resource planning (Chatzoglou et al., 2016; Marchand & Raymond, 2018a) such as Oracle ERP Cloud, Sage Intact, and Microsoft Dynamics 365.

Advancements in cloud technology also introduced cloud-based business performance measurement and management dashboards such as Klipfolio, Qlik, Click Data, and Grow. These tools make it possible to connect different data sources and software tool through the API technologies and show all performance indicators in one place.

Impact of BI and BA on PMS

While many studies focus on the role of BI and BA in organizations, few studies directly study the linkage between BI and BA and the organization’s performance management (Hartl et al., 2016; Richards et al., 2019). In this context, Hartl et al. (2016) delivered statistical evidence of a positive relationship between BI and performance management and recommended how practitioners can use BI in PMS. They showed a significant relationship between data quality, provision, and *pre-defined data analysis* with *closed-loop business processes.* They emphasized that BI could provide information to close the process loops (Hartl et al., 2016).

The quality of BI in organizations also plays a vital role in enhancing companies' performance measurement, management capabilities, and competitive advantages. Peters et al. (2016) examined the quality of BI through three key concepts: (a) infrastructure integration; (b) functionality; and (c) self-service (i.e., managers’ independent use of BI systems) and showed that these factors are playing a significant role in supporting both diagnostic and interactive dimensions of performance measurement capabilities. BI and BA systems' effectiveness also impact performance management

systems' effectiveness (Richards et al., 2019). By surveying 337 companies, Richards et al. (2019) also suggested that the more effective the BI implementation, the more influential the Corporate Performance Management (CPM) related planning and analytics practices are. While both BI and BA contribute to corporate management practices, the information needs are different based on the level of uncertainty versus ambiguity characteristics of management practice (Richards et al., 2019).

Impact of PMS on BI and BA

Performance measurement and management systems are complex socio-technical phenomena. This system, to be effective, needs to focus on different mechanisms and dimensions of a company. By integrating McKinsey's 7S model (Waterman Jr, Peters, & Phillips, 1980) and the MIT90S framework, Jayakrishnan et al. (2018) developed a framework of parameters influencing the big data business analytics and BI in strategic performance measurement and management systems. Based on their framework, *strategic planning system, leadership system, operation focus system, customer management, workforce management, knowledge management, and excellence system* are influencing components. These factors can be used in assessing the structure and functionality of existing strategic performance systems and how this system influences the BI and BA in the company.

Implementation factors of BI and BA on PMS

Business intelligence and analytics are widely accepted as critical areas to improve organizations' performance (Ranjan, 2009; Torres et al., 2018; Watson & Wixom, 2007). As a result, many organizations spend considerable money and effort to obtain faster and more accurate tools and services to collect, organize and analyze data (Ranjan, 2009). However, SMEs face with challenges and issues when implementing BI and BA. Ayoubi (2018) mentioned these challenges as limited IT resources, lack of top management commitment to the BI projects, organization-wide awareness, perception of managers, and cost. Therefore, researchers and practitioners are working towards proposing solutions to adopt and implement BA and BI in organizations successfully. Abai et al. (2019) stated that although many organizations use business intelligence technologies, they still lack analytics implementation. Therefore, they suggested an integrated implementation of business intelligence and analytics in managing organizational performance. This thesis revealed four integrated BI, BA, and PMS implementation factors: *skill*, *documentation*, *visualization,* and *work culture.* They stated that these factors need to be in place for a successful implementation.

Designing BPA framework

The term 'Business Performance Analytics' (BPA) refers to the management and control of the firm's performance through the systematic use of internal and external data and analytical methods (Silvi et al., 2010). While studies such as Schuelke (2013) discussed the benefits of adopting BA

in PMS, the literature lacks a coherent understanding of how BPA could be used to manage and control (diagnostically or interactively) organizational performance (Raffoni et al., 2018). Few studies, such as Raffoni et al. (2018) and Schläfke et al. (2013), contribute to understanding how BPA could be operationalized in a performance management context by providing a general framework and specific practical evidence. For this purpose, Schläfke et al. (2013) introduced a framework within a traditional logic model of *input, process, output,* and *outcome*. Their proposed model can reveal the causal relationships within strategy maps and deliver hard facts about the effects of relationships between different indicators.

Both Raffoni's and Schläfke's models consider the BA and BI as a tool implemented in the traditional PMS. They do not provide a practical solution for fully integrating and implementing such systems in an organization.

Here are few studies concerning with a BPA infrastructure design and implementation (e.g., Stefan et al., 2010; Vallurupalli & Bose, 2018; T Xin & Wei, 2014; Tian Xin & Yu-feng, 2011; Yao & Ma, 2010). These studies designed and executed a practical measurement system by providing a hierarchy of measures, visualization, and analytical solutions.

Designing BPA framework for SMEs

The literature review showed a lack of coherent knowledge in designing PMS-BI for SMEs. Raffoni et al. (2018) was the most relevant study; in designing a BPA as support for performance measurement and management system in a company operating in the construction industry to overcome the limit of analytical measurement of PMS by conducting action research. They first explored the links between PMS and ICT and how ICT can contribute to improving the strategic role of PMS. Then they followed the following steps:

1- Strategy and performance model assessment.
2- Identifying the key questions.
3- Data needs and collection.
4- Designing and developing analytical methods and tools.
5- PMC (Performance Management Cycle)

This framework indicated how the intervention was intended to work and which variables were initially expected to be critical to delivering the intended effects. The post-positivist interventionist nature of the action research helped the researchers question some initial assumptions and understand the complexities not initially perceived. This research provided a theoretical contribution to the research area by developing a preliminary framework grounded in the performance management literature (see Figure 2-1).

After developing the framework, they conducted action research in the selected case. They collected data through several methods in the context of action research. During the project, the research team frequently visited the company, and qualitative data were gathered onsite through interviews, observation, focus groups, company documents and participation in management meetings. They analyzed data through template analysis (Symon & Cassell, 2012) due to its high

flexibility and capability of adapting the research protocol based on the information emerging from the analysis. Figure 2-4 is the final framework showing the steps taken, the issues and problems for each step (squares) and the interventions.

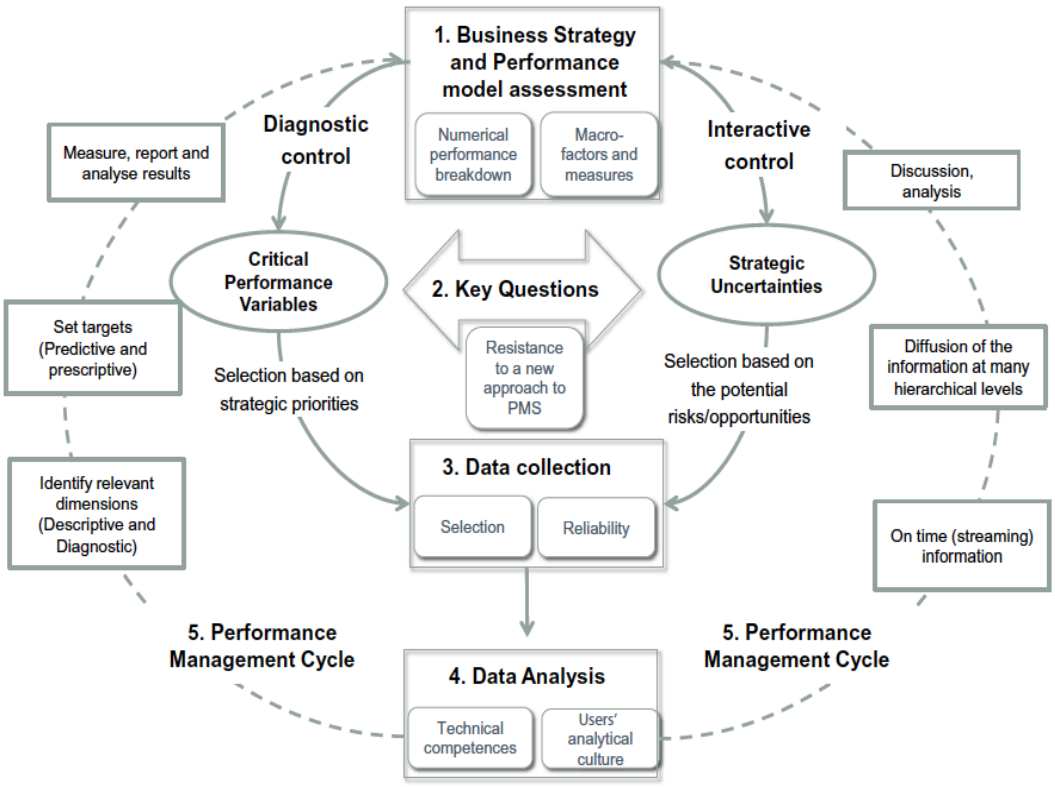


Table 2-5: The final BPA framework (Raffoni et al., 2018)

Their findings confirmed the relevance of the business strategy and performance model assessment as the starting point of BPA development. Second, the actual intervention revealed the importance of translating the strategy assessment into a set of specific questions that BPA should address.

Another study by Schläfke et al. (2013) investigated the capabilities of analytics to understand and control relevant business dynamics through extensive data and analytical methods. This thesis emphasized that analytics could deliver hard facts about the effects of relationships between different performance indicators. They have shown that business analytics could validate causal relationships within standard input, process, output, and outcome categories (see Figure 2-5). This study introduced a framework comprising four layers that comprise the features needed to overcome performance management's challenges regarding analytics. The context contains the internal and external factors that influence the organization. It also considers the factors which occur in the business model. The layers are as follows.

Layer A (capture): This layer comprises the capturing of performance drivers in inputs, processes, and output and outcome categories.

Layer B (couple): This layer comprises the coupling of performance drivers and shows their proposed cause-and-effect connections.

Layer C (control): This layer identifies the cause-and-effect relationships as control levers.

Layer D (communicate): This layer comprises the internal and external communication of the performance drivers.

While this study provides a framework that can identify the application of analytics to extend the understanding of the mechanisms and dynamics of analytics in a performance management context, it lacks a coherent understanding of how such a system can be developed in a natural environment.

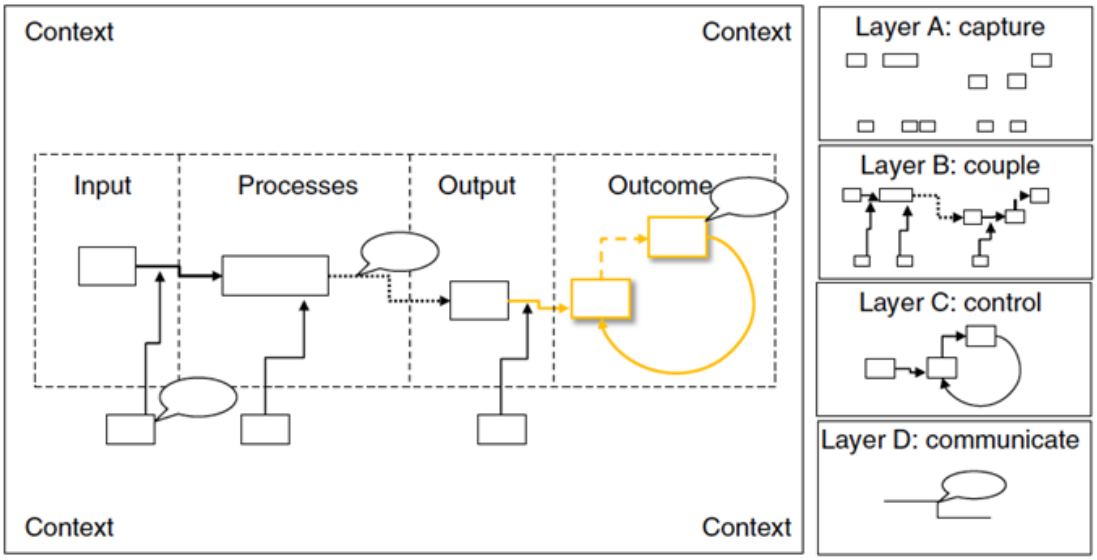


Figure 2-3: Multilayer performance management framework (Schläfke et al., 2013).

2.3.2.3 PMS-BI for SMEs

As stated by Bititci (2018), many advancements in PMS come from practice, which informed the academic literature. This practice involves the mechanisms, procedures, and tools to measure the performance and act upon the results; therefore, to build a theory, whether from practice or other areas of business research, and validate the theory through empirical research, I need to study the organizations and existing PMS practices directly.

Early literature focused on four phases of PMS; design, implementation, use and refresh (Bourne et al., 2000; Neely, Mills, Platts, Richards, Gregory, Bourne, & Kennerley, 2000; Taticchi, Balachandran, & Tonelli, 2012). Contemporary research moved from design to implementation and use of PMS (Bititci et al., 2018), and new themes such as PMS and sustainability, PMS and

project management, and risk management have emerged (Taticchi et al., 2012). Despite the field's maturity, The field still lacks a coherent and comprehensive theoretical model. Therefore, there is a need to develop an artifact by integrating the classic PMS framework and BI systems (Bititci et al., 2018).

Taticchi et al. (2010) stated that researchers are paying attention to delivering logic and procedures to drive the effectiveness of the PMS and frameworks in large companies, while SMEs are dealing with the effectiveness, efficiency, and adaptability of PMS (see Figure 2-4).

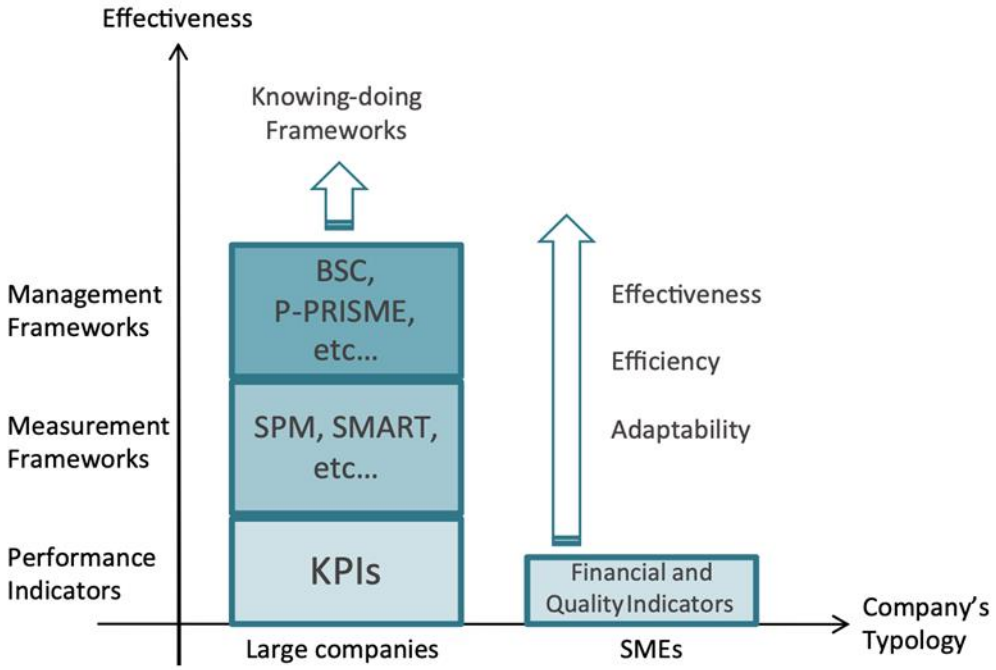


Figure 2-4: PMS studies in large and small enterprises (Taticchi et al., 2010)

These factors need to be addressed in the PMS artifacts for SMEs. This thesis considered the effectiveness, efficiency, and adaptability of the PMS in the SME context and proposed a solution based on the integration of BI and PMS.

To develop a PMS-BI for SMEs, researchers have two possible options. One option is to modify the common PMS considering SMEs' essential characteristics and BI's adoption. Another possibility is to develop a PMS-BI artifact from scratch. This thesis will seek the presence and extent of successful implementation of PMS-BI in selected firms. The level of implementation and the characteristics of the implemented system will express the necessity of a new PMS-BI or modifications to the contemporary PMS by integrating the BA and BI with the existing system. Thus, there could be various kinds of modifications and interventions that can be performed. This thesis suggests adding the BI tools and techniques (e.g., online dashboards, BI integrated systems,

visualizations, cloud-based computing and storage) as a modification or foundation to the contemporary PMS. BI can bring values in all stages of PMM life span, from design to implementation, use and review, by presenting various tools and platforms. Therefore, this thesis aims to investigate how companies use BA in their PMS, understand the gap between the current and desired states, and develop an integrated PMS-BI based on these investigations.

The main challenges associated with PMS-BI designs are adaptability, efficiency, and effectiveness. Taticchi et al. (2012) recommended two interventions to overcome these challenges.

First, they recommended creating a desirable condition for the correct and successful utilization of PMM models within the company. This intervention means providing the organization with proper information technology (IT) tools to extract, gather and analyze relevant data. Within this context, enterprise resource planning (ERP) and business intelligence (BI) software can significantly support PMS initiatives.

Second, PMS models must draw a logical interrelationship between actions and results. Tools such as Success Maps (Neely, Adams, & Crowe, 2001), and Strategy Map (Kaplan et al., 2004), the logic behind Manufacturing System Design Decomposition (MSDD) model (Cochran & Dobbs, 2001) and BSDD model (Taticchi, Tonelli, & Cagnazzo, 2009) can be used to outline this relationship.

2.3.2.4 PMS-BI Design and Development Challenges in SMEs

Based on Hudson et al. (2001), some of the characteristics which hinder the use of PMS in SMEs are as follows:

- Informal and non-documented definition of vision and strategy, which the owners define.
- Its members do not have a clear notion of the corporate strategy.
- Limited resources oblige SME staff to consider financial aspects before others when defining goals, decisions, and outcomes and to restrict investments in organizational consulting and technological equipment.
- Most SMEs have computer applications, such as enterprise resource planning (ERP), for daily activities at an operational level, but few have management control systems. Indeed, they often use Excel instead of an existing decision support system. Moreover, they have very disparate IT tools that do not allow coherent reporting to be carried out.
- There is no prior process for the strategy review and data analysis.
- SMEs cannot usually identify, design and quantify indicators in an integrated way by establishing relations among the indicators from the strategic to the operational levels and aligning them with the enterprise's strategy.
- There is a lack of communication and no culture of using indicators for performance measurement.
- It is challenging to keep skilled, competent staff in the organization.
- Flat organizational structure.

• Personalized management, with little decentralization of authority.

• Internal communication is fast, but externally it is slow due to the shortage of resources, and, in addition, it is focused on the primary stakeholders.

• Only a few customers are trusted, and markets are limited.

• Most of them do not carry out a programme of R&D.

Considering the intrinsic characteristics of SMEs, researchers tailored a general PMS or developed new ones. Taticchi et al. (2010) listed some of the most popular articles discussing such systems:

- Organizational Performance Measurement (OPM) (Chennell, Dransfield, Field, Fisher, Saunders, & Shaw, 2000).
- Improving control through effective performance measurement in SMEs (Hudson, Lean, & Smart, 2001).
- Theory and practice in SME PMS (Hudson et al., 2001).
- Integrated Performance Measurement for Small Firms (Laitinen, 2002).
- Adapting the Balanced Scorecard to SMEs (Davig, Elbert, & Brown, 2004).
- Balanced Scorecard in Non-Profit SMEs (Manville, 2007).
- Measuring the performance of SMEs (Chong, 2008).

Therefore, considering the characteristics of SMEs, the new ideal model should be able to overcome the constraints while connecting strategies into operation by utilizing the tools and technologies. This model should be grounded based on real context and generalizable to other SMEs.

2.3.2.5 Kernel Theories

One of the most critical components of a DSR is kernel theories (Gregor & Hevner, 2013; Hevner et al., 2004). Kernel theories are theories from natural and social sciences which govern design requirements (Walls, Widmeyer, & El Sawy, 1992). These kernel theories may differ from those associated with the design product (Walls et al., 1992).

In this thesis proposal, kernel theories are descriptive theories that inform artifact construction. These theories describe the design's work (Gregor & Hevner, 2013). I used three kernel theories in this thesis: the BPA framework (Raffoni et al., 2018), the Performance measurement system maturity model (Wettstein & Kueng, 2002), and the BI assimilation model (Armstrong & Sambamurthy, 1999). I used these theories as tools to capture the information about the artifact design from the interview questions and constructs from the interview participants. Furthermore, these theories guided us throughout the creative artifact design procedure. In this section, I explain the kernel theories.

2.3.2.5.1 BPA Frameworks

I selected Raffoni's (2018) framework as the theoretical foundation for the BPA, which guided me in the process of defining the problem, designing the artifact, and evaluating it. This framework meets the requirement for procedural design steps and provides structured Business Performance Analytics (BPA) implementation procedure in the BI-PMS context.

Based on my literature review results in section 2.3.1, the foundational theory for our artifact should be aligned with the pertinent SME characteristics and accounts for the PMS-BI system requirements for SMEs. The first identified gap in the PMS for big companies and SMEs is the *lack of comprehensive methodology* in performance measurement and management design and definition in SMEs. The selected BPA framework provides a foundation for designing the artifact, which addresses the comprehensive methodology in PMS definition and design in SMEs. The step-by-step and iterative structure of the BPA framework is a crucial feature reflected in my designed PMS-BI artifact.

The second gap identified between PMS in large companies and SMEs is SMEs' unsystematic performance measurement and management procedures. The systematic approach provided in the BPA design in the Raffoni's (2018) framework guided me to introduce and implement a modular and systematic approach to the design and definition of the PMS-BI artifact.

Finally, the *unbalanced approach to performance measurement and management* is an essential difference in the PMS for large companies compared to PMS for SMEs. While the BPA framework does not provide a clear guideline for the balanced approach to PMS, the systematic approach to the PMS and integration of the BI in the PMS ultimately allow SMEs to design and develop a more balanced PMS. SMEs can use the PMS-BI artifact to define their strategies and objectives systematically and create KPIs based on these objectives. In the PMS-BI artifact, I divided the objectives and KPI definition responsibility between the departments or teams, ensuring a more balanced PMS in the SME.

Assessment of Cases

To better understand the characteristics of the participating companies, I included three types of assessment questions in my interviews. The first assessment question is the performance measurement system maturity level (Wettstein & Kueng, 2002). This assessment aims to measure the maturity level of the performance measurement system. Researchers can use answers to these assessment questions to judge the PMS in place and guide the researchers in improving the running PMSs. The second assessment question concerns the business-IT alignment maturity level (Luftman, 2004). These assessment questions made it possible to evaluate the maturity of the alignment between business strategies and IT. The third set of assessment questions measures the PMS-BI adoption, implementation and use in the SMEs.

These three sets of questions evaluated the readiness and capability of the companies to deploy and assimilate the proposed PMS-BI into their business and provided us with the required criteria for selecting and analyzing the cases and prioritizing the design features.

2.3.2.5.2 Performance Measurement System Maturity Level

Based on Nolan's model of maturity (Nolan, 1979) and Humphrey's software capability maturity model (SW-CMM) (Humphrey, 1988). Wettstein (2002) proposed a maturity model for performance measurement systems. This model determines the maturity level of a PMS in six dimensions. These dimensions are the scope of measurement, data collection; storage of data, communication of performance results; use of performance measures; and quality of performance measurement processes. This assessment then evaluates the companies' PMS maturity level from ad-hoc to adolescent, grown-up, and mature stages. (See Table 2-6)

Table 2-6: A four-stage Maturity Model for Performance Measurement Systems (Wettstein & Keung, 2002)

	Maturity Level 1: ad-hoc	**Maturity Level 2: adolescent**	**Maturity Level 3: grown-up**	**Maturity Level 4: mature**
Scope of Measurement	Only financial performance indicators are considered	Financial performance indicators are measured. In addition, a few non-financial indicators are measured as well.	Both financial and non-financial performance indicators are measured. Performance measurement takes place at different organizational levels.	Financial and non-financial indicators are measured regularly. The indicators in place reflect the stakeholders' interests. Key processes are measured integrally.
Data Collection	Most performance-relevant data is collected manually.	Financial performance data is collected from operational IT systems: however, some manual intervention is needed	The collection of financial performance data is fully automated; the collection of non-financial data needs some manual handling	Internal and external data sources are exploited. The various operational IT systems are integrated. Thus, data collection does not require manual intervention.
Storage of Data	Performance data is stored in various formats (ring binder,	Financial performance data is stored in a central database; non-	Performance-relevant data is stored in local data warehouses using different formats.	Performance data is stored in an integrated IT system.

	spreadsheets, databases, etc.).	financial data is dispersed over different units.		
Communication of Performance Results	Performance results are disseminated on an ad-hoc basis.	Performance results are disseminated periodically to the upper and middle management.	Clear communication structures are established non-financial figures are an integral part of reported data. Most results are communicated via a push mechanism	Financial and non-financial performance results are transmitted to the stakeholders electronically (push option). Additionally, performance results can be accessed electronically (pull option) at a different level of aggregation
Use of Performance Measures	The use of the performance results is not defined	Performance data is used primarily for internal reporting.	Performance data is used primarily for analysis purposes and for communicating strategy and goals to staff.	Performance results are used (1) as a central managerial and planning instrument, (2) to support company-external communication, and (3) to get people involved
Quality of Performance Measurement Processes	The measurement processes are not defined; success de-pends on individual effort.	A certain degree of process discipline exists; successful execution of the measurement processes can be repeated.	The measurement processes are documented and standardized. The execution of the processes is compliant with the description.	Quantitative goals for the measurement processes are set. Continuous improvement of the measurement processes takes place. New technologies and practices are identified

This model guides us in the interview process to follow the conversations, adding more information and insight about the participating SMEs' PMS structure and maturity level. For instance, if participants believe that their current PMS is at an “ad-hoc” maturity level, further questions have focused on the simple data gathering and analysis methodologies rather than complex PMS-BI systems. This model has also been used to compare the companies in the interview analysis section.

2.3.2.5.3 Business Intelligence Assimilation

BI has attracted significant interest from the practitioners, but it largely failed to support organizations' managerial decision-making at both strategic and operational levels (Elbashir, Collier, Sutton, Davern, & Leech, 2013). Since a PMS-BI largely depends on the application of BI at both strategic and operational levels in an organization, understanding the level of assimilation of BI is crucial for evaluating the cases under study and finding the best solution in designing and developing the artifact. Elbashir (2013) stated that shared domain knowledge, and interrelation between senior business, IT executives, and operational-level managers are crucial for enhancing BI assimilation in an organization. Elbashir (2013) discussed that interrelation of strategic IT alignment at both the operational and strategic management levels are the antecedents to BI assimilation.

Armstrong (1999) also emphasized the implication of senior leadership and IT infrastructure on the IT assimilation in firms. They also found a significant relationship between senior leadership knowledge and IT infrastructures' sophistication in enhancing IT assimilation in firms. However, they did not find a significant relationship between the organization's size and IT assimilation.

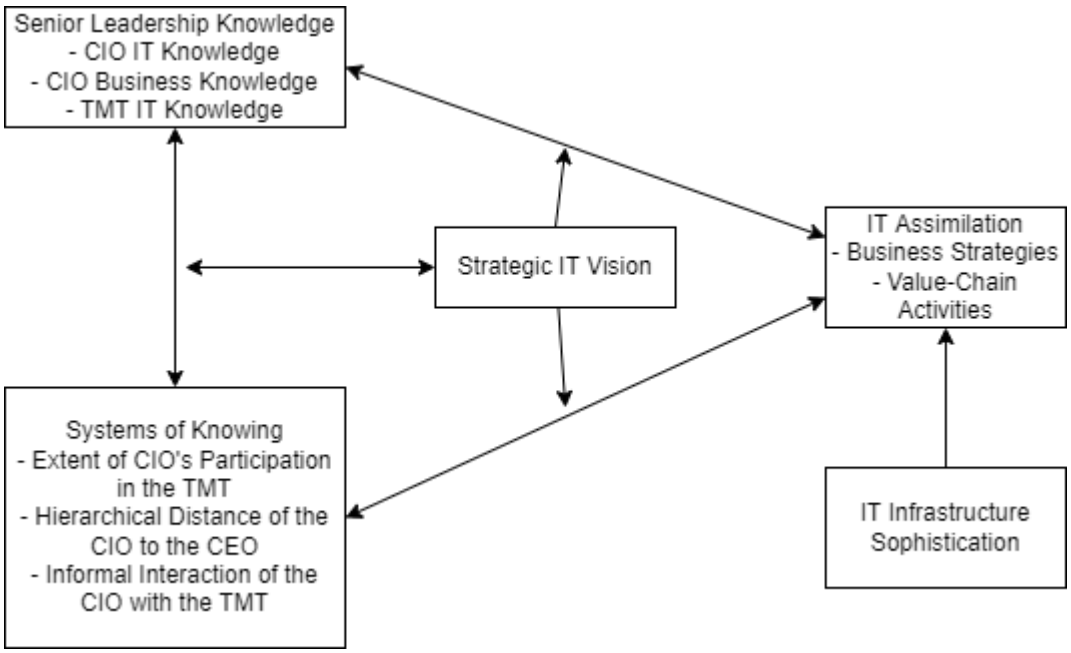


Figure 2-5: IT assimilation, conceptual model (Armstrong, 1999)

I used this model as a guide in data gathering and interviews to assess the participating SMEs' BI tools and assimilation techniques. I assessed senior leadership knowledge as a primary factor in IT assimilation in companies by asking relevant questions. I also focused on the system of knowledge in the data gathering and artifact development stages.

2.3.2.6 PMS-BI Artifact Design and Development

In DSR, an artifact refers to a thing that has or can be transformed into material existence in the form of a product or as an artificially made object (e.g., model, instantiation) or process (Gregor & Hevner, 2013; Hevner et al., 2004). Therefore, a DSR research project can contribute to the knowledge as a viable artifact or at more abstract levels. Gregor & Hevner (2013) considered three maturity levels for the different DSR "outputs" as research deliverables (see Figure 3-10). A specific DSR research project can produce artifacts on one or more levels ranging from instantiations to more conceptual outputs as nascent design theories or well-developed design theories.

Table 2-7: Design Science Research Contribution Types (Gregor & Hevner, 2013)

	Contribution Types	**Example Artifacts**
More abstract, complete, and mature knowledge	Level 3. Well-developed design theory about embedded phenomena	Design theories (mid-range and grand theories)
	Level 2. Nascent design theory-knowledge as operational principles/architecture	Constructs, methods, models, design principles, technological rules.
More specific, limited, and less mature knowledge	Level 1. Situated implementation of artifact	Instantiations (software products or implemented processes)

For this thesis, the artifact, at the lowest level, consisted of both the design process and design product. The design process is meticulously documented to reflect the evolution procedure leading to the artifact product. The design process needs to be replicable and reliable. The design product consisted of the comprehensive PMS-BI for SMEs and the methods required to accomplish the business measurements and management purposes (Level 2). The design process and the artifact are explained in detail in Chapter 5.

2.4 Summary and Research Gaps

Although an effort has been made to characterize business performance analytics, investigating the influence on PMS, important implementation factors, and frameworks to develop such systems, and integrating BA and BI with the PMS, the literature in these fields is in its infancy for SMEs. The number of articles in this field, the proportion of journal articles to conference papers and the quality of publishers reveal a clear gap between PMS and BI studies and the integration of these fields. These studies are usually biased toward the BI or PMS fields and lack a universal integration solution for SMEs. Furthermore, there is a lack of understanding of how SMEs are integrating

these fields. Therefore, there is a need to deeply review both fields and understand how they can be practically integrated. Also, a deeper study is needed to understand SMEs' conventional techniques and methodologies for PMS-BI integration purposes. In the end, solutions could be suggested to selected cases and companies in a similar context.

The identified research gaps are:

- Business performance analytics characteristics for SMEs
- Impact of business performance analytics and performance measurement and management systems based on BI for SMEs
- BPA and PMS-BI implementation factors in SMEs
- Different frameworks for PMS-BI artifact development in SMEs
- Best practices for BI and BA integration with PMS in SMEs

Chapter 3 Methodology

This thesis aims to design and evaluate a PMS-BI artifact for small-medium-sized companies. This artifact consists of a framework, methods, and procedures to accomplish its goals. To fulfill the objectives and satisfy the purpose of this thesis, I used a four-step design science research methodology represented by Hevner et al. (2004). In this chapter, I will provide details about the methodology. I begin the chapter with the research methodology and rationale. Next, I will describe the limitations and concerns, intents of methodology, the unit of analysis, and research steps. Then a detailed description of the steps of the study (Figure 3-1) will be provided. In the end, interview questions, data collection and analysis are explained.

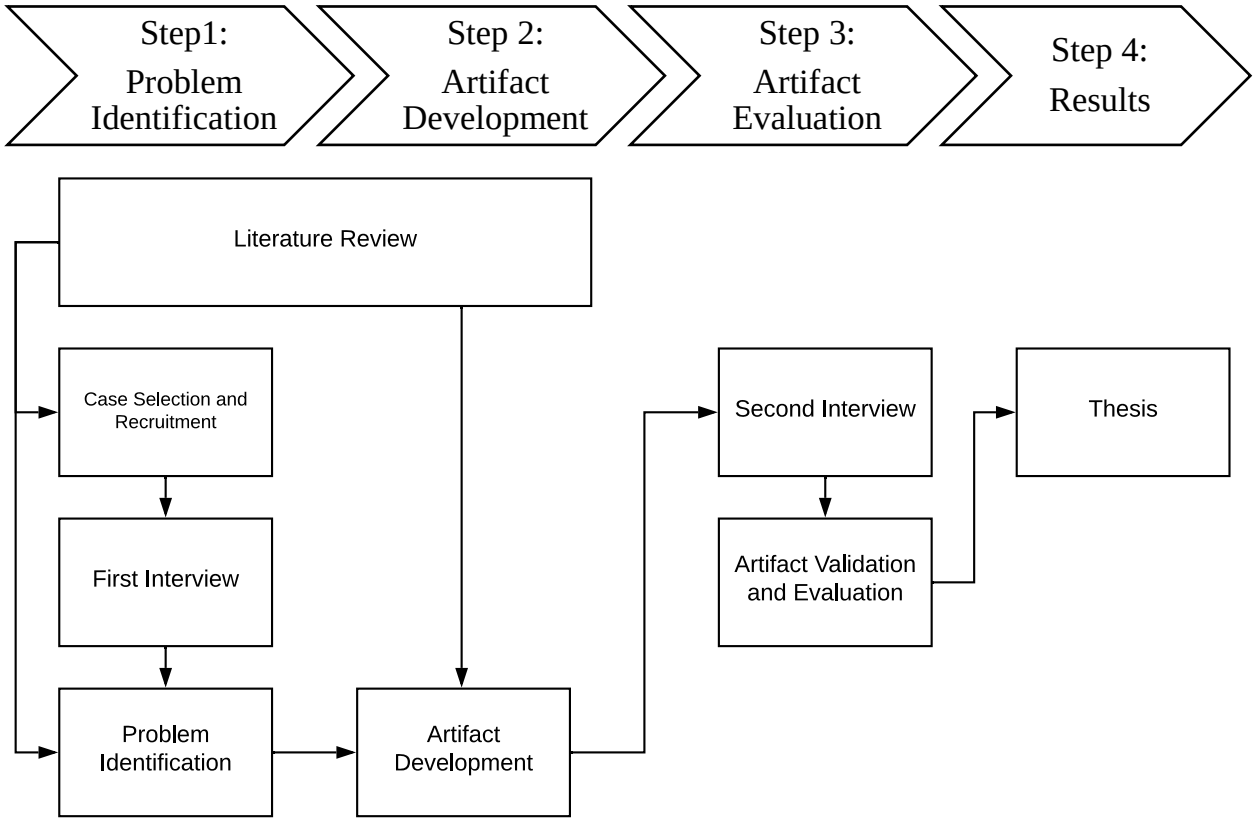


Figure 3-1: Research steps

3.1 Research Design and Rationale

I used a four-step design methodology (Hevner et al., 2004) and a qualitative case study research approach (Benbasat et al., 1987) in the problem identification stage and a standard “usability

testing" questionnaire (Davis, 1989) for evaluating purposes. According to Hevner et al. (2004), when dealing with problems that require building human-made artifacts for problem-solving-oriented purposes, by creating an innovative solution, the design science approach is particularly relevant. In section 2.4 and section 2.3.2, I explained the philosophical and theoretical reasons why a Design Science Research (DSR) and a qualitative case study research methodologies best answer my research questions. In this section, I explain the DSR solution and describe its relevance.

Hevner et al. (2004) stated that two paradigms characterize much of the research in the information system discipline: behavioural science and design science. The behavioural science paradigm seeks to develop and verify theories related to human organizational behaviour. In contrast, the DSR paradigm mainly seeks to extend the boundaries of human and organizational capabilities by designing new and creative artifacts (Hevner et al., 2004). The traditional research methods and DSR are not exclusive but complementary (Dresch, Lacerda, & Miguel, 2015). Furthermore, applying different methods under the umbrella of the design science paradigm is essential since the last phases of DSR comprise real-world experiments to validate the designed artifact in a natural setting (Holmström, Ketokivi, & Hameri, 2009).

The first step is to identify the problem(s) to be solved according to understanding the context and the interests of the people involved with the problem. In this step, the main goal is to focus on the solutions' practical relevance and potential implications. In this step, I defined the class of problems and the target population concerning the problem. A series of semi-structured interviews with knowledgeable participants from selected cases guided us through the definition of the problems and the boundaries of the artifact.

The second step is to create the artifact. In this phase, the literature review and the knowledge gathered throughout the first step will be synthesized for the creativity necessary to build the artifact.

The third step is to evaluate the artifact. An exploratory qualitative usability testing questionnaire is used to evaluate the capability of the artifact to solve the problem (Davis, 1989) and the usability quality of the designed artifact for the practitioners.

Finally, the fourth step is to reflect on both the practical and academic implications of the thesis and draw scientific conclusions.

3.2 Design Science Research Rigor

Two essential factors determine the success of a DSR: rigour and relevance (Dresch, Lacerda, & Antunes, 2015; Hevner et al., 2004) (see Figure 3-2). As shown in the figure, design science research should consider the relevance of research to organizations. Practitioners in the organization can benefit from the results of this analysis and the generated knowledge if the study is relevant to their problems and requirements. A DSR also needs to be rigorous to be considered

valid and reliable and can contribute to an increased knowledge base in each area (Dresch et al., 2019; Dresch, Lacerda, & Miguel, 2015; Ostrowski & Helfert, 2011)

Hevner (2007) emphasized three cycles of DSR: Relevance, Design, and Rigour. The relevance cycle connects the contextual environment of the research with the design science activities. The rigour cycle connects the design science activities with the knowledge base of scientific foundations, experience, and expertise that inform the research project. Hevner (2007) posited that these three cycles must be present and identified in a DSR.

As suggested by Baskerville (2018), to meet these criteria in designing and evaluating the artifact, first, I ensure the relevance of the artifact characteristics and the design process to the implicit and explicit needs and requirements of the cases by doing the qualitative case study. A qualitative case study scrutinizes the intrinsic characteristics of the environment and bridges the artifact design and evaluation process to the problems and requirements of the people, organizational systems, and technical systems under the study. Thus, the success of the relevance cycle is related to the level of rigour of the case study approach (Leonard, 2011).

Another side of the DSR quality is the rigour cycle between the design and evaluation phase and the knowledge base (Drechsler & Hevner, 2016; Dresch, Lacerda, & Miguel, 2015). Since this thesis's most crucial knowledge base comes from the scientific literature and white papers, a systematic literature review is suggested and implemented to ground the artifact on the knowledge base foundations. The rigour of the systematic literature review will ensure the success of the rigour cycle.

A successful artifact design and evaluation also depends on the design cycle's rigour (Sonnenberg & Brocke, 2012). For this reason, I ensured the quality of the design by asking for comments and reviews from the experts (supervisors, committee members, and participating industry experts), iteratively and in different phases of design.

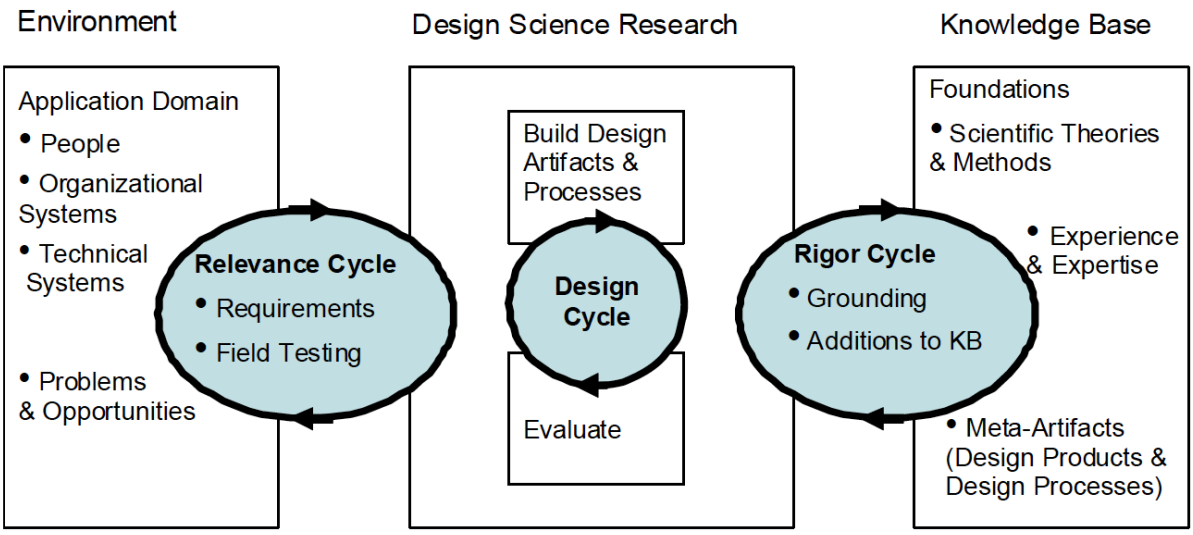


Figure 3-2: Relevance and rigour in design science research. Adapted from (AHevner et al., 2004)

3.3 Problem Identification

The "problem" in this study is considered as all facts and features that influence the quality of SMEs' performance measurement and management practices. Despite the potential benefits of the application of the PMS in SMEs (Garengo et al., 2005; Hudson, Lean, et al., 2001; Jamil & Mohamed, 2011; Marchand & Raymond, 2018b; Tenhunen et al., 2001), my research illustrated that there is a gap between the theory and practice in applying PMS in SMEs. Furthermore, I discuss in 2.3.1 that SMEs usually struggle to efficiently use PMS due to their intrinsic characteristics, which cause issues in applying PMS in SMEs. The main problems are a lack of comprehensive methodology, unsystematic performance measurement and management procedures, and an unbalanced approach to performance measurement and management. These problems are described in section 2.3.1.

In this sense, this thesis seeks to understand the relative needs and issues of implementing and using PMS and BI in SMEs and design, develop and evaluate a PMS-BI artifact based on the needs and characteristics of SMEs.

The structured interviews with stakeholders in selected SMEs allow capturing the information and knowledge related to the performance measurement and management and business intelligence in the cases. This data is used to understand such systems' mechanisms and specific requirements and to develop and evaluate a PMS-BI artifact. Based on Benbasat et al's. (1987) methodology, I used the qualitative case study design for problem identification, artifact design and evaluation purposes.

3.3.1 Class of Problems

Defining the class of problems in which the artifact provides the solutions is a crucial step during DSR (Dresch et al., 2015; Holmström et al., 2009). This is so because although the learning cycles occur in a single setting, there is a need to generalize the findings to organizations facing similar problems (Dresch et al., 2015). The class of problems this thesis target is the PMS-BI operationalization. It involves activities such as developing a new PMS-BI framework, improving the current PMS-related processes, and evaluating the consistency between the constructs of a PMS-BI and alignment between the artifact and the requirements of SMEs.

3.3.2 Case Selection and Initial Interview

3.3.2.1 Case Selection Logic

The target of the thesis is small, medium-sized companies located in Canada with medium to high levels of PMS-BI system implementation. To improve the chance of selecting the right companies, I will focus on the SMEs (5 to 499 employees) with 5+ years of establishment in industries with medium to a high level of digitization (Refer to OECD's "A taxonomy of digital intensive sectors in the Appendix"). Participants from these companies are assumed to have the knowledge and experience to answer the questions in the interview protocol directly and reliably.

The basis for the selection of cases is inclusion and exclusion criteria (Robinson, 2014). The inclusion criteria for cases were: (a) companies with more than 5 (to ensure the applicability of a PMS-BI system) and less than 499 employees (SME definition); (b) companies in the medium to high tech industries (OECD's "A taxonomy of digital intensive sectors"); (c) established at least five years ago. (To ensure the minimum experience of using the PMS and BI); d) Willingness to share information; e) essential PMS and BI systems. The exclusion criteria for cases are (a) companies with a high level of data privacy, making it harder to access information required to develop a PMS-BI.

Digital Intensity level (industries)

To investigate a PMS-BI in a company, I need to know if the company has the required prerequisites in place or not. Since a PMS-BI mainly depends on IT and digital analytical platforms such as BI and BA tools, I must select companies with a high level of digital intensity. By making this selection, first, I ensure that I get related and knowledgeable information throughout my initial interview session. The resulting artifact can be used entirely in similar cases after the study. OECD's "A taxonomy of digital intensive sectors" (Calvino, Criscuolo, Marcolin, & Squicciarini, 2018) is used for this purpose. This thesis used six indicators to classify sectors based on ISIC revision 4. The indicators are as follows:

- Share of ICT tangible investment.
- Share of ICT intangible investment (i.e., software).
- Share of purchases of intermediate ICT goods
- Share of purchases of intermediate ICT services.
- Share of ICT specialists in total employment.
- Share of turnover from online sales.

For this thesis, only the "Share of ICT tangible and intangible (i.e., software) investment," share of purchases of intermediate ICT goods and services," and "share of ICT specialists in total employment" are used to select the companies in sectors with a higher level of IT intensity.

Figure 3-3: Sectoral taxonomy of digital intensity, by indicator, 2013-15 (Calvino et al., 2018)

Selected industries

Based on the selected indicators and sectors with third and top quartile levels, seven sectors and their equivalent NAICS 2017 version 3 industries are selected as follows:

- Telecommunication (517-Telecommunications)
- IT (518-Data processing, hosting, and related services,519- Other information services, 5112- Software publishers)
- Finance (52- Finance and insurance)
- Scientific and R&D, Marketing, Legal and accounting (54- Professional, scientific and technical services)

- Management and administrative services (55- Management of companies and enterprises, 561- Administrative and support services)

3.3.2.2 Unit of Analysis

After defining the research question, researchers must also consider what the case is. Huberman and Miles (2002) defined a case as a phenomenon occurring in a bounded context. Although the PMS-BI can be considered a phenomenon bound to a company, in the case study, the unit of analysis is typically a system of actions rather than an individual or group of individuals (Tellis, 1997). Case study researchers consider not just the voice and perspective of the actors but also the relevant groups of actors and the interaction between them (Tellis, 1997).

The unit of analysis in this thesis is operations related to performance measurement and management and business intelligence tools and technologies. Therefore, the selected cases need to be SME companies that have successfully implemented a minimum level of PMS and BI or are acquiring the required knowledge and technology to measure the performance and analyze the business processes. This minimum level of operation can be assumed if the company is knowledgeable about performance measurement and management and actively uses tools and techniques to gather required data and analyzes them to measure the performance and take the required consequences to manage it throughout the operations and activities. These minimum requirements ensure getting essential information to explore and develop the PMS-BI artifact and validate the outcomes.

Single case or multiple cases?

Case studies can be performed as a single or multiple-case design. When the aim of the study is replication rather than sampling, the multiple case design is more favourable (Tellis, 1997). Yin (1984) states that the generalization of results, from either single or multiple designs, is made to the theory and not to populations. Multiple cases produce more robust and higher confidence in theory-making by replicating the pattern-matching processes (Tellis, 1997).

A multiple-case study is appropriate when researchers tend to explore differences within and between cases. The goal is to replicate findings across cases (Yin, 2017). Because this thesis aims to design a framework that will be replicated between cases, it is imperative to choose the cases carefully to predict similar results across cases or contrasting results based on the theory. Therefore I selected the multiple case as the proper approach for this study.

3.3.2.3 Participant Selection and Recruitment

I recruited key informants amongst employees directly related to performance measurement and management in companies that indicated an interest in participating in the project. I recruited participants through purposive sampling. This sampling technique is mainly used in qualitative research (Tongco, 2007). Purposive sampling is a technique to select participants who are appropriate to answer the research questions of a study (Tongco, 2007). These participants are likely to provide detailed information about the topic of the study because of their familiarity with

it and previous experiences (Barratt, Ferris, & Lenton, 2015). Potential participants are senior managers, directors, and employees directly managing the PMS and BI in their companies.

Participation consists of a semi-structured meeting and one set of anonymous evaluation questionnaires (SurveyMonkey webform). The interview took place online through Zoom meeting and lasted 60 minutes. The evaluation questionnaire typically took no more than 2 minutes to complete.

The first interview (see Appendix: Interview questions) aimed to identify the issues with the PMS-BI and find the gap between the current situation and the best practices. The first meeting consisted of semi-structured open-ended questions to understand the gaps and requirements for designing and developing a PMS-BI artifact. I used the second questionnaire to evaluate the developed PMS-BI artifact. This questionnaire consisted of structured questions on participants' impressions of the designed and developed artifact.

I aimed to recruit between 2 to 5 Key Informants for each case that indicated an interest in the study. I was targeting 5 to 7 companies in the selected industries. After doing the purposive sampling and sending out messages, I interviewed 11 participants from 7 companies.

In the initial interview, participants are interviewed face-to-face using a semi-structured questionnaire. Then, to reduce the bias in the validation and evaluation, all participants are interviewed anonymously through the SurveyMonkey web form. For the case study, the basis for determining the adequate number of interviews is reaching data saturation, which is a point in the data collection process when there are marginal and insignificant changes in the data with the addition of new samples or participants for each case (Marshall, Cardon, Poddar, & Fontenot, 2013). However, I reached data saturation after interviewing 11 participants from 7 cases. In most cases, I interviewed at least 2 participants from each case. For the selected companies with few senior managers and directors participating in the thesis, an adequate number of interviews is reached when adequate information is gathered, and no new information is collected.

3.3.3 Data Collection

After selecting cases and getting ethics approval, I started collecting the data. The data collection had two phases: (a) initial interviews and (b) validation and evaluation questionnaire. (See Figure 3-4)

Figure 3-4: Data collection steps

Semi-Structured interview

The first phase of data collection is performing interviews to assess the cases and collect required insight into the subject. Due to COVID-19, I conducted all the interviews online through Zoom.

Before the interview, I prepared and checked my internet connection and the Zoom application settings. I also prepared the support documents, such as the interview protocol and ethical approval papers.

I briefly discussed the thesis's background and the interview session's plan in the meeting. Then I asked the questions using the interview protocol as a guide. After asking all the questions, I thanked the participants for taking the time to answer the questions and being part of the thesis. I recorded the interviews with the consent of the participants to keep the records and transcribe the interviews. I also asked participants if they would be interested in participating in the evaluation phase.

A structured questionnaire (evaluation)

The second data collection phase validated the artifact using a structured questionnaire consisting of "usability testing" standard questions (Davis, 1989), modified for this research. I prepared this questionnaire in SurveyMonkey and I sent the participation link to participants via email. The artifact package consisting of the brief executive summary, an imaginary case description, and the tools and guidelines has been sent to the participants along with the evaluation questionnaire link. 6 participants answered the questions through the online SurveyMonkey application and submitted the results anonymously. The results have been collected from the SurveyMonkey online application and stored for further analysis.

3.3.4 Interview Questions

The first interview consists of initial interview questions. The set of assessment questions includes questions about the demographics of the participants and questions about the company under assessment. Demographic questions helped us understand the participant's characteristics, and assessment questions evaluated the existing PMS and investigated the company's BI tools and techniques.

Initial interview questions are semi-structured, open-ended questions designed to understand the existing PMS and BI characteristics and the gap between the system and the best practices.

These questions are primarily participant-oriented, not leading, but also worded, well-formulated, and open-ended. The aim is to generate answers from participants that are spontaneous, in-depth, unique, and vivid. The answers also reflect the interviewees' personal feelings and stories.

After the artifact design and development, the second round of data gathering consists of a standard "usability testing" questionnaire (Davis, 1989). This questionnaire gathered the participants' opinions about the usability of the designed artifact in their company.

You can see a list of leading questions in Appendix 2: Questions.

Question Constructs

The questions for the first round of interviews to identify the problems consist of 5 primary constructs. In this section, I explain each construct.

Background

Background questions ask about the participant's previous exposure to the PMS and BI systems and try to understand their level of knowledge and experience with these systems. This construct includes questions about the respondent's current role and responsibilities and the company's PMS and BI implementation level.

PMS planning and definitions

The questions in this construct ask about the planning stage of the company's performance measurement and management practices. I was interested in knowing this routine processes and success factors. Moreover, if the company does not have the planning stage for the performance measurement and management, I was interested in knowing what factors prevent the company from doing so.

PMS design and validation

The questions in this construct include the company's PMS design and validation procedures. I was interested in knowing their decisions based on the PMS processes outcomes and the tools and techniques they use for PMS design and development. This construct also includes questions about the validation processes in PMS design and development.

Technological infrastructure and BA-BI tools and techniques

The questions in this construct mainly focus on the technological infrastructure, including the BA and BI tools and techniques. The questions also ask about the participant's opinion about their experience using these tools and techniques, and specifically about the processes and routines in selecting the BA and BI tools and responsibilities in the company regarding these technologies.

Human resources and management support

This construct is mainly asked about the company's supportive environment, whether the management team supports the PMS and BI and the adequacy of this support. Also, the human resource questions ask about the participant's opinion around the human resource capabilities, training opportunities and knowledge of the key personnel about the PMS and BI.

3.3.5 Data Analysis

After collecting the transcripts, I member-checked the initial interpretations. Member-checking is the process of asking participants to review the transcript of their interviews and approve the information's accuracy and correctness (Harper & Cole, 2012).

After the member checking phase, I coded the data using qualitative analysis software (NVivo). I followed Yin's (2017) five steps in case study data analysis.

The five steps for Yin's (2017) analytical method include (a) compiling, (b) disassembling, (c) reassembling, (d) interpreting, and (e) concluding. In the compiling phase, I sorted and reviewed the documents. In the disassembling phase, I broke the information into smaller segments (e.g., words, phrases, and sentences) and assigned codes and labels to the segments. In the reassembling phase, I reorganized the parts into different groupings in a sequence (Yin, 2017). In the last phase, I used reassembled sequences to generate a coherent narrative of the overall interpretation. Results from the literature review are also added to the analysis and compared accordingly. This phase involves the development of the conclusions. These phases are repeated for each case. The guiding framework for my analysis has been the BPA framework by Raffoni (2018).

3.4 Artifact Development

I used two sources of concepts to develop the artifact: Literature and a case study. The case study provided me with a list of significant problems with PMS-BI in the selected SMEs (Section 4.5). I also used this case study to extract and explain the themes related to a PMS-BI (Section 4.4). Literature also suggested solutions to the identified problems with PMS-BI in SMEs (Section 4.5) and kernel theories (Section 2.3.2.5). PMS-BI problem analysis and solutions in literature resulted in artifact features (Section 5.3.1). Also, kernel theories and thematic analysis resulted in artifact components (Section 5.4). Artifact components are systems and subsystems that create the primary building block of the PMS-BI artifact and the features that define what essential factors should be considered in implementation and use in SMEs. The final artifact consists of these components and features.

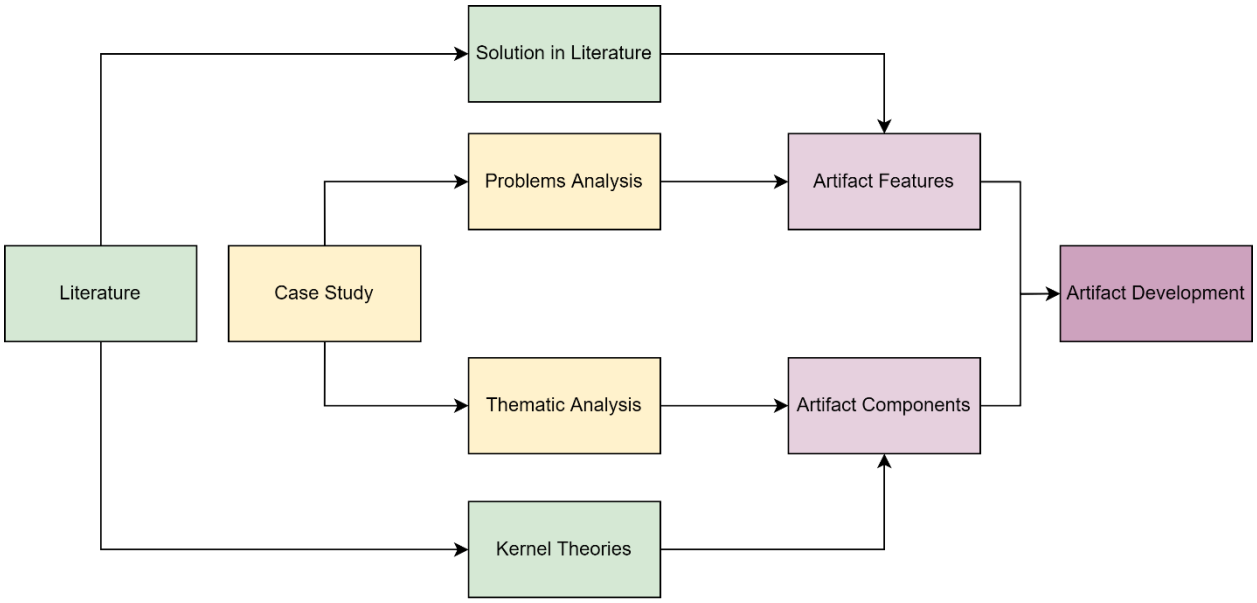


Figure 3-5: From "Literature" and "Case Study" to "Artifact Development"

3.4.1 PMS-BI Artifact

The final PMS-BI artifact contains methods for accomplishing the business performance measurement and management goals. In addition to the methods, I added the required models, procedures and guidelines to the artifact package. The proposed design aimed to explain how the PMS-BI framework for SMEs is structured, what methods are needed to accomplish the goal of the artifact and what the pre-requisites for the successful implementation and use of the PMS-BI artifact are. The requirements for the design came from the literature and interview sessions with the participants.

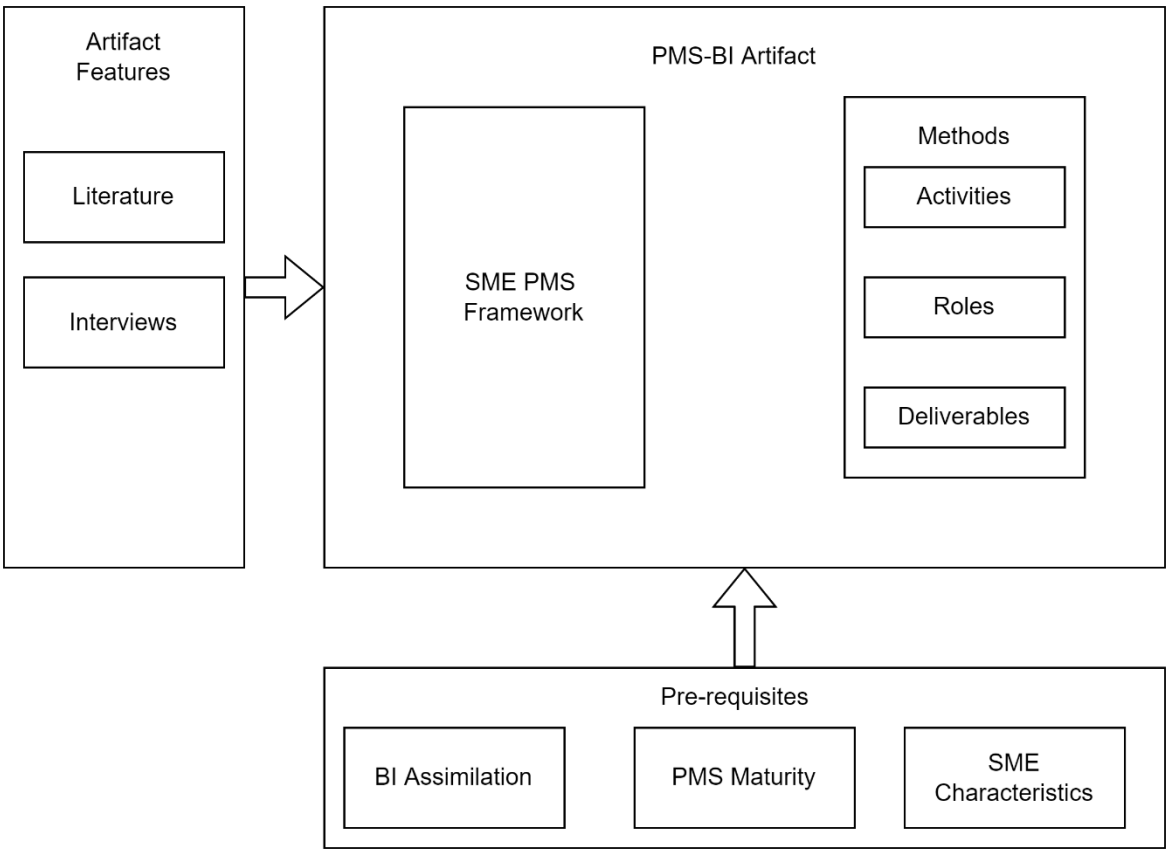


Figure 3-6: PMS artifact design

Pre-requisites

My artifact design and development stage need to investigate three necessary prerequisites. First, BA and BI's role in the organization must be carefully investigated. Whether the BA and BI are already assimilated into the organization or need to be part of the PMS-BI artifact and how this vital component to the PMS-BI system needs to be implemented in the performance measurement

and management practices is the question needs to be highlighted in the artifact design. PMS maturity and SME characteristics are also defining the structure and building blocks of the PMS-BI product.

3.5 Artifact Evaluation

Based on Hevner et al. (2004), there are five design evaluation methods (see Figure 3-11). In this thesis, I used descriptive scenarios and evaluated the usability of the artifact using the standard usability test questionnaire (Lewis, 2006). This type of evaluation builds a scenario about the artifact used in the context to build a convincing argument for the artifact's utility (Hevner et al., 2004). After presenting the artifact and the scenario to the selected SME managers, I used a usability test to understand the respondent's opinions about the artifact illustrated through the scenario in their natural context.

Table 3-1: Design Evaluation Methods (Hevner et al., 2004)

1. Observational	Case Study: Study artifacts in-depth in a business environment
	Field Study: Monitor the use of artifacts in multiple projects
2. Analytical	Static Analysis: Examine the structure of the artifact for static qualities (e.g., complexity)
	Architecture Analysis: Study fit of artifact into technical is architecture
	Optimization: Demonstrate inherent optimal properties of an artifact or provide optimality bounds on artifact behaviour
	Dynamic Analysis: Study artifact in use for dynamic qualities (e.g., performance)
3. Experimental	Controlled Experiment: Study artifact in a controlled environment for qualities (e.g., usability)
	Simulation - Execute artifact with artificial data
4. Testing	Functional (Black Box) Testing: Execute artifact interfaces to discover failures and identify defects
	Structural (White Box) Testing: Perform coverage testing of some metric (e.g., execution paths) in the artifact implementation
5. Descriptive	Informed Argument: Use information from the knowledge base (e.g., relevant research) to build a convincing argument for the artifact's utility
	Scenarios: Construct detailed scenarios around the artifact to demonstrate its utility

The same cases from the initial interview are targeted and recruited to validate and evaluate the created artifact. The recruitment is based on the answers collected for the question about their interest in contributing to the validation and evaluation phase. The reason for selecting the same cases and recruiting the same participants is their knowledge and experience with the subject of study and the higher probability of their further contribution.

3.5.1 Case Study, Data Collection and Analysis

The cases for the evaluation phase are the same as for the problem identification phase. I asked for the participant's interest in contributing to the evaluation and validation phase in the first interview. I sent the artifact documentation and description to the interested participants, and I asked them to fill and submission of a standard "usability testing" questionnaire (Davis, 1989) over the SurveyMonkey.

Participants had two options for participating in the validation/evaluation phase. If they were interested, I could present the artifact to the companies and would ask the participants to fill out the questionnaire afterward. To keep this section anonymous, I would leave the room while the participants fill out the questionnaire. After the completion of the fillings, I would collect the questionnaire. The second option for the participants to select is a questionnaire which can be sent through email or web form to collect the data. Participants had a few days to complete the questionnaire and send it back for analysis. However, all participants selected the second option.

Answers were analyzed, and the results were synthesized and reflected in the artifact design. See more details in Chapter 4.

This learning cycle (see Figure 3-7) would be continued by conducting more iterations if the design evaluation was unsatisfactory. However, only one cycle of data gathering for this phase has been done due to the limited time. Further iterations need to be done in future studies.

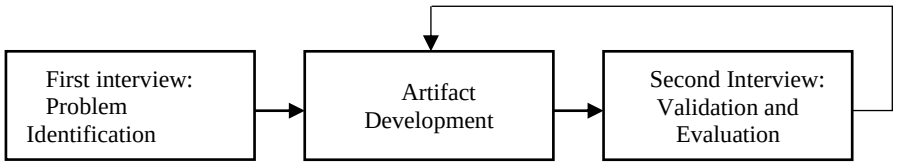


Figure 3-7: Design learning cycle

Chapter 4 Case Study

In this chapter, I present the results and analysis of the collected interviews and separate them into five sections. The first section describes the case study approach. The second section describes the interviews. The third section introduces the selected cases. The fourth section describes the themes; finally, the last section identifies the problems and provides solutions from the literature.

4.1 Case Study Approach

I selected the case study approach for the "problem identification" and "evaluation" stages. The decision to use a case approach is not clear-cut (Benbasat et al., 1987). However, some guidelines help researchers determine whether the case study is an appropriate design for their intended research. Yin (2017) stated that when your primary research question is "how" or "why,"; one have little or no control over behavioural events; and, when one's focus of the study is a contemporary phenomenon, a case study is a proper research design (p. 33). The case study also can be used in different levels of knowledge creation. It can be used in different stages of research, such as exploration, explanation, and description (Yin, 2017), as well as a hypothesis generation and testing (Bonoma, 1985). According to Hevner et al. (2004), Dresch et al. (2015), and Holmström et al. (2009), the case study approach is suitable for the evaluation phase in the design science paradigm when the goal is to observe how the artifact works in a natural setting and if it can solve the problem with satisfactory results, improving the performance of the business.

Yin (2017) defined a case study as an investigation of a contemporary phenomenon in depth and within its real-world context, when the boundaries between the phenomenon and context may not be clear. This definition also makes it evident that designing a PMS-BI artifact, which in turn is a complex social phenomenon that occurs in an organization's context, can be most favourably benefited from a case study design approach.

Applying this design will satisfy the practical concerns of people in the context of the thesis and fulfill the goals of social science by introducing a detailed PMS-BI artifact. The scope of this thesis includes the overall performance measurement system covering all aspects of the business. The proposed artifact follows concepts, tools and techniques previously reported in the performance measurement and business performance analytics literature. I modified it to the needs and requirements of the selected cases.

4.1.1 Qualitative Case Study Research

I selected the qualitative methodology for this stage of the thesis. The reason for selecting a qualitative methodology is that existing literature has only focused on theorization and

formulation, and insights from a practical point of view are missing. This means that only a few qualitative studies have been conducted about PMS and BI, and literature could benefit from this thesis by using the gained insights for practical purposes. The qualitative methodology can obtain more profound insights from smaller groups by collecting specific information about the social construct of the reality and patterns and processes underlying this phenomenon.

Qualitative research aims not to adopt general laws but to investigate different effects. However, as a result, the generalizability of the qualitative studies is lower (Myers, 2000). A qualitative approach such as interviews is suitable for studies in areas in which limited research has been done. Qualitative research is suitable for studies investigating and explaining complex situations (Saunders, Lewis, & Thornhill, 2007). This methodology is appropriate for this thesis because the design and development of PMS-BI have only been studied recently and have received little attention. This novelty makes it difficult to understand the relationships between practical use and the techniques, activities and benefits depicted in literature. Therefore, this thesis has shed light on the subject by going deeper into the knowledge and experiences of practitioners and reporting the finding by designing and developing a comprehensive PMS-BI artifact.

4.1.2 Case Study Limitations and Concerns

Case study research is prone to selection bias, whereby the choice of cases biases the research findings (Rose, Spinks, & Canhoto, 2014), particularly when researchers exclude cases that contradict the favoured theory. In this thesis, cases are selected based on the criteria and validated by experts to reduce selection bias.

Another criticism of the case study methodology raised is generalizability, mainly when it depends on a single case (Tellis, 1997; Yin, 2017). Yin contested that criticism by explaining the difference between analytic generalization and statistical generalization: “In analytic generalization, a previously developed theory is used as a template against which to compare the empirical results of the case study” (Yin, 1984). Therefore, the findings of this thesis may not be directly generalizable to a broader range of industries and companies performing in different contexts. However, the developed framework can be used as a template for empirical studies in these cases.

The limitations and concerns about the case study research methodology consist of a broad list of technical and theoretical issues. Hodkinson and Hodkinson (2001) listed the limitations of case studies as follows:

- There is too much data for easy analysis.
- Very expensive if attempted on a large scale.
- The complexity examined is challenging to represent.
- They do not lend themselves to numerical representation.
- They are not generalizable in the conventional sense.

- They are most potent when researcher expertise and intuition are maximized, but this raises doubts about their "objectivity."
- They are easy to dismiss by those who do not like the messages they contain.
- They cannot answer many relevant and appropriate research questions.

In this thesis, considerations are given to construct internal and external validity and reliability (Tellis, 1997; Yin, 2017). Symon and Cassell (2012) stated that missing rigorous

validity and reliability tests in case study research is particularly causing problems for at least two reasons; First, case studies are tools in the critical, early phases of a new management theory, when key variables and their relationships are being explored; Second, case studies are carried out in collaboration or close interaction with practitioners, and they deal with real management situations in the real-world context (Ebneyamini & Sadeghi Moghadam, 2018).

4.1.3 Case Study Validity and Reliability

Despite the advantages of the case study method in management science, its reliability and validity remain in doubt (Riege, 2003). To ensure the trustworthiness and quality of the case study, several procedures and considerations are suggested by researchers (Gibbert, Ruigrok, & Wicki, 2008).

Internal Validity

Internal or logical validity refers to the causal relationship between variables and results (Gibbert et al., 2008). The researcher must follow the rules and instructions in providing plausible causal arguments and logical reasoning, clearly defending the conclusions. Internal validity refers to data analysis (Yin, 2017). Gibbert et al. (2008) proposed three measures to enhance validity. First, a case study should be based on a clear research framework. Second, researchers should compare the observed patterns with predicted ones or patterns established in previous studies through pattern matching. Third, theory triangulation enables a researcher to verify findings by adopting multiple perspectives.

In this thesis, to increase the internal validity of the case study, I used the previous theory, BPA by Raffoni (2018), as my guiding principle both in the design of the questions and the extracted features for the artifact design purposes. BPA provided a research framework, and the results gathered from my case study are compared with the construction of this framework.

Construct Validity

The construct validity of a study refers to the quality of the conceptualization or operationalization of the relevant concept (Gibbert et al., 2008). In other words, it refers to the extent to which a study investigates what it claims to investigate. Construct validity needs to be considered during the data collection phase. First, researchers should establish a transparent chain of evidence to enhance the construct validity to allow readers to reconstruct the path from the

initial question to the conclusion. Second, researchers need to triangulate the collected data using different data collection strategies and sources (Gibbert et al., 2008).

In this thesis, I documented and followed the DSR methodology rigorously to enhance the construct validity of the study.

External Validity

External validity or generalizability is grounded in the belief that developed theories must be shown to be relevant to the study context and other similar settings (Gibbert et al., 2008). Yin (1984) stated that generalization of results, from either single or multiple-case designs, is made to the theory and not to populations. Therefore, multiple cases strengthen the results by replicating the pattern-matching, thus increasing confidence in the robustness of the theory (Tellis, 1997). However, Gibbert et al. (2008) stated that neither single nor multiple case studies allow for statistical generalization, which means that they are unable to infer conclusions about a population. Gibbert (2008) emphasized that to allow the reader to appreciate the researchers' sampling choice, researchers should provide a clear rationale for the case selection and details on the case study context.

For external validity, I recruited participants from multiple cases. This selection is also based on criteria which reduce the bias and enhance the study's external validity.

Reliability

Reliability refers to the conditions enabling subsequent researchers to arrive at the same insights if they follow the study along with the same steps (Gibbert et al., 2008). Two essential factors in reliability are transparency and replication. Transparency can be enhanced by producing clear and detailed documentation and clarifying research steps. The case study protocol is an important document that guides researchers to follow specific rules and allows readers to replicate the study. Replication can be accomplished by putting together a case study protocol, the case study documents, and the narratives collected during the study (Yin, 2017). These documents facilitate the replication of the case study (Gibbert et al., 2008). The package containing the guidelines, tools, procedures, and a detailed use case scenario (refer to Appendix) can be used to replicate the use case in practice. The proposed use case scenario is mimicking an SME that investigates its current PMS using the tools provided in this package, then discovers the issues with its conventional PMS, and ultimately with the help of the procedures and steps provided in the executive summary, improve the PMS by introducing the BI and new PMS modules.

4.2 Interview Description

For this study, I interviewed 11 participants from 7 Canadian SMEs. Participants included founders, CEOs, directors, product leaders, and executives. As outlined in Chapter 3, each interview consisted of a 60-minute semi-structured interview. I outlined the questions in the Appendix.

After collecting and transcribing interviews, I used NVIVO software to thematically analyze the transcriptions and assign codes and themes to the texts. I conducted the analysis using the Template Analysis steps proposed by Brooks et al. (2014). First, all interviews have been reviewed separately to familiarize us with the data. I conducted a preliminary coding and clustering of the codes. Then, I developed the initial *Template* using the *a priori* themes and initial clusters. Then, I used this template to analyze the data further and focus on affluent parts of the texts. The initial template has been reviewed and modified iteratively, and the eventually defined final template. I used this template to interpret the data and the findings. I outlined the result in the Appendix.

4.3 Selected Cases

In this section, I describe the selected companies. These companies are selected based on the case selection criteria in section 3.3.2.1.

Company A

Company A is a medium-sized enterprise located in Ottawa. This company was founded 12 years ago based on an innovative idea. Co-founders of the company developed an engineering idea while doing their Ph.D.; then, they got funding to establish their businesses. Their main product provides an automated solution in construction. This means that their company is based on cutting-edge technology, but their main clients are low to medium-tech companies, creating a unique situation for them. They have had good growth over the past 12 years and seeking to continue this growth by adding new innovative products to their offerings. They are also working toward expanding its presence in national and international markets.

Company B

Company B is a small product design and development consultation company located in Ottawa. This company is a very young enterprise founded by four experienced product designers and managers. They have recruited a few other experienced designers and product managers and expect to grow their business in the next couple of years. Their clients are mostly *Company C*

Company C is a young small-sized company located in Montreal. Their focus is on providing their clients with consultation and management learning packages. This company has changed its focus from pure consultation to a broader range of products and services, such as a performance measurement and management cloud-based dashboard. Their clients range from companies in low-tech to medium-tech and high-tech industries. Another critical target market is industry clusters. They also have clients located in North America, Europe, and Asia.

Company D

Company D is a medium-sized, high-tech and mature enterprise located in Gatineau. They help healthcare companies craft digital and connected health solutions. They are a full-service software design and development consultancy specialized in the healthcare industry. A larger enterprise has recently acquired them.

Company E

Company E is a medium-sized, very mature, and family-based enterprise. They are specialized in a low-tech industry, and their target market is very niche and specialized. Although they are performing in a low-tech industry, they have introduced a few high-tech services both as their offering and for their operations. Their services are location-based and require heavy machinery and custom-built equipment.

Company F

Company F is a small-sized enterprise. Their main product is an online dashboard and a series of traffic monitoring and management applications. This company is in Ottawa and was founded based on an innovative idea. Their customers are ranged from governments, municipalities, and large enterprises. They plan to expand their basket of products and services to other high-tech businesses.

Company G

This company is a very young, highly specialized, and innovative company located in Ottawa. Their main product is a health monitoring gadget in the research and development and product-market-fit stage. This company mainly consists of young, highly educated professionals and engineers. They are in their early stage of growth and expect to have a very high valuation shortly by introducing their product to the market.

4.4 Description of Themes

4.4.1 Thematic Analysis

A thematic analysis method (Braun & Clarke, 2006) is selected to analyze the collected data. This methodology is practical when researchers position their study within either realist or constructionist paradigms (Braun & Clarke, 2006).

In the context of PMS- BI artifact design and development, thematic analysis is applicable because it enables me to investigate the meanings that practitioners attach to their performance measurement and management in their company, the significance and utility of this system in their company and their social constructions of it. At the same time, this methodology enables me to examine how these constructs reflect the ‘reality’ of participants’ lived experiences and the utility of the constructs in the context of their experience (Evans & Lewis, 2018).

Therefore, to understand how participants perceive the PMS and how they use it in their company, as well as how they construct their social world through the meanings and material experiences and context around this object, thematic analysis is considered the proper research methodology for this phase of the study.

4.4.1.1 Template Analysis

Template analysis is a thematic data analysis that develops a coding template to summarise themes identified by researchers as necessary in a data set and organize them in a meaningful and helpful manner (Brooks & King, 2014). This technique is proper when a researcher takes a "realist" position and is concerned with the "discovery" of underlying causes of human action and phenomena. It can also be used for a "constructivist" study that assumes that there are always multiple interpretations of any phenomena. These interpretations depend upon both the researcher's position and the research's specific social context. (Brooks & King, 2014)

I used the template analysis technique to summarise the themes identified in the interview transcripts and attach meaningful interpretations to each theme. The templates mainly consist of stages of a PMS design and development and performance management cycles proposed by Armstrong (2005), Bourne (2000), de Waal (2007), Frangopol (2011), Helden (2012), and Neely (2001). These templates comprise a plan, execute, and control stage of a performance management system life cycle. An additional "problem context" theme is also provided as an overarching theme related to the BI system and the other related contextual meanings. I used this in the arrangement of the questions, theme identification and interpretation and artifact component and sub-system definition and design stages. In the next section, I describe how this template is shaped using the *a priori* themes.

4.4.1.2 A priori Themes

In template analysis, it is common to use themes identified before coding. These are known as a priori themes and are usually identified prior to the study; researchers identify assumptions that should be focused on during the analysis (Beck et al., 2013; Brooks & King, 2014; Peffers et al., 2007). These themes can be removed or modified during the analysis.

Since I have identified frameworks and concepts as my 'kernel theories' within the design science research methodology, these theories' concepts and dimensions are my initial themes.

After identifying the text themes and attaching labels (codes) to them, I organize them into higher-level themes. I reorganized the themes iteratively until reaching the saturation level.

To explore the utility and structure of PMS amongst participating SMEs, I use dimensions derived from the BPA framework by Raffoni (2018) and the core components of a PMS from literature (Armstrong & Baron, 2005; Bourne et al., 2000; Lebas, 1995; Marchand & Raymond, 2008, 2018) as *a priori* themes in data analysis. These themes provided a logical starting point for the analysis and allowed us to define more relevant codes emerging during the transcript review. These themes, along with the generated codes then synthesized into the final template structure.

a priori themes from the BPA framework by Raffoni:

1- Strategy and Performance model assessment

2- Identifying the key questions for control

    2-1 identifying the critical questions for diagnostic control

2-2 identifying the critical questions for interactive control
3- Data needs and collection
4- Designing and developing the analytical methods and tools
5- Performance management cycle
5-1 performance management cycle (diagnostic control)
5-2 performance management cycle (interactive control)

After defining the themes and codes, I organized them into clusters and created the initial themes. Deciding which stage of the analysis to produce the initial themes is an essential consideration (Brooks & Kings, 2014). Considering I already have highlighted the critical frameworks and system components as my kernel theories in DSR methodology, I can use the dimensions from these established frameworks as *a priori* themes. These themes and codes guided me in the process of reading and reviewing the transcripts and producing the initial template. This strategy will help me focus on the codes and themes which are relevant and meaningful to my PMS-BI artifact design and create the initial template prior to the deep analysis of the codes.

Five initial high-level *a priori* themes, as mentioned in the previous section, guided me during the initial reading of the transcripts. Three main themes emerged after the first round of coding the texts and organizing the codes into the hierarchy of overarching themes, which encompass the narrower, more specific themes. These themes were Planning, Execution, and Control of the PMS.

After defining the final template, it is applied to the complete transcription to code the uncoded and relevant text in parallel. Parallel coding is a technique where the same text segment is classified within more than one different code at the same level (Brooks & King, 2014).

4.4.2 Summary of Themes

In this section, I summarize the higher-level and lower-level themes in detail and add examples quotations from the participants to support the explanations.

4.4.2.1 Plan

The a priori *plan* theme consists of the codes related to the performance management system planning activities. I identified six distinct themes through the study of the transcripts related to planning. These themes range from the PMS goal-setting to PMS planning support activities, PMS planning responsibilities, PMS planning challenges, PMS planning validation, and PMS planning for the future. Each theme is explained in this section, and I provided instances of the themes from transcripts.

4.4.2.1.1 PMS goal setting

Companies usually do annual and quarterly performance planning. The marketing manager of company A says, "…in terms of deliverables, … we [plan] on an annual basis, we also break [goals] every quarter as quarterly goals. … and goals have KPIs associated with them."

Companies also review their goals quarterly and annually. CEO at company B says: "… if a business function is not performing as it should, we … sit and plan goals around that."

4.4.2.1.2 PMS planning support and conditions

Companies sometimes invite external mentors and facilitators to manage the meetings in performance planning sessions. CEO at company A says: "… we invite a couple of coaches, mentors, external facilitators [to strategic performance planning sessions] to challenge the people to get to the strategic goals right." Companies sometimes do not have enough knowledge and experience running performance planning sessions. CEO at company E usually uses external help to manage these sessions: "I would say we would need to hire someone to do [performance planning session management] as I am on other tasks, but I would say we need to hire someone who has the knowledge and can implement such a system."

Company A's CEO also believes that a successful company should consider using analytics and data to perform better in the PMS planning sessions and running the company. "So, this is super important to the leaders of the company to believe in and also have a good grasp of the data and then running the company based on the data, numbers, data analytics."

Employee engagement is another critical factor in PMS planning. The marketing manager at company D believes: "I need to find a different tool or mechanism to gauge the employee engagement moving forward."

Companies sometimes are reluctant to run the performance planning meetings and believe that small companies or small teams do not have to have these meetings. CTO at company F says: "…but I believe that maybe going above ten people or maybe the four or five people in each department that would make more sense to have this type of planning and spending sometimes on that."

4.4.2.1.3 PMS planning responsibilities

Different people are responsible for PMS planning in companies. Marketing manager at company D says: "In part will ultimately HR is accountable for creating the infrastructure for the performance management, but then it is the managers are accountable for actually executing on the performance management." Moreover, in some companies, specifically smaller ones, it is the responsibility of the co-founders and managing partners, "… it is not a hard split like that it is, you know, no, I am 70 and 30 of the other he is 30 and 70 of the other. Nevertheless, you know, kind of internal project operations, you know, are led by one of the senior partners." CEO at company B stated.

4.4.2.1.4 PMS planning challenges

There are also some challenges and success factors in planning for PMS. One of the main issues, specifically in smaller companies, is continuous changes; these changes usually make it hard for them to have a successful performance plan. CEO at company F says: "… basically for the start-ups that things change, you cannot quantify those [plans] because many things are still in an evaluation mode. So, you are testing your product-market fit; you are testing your marketing strategy, sales strategy." Marketing manager at company A also believes: "… we are swamped. … and on top of everything, we are a small company and fast-growing, as you may imagine, it is hard, even from experience in big companies or companies of all sizes, it is hard to dedicate the time to do this process." The limited time also has pressure on companies, "First I would say time. The second will be probably like that knowledge, and the right person to do it." CEO at company E stated.

Another big challenge is that different peoples' opinions are usually involved in these processes. CEO at company B says: "The challenges are that you are dealing with other human beings with other opinions." Moreover, for younger companies, you must overly rely on prior experiences of the more experienced employees, "Right now as, as a young company, we can only rely on the body of knowledge of my prior experiences. Furthermore, my co-founders have two of us have worked together for over a decade, but there's another one of my co-founders that's new to my relationship which has a different history."

Reaching consensus and having an alignment is another challenge in planning for performance. "I'd say part of it is getting an alignment." Marketing manager and Company D says.

4.4.2.1.5 PMS planning validation

The PMS planning validation validates the quality and relevancy of the performance plans and KPIs. The performance plan and KPIs are usually reviewed and validated quarterly. CEO at company A says: "… in our quarterly business review meeting; we see that one, for example, KPI that used to measure that performance is not applicable anymore, because of such feedback, user feedback, salespeople feedback, or change in the feature of the product, something we were measuring on the product side is not applicable anymore."

4.4.2.2 Execute

Executing the performance management includes activities and processes related to designing the metrics and measuring the performance of the teams and departments against the planned goals and objectives. PMS execution themes include the PMS in place in companies, PMS design and PMS execution process.

4.4.2.2.1 PMS in place

The PMS in place theme contains the company's current PMS activities, processes, and components. It includes PMS in departments and teams.

Few companies have established systems such as MBO (Management by Objectives). However, these systems are not tuned for performance management. The marketing manager at company A states that: “Yes. So, for performance management, we have an MBO structure and this MBO structure. It is more a process; we have a tool that we are using. With it, the tool is not very finely tuned to the performance management.”

For other companies, the performance management practice is more limited to specific projects or products. Companies usually define and use simple KPIs for their current projects. CEO at Company C says: “So, the KPI is straightforward because it is to establish a planning for a project … .” They also believe it is vital to keep all information in one place, “So that's why it's important to have an integrated system to have the same information in one place.” In some other companies, performance measurement and management are more related to budgeting. Co-founder at company C says: “[Performance measurement and management] is mostly related to accounting … [and] budgeting.”

Company B's CEO also believes that their company's performance measurement and management are limited: “So, performance measurement, this is where… we go to the very crude, very basic.”

The goals and performance management objectives are set for teams, departments, and individual levels. CEO at company C says: “So, we have a company goal, we have a team goal, and we have an individual goal.” Alternatively, in company A, the company's CEO believes: “we do have it for different departments, we do have it for at corporate level for different departments, for example, HR… .” They also have some degree of flexibility in teams which allows the individual teams and departments to measure and manage their performance in their ways: “But each department, they have their own details base of, measuring, looking at the data, on their mindset, also the level of their business acumen or experience or tech-savviness…. So, different departments have different methods for performance measurement and management.” Individual employees also have flexibility over their performance objectives and measurement methods, Marketing manager at company D believes: “…various [performance objectives] self-driven by the employees, and it varies by employees, they set their objectives. And then we meet every quarter to review them and have conversations about them.”

Companies manage performance in different teams and departments based on annual and quarterly reports and appraisals. “Each department brings their own annual operational planning department on operational based on the goal, there's a format template, we have two pages, in order to look at, each of them needs to have two, three or four goals, each department, let's say marketing, each of the goal has two sets of information.” Company A’s CEO says.

4.4.2.2.2 PMS design

Companies consider different factors in designing the PMS. CEO at company C says: "[In designing the PMS] we have to consider a technical factor, we have to consider capability factor, we have to consider individual factors." Co-founder at company B also believes that the health and overall performance of the companies are essential factors in designing the PMS: "we measure what's important, and what is an indicator of our overall health as an organization."

Some companies also set goals and objectives using the SMART methodology. The marketing manager at company A states: "A smart goals are definitely how we frame it. …. A good way to do it, is to make goals like Specific, Measurable, Attainable, Realistic, and timely."

The design validation is usually accomplished in reaching the previous goals. Co-founder at company B believes: "…the validation is probably more in the accomplishments that we have in the previous year." Other companies see it as accomplishing the delivery to clients. The marketing manager at company A says: "…everything that we do is for clients. So, the utilization is within the context of delivering client work. profitability is within the context of delivering client work.", and they evaluate and validate their performance measurement and management system by measuring how well they delivered the service or product to the clients, "Individual Performance Measures, client interaction, relationship management, project management are all things that we evaluate individuals on."

Some companies use peer and manager reviews to validate their KPIs and the overall PMS. CEO at company E states: "When we create the KPIs, they are typically peer-reviewed, as well as manager reviewed, and as a leadership team, we'll all agree on them."

4.4.2.2.3 PMS execution process

Performance management execution is usually limited in the companies. Smaller companies such as company F usually manage their performance by measuring the teams' achievements against defined timelines. CTO at company F says: "So we also track the timelines, which can be converted to performance, let's say for the for the development team or for the sales and marketing team." Company G has another simple method to measure and manage performance. CEO at company G says: "We are looking actually on output, what we will have physically. [the output is] better prototype which is working functionally."

Larger companies have more complex metrics. CEO at company A says: "I'm looking is the number of Qualified Leads, Marketing Qualified Leads (MQL)." Furthermore, they usually follow a more balanced measurement routine such as MBO.

Performance measurement in company D is more decentralized; the planning and execution are done in collaboration with employees and individual teams. Marketing manager at company D says: "we'll come up with the priorities for us as a team and this is, we have a one-day planning meeting. Moreover, aside from that, we'll look back, and we'll look ahead, and we'll probably use

Miro, a collaboration tool to kind of go through, have a conversation about it, and then normally might have the practice lead."

Company C has a different routine for performance measurement and management. They usually measure the budget as a sign of the performance health of the company. Cofounder at company C says: "… in terms of what we need before the end of the month, practically the day before the last the last day of the month [we review the budget and give feedback]". They also follow a different routine for project performance health measurement and management. They say: "So we do the Gantt. However, when we split [large projects] in macro numbers, let's say the deliverable. As much that we are advancing closer to the production, we split it not more [granular] deliverables…." This company also reports to bank and investment companies daily. "So being the things related to the analysis of a balance sheet income, income statement, everything you need to have in your business plan should be ready every day. Our business plan is always ready to be in a 24- or 48-hour period, linked with just in time balancing [to be sent to investment company]… every end of the week, every first day or last day of the month, we're in a position to give everything that we have linked to the performance, to the bank….Every day, we put in place a 90-day cash flow that is integrated with the payroll and all the projects."

Companies are also measuring performance in different frequencies. CTO at company F says: "[we measure codes performance] at the end of each day, we have multiple releases. Sometimes it's weekly and sometimes, for big features, is a master release."

KPI definition is also an important activity in performance management execution. Some companies use sophisticated methods and KPIs such as Marketing Qualified Leads (MQL), "KPIs are related to marketing qualified leads, then we have websites being an important part of, of marketing work, and lead generation, we have KPIs that are associated with a website performance.", says marketing manager at company A. They continue: "So the speed, also number of visitors, percentage of organic visitors who come to the website, then on the other side, related to the marketing, qualified leads who come through organic sources, we follow keywords and their performance or our keywords and their performance in terms of ranking. Regarding search engine optimization." PMS systems can be very complex in companies. The company's CEO says: "Yeah, probably [we have] more than 100 KPIs."

Tracking revenue and profitability are an important KPI. Co-founder at company B says: "All of it is about profitability. So, our official KPIs that we track and measure for our utilization. So, we're looking for a target utilization rate of 70% for our consultants' margin…. Of course, we also track things like inbound leads into the sales funnel and the number of inbound leads; we have some social media type KPIs that we track from our engagement in our marketing efforts. That's just to see if we're getting value for money on what we spend in marketing."

Some departments also have specific KPIs. The marketing manager at company A says: "KPIs [in my department] are more around customer satisfaction and employee satisfaction."

Companies usually don't follow a systematic methodology to define KPIs and measure the performance of the company or departments. CEO at company C says: "So, again, we don't have any performance measurement and management system in place." CTO at the same company says:

“To be honest, we don't have any official writing or official way of writing the measures on the performance and things like that.” Companies such as company F also don’t measure performance since they believe they are in the process of prototyping and do not have any revenue stream to measure.

Company C plans to develop a systematic way and implement a dashboard to measure and manage its performance. CEO at company C says: “we don’t have [A systematic PMS], but it is in our goal to have this kind of dashboard to measure what we do….” Company E also has a very simplistic approach and uses Microsoft Excel. CEO at company E says: “We don't. we usually measure, well, by Excel…” Company B also does not follow a standard methodology. Co-founder at company B says: “No, not a formal process for validating the measures. Myself and my partners, we have 20 plus years of consulting experience. Thus, over those decades, there has been a lot of trial and error.”

4.4.2.3 Control

The control a priori theme includes monitoring, reviewing, and controlling the company's performance by giving feedback and managing the teams or individual performance by the managers and leaders.

4.4.2.3.1 PMS monitoring and review

The performance control process usually starts with reviewing the previous period’s performance. CEO at company A says: “So to see [the performance] based on the information we have, some of the past KPI we are collecting, [such as] market experience, customer, we seek the kind of feedback with all those metrics, to revisit the last year strategic goals, and also to see what would be determined collectively with all leadership team and my executive team to identify, determine, what would be the three or four or maybe sometimes five top strategic goals of the company.” The CEO also monitor around 20 essential KPIs daily basis, “maybe [daily] I'm looking at 20 KPIs.” CEO at Company F also states that they follow a daily routine of reviewing the metrics, “We have access to the [codes evaluation] tool. I'm the one who reviews the overall performance and decides about that.”

Company A has a decentralized mechanism of performance review. In this company, leaders and employees have a voice over the company's performance, departments, and individual employees. The marketing manager at company A believes: “ we do [performance review and feedback]. The process is such that we do mediations and [...], quarterly and annual. And the process has two sides. [First] the manager does the evaluation, and the direct reports do theirs. And then they have an opportunity to meet to discuss and say if the employee has, if there is no agreement between the two, there is a way to document that…. Also, employees share their opinions on the tools we’re using…. So, after our first annual review, we had on top of providing feedback in writing, we had a meeting.” Company D has a similar mechanism of participating the employees in the

performance review process. Marketing manager at company D says: “Yeah, so one of our initiatives was around that employee pulse survey to try and get data [about the performance] on an ongoing basis just to understand how people are faring…. they give us feedback as a part of the process, itself.” Company F has a review routine and feedback as well. CTO at company F says: “We all have our one-on-one meeting every month, but we have some performance feedback at the end of each year. We review what they have done. We are getting some feedback from them and see where we can get better.”

4.4.2.3.2 PMS management

In the companies that participated in this study, the CEO has an essential role in performance management. CEO at company A says: “So when I go every day in the office, …I have maybe ten tabs open on my three screens. Most of them are kind of looking at the KPI early morning. For marketing, the most important KPI I'm looking for is several Qualified Leads, Marketing Qualified Leads (MQL).” Co-founder at company B also states that: “[We do] all sorts of strategic and tactical decisions [based on performance measurement] actually. What we want to be as an organization, which verticals we should be operating in, which sectors we should be targeting with our business development, dollars, and time.”

Companies also make strategic decisions based on performance measurement. CEO a company E says: “We usually, we do a kind of the analysis will won't be like, how to improve the I would say the profit of the project or the how-to reduce certain expenses and how to get next time more accurate on certain evaluation that we did not really teach at the beginning. And then we can just postpone it and the next project.”

To a certain extent, employees also have flexibility and freedom on what personal objectives they pick and how to achieve them. The marketing manager at company D says: “Well, ultimately, it's the employees’ decisions about how they're going to drive their own self-growth and achieving their objectives.”

There is also a mechanism for reaching a consensus about the strategic decision related to the company's performance. Co-founder at company B says: “Generally, so there's three of us. So, there's no; there's no chance of a tie. So, there is the debate, and then we generally come to a consensus; I cannot think of a situation where we've been deadlocked, or each of us had our preferences.”

4.4.2.4 Problem Context

The “problem context” a priori themes are related to the context and background of the problem in the cases. What is their business intelligence environment? What is the PMS context? How is business intelligence integrated with the PMS? Moreover, what are the overall characteristics of the participated SMEs?

4.4.2.4.1 Business Intelligence

Some companies don't have the BI capabilities and infrastructure in place. CEO at company C believes: "So now in our team, we don't have the capability to build this kind of system [BI].", but they have the plan to develop or implement a BI system in future. They continue: "… it is a various routing system to establish a [BI] dashboard. So, it is our target to have a KPI dashboard. With Tableau, it is straightforward." And some of them only use traditional approaches. CEO at company E says: "Well, I would say the other tools there is like the actual paper and reports that we made on every project…. the accounting software that we have, it's probably the only tool that we really use; to follow data."

The level of BI implementation and infrastructure varies between the companies. Some of them are using a very simple and focused BI. Marketing manager at company D says: "… in terms of what we use internally, we're pretty much driven by just Google Sheets, and analyzing data that gets pulled out of different systems that we have across the company, whether it's our financial tracking tool system or the system that we use to track time for employees." Company G uses tools only for tracking the money and investment. They say: "it's not a deep analysis, and we don't really want deep analysis, but it's like, how much money we get? Moreover, what are the sources from that we get this money…. So, this is the financial part that we're using Excel and QuickBooks, only to put the upload the invoices to make sure that we're tracking in case of receiving audit from the government."

Companies are using different tools and techniques to gather data and business insights. The marketing manager at company A says: "on the highest level some tools that we use are Hub-Spot and Google Analytics, and Google Ads as well. So, we are very analytical in general and our founders and, me personally, so we measure everything, and some data insights come from these measurements." Each department in company A has its toolset. They add: "… SEMrush comes to mind is one of them and then going further out to you, of course, we have QuickBooks, and on the accounting side we have a full fishbowl a slew of other tools as well. On the sales side, we have several tools. We are using ZoomInfo and LinkedIn Navigator …. then on the process, Microsoft Suite is what we used for communication on SharePoint." CEO at company F says: "… we do not have any, like a customized [BI] except the CRM that we use for the BI…. that's only for the marketing and sales."

CEOs and managers are responsible for monitoring the use of BI applications and tools in the companies. Marketing manager at company A says: "I mean ultimately again because we're so small, I would say the CEO and CTO [are responsible], the two founders they probably have the biggest view of the most the high-level view of all the tools and business intelligence tools.", they also have a routine to use and monitor the KPIs in BI tools, "at Wednesday nights, I produce my weekly updates based on the input I get from my managers. And this is my most cherished part of the week. This is where I look at the numbers and they see how we do statically this week on all our KPIs."

Data comes from various sources. Co-founder at company B says: “So the inbound stuff, of course, we get automatically from observable user data, [for example] how many people click on link or comment. In terms of tracking profitability, we need our employees to log their tasks, their time spent on task accurately, ... And then the rest, the financial stuff is generated automatically from our invoicing and our payments. Half of it is manual; half is automatically generated.” Company A collects data from sensors installed on the client’s devices. CEO at company A says: “[Data comes] from the cloud. [We have] several sensors installed, in client’s devices, whether, the customers are using appropriately, or the failure of sensors, we collect the data remotely.”

4.4.2.4.2 PMS context

The size of the companies is the most crucial factor influencing the level of PMS implementation and its characteristics. CEO at Company F believes that the company's size and age make it harder to plan for the performance: “… so, the company is small, right. We're eight people, and we started a year ago as two people. Thus, the planning is very vague and is very basic.” CEO at company C has the same point: “… because the overall KPI is tied to other factors within the start-up environment [it’s tough to execute it] …. there is no system in place for us. We just use whatever is available.”

Company C’s challenge is that its PMS is overly tied to employees. CEO at company C believes: “… sometimes the most important thing on this [PMS failure] is the human factor.”

Another critical challenge is the lack of a systematic approach to performance measurement and management in SMEs. CEO at company B believes that the challenge with the current system is that the metrics are not representative of the performance: “… there is always the question of, are the things that we are measuring truly, Representative? Are they representative of the organization's and individuals' overall health and performance? So, there is this aspect of validity? Where we are making money, we're not going broke, but are we making as much money as we should? Are we being efficient? are we growing? So those types of things are, it's a little frustrating because it is not as empirical as one would, one would assume.” Company F's CEO believes they don’t have a systematic PMS: “So generally, we don't have any defined performance measure system in the company. We have some kind of goals and target sets. However, it's not something systematically built-in yet….” their PMS is more around the projects in a product, marketing and sales department, “what we have is project management within the different departments, especially with the product and also the marketing and sales.”, and they implement based on their needs, “We just use whatever is available.

Furthermore, maybe the data is not perfect. However, based on our size, revenue and volume of the business that we have, it is just good enough.” Another challenge is the lack of PMS responsible role in the company. CEO of company A believes: “there is a need for a business analyst or somebody to take care of the KPI of company. We do not have that person.”, or marketing manager at company D says: “…performance is self-driven by the employees, and it varies by employees,

they set their objectives. And then we meet on a quarterly basis to review them and have conversations about them."

PMS and BI are weakly integrated into companies. CEO at company B says: "I think our [PMS and BI] is kind of a merged. The KPIs and the decision-making tools are merged together.", but they understand the importance of such integrated systems. CEO at company C says: "… it's important to have an integrated system to have the same information in one place is very important."

Companies use tools designed for various performance measurement purposes: "So bamboo HR that we actually use for HR management, and for the performance of people management is really not meant to be for that.", a marketing manager at company D states. Company B also has a manual process of extracting data from BI tools and using it for performance measurement and management, "Basically, we must be able to track everything with as little manual input as possible. So back-end integrations into the tools we use to deliver the work."

4.4.2.4.3 PMS-BI integration

The complexity and time requirements for an integrated approach challenge SMEs. The marketing manager at company B says: "I'm familiar both with Qlik and Klipfolio. Yes, but as you're probably aware, both seem better suited to larger organizations and have a more formalized structure. Moreover, for smaller organizations with a less formalized structure, I think they are less useful. And sometimes, the time it takes to configure the systems properly isn't worth it, or you don't have that extra time [to configure it]."

CEO at company B believes that this integrated PMS system is an opportunity for SMEs, "If you're successful with what you're describing, the opportunity means that small companies can have the advantage that large companies have. A large organization has an entire department dedicated to data analytics, business intelligence, and data science; small organizations don't have those resources. Moreover, it allows smaller organizations to be more effective and objective in their decision-making by giving them actionable data. So, what we rely on our intuition and guesswork, and our approximation, as a small organization, could become a lot cleaner and more reliable." They believe tool provider companies need help and guidance to implement these integrated systems: "But Klipfolio doesn't know how to do that. Maybe they need some help from other people. They create the tools but don't have the guidelines and processes to help companies do that."

The cost of acquisition and maintenance of the integrated BI software is another critical challenge for SMEs. CEO at company A says: "if you want to do that [performance measurement], you probably need a good budget. It is very costly. … I think that all you need [for integration] is to switch to an ERP solution, like NetSuite or SAP basic… but I heard from other companies that it's very costly. … initial cost is not too much. You can get the license, but the maintenance cost is very high."

4.4.2.4.4 SME context

The SME characteristics make integrating the PMS systems typically designed and tuned for the larger organizations challenging. CEO at Company F believes that they have to do multiple jobs, “So we as a startup, because of our size, we do different jobs, even as a CEO, you have to help with the sales and marketing. And sometimes you have to do jobs related to product and also do customer support, but generally, whatever under CEO description is my main responsibilities.”

Another essential characteristic of the SME is its continuous change. This change makes it challenging to adopt or implement a PMS system. CTO at company F says: “So it is just a kind of [challenge], because of the startup mode, things change fast…. We can not spend much time building the system you mentioned [PMS-BI]. And I think that is the reason it must be agile and nimble in the company in startup mode.”, Marketing manager at company C has the same opinion, “To be honest [we do not use integrated PMS-BI], because things are getting changed a lot…. we're kind of revising our business plan, revising our products, our offering. …”

Due to the complexity of the PMS systems, company B sometimes uses traditional approaches to measure and manage performance. CEO at company B says: “… for a start-up, it's fine to do it on paper, if you will, because of the organization's size, and the level of complexity in terms of career management, progression, goal setting, etc.”

Company B also relies on external help. CEO at company B says: “… the other challenge with smaller companies is, in many situations, you rely on third-party expertise.”

On the other hand, the CEO at company F believes that when you grow your team, you may have communication challenges: “I think [another challenge] is this size of the company. Once you get bigger, it's more difficult to manage and track the performances, versus that you have a smaller team that you can have day to day communication with almost all the team members.”

4.4.3 Comparing PMS in Companies

PMS in companies varied in patterns and characteristics. The template analysis helped me extract these patterns and prepare a comparison table (see Table 4-1: Comparing PMS in the cases) to compare the PMS in the cases.

This comparison helped us to acquire a better understanding of the context. This table contains the “company pseudo-name,” PMS sub-systems, and SME context.

Table 4-1: Comparing PMS in the cases

Company	Plan	Execute	Control	Context
A	Planning is systematic. MBO	This company has a balanced PMS.	The control process is done	The company is a medium-sized,

	process is used to guide the planning for performance management. The company has pre-annual, annual, and quarterly planning sessions. The CEO is responsible for reviewing the annual performance reports. Each department should prepare the report for the previous session and set objectives for the upcoming session.	KPIs are defined based on the overall and departmental objectives. The company has more than 100 KPIs. CEO directly monitors a few important KPIs daily and gives feedback to managers.	mainly by reviewing the periodical reports and setting new objectives. Employees also have their growth goals set by themselves and reviewed by managers.	technology-based, fast-growing one in a medium technology industry. They have high IT and BI knowledge and are passionate about PMS and BI integration.
B	Planning is more about the utilization of the consultation contract. Three co-founders reach to consensus about the plans. They usually plan based on their own previous experience.	The PMS is not balanced. Metrics and KPIs are mainly about the utilization of consultation contracts. They usually use traditional PMS on Excel. Data was gathered from BI tools manually and used to measure the metrics. The process is unofficial and unstructured.	The control is limited to the projects and consultation contracts. The routine for control starts from reviewing the contracts' metrics and setting targets for the contracts' utilization.	The company is very young and small. They are in the consultation industry. Founders have extensive experience in the field and good knowledge about BI and IT, but PMS-BI implementation is minimal. They do the analysis manually.
C	The planning is unofficial and mainly about the company's budgeting and financial health. The CEO is responsible for the planning. The co-	The execution is mainly about budgeting. Accounting software is the primary tool to measure the organization's financial health and	They control the projects by only financial metrics. They do not have a specific routine for control.	The company is young and small in a very high-tech industry. Their knowledge of IT and BI is good, and the founders have previous experience in the

	founders have previous experience in the industry and pick the KPIs based on their knowledge.	performance. Their PMS is unbalanced.		manufacturing industry. They also have a plan to introduce a PMS-BI system in future.
D	Planning is mainly done in the annual and quarterly performance meetings. External facilitators guide the performance planning, and managers are directly involved with the process. This company has a great emphasis on decentralizing performance planning. Employees are also involved in the process partially.	The performance execution is team-based. They have the flexibility to set personal objectives and set metrics and KPIs to measure them. Managers also have the flexibility to set the team-wise KPIs.	Managers usually control their team's performance by having weekly meetings. They use informal control processes, and each team has the flexibility to define its procedure and routine.	The company is a medium-sized high-tech company. They are mature and have had outstanding growth recently. They are familiar with the BI tools and use them in different teams. However, they do not have an integrated PMS-BI system in place.
E	The CEO and top managers usually do the planning. They do not have a specific, official planning routine for the performance.	The PMS is unbalanced and mainly measures and manages the company's budgeting and financial performance. They use simple tools such as Excel and accounting software to collect and analyze data.	The performance control is done mainly by the CEO and is centralized.	The company is a medium-tech and medium-size company in a low-tech industry. It is a very mature organization that primarily relies on traditional methods and tools to gather and analyze data. Their knowledge about BI is minimal.
F	Planning is more about the projects. They have an unofficial routine for performance planning. CEO and	The PMS is not balanced but measures HR, sales, and product-related metrics. The BI is used in a limited	The control process is unofficial. The CEO and CTO are responsible for the company's	The company is a high-tech company in a high-tech industry. The company's size is minimal, and they

	CTO are primarily responsible for performance planning.	fashion for performance measurement and management. They also do not have a specific KPI definition and system design procedure.	performance and usually give feedback during one-on-one meetings with the employees.	are a young company providing an innovative product. Although they are familiar with the BI and IT technologies, they have not implemented any PMS-BI in their company.
G	The planning considers the quality and performance of the prototype. It is almost unofficial and limited to a few departments.	Execution of the PMS is limited to the metrics related to the quality of their prototype.	They only control the quality of the product and their budgeting.	The company is a very young and small start-up working in the early stages of an innovative product. Founders have subject matter experience and knowledge, but they lack knowledge about the BI and PMS-BI integration. The company is more involved in the engineering of the prototype.

Companies show a spectrum of PMS and BI adoption and applications. I found out that medium-sized companies (A, D) tend to have a more systematic and balanced approach to performance measurement and management. In contrast, smaller companies (B, C, F) usually do the performance measurement and management on an ad-hoc basis. The relationship between the size of the company and the structure of implemented PMS and its application is investigated in the literature (i.e., Hudson, Smart, et al., 2001; Neely, 2005; Rojas-Lema et al., 2020). In medium-sized companies (A, D), the performance management and decision-making process based on performance measurement rely on the system in contrast to the small companies in which the CEO is responsible for the performance metrics definition and interpretation; thus, the judgment and the control is more objective. In company A, for instance, the CEO is only responsible for the annual performance review and is not directly involved in the departments and individual performance planning and control. This pattern is observed in company D, as well. They have decentralized their performance planning by allowing teams and departments to define and execute their

performance metrics and KPIs. In smaller companies, executives primarily use their judgement to support decisions; this decision-making does not use empirical data or employee participation in establishing organizational goals, as Na-Nan (2017) argued.

The company's size also determines the quantity and quality of the PMS-BI tools and training a company can acquire. Molodchik (2016) indicated that the company's size moderates the relationship between different intangible resources and companies. They argued that there is a meaningful difference in the employment of the six types of intangible resources: human resources, management resources capabilities, innovation and internal process capabilities, customer loyalty and networking capabilities. From these six resources, my analysis showed that company A and company D (medium-sized companies) acquired and used human resources (more knowledgeable and resourceful human resources in both companies). Also, there is a meaningful difference with other companies regarding the innovation and internal process capabilities (MBO as a PMS process in company A).

The second pattern observed is that companies in the high and medium-tech industries (A, B, C, D, F, G) are more knowledgeable about performance measurement and management and BI's applications in this field. This pattern is also discussed in the literature (i.e., De Gooijer, 2000; Ho, 2009; Navarro & Moya, 2005). The size of the company and the human resource's knowledge about the PMs and BI can be considered an SME background. In this sense, Na-Nan (2017) argued that the SME background factors such as the number of employees, years of existence, business fields, industrial Groups, and HR management are highly correlated with performance management existence in an SME.

The third observed PMS characteristic difference in the companies is that companies in high-tech industries (A, D, F, G) are more likely to use BI technologies in their PMS execution and control processes. These companies are aware of the BI applicability in the performance measurement and acquired some BI tools such as dashboards (A, F) for these purposes. The literature also provided evidence of the relationship between the industry's technology level and the BI implementation success in companies (Liang & Liu, 2018; C M Olszak, 2015; Celina M Olszak, 2016).

4.5 Identified Problems and Solutions in Literature

This section extracts critical problems with the current PMS in the selected SMEs from the transcripts. These pain points are observed by participants in the process of PMS-BI implementation and use in their companies. Although this list does not represent all the problems and issues with the PMS in SMEs, it provides me with the key areas to focus on when designing the PMS-BI artifact.

This section presents a table of the problems and gaps in the current PMS in participated cases. This table has briefly defined the problem and solutions provided. The problems and solutions are explained in the following paragraphs.

Table 4-2: Identified problems, their description and the solution provided in the literature

Problem	**Description**	**The solution provided in the literature**
Lack of effective communications	SMEs have communication problems regarding the strategies, PMS procedures, and results.	Communicate using the reporting and documentation (Na-Nan et al., 2017; Piva et al., 2009; Sardi et al., 2020) Communicate utilizing information and communication technologies (Berry et al., 2009; Hackler & Saxton, 2007; Richards et al., 2019; Sardi et al., 2020)
The complexity of the PMS	Current PMSs are complex, and SMEs lack the resources to implement them.	Use PMS models specifically designed for SMEs (Ates et al., 2013; Garengo et al., 2005) Reduce the social and technical complexity of PMS (Okwir et al., 2018; M. Smith & Bititci, 2017)
Limited budget	Current PMSs are expensive, and SMEs lack financial resources.	Use PMS models specifically designed for SMEs (Ates et al., 2013; Garengo et al., 2005) Use cloud-based PMS (Gupta et al., 2018)
Change management in SMEs	SMEs are changing rapidly, and rigid classic PMSs are not sufficiently quick in change. These changes cause instability in the organization and challenge the new process introduction.	Use innovation management strategies and change management planning techniques (Bakås et al., 2011; Havlicek et al., 2013; McAdam et al., 2000)
Unbalanced PMS	PMSs in SMEs are usually implemented unbalanced.	Use a balanced PMS designed for SMEs (Garengo et al., 2005; Hudson,

		Lean, et al., 2001; Manville, 2007; M. H. Smith & Smith, 2007)
Lack of experience and knowledge related to PMS	SMEs usually lack the necessary knowledge and experience in PMS design and development.	Use knowledge sharing approaches and methodologies in SMEs (Bagnoli & Vedovato, 2014; Ngah & Jusoff, 2009; Staplehurst & Ragsdell, 2010)

4.5.1 Lack of Effective Communication

Interviews with participants showed that communicating the information about the PMS and strategies is one of the most critical problems in SMEs. Communicating the performance objectives and goals horizontally between the teams and vertically between different levels is usually lacking in the participating SMEs. In SMEs, communication provides employees immediate feedback on the outcomes of actions, representing the processes used to implement the business strategy and the information needed for strategy validation (Goshu & Kitaw, 2017; Ittner & Larcker, 2005; Sardi et al., 2020). Because of the benefits of PMS communication in SMEs, Ates (2013) discussed that internal and external communication is one of the recommended areas for improvement in SMEs regarding their PMS.

One of the approaches to fostering communication in SMEs is using formal and informal performance reports (Na-Nan et al., 2017; Piva et al., 2009; Pock et al., 2004). Sardi (2020) states that two success factors in SMEs' performance management maturity are related to reporting communication. These two factors provide real-time analysis and reports and promote self-monitoring of activity reports (Sardi et al., 2020). They recommended using automated procedures to be accessed by all management functions and selected staff. This information should be available in real-time through internal software. Sardi (2020) recommended visual reports that primarily benefit senior staff and staff with limited technological fluency to provide better results.

Modern information technology and specifically designed software are complementary tools that provide flexible and adaptable communication environments (Berry et al., 2009; Sardi et al., 2020). In this sense, modern BI and BA tools provide communication tools and software in which employees and leaders can communicate with lower ambiguity and higher accuracy (Richards et al., 2019). Therefore, two systematic solutions in the literature to mitigate SME communication problems are using reports and applying BI and BA tools and software.

4.5.2 The complexity of the PMS

Interviewed participants complained about the complexity of PMS and believed that one of the reasons that hinder the implementation of PMS in their company is its complexity. This issue is observed to be a more serious problem for smaller companies. Okwir (2018) states that the process of improving performance management systems is impeded by complexity. Complexity is a mismatch between existing organizational practises and procedures and the organizational controls associated with PMSs (Okwir et al., 2018).

Based on Smith and Bititci's (2017) framework that proposed two types of complexity, which are social complexity and technical complexity, Okwir (2018) identifies six sources of complexity and grouped them into these two types (see Table 4-3: Complexity types and dimensions (Okwir et al., 2018)).

Table 4-3: Complexity types and dimensions (Okwir et al., 2018)

Social Complexity	Technical Complexity
Role complexity	Methodological complexity
Task complexity	Analytical complexity
Procedural complexity	Technological complexity

4.5.2.1 Social Complexity

Social complexity is associated with leadership, hierarchical structures, empowerment, trust, motivation at work, employee behaviour, training, skills, trust and culture (Okwir et al., 2018; M. Smith & Bititci, 2017). These factors are linked to organizational social control and are usually impacted by behavioural factors (Elzinga et al., 2009).

Role complexity

Organizations built based on hierarchical relations with a clear flow of authority allow their members to achieve business success and objectives (Rizzo et al., 1970). In democratic organizations, introducing a PMS will create conflicts and ambiguity regarding the roles and responsibilities (Okwir et al., 2018). This role complexity can be managed in an organization by controlling behavioural factors such as empowerment, autonomy, trust, communication, and training (Jackson & Schuler, 1985; Rizzo et al., 1970).

Task complexity

Introducing a new PMS to an organization often causes substantial ambiguity and conflict, leading to task complexity (Adler, 2011; Broadbent & Laughlin, 2009). Okwir (2018) states that task complexity emerges from a lack of task clarity and inter-relationships and conflicts; hence, mature social controls associated with task complexity must also be addressed.

Procedural complexity

When a new socio-technical artifact such as PMS introduces into the company, ambiguity and conflict will be initiated (Okwir et al., 2018). When there is a change in the routine, procedural complexity arises due to a lack of information about priorities or the course of action. This complexity arises when new procedures and implications are not conveyed to employees (Franco-Santos & Otley, 2018; Okwir et al., 2018).

4.5.2.2 Technical Complexity

Based on the classification of PMS complexity by Okwir (2018), the second theme in PMS complexity is technical complexity. This theme is related to frameworks or models, information systems, data gathering methods, analysis, and visual communication associated with a PMS. This theme consists of methodological, analytical, and technological complexity.

Methodological complexity

The difficulty was selecting the type of key performance indicators (KPIs) and their calculations. The number of KPIs to be used is often attributed to a conflict between an approach to choosing measures (such as quantitative vs. qualitative) and the difficulty of selecting the type of KPIs and their calculations. The number of KPIs to be used (Okwir et al., 2018). Franco-Santos (2007) and Franco-Santos & Otley (2018) looked at how system dynamics and multicriteria decision analysis might improve the efficacy of picking measures throughout the design and implementation of a PMS while incorporating feedback from all stakeholders. Based on their findings, they suggest that using such techniques can help companies deal with methodological complexity.

Analytical complexity

When it comes to integrating PMSs in organizations, it can be challenging to understand each measure, how it interacts with other measures, and how it affects the overall strategy of the company. Companies frequently disrupt these connections, increasing analytical complexity (Bitici et al., 2000). As a result, organizations should employ more scientific and objective approaches for defining and implementing measurements, such as mathematical and simulation modelling, systems dynamics, cause and effect analysis, correlations, and regression (Okwir et al., 2018).

Technological complexity

The technological complexity is associated with the organizations' engagement in the digital economy and the failure to use technology appropriately in performance measurement and management (Okwir et al., 2018). Turner (2013) studied the implementation of performance measures and concluded that if the implementation is well-structured, resourced, and focused on enhancing the competence of technical controls, PMSs can improve business performance.

Thus, based on Bitici (2000); Franco-Santos (2018); Okwir (2018); Turner (2013), to mitigate social complexity in an SME, the designed PMS should improve behavioural factors by

empowering all employees, giving a higher level of autonomy, foster trust, improve the communication and train the responsible stakeholders. Furthermore, organizations should employ scientific and systematic approaches in performance measurement and management development to reduce the technical complexity.

4.5.3 Limited Budget

According to participants, limited budget in SMEs is their primary concern when implementing and using a PMS. For SMEs, financial constraints shape the firm's strategies (Makhija, 2003). In this sense, Gupta (2018) suggested that SMEs can use cloud-based Enterprise Resource Planning (ERP) software for PMS purposes.

Participants are concerned about their return from investment on the PMS. However, spending on the PMS is beneficial to the overall performance of the company, which, in turn, can increase the revenue and effectiveness of the SME (Greiling, 2006; Neely et al., 1995, 2000).

4.5.4 Change Management in the SME

Change in companies impacts all organizations irrespective of size, but (Ritchie & Brindley, 2000) discussed that change in smaller companies has a more intense effect on the strategies and planning. Researchers investigated the pace of change in SMEs from different perspectives. For instance, researchers in the change management field consider innovation management as the core of the change when companies are introducing new systems or implementing a new process (Breckova & Havlicek, 2013; Havlicek et al., 2013; McAdam et al., 2000). Process innovation in an SME is successful only if there is an appropriate benefit to the individual groups of the company (Havlicek et al., 2013). However, at the same time financial requirements of the company owners and other stakeholders must be respected, and the process innovation cannot endanger the company's stability (Havlicek et al., 2013; Pertuz & Pérez, 2021; Suwaidi et al., 2020).

Challenges and success factors exist for implementing a new process into an SME. Bakås (2011) listed six success factors of implementing a new process in an SME:

1- Ensure strong management involvement.
2- Develop thorough employee participation.
3- Allocate sufficient time for preparing the organization.
4- Focus on creating motivation to complete initiatives.
5- Build competence internally in the organization.
6- Establish a performance evaluation system.

The PMS artifact should consider these success factors as the designed PMS features to ensure successful change management in the SME.

4.5.5 Unbalanced PMS

Traditionally, PMS in companies was only implemented in specific areas of the business and operations, such as finance and human resources (Neely, 2005). The traditional models then evolved, and many scholars advocated for a more balanced approach to performance measurement and management (Kaplan & Norton, 1992; Neely, 2005; Neely et al., 1995). Even though balanced PMS has numerous benefits compared to unbalanced PMS, small companies usually focus on the operational and financial performance, and balanced models are rarely used (Garengo et al., 2005).

Although the balanced PMS has been successfully implemented in many large organizations, there is little evidence that it is used in SMEs (Garengo et al., 2005; Rompho, 2011; Sardi et al., 2020). Rompho (2011) states that the inadequate implementation and use of balanced PMS in SMEs do not indicate limitations specific to SMEs by nature, where a rapid response to change is necessary and inevitable. They believe that a critical cause for failure of the implementation of balanced PMS (i.e., Balanced Score Card) in SMEs is the frequent strategy changes. Frequent changes in the organization's strategy make designing and developing balanced PMS problematic since the design and implementation process is time-consuming and slow. Therefore Rompho (2011) suggested using more simplified and dynamic PMS in SMEs, which can be changed quickly and respond to the strategic changes more effectively.

4.5.6 Lack of Experience and Knowledge related to PMS

Based on my findings, lack of industry and market expertise and limited knowledge management orientations in the SMEs is another problem in limited PMS implementation and use in these organizations (Jamil & Mohamed, 2011). Although tacit knowledge exists in SMEs, and knowledge management will benefit SMEs as they are rich in knowledge but lacking in expertise, due to financial and budget limitations, knowledge management is almost impossible for SMEs (Ngah & Jusoff, 2009). SMEs have an efficient and informal communication network, but knowledge sharing tailored to their characteristics and requirements is critical for SMEs to improve competency and organizational performance (Ngah & Jusoff, 2009; Staplehurst & Ragsdell, 2010). In SMEs, communication and collaboration are critical for knowledge and experience, as well as the organization's performance goal and objective share. New technological advances in business intelligence and analytics, such as cloud dashboards and the system as a service platform, make it easier for employees to share their tacit knowledge and expertise regarding performance measurement and management and announce the objectives and goals of the company (Busi &

Bititci, 2006). These technologies make it possible to move from a performance measurement system into a performance management system in which managers not only measure the performance but, by sharing the knowledge and cooperating in the performance design and implementation with employees, manage the performance as well (Busi & Bititci, 2006; Schmitz & Platts, 2004).

Chapter 5 Artifact

5.1 Introduction and Background

Following the DSR (Design Science Research) methodology, steps 2 and 3 (Figure 5-1) are about artifact development and evaluation, respectively. This chapter explains these steps. First, I briefly explain the foundation for the artifact design. In the second part, I introduce the artifact development process by exploring the conceptualization of the artifact features from identified problems and explain the feature extraction, selection, and prioritization process. These features come from literature and interviews for the cases and highlight the critical factors to consider in the design. I sort these features, provide additional features, and prioritize them. In the fourth section, I explain the artifact components by presenting the architecture and life cycle of the PMS-BI artifact. In the last section, I discuss the artifact evaluation results and propose reflections and recommendations for future studies.

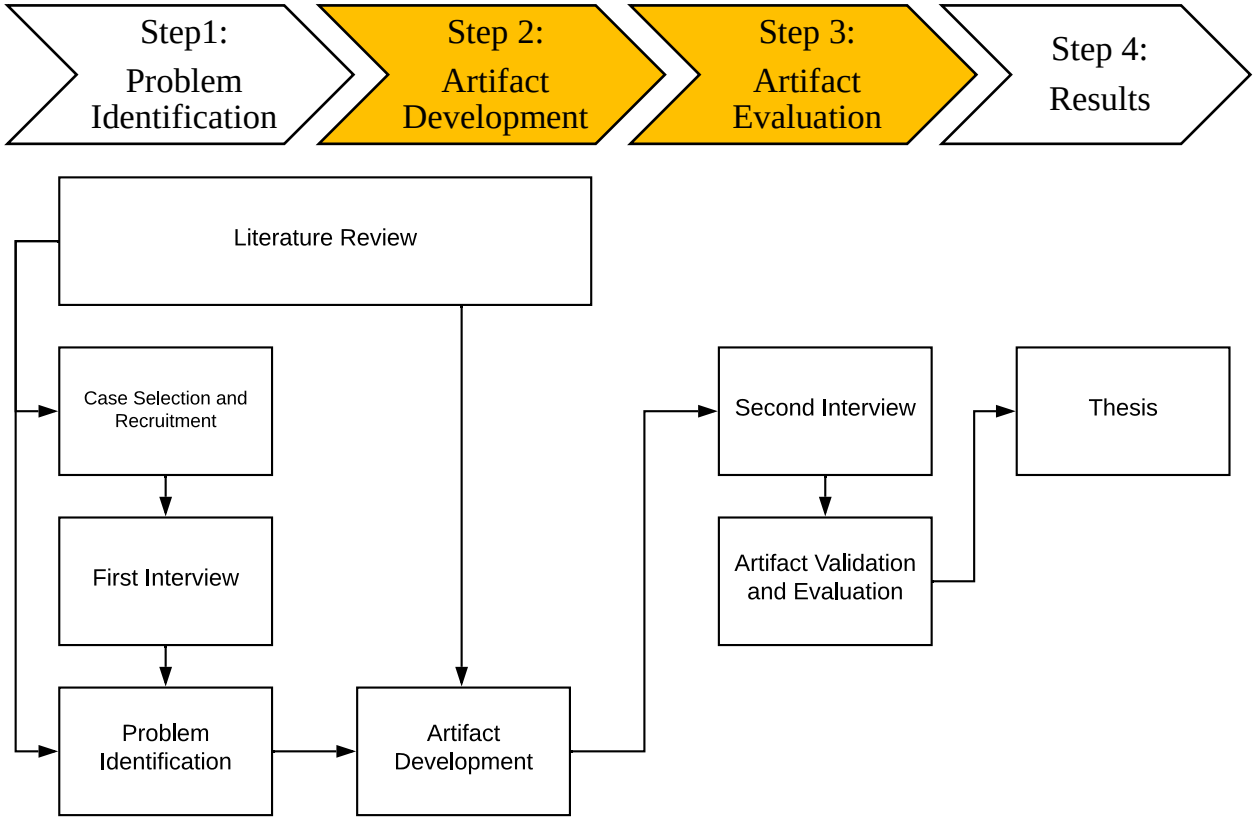


Figure 5-1: Research steps (artifact development and evaluation)

5.2 Artifact Design Foundations (DSR Methodology)

The DSR methodology guides the researchers in designing an artifact by collecting relevant ideas from literature and real-world contexts. Researchers then identify the problems and turn these ideas into design features. Eventually, researchers build the artifact and evaluate it. The knowledge accumulated from the literature review and problem identification phases is a valuable resource in the artifact development step. This step is a creative process of combining extracted features with building an artifact to solve the problem better. Hevner (2004) believes that the solution development phase is a creative problem-solving process influenced by the inputs from the problem identification and prior experience of the researcher(s).

In this study, the information collected from the literature review is reflected in the kernel theories. These theories influenced the design process and the ultimate features of the artifact. These theories also guided the theme and template development in the interview analysis process.

5.3 Artifact Development

The artifact development and evaluation is an iterative process of collecting the features, prioritizing the features, developing the architecture and system processes, and ultimately, evaluating the artifact (Dresch, Lacerda, & Antunes, 2015; A. R. Hevner, 2007). In this thesis, I designed and developed the artifact by combining the knowledge extracted from the literature and the participants' opinion and evaluated the final artifact with participants using a standard "usability questionnaire." Then I discussed the evaluation results and highlighted the artifact's aspects that need to be changed or improved. Due to the limited time, I accomplished only one DSR cycle; however, further cycles are recommended in future studies to achieve results.

5.3.1 From Identified Problems to Artifact Features

The artifact design process started with problem identification. As stated in section 3.3, the "problem" in this study considers all facts and features about PMS, BI and the company context, which influence the quality of the SME performance measurement and management practices. All companies use performance measurement and management to some extent, but the level of implementation and the characteristics of the PMS are distinct for each company (Garengo et al., 2005; Jamil & Mohamed, 2011; Sardi et al., 2020). Moreover, the general characteristics of SMEs and the unique situations in each company are among the factors I considered in the problem identification.

In Chapter 4, I analyzed and listed the companies' characteristics and compared their PMS. I used these characteristics to extract and prioritize the features of the artifact (see Figure 5-2).

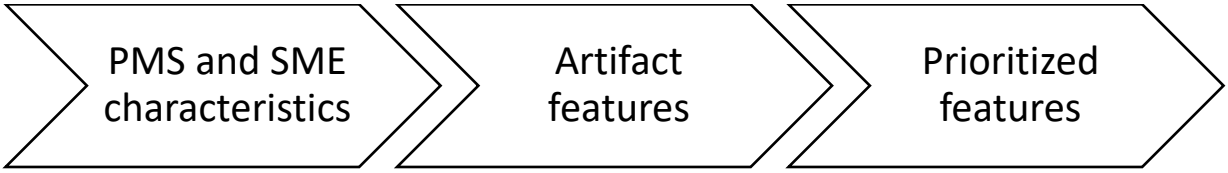


Figure 5-2: From PMS and SME characteristics to artifact features

In section 4.5, I identified problems in the participating cases and explained solutions extracted from the literature. In the following section, I connect each solution to corresponding PMS-BI features. As Hevner (2010) explained, artifact development is an innovative path from the discovered problem into artifact features and components. This conceptual translation of the solutions to PMS-BI features is influenced by my contextual experience in the BI field and following recommendations in the information system and PMS-related literature.

The first two columns in the Table 5-1 are problems and solutions provided in the literature. These columns are copied from Table 4-2. The third column is PMS-BI features.

Table 5-1: Problems, solutions, and PMS-BI features

Problem	**The solution provided in the literature**	**PMS-BI features**
Lack of effective communications	Communicate using the reporting and documentation (Na-Nan et al., 2017; Piva et al., 2009; Sardi et al., 2020) Communicate by employing information and communication technologies (Berry et al., 2009; Hackler & Saxton, 2007; Richards et al., 2019; Sardi et al., 2020)	Using a decentralized, cloud-based BI dashboard for reporting and communication (Baboo & Prabhu, 2013; Park et al., 2017; Queiroz et al., 2018).
The complexity of the PMS	Use PMS models specifically designed for SMEs (Ates et al., 2013; Garengo et al., 2005) Reduce the social and technical complexity of PMS (Okwir et al., 2018; M. Smith & Bititci, 2017)	The PMS-BI is designed with simplicity in mind. Modular PMS-BI system design (Levin, 2015)

Limited budget	Use PMS models specifically designed for SMEs (Ates et al., 2013; Garengo et al., 2005) Use cloud-based PMS (Gupta et al., 2018)	BI dashboards (Llave, 2017; Negash & Gray, 2008; Raj et al., 2016) Modular PMS-BI system design (Levin, 2015)
Change management in SMEs	Use innovation management strategies and change management planning techniques (Bakås et al., 2011; Havlicek et al., 2013; McAdam et al., 2000)	Iterative system design (Folan & Browne, 2005; Lohman et al., 2004; Nudurupati et al., 2011) System evaluation and maintenance (Lebas, 1995; Letsoalo, 2010)
Unbalanced PMS	Use a balanced PMS designed for SMEs (Garengo et al., 2005; Hudson, Lean, et al., 2001; Manville, 2007; M. H. Smith & Smith, 2007)	Artifact helps the balanced design of PMS (Bourne et al., 2000, 2003; Stivers & Joyce, 2000)
Lack of experience and knowledge related to PMS	Use knowledge sharing approaches and methodologies in SMEs (Bagnoli & Vedovato, 2014; Ngah & Jusoff, 2009; Staplehurst & Ragsdell, 2010)	Use BI-based documentation tools.

5.3.2 PMS-BI System Design Process

After extracting the features, I started designing the PMS-BI system. For this reason, I used Miro (an online drawing and designing collaborative environment) to iteratively design and discuss the structure of PMS-BI in each company. Company PMS-BI diagrams are illustrated in Figure 5-3 for company A, Figure 5-4 for company B, Figure 5-5 for company C, Figure 5-6 for company D, Figure 5-7 for company E, and Figure 5-8 for company F.

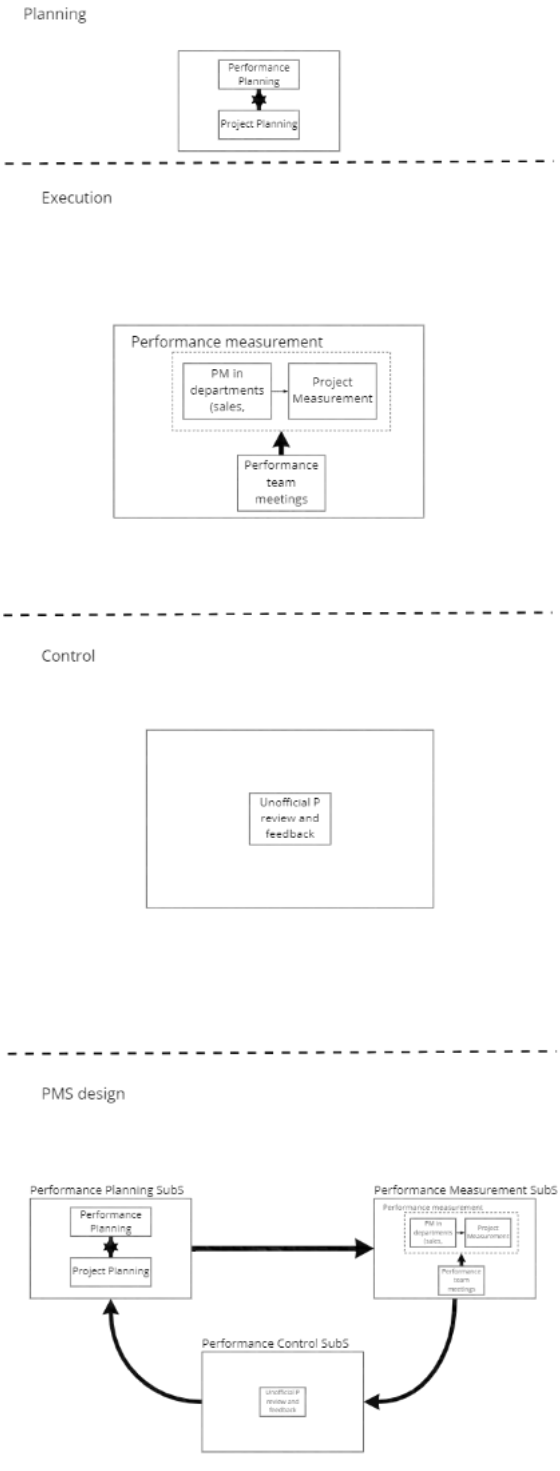
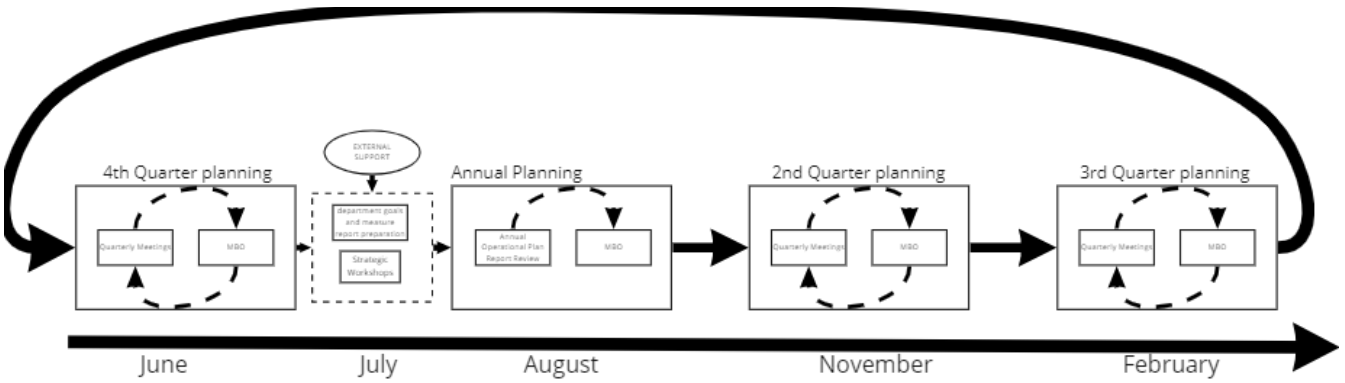


Figure 5-3: Company A PMS-BI diagram



Department Annual Operational Plan Report Preparation

D:

- longer term strategic planning strategies three to five years and beyond
- Mid-term annual and quarterly goals extracted
- Five goals and how to achieve them next year and how to measure them (KPIS)
- Collaboration between teams and work together over the common goals.

Strategic Workshops

D:

- operational two-pages action plans prepared and presented
- MBO synthesized based on quarterly goals and KPIs
- Additional KPIs extracts
- 4-5 goals for each department

P:

- get feedback from external supports (coaches, mentors)
- Revisit the strategic goals
- 5, two-hours personal workshops
- Off-site
- Each goal has two information attached to it: Targets, and activities (in KPIS) needed to reach the targets
- Dependencies (financial resources, human resources,...) analyzed
- CEO review the departments annual plan
-

MBO

Quarterly Meetings

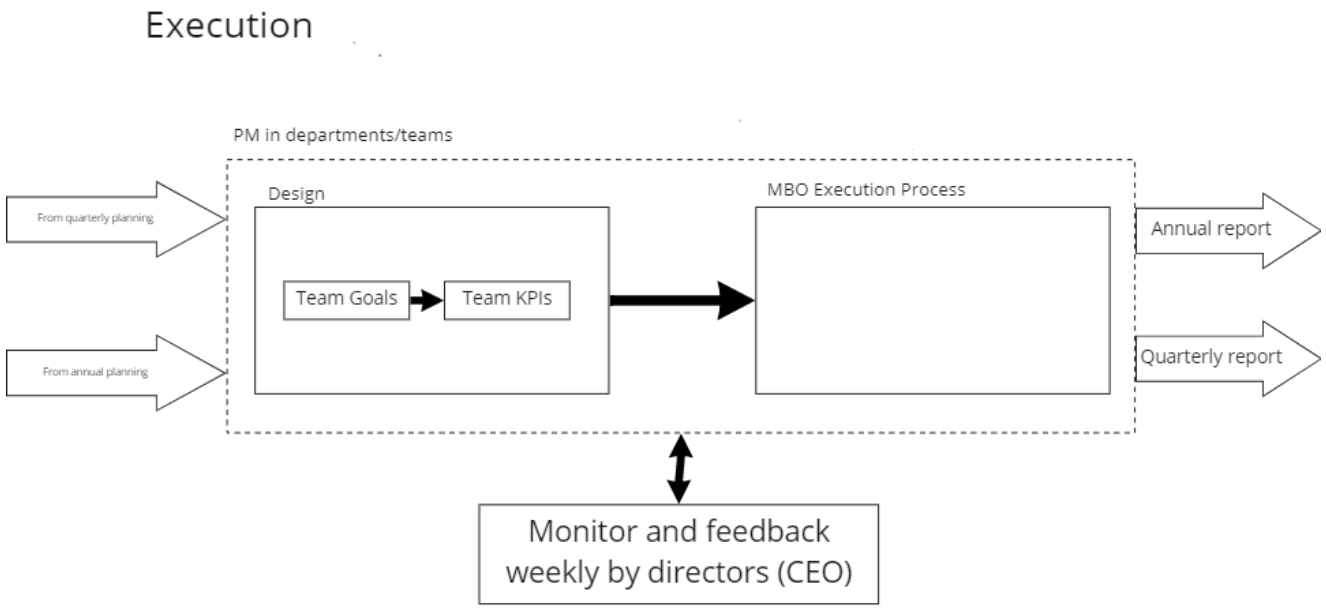
D:

- One day board meeting
- Two week after the quarterly meeting
- review quarterly goals and targets
- Adjust goals and targets
- Validate and Modify KPIs

Annual Planning

Annual Operational Plan Report Review

- Operations plan is extracted and published
- Everyone has access to the operational plan
- Financial incentives (10%-20%) is defined if goals reached
- Department heads and managers are responsible for cascading the responsibilities and individual plans



Design

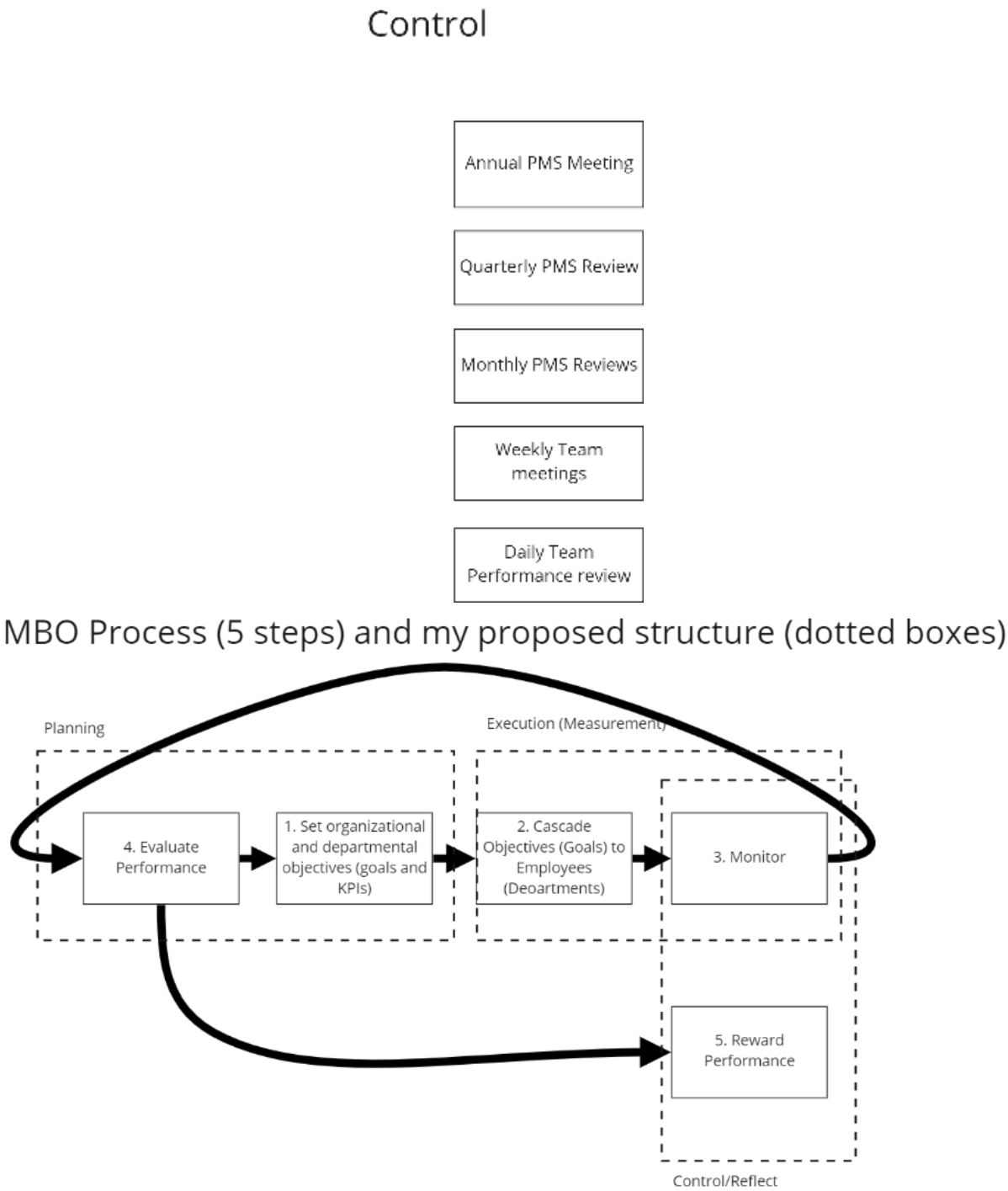
- Goals and KPIs modified from previous sessions
- Goals and KPIS are set in MBO
- MBO is defined and followed in quarterly performance planning meetings

PM in departments/teams

- Each departments use different tech stack,
- Departments have flexibility to decide which tools to use and how to measure performance
- Internal team discussions and decision making based on department strategic goals and performance targets, and corporate goals
-

MBO Execution Process

- Teams share their KPIs with directors
- Measures are not in a single dashboard


Control
Annual PMS Meeting
Quarterly PMS Review
Monthly PMS Reviews
Weekly Team meetings
Daily Team Performance review
MBO Process (5 steps) and my proposed structure (dotted boxes)
Planning
Execution (Measurement)
4. Evaluate Performance
1. Set organizational and departmental objectives (goals and KPIs)
2. Cascade Objectives (Goals) to Employees (Deoartments)
3. Monitor
5. Reward Performance
Control/Reflect

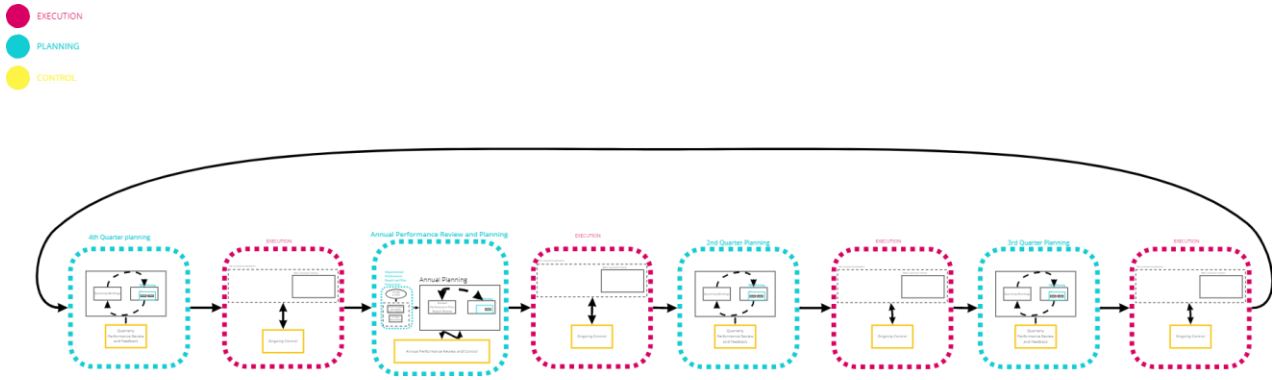
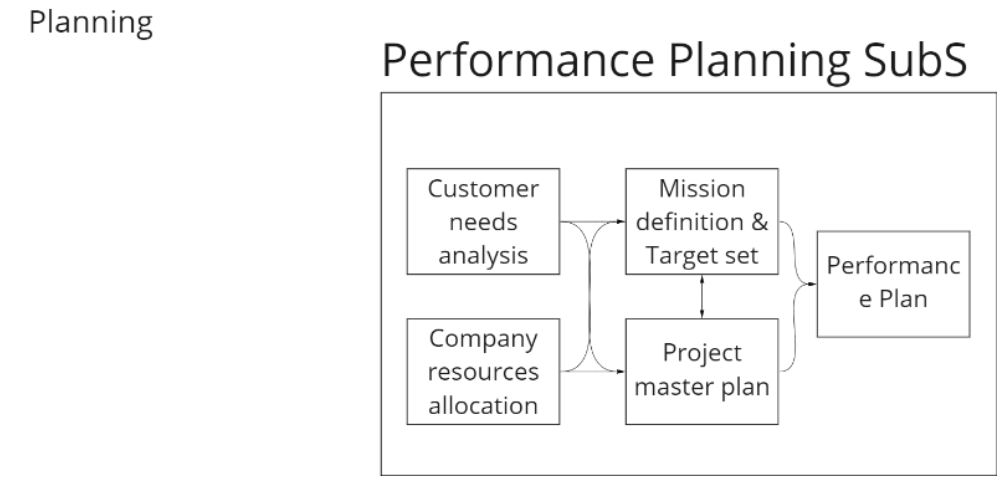
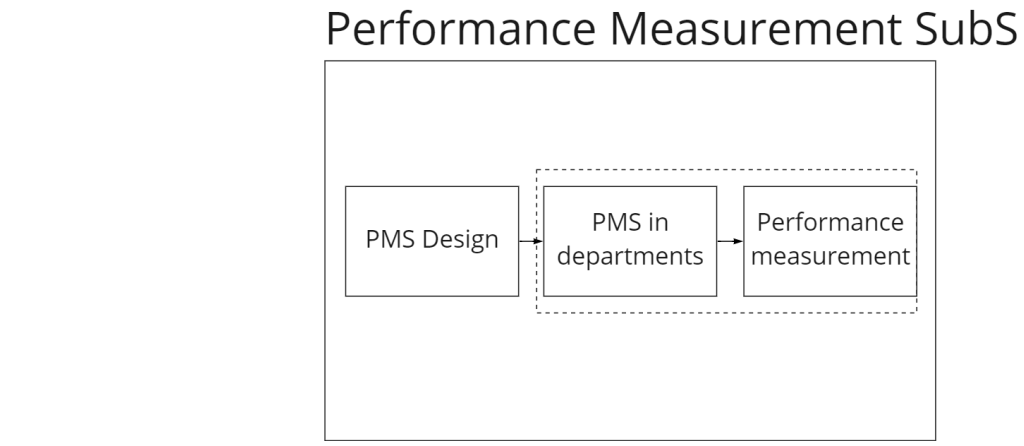


Figure 5-4: Company B's PMS-BI diagram





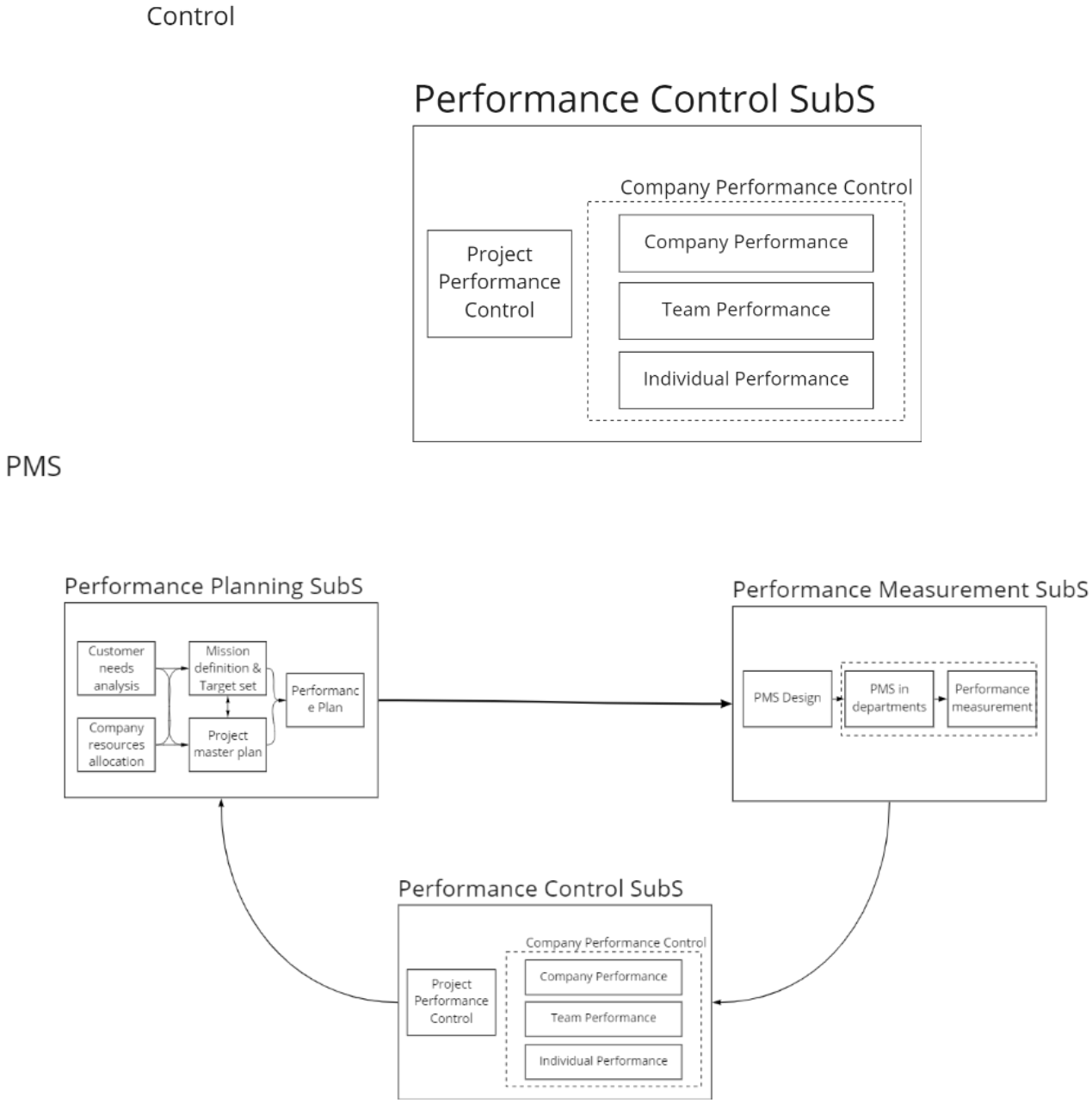
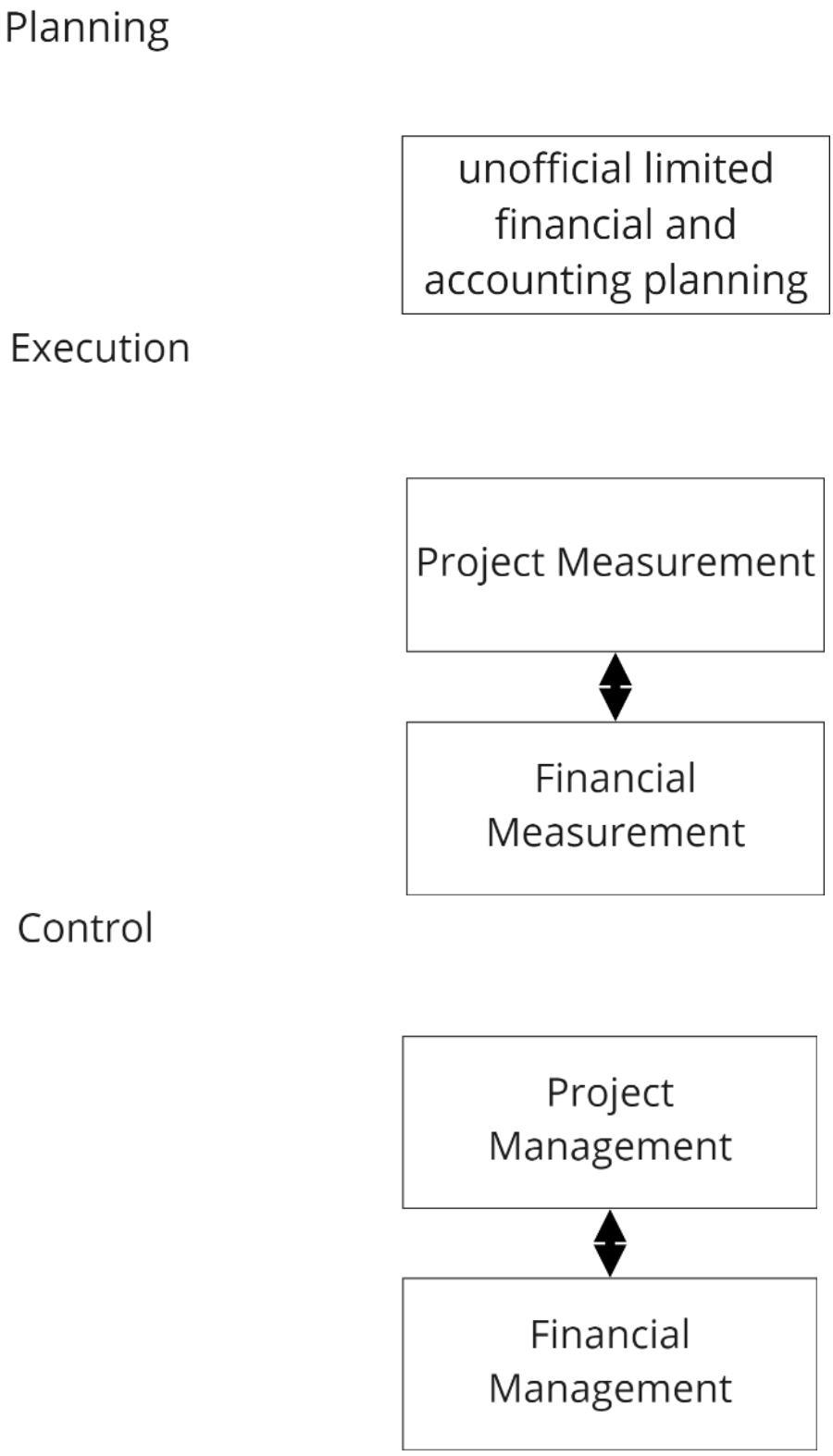


Figure 5-5: Company C's PMS-BI diagram


Planning
unofficial limited financial and accounting planning
Execution
Project Measurement
Financial Measurement
Control
Project Management
Financial Management

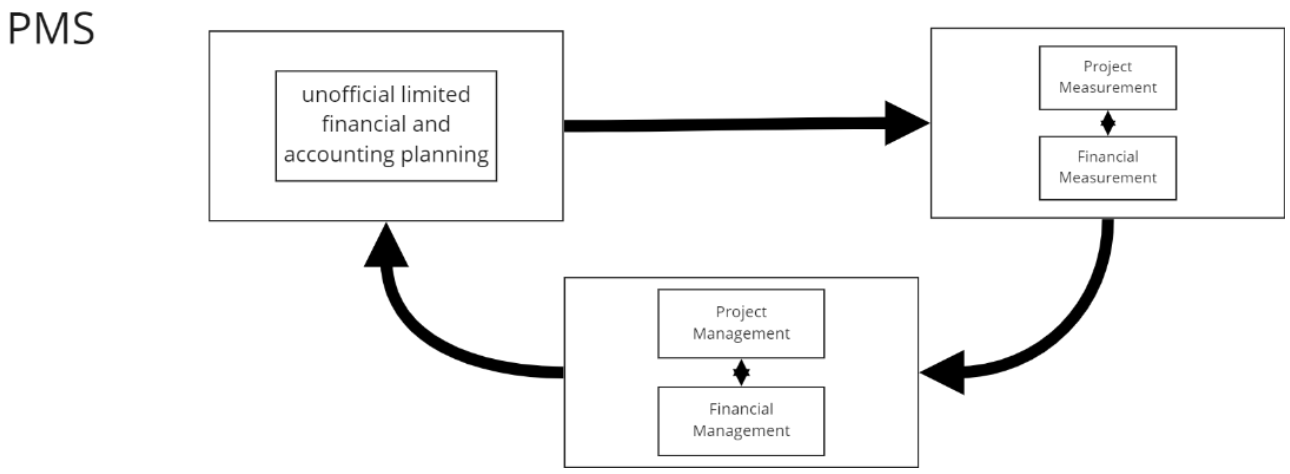
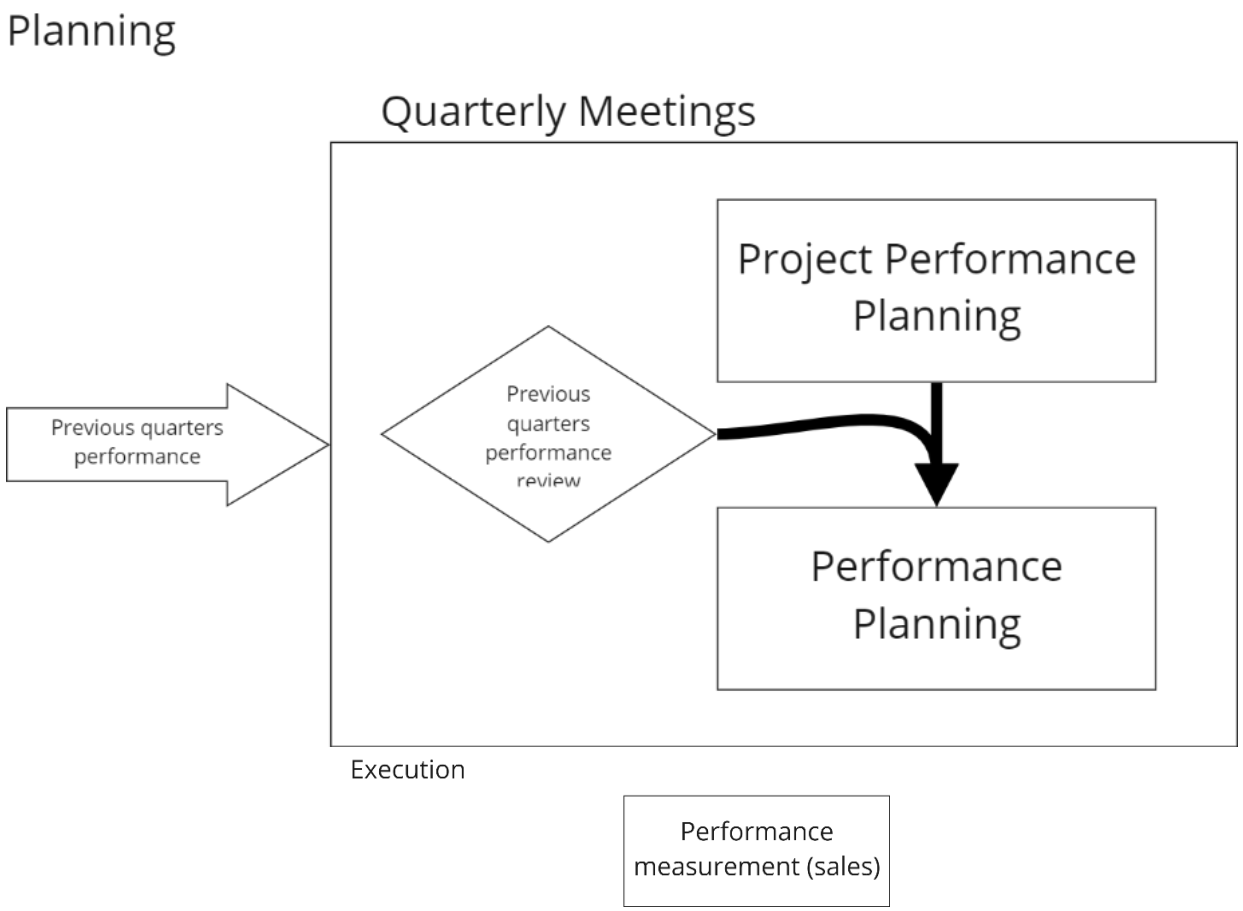


Figure 5-6: Company D's PMS-BI diagram



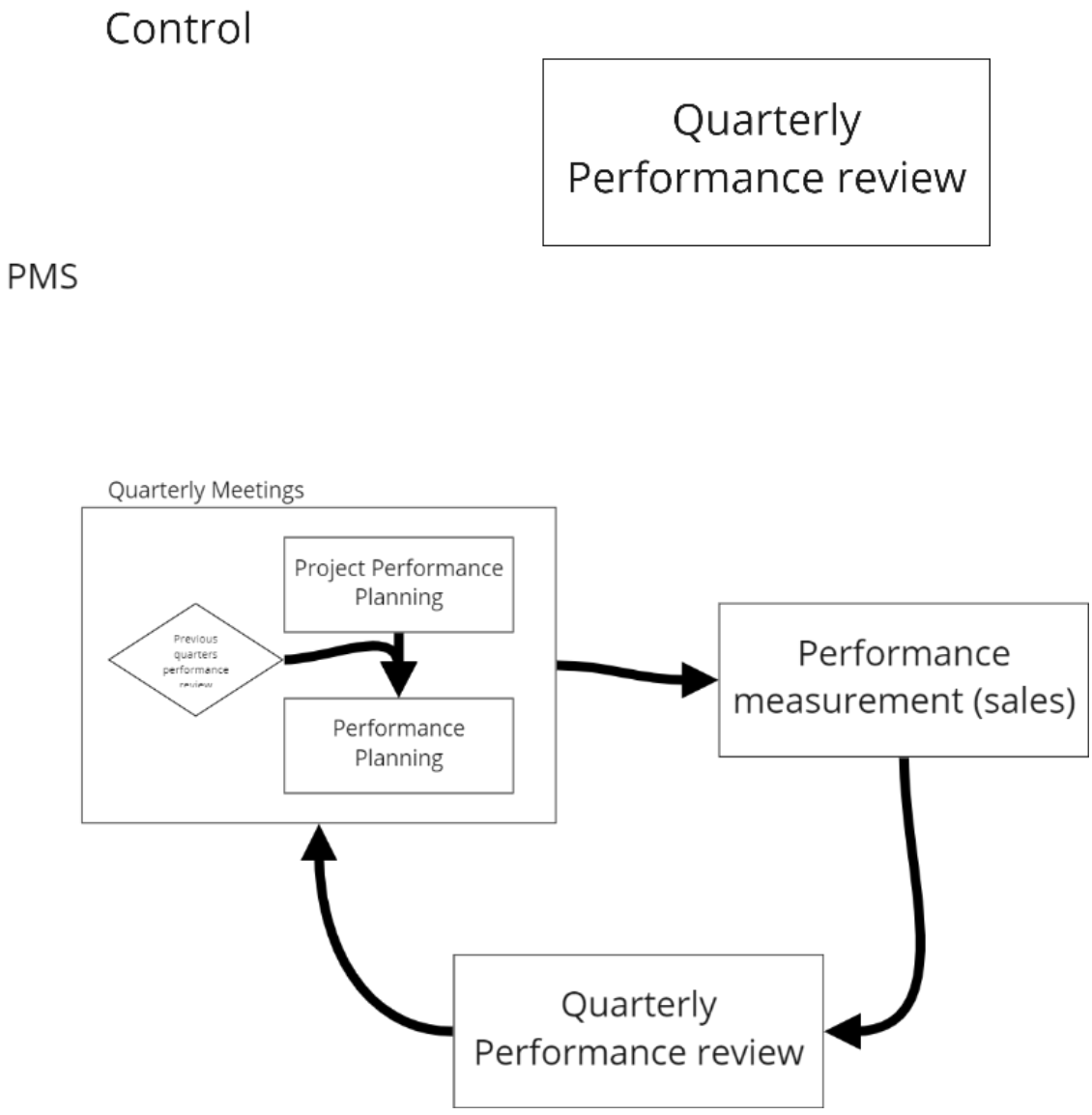
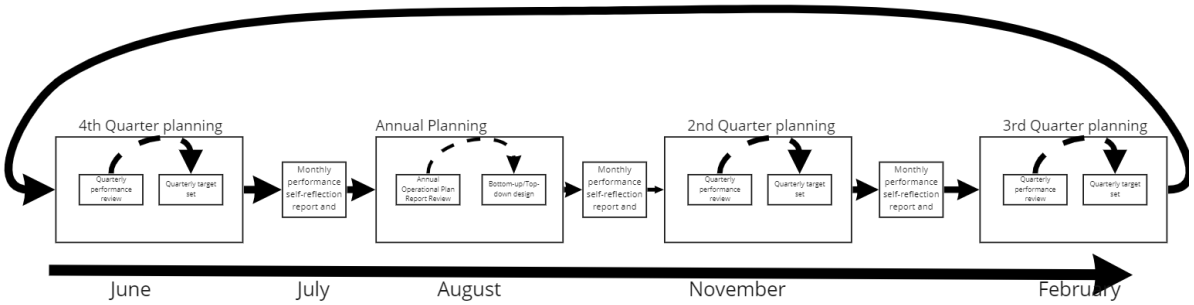
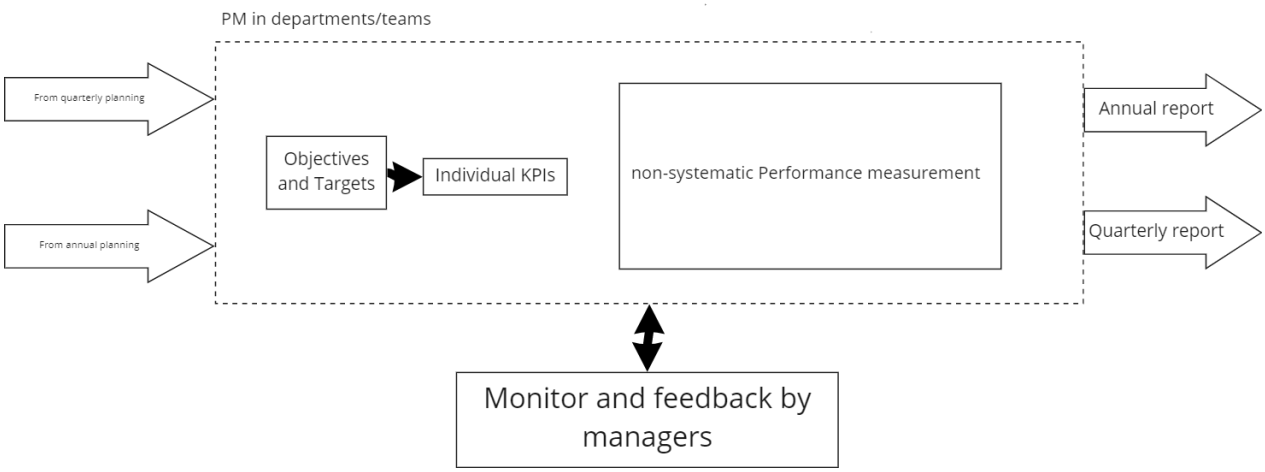


Figure 5-7: Company E's PMS-BI diagram

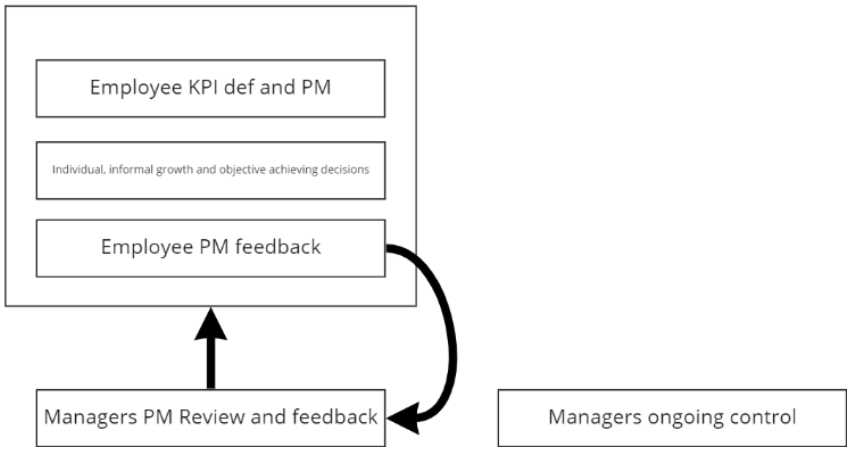
Planning



Execution



Control



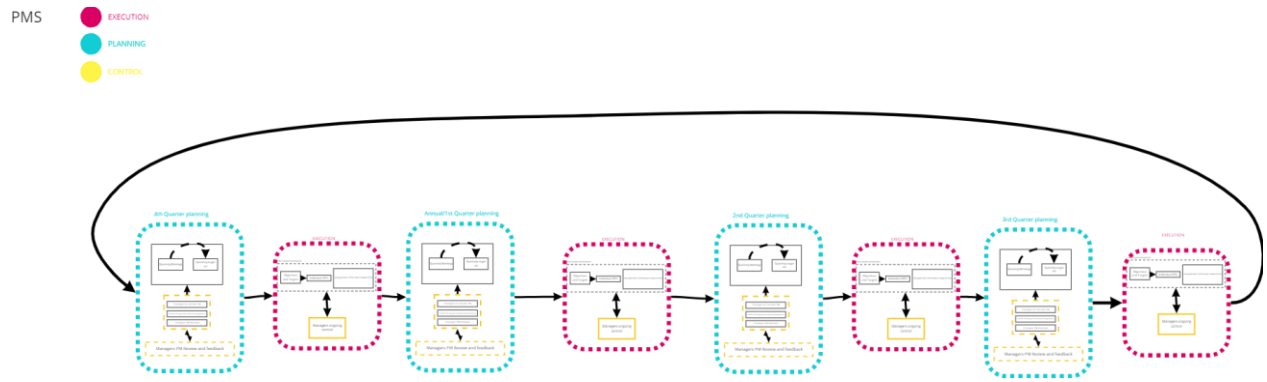


Figure 5-8: Company F's PMS-BI diagram

These diagrams are then used to understand the general patterns and structures of PMS-BI in the collaborating cases. Then I tried to extract and draw the general structure of the PMS-BI. This diagram (see Figure 5-9) shows the main components of the system and the connections between them. This diagram is then used to create more readable and usable diagrams.

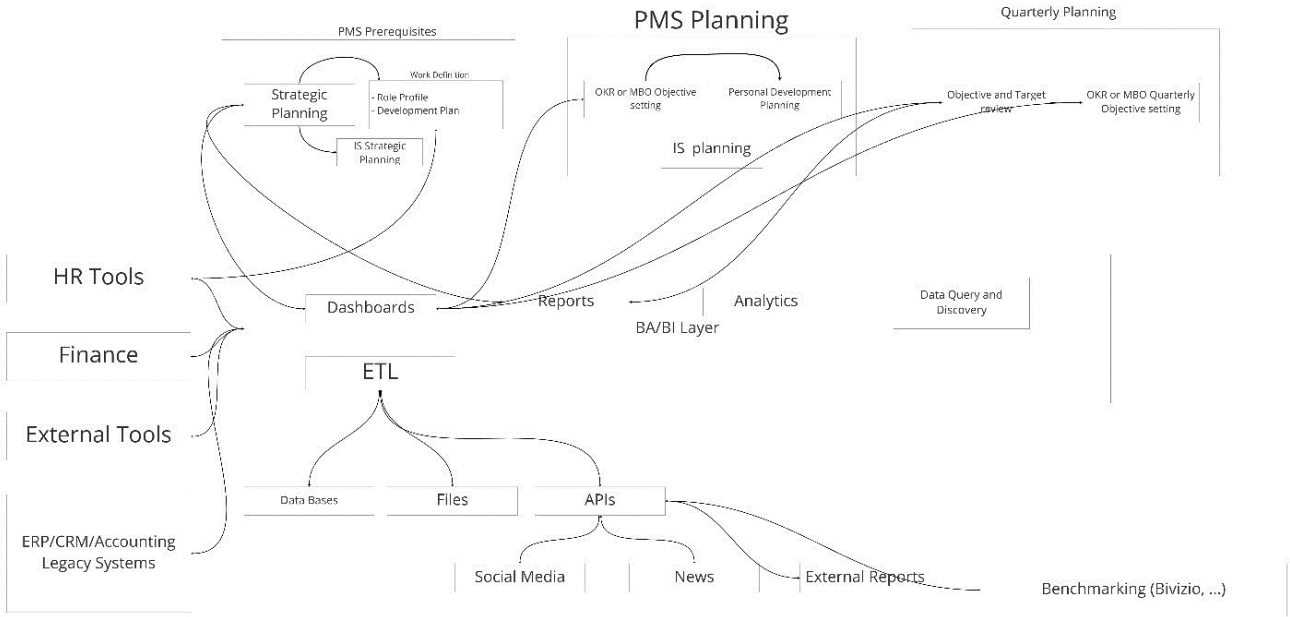


Figure 5-9: A general PMS-BI diagram

Essential features such as being easy to use, adaptability, and flexibility led us to consider a modular design for the system. The system's modularity means I dissected the proposed PMS-BI system to its subsystem, components, and connections. In addition, to make it easier for SMEs to implement and use, I added the “executive summary,” “tools and guidelines,” and an “imaginary company case.” These documents and tools guide the SMEs to investigate their current PMS and

BI, find and highlight the necessary changes to these systems, choose the PMS-BI modules to be implemented and evaluate and maintain the system based on their capabilities and requirements.

After finalizing the core structure of the PMS-BI, I used Draw.io (an online drawing and collaborating environment) to draw system architectures. The reason for selecting this application is its better drawing capabilities. The overall structure of the system is shown in Figure 5-10. The general PMS-BI architecture and its components are explained in section 5.4.

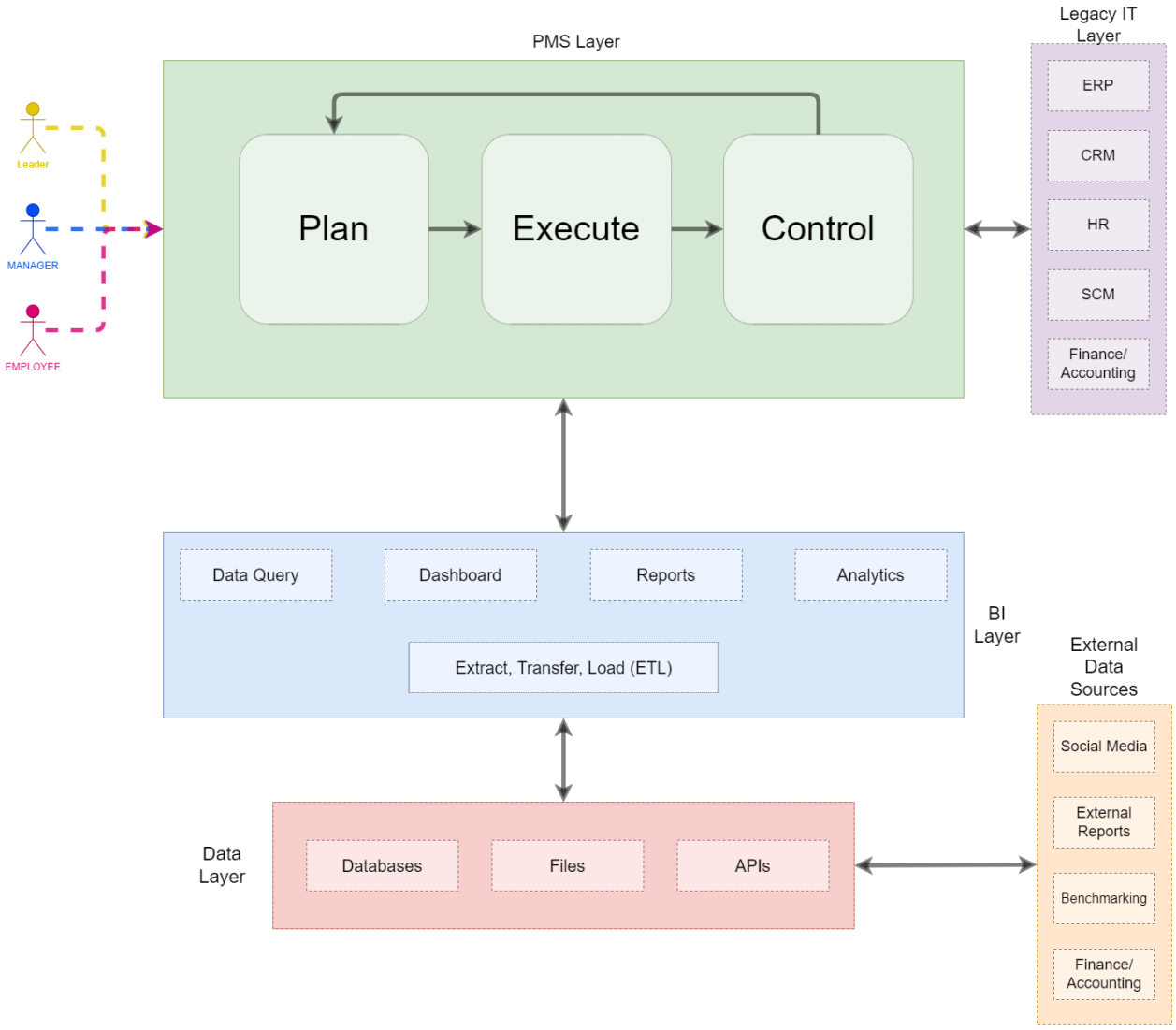


Figure 5-10: Overall structure of the general PMS-BI

5.4 Artifact Components

I started designing the artifact after selecting the features and sketching the system diagrams. The designed artifact consists of PMS-BI and supporting tools and guidelines. Also, I added an imaginary company case to make it easier for SMEs to understand the PMS-BI lifecycle and its benefits for a company. In this section, I explain each part. Moreover, I describe the design's reason and purpose in detail.

5.4.1 PMS-BI architecture

Based on the literature (Nur Hani Zulkifli Abai et al., 2015; Ferreira & Otley, 2009) and interview analysis, I dissected a performance management system into three subsystems: plan, execute, and control. These subsystems work together to conceptualize the company's strategies, translate these strategies into actionable objectives and goals, measure the individual and team's performance toward achieving these goals and control the actions through timely feedback and performance reports.

The literature suggests that business intelligence systems make performance measurement and management more efficient and effective: BI allows leaders to have a more comprehensive view of the internal and external environment which in turn lets leaders have complete control over the performance of the company (Pugna et al., 2011; Rajnoha et al., 2016). Managers can benefit from this integrated system by better understanding the strategies and objectives and controlling their team's performance toward the company's overall objectives (Bogdana et al., 2009; Pugna et al., 2011). These systems also provide a more democratized and decentralized information system in which employees can have a better understanding of the objectives and goals and are better able to define and pursue their own development goals, and ultimately feel themselves contributing to the overall success of the organization (Nazier et al., 2013; Papadopoulos et al., 2015; Shi & Lu, 2010).

In this section, I will introduce the subsystems and propose a sequence of performance measurement and management activities.

5.4.1.1 PMS-BI Subsystems and Components

As mentioned before, a Performance Management System (PMS) is a set of managerial activities to measure and manage the company's and individuals' performance. A typical PMS comprises a three-step cycle (see Figure 5-11). This cycle starts with the planning activities, continues with the execution process, and ends with the control procedures (Lebas, 1995). This loop continues to evolve each year by reviewing the past year's outcome, and managers decide on the new year's outcome.

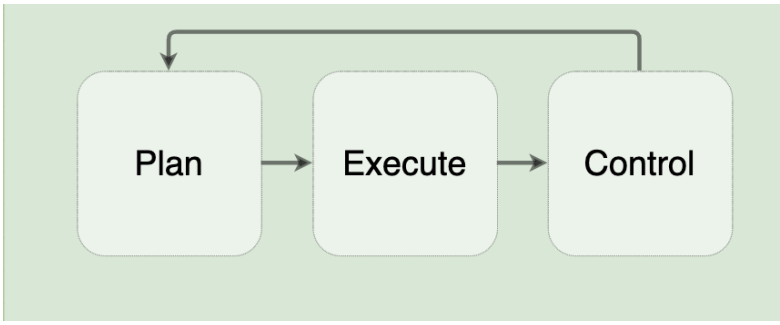


Figure 5-11: A performance management cycle

Performance management is usually built on top of an information technology layer (Bititci et al., 1997). This layer consists of interconnected systems such as the legacy organizational systems and the business intelligence and analytics platforms. In this artifact, I consider business analytics (BA) as a part of the business intelligence (BI) system.

The data required in a PMS also comes from a data layer that consists of internal activities and can be connected to capture and transfer external data. Different users also interact with this system differently and throughout different stages. Leaders, managers, and employees are connected directly to the PMS layer. They are also involved with the operation and management of the other layers, but for the sake of simplicity, I focus on their relationship with the PMS layer.

After adding the BI and data layer and the system players, the comprehensive and simplified system design is as follows.

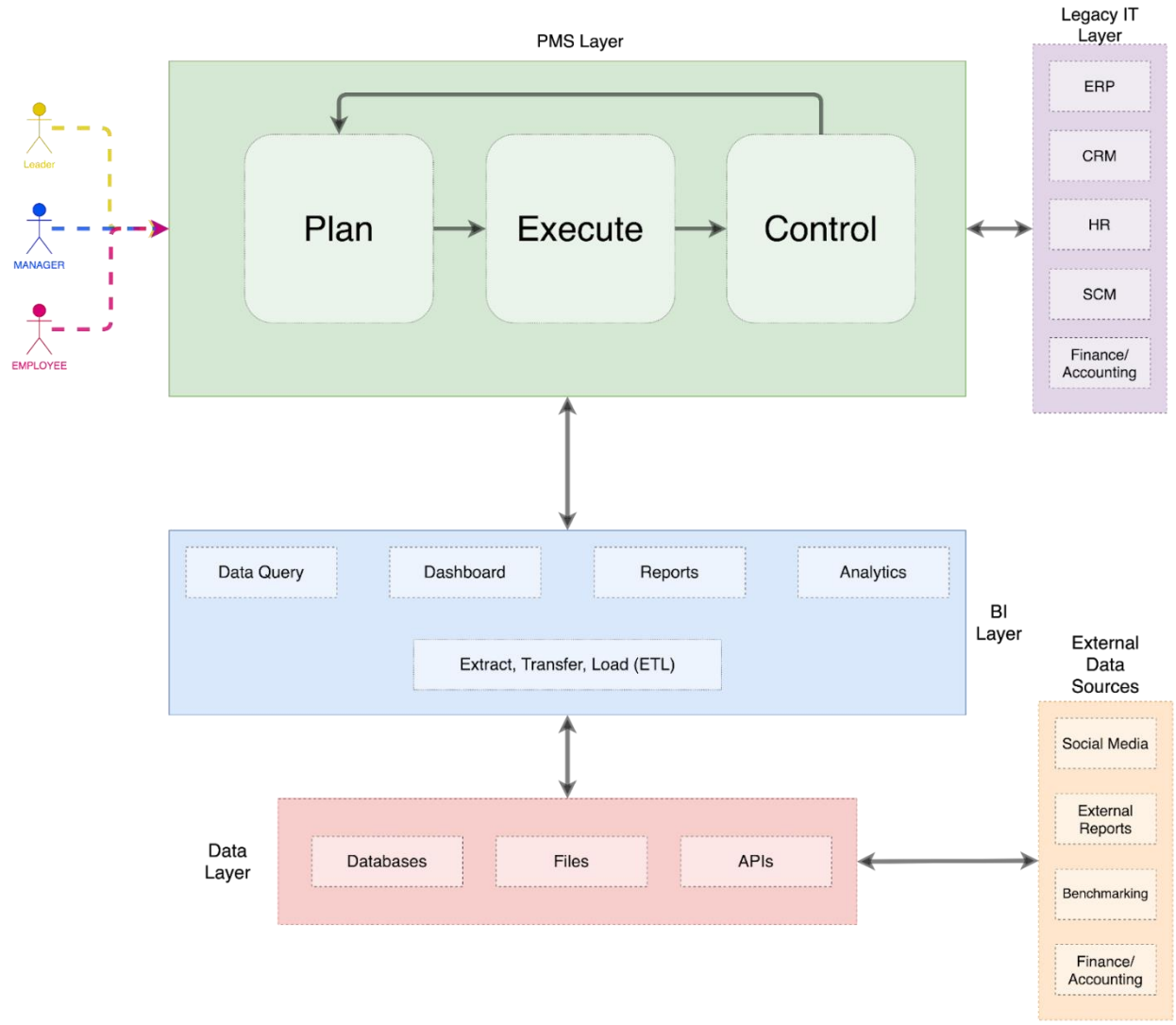


Figure 5-12: A PMS-BI information system

5.4.1.1.1 Plan

The planning subsystem consists of three main components: prerequisites, annual, and quarterly. These components are the managerial activities needed to prepare and plan the performance management procedure (Figure 5-13).

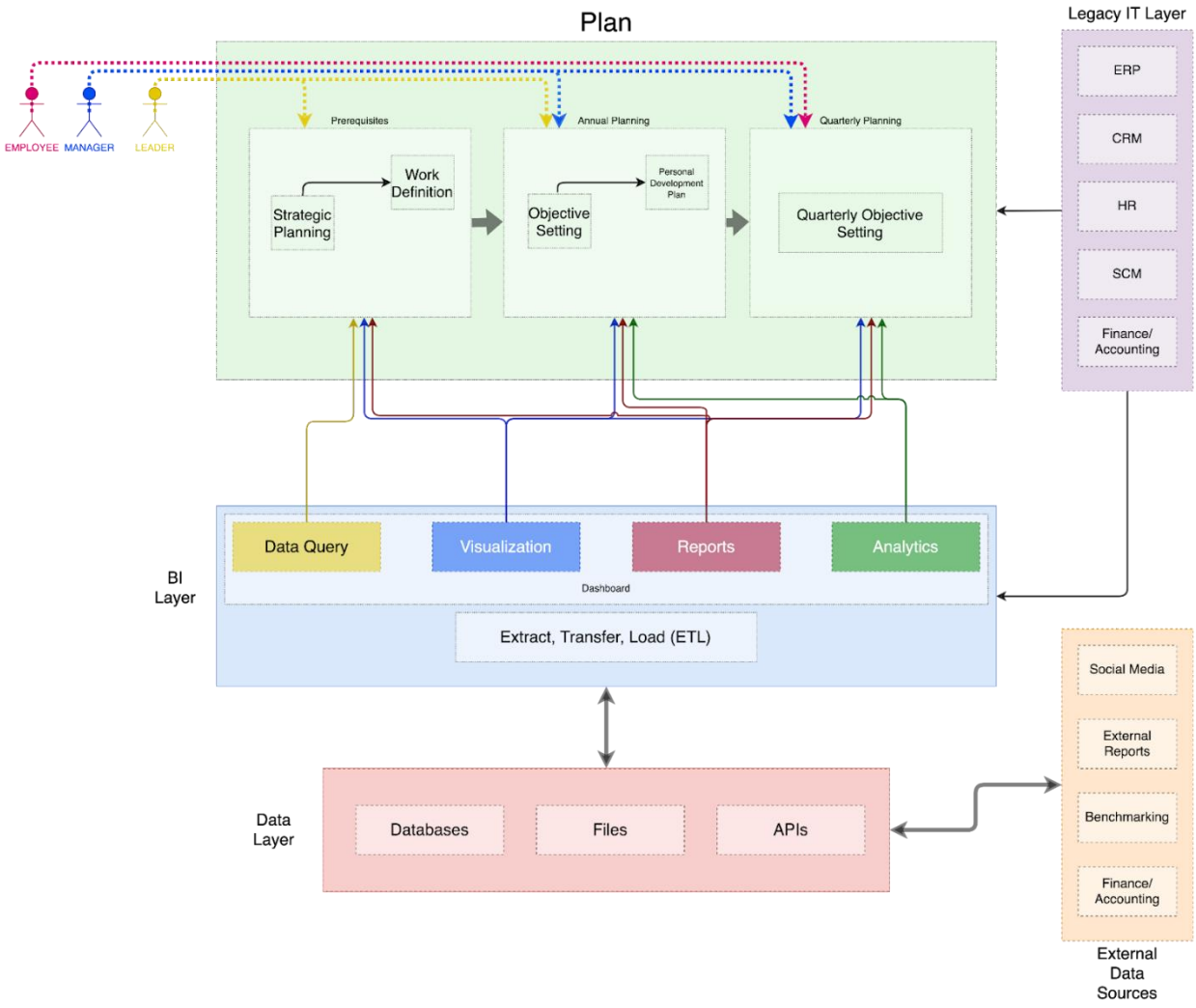


Figure 5-13: Plan subsystem and connections to other layers and roles

Prerequisite planning

Prerequisite planning is a managerial activity that involves leaders and managers. This component usually takes place along with the annual planning. Its components are Strategic planning and Work definition.

Data query, visualization and generated reports are the BI functions guiding the leaders and managers to make better decisions and set more accurate strategic plans. The previous year's performance also defines the work definition.

Annual planning

The annual planning consists of activities and processes to review and prepare the "Objective setting" and "Personal development planning" components. Leaders and managers are usually involved in this component.

Leaders and managers use visualization, reports and analytics to set objectives based on the strategic plans and other inputs. The individual activities also guide the personal development plan.

Quarterly planning

The quarterly planning mainly consists of quarterly objective setting. Managers and Employees are involved in this activity every quarter.

Analytics, visualization, and reports are inputs that help managers and employees make better decisions and set more effective and efficient objectives.

5.4.1.1.2 Execute

An execute system consists of Design, Build, and Measure cycles. Each component comprises different activities and processes (see Figure 5-14).

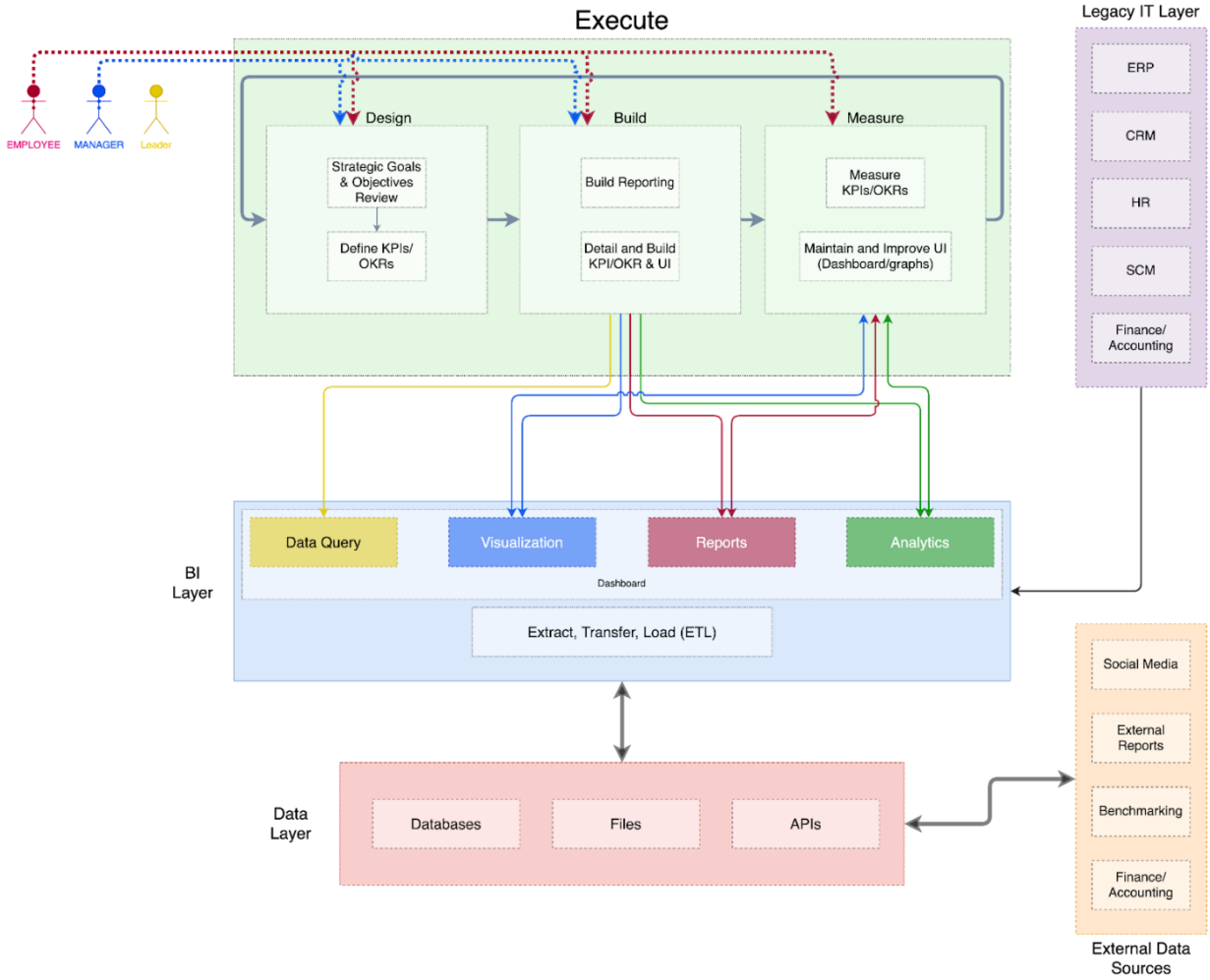


Figure 5-14: Execute subsystem and connections to other layers and roles

Design

The performance measurement and management execution subsystem is an ongoing process that starts by reviewing and understanding leaders' strategic goals and objectives. Then KPIs or OKRs are designed by translating the objectives into the measures and setting targets.

Build

The Build subsystem then creates and maintains the report format and reporting procedure. This report is shared with the leaders and other managers periodically. Another activity in the build phase is building and implementing the KPIs or OKRs and the user interfaces. The user interfaces can be BI dashboards, graphics, and charts.

Measure

KPIs or OKRs are measured in the measure phase, and the user interface is maintained. Employees and IT personnel work together to keep the process running smoothly and update the dashboards and measures regularly based on the manager's feedback.

5.4.1.1.3 Control

The control subsystem consists of the Employee review and reward process and performance feedback (see Figure 5-15).

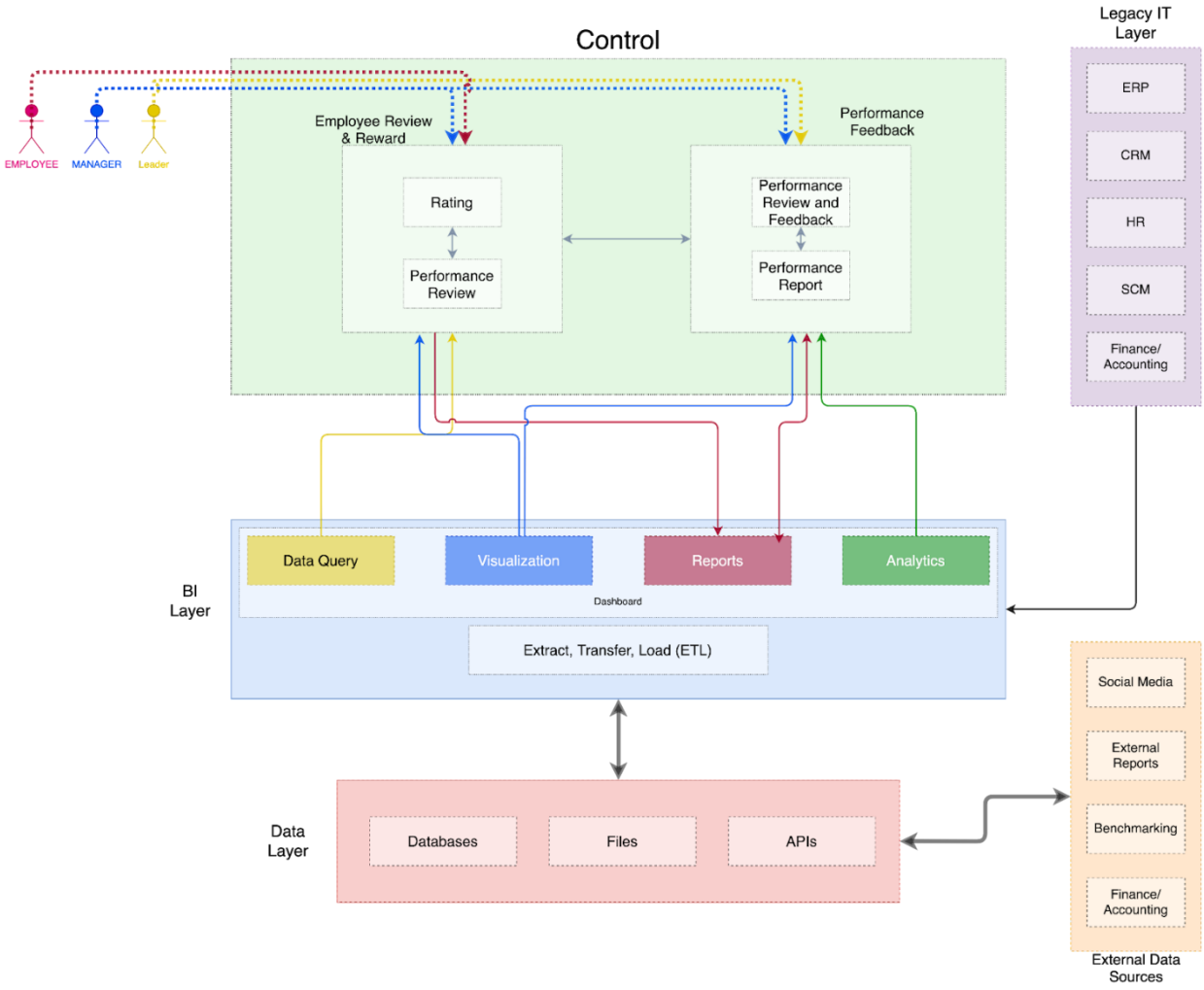


Figure 5-15: Control subsystem and connections to other layers and roles

Employee Review and Reward

The employee feedback component reviews the individual employee performance and rates them based on the work definition and performance achievements. Managers are actively performing the review and set rewards based on that. It uses visualization and data query to review the performance and the individual achievements.

Performance Feedback

The performance feedback component consists of team and department performance review and feedback and the performance report creation and update. Managers and leaders do the ongoing review and give feedback to the employee. They use visualization, reports, and analytics as decision support tools and reflect the performance in reports.

5.4.1.2 PMS-BI Activities

This section will explain the main activities and their timelines (see Figure 5-16).

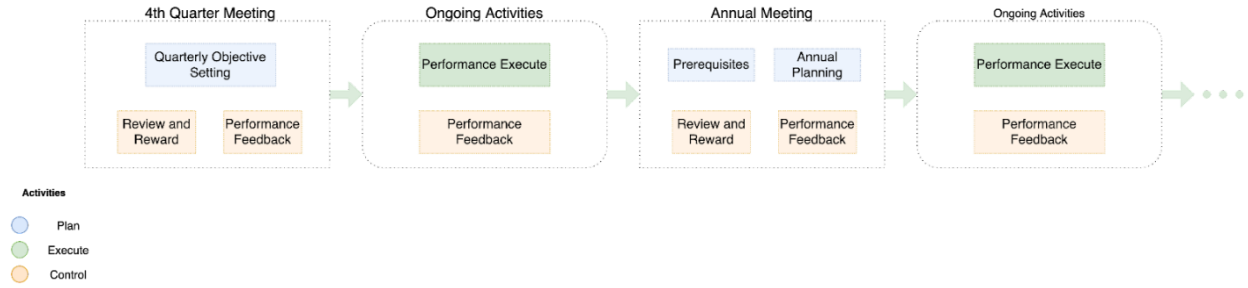


Figure 5-16: Performance measurement and management activities throughout a year

Annual Meeting

A few days before starting the annual meeting, or on the same day, prepare for the leader's prerequisite meeting. This meeting is about understanding and creating the company's strategic planning. Usually, only the leaders are involved with this activity. Senior managers can be added to this meeting if their experience and knowledge are necessary for more effective strategic planning. The second important activity is work definition. Work definition is essential in case new roles and responsibilities need to be introduced to the company in the coming year.

The next stage is holding the annual performance meeting. The annual performance meeting can be part of the company's annual meeting or can be held in a separate meeting. The main activity of this meeting is to set the performance objectives and review and define the personal development plans. The input for this stage comes from the team's performance reports and reviews that are part of the control subsystem. Personal performance reviews and reward reports are also gathered from the control subsystem to help work definitions and objective settings.

Ongoing Activities

There are also ongoing activities for performance measurement and management. The performance execution, performance review, and feedback activities are done throughout the year, and everyone is involved. These activities are related to real-time performance measurement, monitoring and ensuring that the company operates efficiently and effectively toward strategic goals and objectives.

Quarterly Meetings

The activities in the quarterly meeting are primarily concerned with the quarterly objective review and setting an objective, giving the performance feedback to the managers, and reviewing employee performance. Setting rewards are activities from the control subsystem.

5.4.2 PMS-BI Lifecycle

The PMS-BI life cycle consists of six phases. These phases are as follows.

Adoption decision, acquisition, implementation, use, maintenance, and evolution. Each phase consists of different activities and processes. Multiple tools and documents have been created and suggested for each phase to help leaders and managers understand and implement the process successfully.

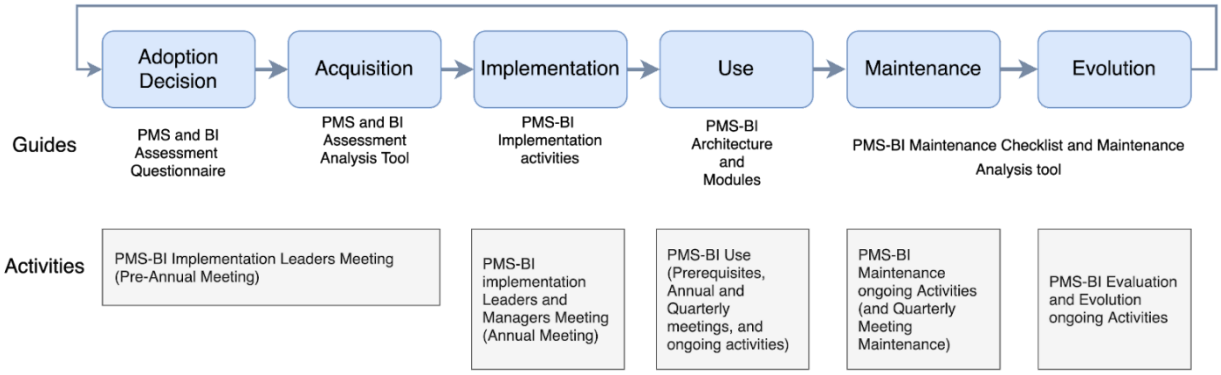


Figure 5-17: PMS-BI life cycle

5.4.2.1 Adoption Decision Phase

In this phase, leaders question the need for an improvement to the current system or the adoption of a new system that addresses the business challenges and improves the operations toward achieving the strategic goals. This decision phase includes the definition of system requirements, their goals and benefits, and an assessment of the impact of adoption at a business and organizational level.

This artifact guides leaders in assessing their current PMS and analyzing their BI systems' readiness.

PMS-BI Assessment

Before using the system, the assessment questionnaire helps companies spot issues in their current system and highlight the places that need improvement. The PMS-BI assessment consists of two main parts. The PMS assessment and BI assessment. The PMS assessment questionnaire shows which part of the company’s current PMS needs improvement and which module must be modified or implemented. The BI assessment outlines the company’s BI system readiness and illustrates the weaknesses.

You can find the PMS-BI assessment questionnaire in the “Appendix” section “PMS-BI assessment questionnaire.”

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5.4.2.2 Acquisition Phase

This phase contains the PMS-BI module selection that best fits the organization's requirements. The “assessment analysis tool” outlines the aspects of the current PMS to be improved.

An external consultant can facilitate this selection by providing guidance and information. Factors such as return on investment, training for the managers and employees, and maintenance services also need to be analyzed.

PMS-BI Assessment Analysis Tool

The PMS-BI assessment tool is a simple table that translates the questionnaire results into recommended improvements. These improvements are also linked to the corresponding PMS-BI modules, which can be selected in the “Acquisition phase” and are candidates for potential implementation.

The PMS-BI assessment questionnaire and assessment analysis tool are in the “Appendix” section “PMS-BI assessment analysis tool.”

5.4.2.3 Implementation phase

After selecting the modules to be implemented or the aspects of the current system to be improved, the leaders should make the decisions and plan for the implementation. The “PMS-BI Implementation Activities” figure shows the decisions and essential activities necessary to implement the new PMS-BI and their sequences.

You can find the “PMS-BI Implementation Activities” in the “Appendix” section “PMS-BI Implementation Activities.”

5.4.2.4 Use phase

After completing the implementation phase, the company will move forward to the use phase. The use phase consists of subsystem activities and modules. These modules and activities are described in the PMS-BI architecture, and more explanations are provided in the “Module explanation” section in the Appendix.

5.4.2.5 Maintenance phase

The maintenance phase consists of ongoing activities to find the issues and plan for improvement.

“PMS Maintenance Checklist” shows the maintenance criteria, the corresponding questions to be answered and the modules that need improvements.

This checklist can be used every quarter to understand the quality of the current system and the aspect of the system which needs improvements.

The “PMS-BI Use and Maintenance Checklist” can be found in the Appendix.

5.4.2.6 Evolution phase

After implementing the system and getting feedback from users and managers, the executive team must prepare a document that highlights the pros and cons of the system and how this system can be improved. The “Use and Maintenance Checklist” can be used for this purpose. You can find the checklist in the artifact package appendix.

Leaders must then document and review the activities in this checklist quarterly and annually.

5.4.3 Imaginary Company Scenario

An imaginary case is introduced and added to the artifact package. This case is an imaginary company that has identified a few problems with its performance measurement and management practices and uses the artifact's tools and guidelines to design and develop its PMS-BI. To develop this case, I tried to reflect on the SME characteristics and general situation of SMEs. You can find the imaginary company case in the appendix.

This document starts with an introduction and case description. Then it describes the problem this company has with its PMS. Then it shows how the company's CEO cooperated with managers and employees, using the artifact’s guidelines and tools, identified the problems and improvement points and developed the solution. I used diary storytelling techniques to make the steps they took and the processes they performed easier to understand and follow. In this technique, I followed the activities of the company's CEO, responsible for the PMS, in a diary format. In the end, I explained the benefits of the artifact to the company and summarized the process.

5.5 Artifact Evaluation

The Design Science Research (DSR) methodology has four stages: problem identification, artifact development, artifact evaluation, and presentation of results. Moreover, a typical DSR evaluation stage may include testing artifact quality, functionality, accuracy, performance, and usability (Hevner & Chatterjee, 2010). This thesis includes the PMS-BI artifact, and its goal is to help SMEs design and develop their own PMS based on BI tools and technologies. The artifact includes the PMS-BI system structure, the guidelines, and various designed tools. Therefore, the evaluation of the artifact intends to check if my choice of PMS-BI modules and activities are helpful for and usable by SMEs.

A standardized “usability questionnaire” (Assila & Ezzedine, 2016) assesses the artifact's usability. The results are used to evaluate the artifact and highlight the improvements.

This section focuses on the evaluation stage involving PMS-BI artifacts. First, I introduced the evaluation method, then described the evaluation results, and ultimately, I explained the artifact evaluation reflection on the artifact and highlighted the recommended changes.

5.5.1 Usability Testing

To evaluate the artifact, I used a "usability testing" questionnaire (Davis, 1989). The International Organization for Standardization (ISO) defines usability testing as assessing the degree to which a user can use the product in a specified context to achieve the use objective and covers efficacy, effectiveness, and satisfaction. Moreover, usability testing aims to explore the application's strengths and weaknesses and improve usability (Bevan et al., 2016).

This study adopted the Usability Questionnaire (UQ) proposed by (Davis, 1989) to assess the usability of the artifact. The contents of UQ were used to measure the usefulness, ease of use, and self-predicted future usage.

Table 5-2: Usability testing questions and constructs, adapted from (Davis, 1989)

Question	Construct
Q1: Using PMS-BI Artifact in my job would enable me to accomplish tasks more quickly.	Ease of use
Q2: Using PMS-BI Artifact would improve my job performance.	
Q3: Using PMS-BI Artifact in my job would increase my productivity.	
Q4: Using PMS-BI Artifact would enhance my effectiveness on the job.	
Q5: Using PMS-BI Artifact would make it easier to do my job.	
Q6: I would find PMS-BI Artifact useful in my job.	
Q7: Learning to operate PMS-BI Artifact would be easy for me.	Usefulness
Q8: I would find it easy to get PMS-BI Artifact to do what I want.	
Q9: My interaction with PMS-BI Artifact would be clear and understandable.	
Q10: It was easy to become skillful using PMS-BI Artifact.	
Q11: It is easy to remember how to perform tasks using PMS-BI Artifact.	
Q12: I would find PMS-BI Artifact easy to use.	
Q13: Assuming PMS-BI Artifact would be available on my job, I predict that I will use it regularly in the future.	Self-predicted future usage
Q14. Would you prefer to perform inspections paper-based or using PMS-BI Artifact?	

5.5.1.1 Model of Usefulness, Ease of Use and Self-predicted Future Usage

The usability testing method offers the potential for improving systems and artifacts. This evaluation methodology measures a system's usability from its users' perspective. Since the artifact is not yet implemented, we used this questionnaire to understand the respondents' opinions about its usability if they decide to use it in their company. Also, the imaginary company scenario provided in the artifact documentation helps them imagine the artifact components, processes, and usages in their company. For example, this methodology evaluates if users find the artifact easy to

do what they want it to do. However, even if users believe that the artifact is valuable, they may also believe that the tool is too difficult to use and that the performance benefits are outweighed by the effort of using a tool (Laitenberger & Dreyer, 1998). Therefore, in addition to the usefulness of the artifact, ease of use is a crucial factor to consider. The artifact can also be helpful now, and users would be able to use it quickly. However, their intention to use it in the future is a significant determinant that shows the usability of an artifact. Davis (1989) defines these concepts as:

- Perceived usefulness is "the degree to which a person believes that using a particular system would enhance his or her job performance." Therefore, an artifact with higher perceived usefulness is an artifact that users believe that it positively influences the performance.
- Perceived ease of use is "the degree to which a person believes that using a particular system would be free of effort." This states that a tool that is easy to use is more likely to be accepted by users, and they will use it in future with a high probability.

To measure the usability of an artifact, I do not have any objective measure. Hence, I have to use subjective measures for which I apply a Likert or "summative" scale (Albaum, 1997). In my questionnaire, respondents must select one of seven labels: very unlikely, unlikely, somewhat unlikely, neither likely nor unlikely, somewhat likely, likely, and very likely. A score is assigned to each response, and the scores belonging to a particular concept are combined so that subjects with the most favourable attitude will have the highest concept score. In contrast, subjects with the least favourable attitudes have the lowest concept score. I present the complete questionnaire in the "Appendix" section "Artifact Evaluation Questionnaire (Usability Testing)."

5.5.1.2 Artifact Evaluation Process

To evaluate the design artifact's usability, I prepared a package consisting of an executive summary, an imaginary business case, and a spreadsheet including the required tools and analytics. This package is reviewed and evaluated by supervisors and the collaborating company C. After multiple iterations, I finalized the package. Then I sent this package to the collaborating respondents via email and asked them to complete the questionnaire. The questionnaire was created and shared on the SurveyMonkey website. To keep the responses anonymous, I only collected the direct responses to the questions, and no other information was saved. This anonymization avoided biased answers or breaching the correspondents' private information.

I collected responses from 11 participants. The detail of the responses is discussed in the next section.

5.5.2 Artifact Evaluation Results and Discussion

After collecting the responses (details in "Appendix," section "Evaluation Results"), I discuss the results in this section.

The findings of this evaluation indicated that the PMS-BI artifact was perceived as particularly useful and usable by evaluation participants. However, a few measures showed factors which can be improved in my artifact.

The task and application of the PMS-BI artifact are to help SMEs measure and manage their performance using BI tools. The artifact's usability measure indicated a positive current outcome of the application of the artifact and a high probability of future adoption. The usability measure of the artifact was indicative of useability problems requiring improvement. In this section, we described the results for each question.

- Q1: Using PMS-BI Artifact in my job would enable me to accomplish tasks more quickly.

Four respondents answered "somewhat likely," and two answered "very likely" to this question. The answers are mostly positive and confirm the usability of the artifact to accomplish tasks more quickly. However, 4 "somewhat likely" answers show that respondents are not entirely confident about their answers.

- Q2: Using PMS-BI Artifact would improve my job performance.

Three respondents answered "likely," and three answered "very likely" to this question. Answers are primarily positive and showed respondents' high confidence about this artifact's usability in improving their job performance.

- Q3: Using PMS-BI Artifact in my job would increase my productivity.

One respondent answered "somewhat likely," three respondents answered "likely," and two respondents answered "very likely" to this question. Answers are primarily positive and range from somewhat likely to very likely. Respondents believe that this artifact will increase their productivity.

- Q4: Using PMS-BI Artifact would enhance my effectiveness on the job.

One respondent answered, "neither likely nor unlikely," 1 respondent answered, "somewhat likely," two respondents answered "likely," and two respondents answered, "very likely." Answers are favourable; however, "neither likely nor unlikely" and "somewhat likely" show that a few of the respondents doubt the artifact's usability in enhancing the effectiveness on the job. Therefore, this question is a candidate to consider as a potential improvement to the artifact.

- Q5: Using PMS-BI Artifact would make it easier to do my job.

Three respondents answered “somewhat likely,” and three answered “very likely” to this question. Answers confirmed that respondents believe this artifact makes it easier to do their job.

- Q6: I would find PMS-BI Artifact useful in my job.

Two respondents answered “likely” twice and “very likely” four times. These answers show that the respondents believe the artifact is helpful in their job.

- Q7: Learning to operate PMS-BI Artifact would be easy for me.

One respondent answered, “somewhat unlikely,” 1 respondent answered, “neither likely nor unlikely,” two respondents answered, “somewhat likely,” and two respondents answered, “very likely.” Answers to this question range from “somewhat unlikely” to “very likely,” which shows that there is a spectrum of opinions about the easiness of this artifact. This question raises a flag, and ease of use should be considered a potential improvement to the artifact.

- Q8: I would find it easy to get PMS-BI Artifact to do what I want.

Two respondents answered, “neither likely nor unlikely,” two respondents answered “likely,” and two respondents answered, “very likely.” Answers to this question, like the Q7, show that the artifact's easiness is a potential for improvements. A few of the respondents believe that it is likely not very easy to accomplish what they what to do using this artifact.

- Q9: My interaction with PMS-BI Artifact would be clear and understandable.

Three respondents answered “somewhat likely,” and three answered “very likely” that their interaction with the artifact would be clear and understandable. Therefore, they are mostly positive about this factor.

- Q10: It was easy to become skillful using PMS-BI Artifact.

Two respondents answered “somewhat unlikely,” two respondents answered “somewhat likely,” 1 respondent answered “likely,” and one respondent answered “very likely.” Responses to this question show that a few respondents find it not very easy to become skillful in the PMS-BI artifact. This question needs to be further discussed.

- Q11: It is easy to remember how to perform tasks using PMS-BI Artifact.

One respondent answered, “neither likely nor unlikely,” two respondents answered, “somewhat likely,” and three respondents answered, “very likely.” Responses show a level of confidence of the respondents in remembering how to perform tasks using the PMS-BI artifact.

- Q12: I would find PMS-BI Artifact easy to use.

One respondent answered, “neither likely nor unlikely,” and five respondents answered “likely.” Responses reveal that respondents find it easy to use PMS-BI.

- Q13: Assuming PMS-BI Artifact would be available on my job, I predict that I will use it regularly in the future.

One respondent answered, “somewhat likely,” three respondents answered “likely,” and one respondent answered, “very likely.” Answers show that respondents predict that they will use the PMS-BI regularly in future.

- Q14: Would you prefer to perform inspections paper-based or using PMS-BI Artifact?

One respondent answered, “I will somewhat likely use PMS-BI,” 3 respondents answered, “I will likely use PMS-BI,” and two respondents answered, “I will very likely use PMS-BI.” Responses show that respondents prefer to use PMS-BI artifacts.

5.5.3 Artifact Evaluation Reflection and Recommendation

Usability testing results showed that respondents believe the PMS-BI artifact is usable and easy to use. It also states that the users see the potential benefit of the PMS-BI in their company if it is adopted and implemented. However, a few factors can be modified to improve usability and ease of use. In this section, the concerning factors and related improvements are recommended.

Perceived Potential Effectiveness of the artifact

Responses to Q4 showed that the effectiveness of the artifact in accomplishing the tasks could be improved. In usability testing, effectiveness refers to “the accuracy and completeness with which users [of an artifact] achieve specific goals” (Frøkjær et al., 2000). Effectiveness measures the quality of the solution provided by the designers. In this study, two factors influence the quality of the provided solution: 1) the quality of the artifact itself; 2) the quality of the artifact presentation.

To improve the quality of the artifact, further studies and experiments in a natural context must be done to iterate over the design features and fix the usability issues. Moreover, to improve the quality of the presentation, we recommend using more interactive and high-quality graphical representations of the solutions and processes.

Learning the artifact and becoming skillful in using it

A few questions (Q7, Q8, Q10, Q11) concerning the learning and becoming skillful in using the artifact also suggested that the representation of the artifact content should be improved. We recommend that, in the future, more professional editorial and graphical improvements be made to the artifact package. Improving the quality of the content will increase the learning capacities, and users can become skillful in the content. Another suggestion is hiring a facilitator or trainer to provide territorials and necessary training to the users.

5.5.4 Evaluation Limitations

This study's sample size (n=5) limits generalizing of the usability results. However, the usability test is intended to evaluate the artifact and highlight the necessary improvements. Future studies must evaluate the artifact in different contexts and generalize the results. Nielsen (1994) recommended that at least 20 end-users would be sufficient to achieve power. Nielsen and Landauer reported that 31% of useability problems could be identified with a single user, and more than 80% of usability problems can be identified with a sample of five users (Nielsen, 2000; Nielsen & Landauer, 1993). Thus, the premise was that use of a small sample would be sufficient to identify potential problems of the PMS-BI that would affect its usability and adoption.

Another intrinsic limitation was that the responses were based on self-perception, which is subjective. A notable attribute of the collected data was that the respondents were involved in the first round of the interview. The subjective nature of the perception of usability relies on respondents' sharing their opinions openly without incorporating any existing bias (Hodgson et al., 2018). Therefore, a critical limitation to evaluating the artifact is the potential bias in the evaluation results. We did not collect personal information from the respondents to mitigate the bias effect.

Future studies might incorporate additional SME characteristics (size, industry, location) or respondents' experience with the PMS and BI system factors. This will permit further investigation, as in exploring how more minor and less experienced respondents would score. In addition, the sample was a convenience sample. The respondents were not randomly selected from the target population. The years of experience varied widely, and given an insufficient number of respondents within age and experience groups, outliers possibly skewed the results.

Chapter 6 Conclusion

My preliminary research and systematic literature review showed a gap in the research on the PMS design domain for SMEs. In this thesis, I aim to design and develop an artifact that helps SMEs develop their own PMS, integrate it with the BI, and improve their performance measurement and management practices. To do so, I followed a design science research methodology and used a case study in the information collection and artifact validation steps. I first performed a systematic literature review, then interviewed 7 SMEs to collect the required data. Then I developed the artifact by considering the features necessary for a PMS-BI system aligned with the SMEs' characteristics and needs. I prepared a package consisting of the artifact documentation and design tools to evaluate the artifact. I shared this documentation in the form of a package with the participants. Then I used a standard usability test questionnaire to understand the usability of the artifact, and I highlighted the crucial usability improvement areas.

6.1 Answers to Research Questions

This section summarizes the answers to the research questions I asked in Chapter 1. I have one main question and two sub-questions.

To answer this question, I divided it into two sub-questions. Answering these questions helped me define the sub-systems and activities and extracted the system features. Then I used this information to develop the PMS-BI artifact for SMEs. I explained the design process in Chapter 4 and Chapter 5. I start with the sub-questions, then answer the main question.

Sub-questions:

- *What are the components and activities related to BI in SMEs?*

I answered this question in Chapter 4 and Chapter 5, where I first interviewed participants and then used the interview results to define the artifact design features.

Our data confirm the application of various BI tools and techniques in the participating SMEs' performance measurement and management practices. The level of BI application for performance measurement and management purposes is different. It ranges from a minimal level of adoption and implementation in some companies to a full-fledged level of usage. It is noteworthy that I selected the participating companies from the industries with medium to high levels of digitalization.

In general, I conclude that smaller companies in industries with a lower level of digitalization tend to use more traditional approaches to measure and manage their performance. Larger companies in the industry with a higher level of digitalization tend to use more advanced and

integrated BI tools and techniques for PMS purposes. However, my data confirm a range of BI's acceptance and application in the participating companies.

By considering the size of the companies and the level of digitalization, I illustrate a matrix (see Figure 6-1) which shows companies' approaches to the PMS and BI. Smaller companies with a lower level of digitalization tend to use a traditional, usually unbalanced approach to PMS. BI is also limited to simple tools such as MS Excel. Smaller companies with a higher level of digitalization show mixed and unbalanced use of BI and PMS. Larger companies with a lower level of digitalization usually use a traditional approach to PMs and mixed usage of BI. On the other hand, larger companies with a higher level of digitalization use more balanced and modern PMS-BI.

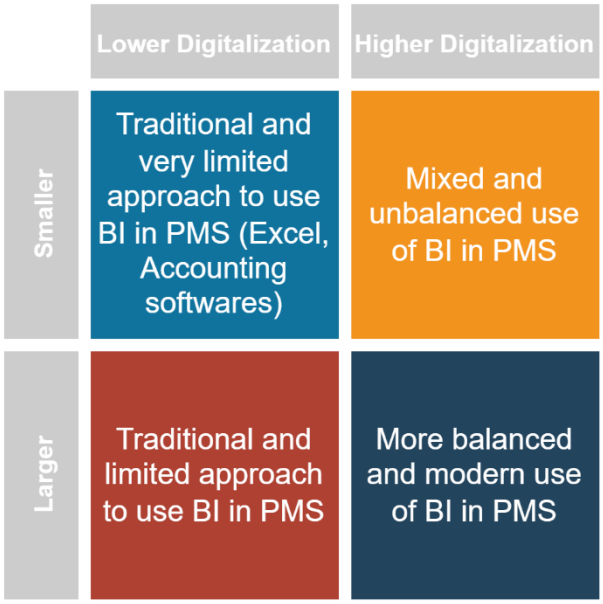

Figure 6-1: Digitalization level of the company and its size concerning the use of BI in PMS

- *What are the main components and activities of the PMS in an SME?*

I described the characteristics of a PMS system in detail in Chapter 4 and Chapter 5. My data confirms the adoption and implementation of the PMS in all companies. However, the characteristics of the PMS and approaches to the PMS are various in SMEs. PMS is ranged from unbalanced and informal to balanced and formal. Smaller and younger companies tend to measure the company's financial health, while more prominent and mature companies use balanced and complex approaches. Larger companies use approaches such as MBO (Management By Objective) to define objectives and measure the performance of the individual departments towards reaching the targets.

Another characteristic of the PMS is how much it is centralized in the company. In some companies, performance measurement and management are centralized to the executives, but others have a more decentralized approach. In centralized PMS, the CEO or top management is responsible for defining the strategies and objectives of the company and the individual departments. In contrast, in companies with decentralized PMS, each department has the flexibility and authority to define its objectives. However, the strategies are central to the top executive team in both approaches.

Our data showed that PMS activities also could be summarized into different operations. These operations include the processes companies perform over the year to plan, execute, and control performance measurement and management. These activities usually include annual planning, year-round performance measurement, management execution, and control activities.

Companies have various procedures and activities for PMS. A few companies perform the planning once a year; however, most other companies have planning cycles each quarter. My data also showed that companies have various perspectives on performance measurement execution. A few companies rely on more traditional and non-systematic performance measurement, while others have an integrated and more systematic performance measurement approach.

- *What are the main components and activities of the PMS-BI in an SME?*

The main sub-systems of a PMS-BI are described in detail in Chapter 4 and Chapter 5 and reflected in the artifact documents in the Appendix section.

Our data showed that PMS-BI consists of three main sub-systems: Plan, execute, and control. The literature also confirmed the existence of these subsystems (Armstrong, 2009; Armstrong & Baron, 2005; Frangopol, 2011).

The planning subsystem consists of three main components:

- Prerequisites
- Annual
- Quarterly.

These components are the managerial activities needed to prepare and plan the performance management procedure.

An execute system consists of design, build, and measure cycles. Each component also comprises different activities and processes. The control subsystem consists of the “employee review,” “reward process,” and “performance feedback.”

For more detailed information about the sub-systems and their components, see section 5.4.

I described the main BI tools and techniques in detail in Chapters 4 and 5.

Companies use various BI tools and techniques for performance measurement and management. The adoption and integration level varies from elementary tools such as Excel and low-level integration into sophisticated systems such as Salesforce, BambooHR, and SAP Success factors. Smaller companies tend to use more straightforward software such as Excel and accounting tools

to measure and manage the overall performance of the company or departments. However, larger companies with a higher IT adoption and integration applied more sophisticated and complex BI techniques.

6.2 Limitation and Threats to Validity

This research has several limitations. One fundamental limitation of this research is the narrow scope used in developing the artifact. The research scope focused on developing an artifact to facilitate building performance measurement and management based on the business intelligence and lacks the focus on other dimensions of an artifact implementation and development in an SME, such as project management and change management procedures. Implementing or adopting an artifact in a company is a complex process containing various procedures and mechanisms that should work hand in hand to ensure the successful adoption, implementation, and use of the artifact in the company.

This thesis has an important limitation in the data analysis phase. After conducting the interviews and gathering the transcript, I solely did the coding. Analyzing the data with a single coder has a significant limitation and may expose bias to the coding results. To eliminate this bias, primarily I used a systematic approach to the data gathering and analysis. Secondary, I rigorously documented the whole process, so others can replicate it. Experts' opinion is also used to validate the findings.

Another significant limitation in this study is that the choices made to scope the artifact include focusing on only experiences rather than other types of knowledge, such as metrics, facts, or heuristics. Participants' experiences with performance measurement and management are simply one component of knowledge that may or may not provide the necessary knowledge to design and develop a PMS-BI artifact. I eliminated this problem by specifying a narrow context (PMS-BI in medium to high-tech SMEs). By narrowing the context only to include the SMEs and selecting participants from organizations with a higher level of digitalization and technology adoption, I narrowed the scope of the study. However, this intentional narrowing of the scope of the study proposes a threat to its generalizability. This threat exists in the evaluation of the artifact, as well. Future studies must explore the problem in a broader and more natural context. Future studies can also adapt the PMS-BI artifact to different contexts and applications and investigate its validity and applicability. Moreover, adapting the artifact in different contexts requires more intense evaluation and modifications to the original PMS-BI artifact proposed in this study.

Another limitation of this research is the artifact evaluation. For evaluation purposes, I applied the usability test questionnaire. Given that this standard test evaluates only the usability aspects of the applied artifacts, it assesses only its usability. It ignores other characteristics such as necessity, resource requirements, adaptability, and flexibility. Although the evaluation provided the expected support, further studies still need to be performed to cover a more comprehensive view of the artifact. Another limitation in evaluating the artifact using a usability questionnaire is that

researchers use this questionnaire to evaluate an applied artifact, while my PMS-BI is not applied yet. I provided an imaginary PMS-BI implementation scenario to tell the story, to mitigate this limitation. A company takes the whole PMS-BI design and implementation process by applying the proposed guidelines. Then, I asked the respondents to evaluate if the PMS-BI artifact was implemented in their organization. Moreover, the evaluation was done only once, and the recommendations was only applied once. These minor changes have not been evaluated.

6.3 Summary of Contributions

In this thesis, I employed the DSR (Design Science Research) methodology to design and develop a PMS-BI artifact for SMEs. This approach has both practical and scientific contributions. The DSR approach, in the first step, guided me to collect information from the literature and participants and ensured knowledge creation from both sources. Then, the creative and systematic artifact design phase of the DSR methodology helped me combine the ideas from literature and practice. Then, the evaluation phase of the DSR helped me assess the created artifact in the previous section against the participant's requirements. In this section, I described the contributions of this thesis to the SME and body of knowledge.

6.3.1.1 Practical Contribution to SMEs

The results of this thesis comprise the PMS-BI artifact package, which SMEs can use to define and develop their PMS-BI system. This package consists of:

- An executive summary for PMS-BI adoption and development
- A document to show the application of a PMS-BI artifact in an imaginary case
- A set of tools and guidelines to help SMEs evaluate and maintain their PMS and choose the necessary modules and components from my PMS-BI recommended module list

This package can help companies evaluate their current PMS status and find the necessary improvements. I purposefully developed the modular approach to make it easier and more convenient for SMEs to select the components that can add value to their PMS practices. One of the main problems with the monolithic approach to PMS, specifically for SMEs with limited time and budget, is that they do not provide the modules and components which can be adopted and implemented individually and wherever needed. For instance, if an SME finds out that it is doing weakly in the planning phase, but its activities in the execution and control are satisfactory, it can pick and add the planning modules and skip modifying the execution and control sub-system. Therefore, SMEs can manage their precious time and budget on the most critical improvements rather than an overall change to their current PMS.

Another significant contribution of this thesis and the guidance package is that SMEs can use it for employee training. The step-by-step and practical explanations make it a potentially good source of information for the whole company to learn how the PMS mechanism works and how they can contribute to the improvement practices.

6.3.1.2 Contribution to the Body of Knowledge

In addition to the contribution to the SMEs, this thesis exemplifies how design science research is an inclusive framework that uses multiple research methodologies to address a research problem through artifact development. Researchers often perceive DSR as a methodology to address technical problems within information science; however, my research has used DSR to address a practical problem within performance measurement and management. I tweaked the steps and procedures to adapt the DSR methodology for this study. In the information gathering and problem definition steps, I used two sources of knowledge: literature and practice. I compiled the information gathered from these sources into features of the system. Then through a creative process of artifact design, I combined these inputs to define the artifact's sub-systems, activities, and components. There is no standard approach in the literature to follow, so I designed my own approach.

Then in the evaluation phase, the conundrum was to answer this question: How can I evaluate an artifact that is not applied yet? After considering different solutions and brainstorming with supervisors, I decided to write a story of an imaginary case that uses my artifact to design and use the PMS-BI. Then I explained how this imaginary company used this artifact to step-by-step design and use it, what challenges they had, and how this artifact guideline and tools helped them solve their problems. This story helped participants imagine and evaluate the artifact using a usability questionnaire. These novel approaches can be replicated and modified in future studies to answer similar questions by other researchers.

In addition to the contribution of this thesis to the DSR field, the gaps identified in the literature about PMS-BI for SMEs can guide future studies. Future work needs to address this gaps by conducting theoretical and practical research. The DSR approach to the PMS-BI in this thesis can be a part of the research's future knowledge generation and problem awareness phases.

6.4 Recommendation for Future Studies

There are several opportunities for future studies. As shown in the DSR cycle (see Figure 3-1), design research is often an iterative process requiring one to revisit the initial phase until the complete redefinition and evaluation of the artifact. One opportunity is to revisit the “problem identification” phase by conducting a more in-depth literature review and conducting further interviews in wider scopes. This exploration could help obtain a more comprehensive and accurate

view of SMEs' PMS and business intelligence, resulting in better design features. These features will yield a more practical artifact design.

The most prominent potential for future research includes a more complex and comprehensive evaluation of the PMS-BI artifact. This evaluation may require applying various standard IS artifact evaluation procedures. After completing these additional evaluations, researchers can make modifications to improve the artifact.

One future experiment could examine the utility and adaptability of the PMS-BI artifact in a different context. Researchers can test the artifact in a significant company context. Then the results can be used to see if the artifact is adaptable to these companies or not. If the answer to this question is positive, what type of modifications should the researchers make. These types of experiments also can be conducted to test the adaptability of the artifact in companies with a lower level of IT implementation. Researchers can group these modifications into different tasks with various priorities.

Another significant opportunity for future studies is to apply different methodologies for the data gathering phase of the study. I collected the necessary information from only two sources of the literature and exploratory qualitative interview with participants. Researchers can use methods such as grounded theory or use cases to collect the information from the participating companies. These different designs could be more appropriate in the studies where the researchers have much more time or a closer connection to the cases.

Given that I developed the PMS-BI and evaluated it specifically to assist SMEs with their PMS design and development, one extension to this research is applying the PMS-BI to other management aspects, such as change management or digital transformation. Researchers can adapt the PMS-BI artifact to these studies by using it as a source of change in the organization and assessing the results or investigating the necessary transformation in an organization by using the evaluation tools and guidelines incorporated in the PMS-BI artifact package.

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Appendices

OECD's "A taxonomy of digital intensive sectors."

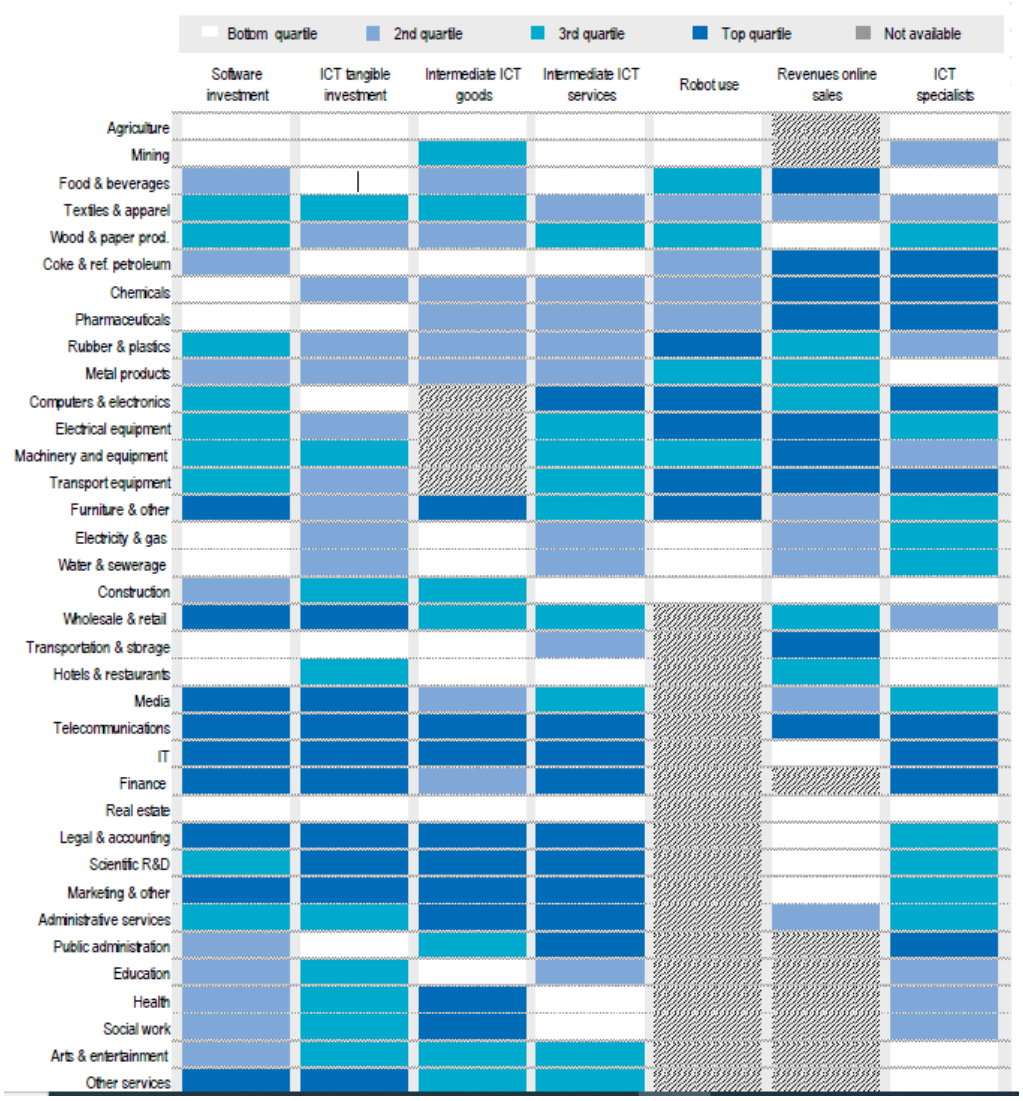


Figure A- 1: Sectoral taxonomy of digital intensity, by indicator, 2013-15; adapted from (Calvino et al., 2018)

Interview Questions

Terminology

PMS: Performance measurement is collecting, analyzing and/or reporting information regarding the performance of an individual, group, organization, system or component.

BI/BA: Business intelligence comprises the strategies and technologies used by enterprises for the data analysis of business information.

Questions:

1- Background

1-1 Can you please describe your role and your business responsibilities?

For how long have you worked in this role, and what position did you have before?

1-2 What are the main deliverables that you are responsible for? (Not for CEO)

1-3 Does your company have performance measurement, management, and BI/BA systems?

1-4 What is your experience with performance measurement and management in the current company?

1-5 What performance measures (KPIs, OKRs) are you using directly in your department/team (In your company; if CEO)?

2- PMS planning and definitions

2-1 What is your personal experience with the planning stage?

2-2 Is there any routine process for planning for PMS in your company?

If Yes:

2-2-1aWhich factors do you consider as success factors for the planning process?

2-2-2a What are the challenges or barriers to the planning process?

2-2-3a Which teams or persons are responsible for the planning?

2-2-4a Was the planning experience positive or negative? Why?

If No:

2-2-1b If your company does not have a planning phase, why not? What prevents planning?

2-2-2b What conditions and supports need to be in place to mitigate the problem?

3- PMS design and validation

3-1 Can you tell me about your experience with the PMS design and KPIs definition in your current company?

3-2 What type of decisions do you support with the PMS?

3-3 What measures and which KPIs are used?

3-4 Which tools and systems are in place?

3-5 What is the process of design and development of PMS? Is there any standard methodology?

3-6 Who is responsible for designing and developing the measurement system?

3-7 What was the validation process for the designed PMS and defined KPIs?

3-8 Was the experience positive or negative? Why?

3-9 If your company does not measure the performance as intended, why not? What are the problems and issues?

3-10 What conditions and supports need to be in place to mitigate the problems?

4- Technological infrastructure and BA-BI tools and techniques

4-1 Which tools and techniques are you using for BI/BA**?**

4-2 What is your experience with the company's BA and BI tools and techniques?

4-3 Is there any process and routine in selecting and using the tools and applications? How do you use them?

4-4 Which teams or persons are responsible for the tool selection and validation?

4-5 Which teams and persons are responsible for the BA and BI tools application? Who puts data? Who makes the analysis? Who makes decisions based on the analysis?

4-6 Is your experience with these tools positive or negative? If positive, what are the positive points and if negative, what are the negative points?

5- PMS and BA Integration:

5-1 In your opinion, how PMS and BI-BA can be integrated into one system?

5-2 Which BI-BA capabilities are aligned with PMS?

5-3 What capabilities are required for PMS but not supported by BI-BA tools and techniques?

5-4 What can go wrong with the integration? How can these problems be mitigated?

5-5 What are the opportunities with this integration?

5-6 Which teams and persons should be responsible for the integration?

6- Human resources and management support

Management support

6-1 Is the management team supportive of the PMS? What about the BI and BA?

6-2 Who is responsible for the PMS and BA? Who supervises the process?

6-3 Do you think that the level of support is sufficient?

Human resource

6-4 Is there any routine and process for training?

6-5 Is there any process for documenting and sharing the knowledge and experience?

6-6 Do you get feedback and comments about the PMS and BA from employees?

6-7 In your opinion, is your company knowledgeable and experienced with the PMS and BA?

6-8 Is any issue with management support and human resources related to the PMS and BA? If yes, how can it be fixed?

Themes Extracted from Interviews

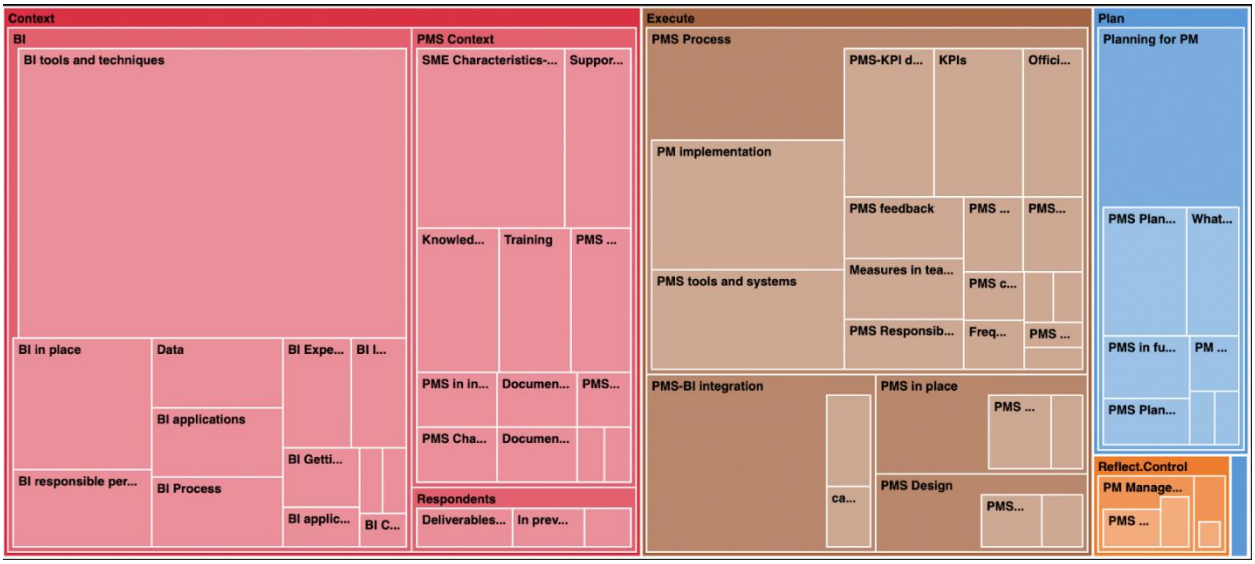


Figure A- 2: Themes extracted from interviews (Nvivo export)

List of Themes

Table A-1: List of themes

Context	*Files*	*References*
BI	1	1
BI and BA Teams	1	1
BI application experience	1	2
BI applications	4	6
BI Characteristics	1	1
BI Experience	4	5
BI Getting Support	2	3
BI Improving	2	4
BI in place	3	6
BI in Departments	5	6
BI Planning	1	1
BI Process	2	4
BI introduction	1	2
BI responsible personnel	6	7
BI tools and techniques	10	26
BI tools and techniques selection responsible	5	8
BI tools instances	10	28
BI tools selection routine	6	6
BI tools validation	4	6
Data	2	2
Data Characteristics	1	1
Data comes from	2	2

Data store	1	1
PMS Context	0	0
Documentation	3	3
Documentation-Knowledge management	3	3
Knowledgeable Employee	1	1
Knowledgeable HR	7	8
Knowledgeable Management	1	1
PMS Challenges-Barriers	2	3
PMS Characteristics-Dynamics	3	6
PMS in industries	1	3
PMS Initiation-Management support	2	2
SME Characteristics-dynamics	3	12
PMM problem and issues in SMEs	1	3
SME vs. Big Company	1	1
Things are changing a lot	2	2
Support from outside	6	8
Training	7	7
Respondents	0	0
Deliverables by respondent	3	3
In previous company	2	3
PMS Past Experience	2	2
Execute	0	0
PMS Design	5	5
PMS Design and Definition Standard methodology	2	2
PMS Design Validation	3	3
PMS in place	6	7

PMS in place for departments-teams	2	2
PMS in teams	2	4
PMS Process	6	12
Frequency of measurement	1	1
Team meeting	1	1
KPI Validation Process	1	1
KPIs	7	9
Measures in team-department	4	5
Official measurement process	3	3
Measurement documentation	1	1
What do they measure	1	2
PM implementation	3	6
PMS implementation level	4	9
Support of management for the PMS	2	2
PMS condition-Support	2	2
PMS Experience (Positive or Negative)	2	3
PMS feedback	4	5
PMS Goal Setting	1	1
PMS Meetings	1	1
PMS Responsible personnel	3	4
PMS Review	1	1
PMS Standard Process	2	3
PMS tools and systems	9	13
PMS-KPI definition and Decision support	2	4
Decision Based on the PMS	2	2
KPI Definition	1	2

Responsible for PMS and KPI Definition	1	1
PMS-BI integration	8	20
capabilities are required for PMS but not supported by business analytics	2	2
PMS-BI integration responsible person	2	3
Plan	0	0
Planning for PM	8	16
PM Planning Responsiblities	2	2
PMS in future	3	4
PMS Planning Challenges-Barriers	7	8
PMS Planning Success Factors	3	3
PMS Planning Support and conditions	1	1
PMS Validation	1	1
What condition-support needs to be in place for pm Planning	4	5
Reflect.Control	0	0
PM Management	1	1
PMS and Decision Support	3	3
PMS CEO involvement	1	2
PMS Monitoring	1	1
PMS Monitoring intervals	1	1

Artifact Evaluation Questionnaire (Usability Testing)

This survey will measure the perceived usefulness, ease of use, and self-predicted future usage of the PMS-BI artifact.

In this survey, the " artifact " refers to the PMS-BI system, the guidance documents, and the provided tools and templates.

* Your response will be kept anonymous.

1. Using PMS-BI Artifact in my job would enable me to accomplish tasks more quickly.

- o Very unlikely
- o Unlikely
- o Somewhat unlikely
- o Neither likely nor unlikely
- o Somewhat likely
- o Likely
- o Very likely

2. Using PMS-BI Artifact would improve my job performance.

- o Very unlikely
- o Unlikely
- o Somewhat unlikely
- o Neither likely nor unlikely
- o Somewhat likely
- o Likely
- o Very likely

3. Using PMS-BI Artifact in my job would increase my productivity.

- o Very unlikely
- o Unlikely
- o Somewhat unlikely
- o Neither likely nor unlikely
- o Somewhat likely
- o Likely
- o Very likely

4. Using PMS-BI Artifact would enhance my effectiveness on the job.

- o Very unlikely
- o Unlikely
- o Somewhat unlikely
- o Neither likely nor unlikely
- o Somewhat likely
- o Likely
- o Very likely

5. Using PMS-BI Artifact would make it easier to do my job.

- o Very unlikely

- Unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Likely
- Very likely

6. I would find PMS-BI Artifact helpful in my job.

- Very unlikely
- Unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Likely
- Very likely

7. Learning to operate PMS-BI Artifact would be easy for me.

- Very unlikely
- Unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Likely
- Very likely

8. I would find it easy to get PMS-BI Artifact to do what I want.

- Very unlikely
- Unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Likely
- Very likely

9. My interaction with PMS-BI Artifact would be clear and understandable.

- Very unlikely
- Unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Likely
- Very likely

10. It was easy to become skillful using PMS-BI Artifact.

- Very unlikely

- Unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Likely
- Very likely

11. It is easy to remember how to perform tasks using PMS-BI Artifact.

- Very unlikely
- Unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Likely
- Very likely

12. I would find PMS-BI Artifact easy to use.

- Very unlikely
- Unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Likely
- Very likely

13. Assuming PMS-BI Artifact would be available on my job, I predict that I will use it on a

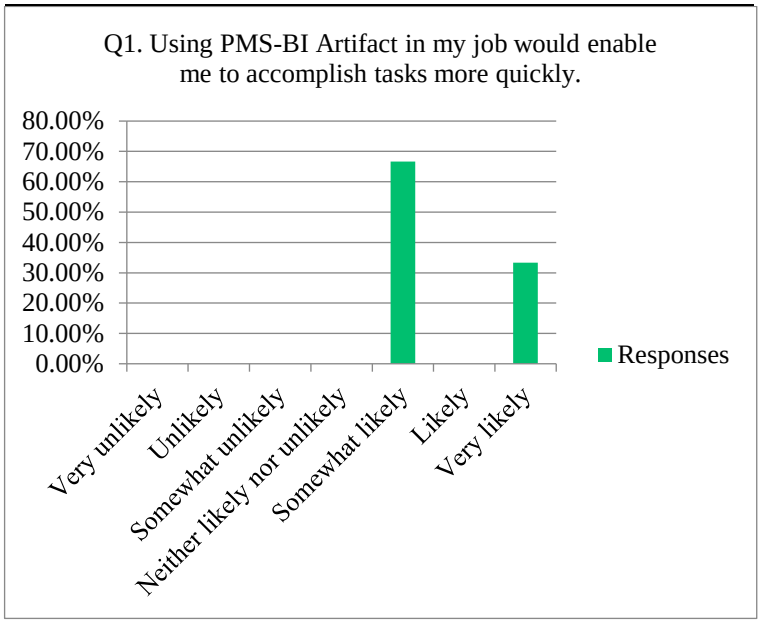
- Regular basis in the future.
- Very unlikely
- Unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Likely
- Very likely

14. Would you prefer to perform inspections paper-based or using PMS-BI Artifact?

- I will **very unlikely** use PMS-BI
- I will **unlikely** use PMS-BI
- I will **somewhat unlikely** use PMS-BI
- I will **neither likely nor unlikely** use PMS-BI
- I will **somewhat likely** use PMS-BI
- I will **likely** use PMS-BI
- I will **very likely** use PMS-BI

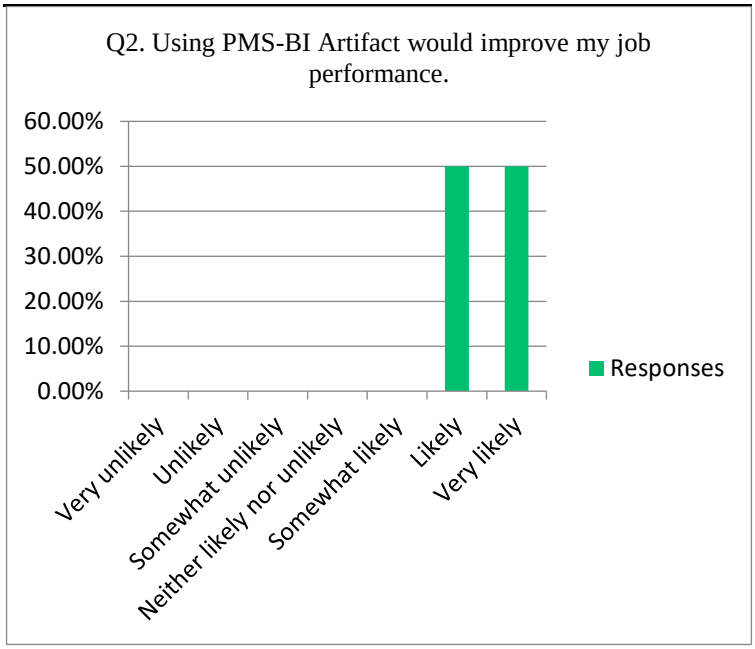
Evaluation Results

Q1. Using PMS-BI Artifact in my job would enable me to accomplish tasks more quickly.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	0.00%	0
Neither likely nor unlikely	0.00%	0
Somewhat likely	66.67%	4
Likely	0.00%	0
Very likely	33.33%	2
	Answered	6
	Skipped	0



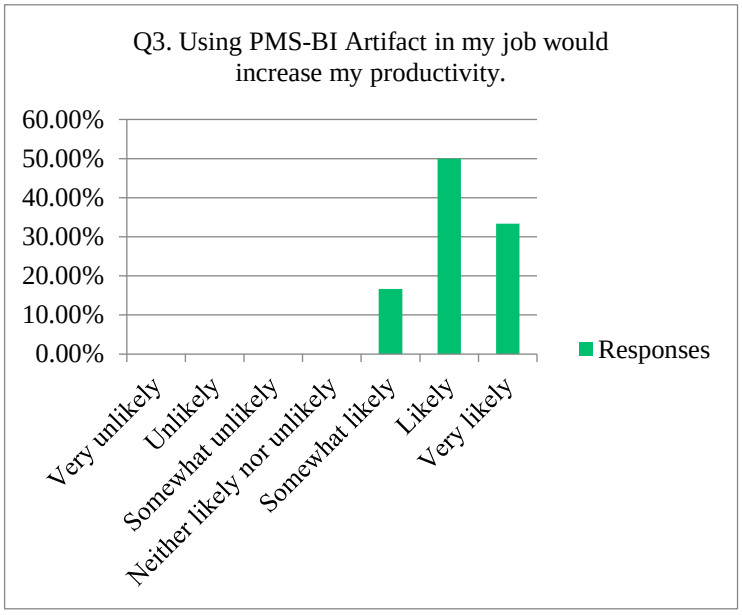
Q2. Using PMS-BI Artifact would improve my job performance.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	0.00%	0
Neither likely nor unlikely	0.00%	0

Somewhat likely	0.00%	0
Likely	50.00%	3
Very likely	50.00%	3
	Answered	6
	Skipped	0

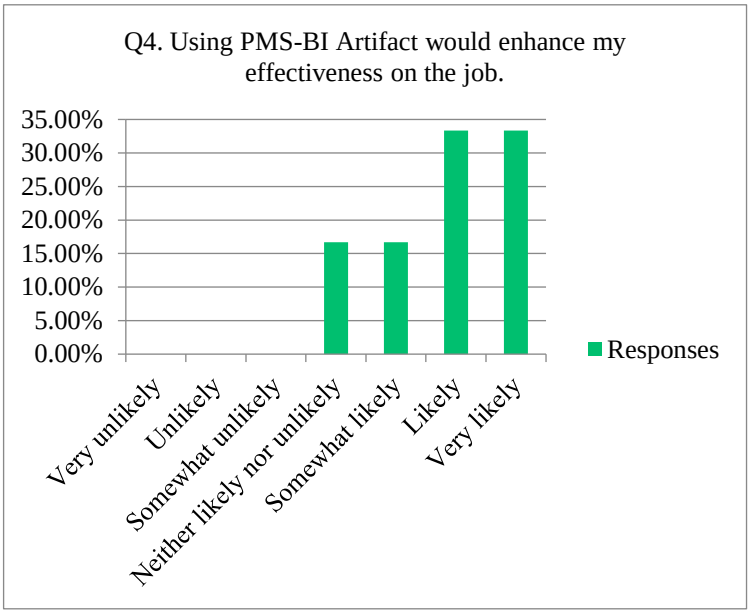


Q3. Using PMS-BI Artifact in my job would increase my productivity.

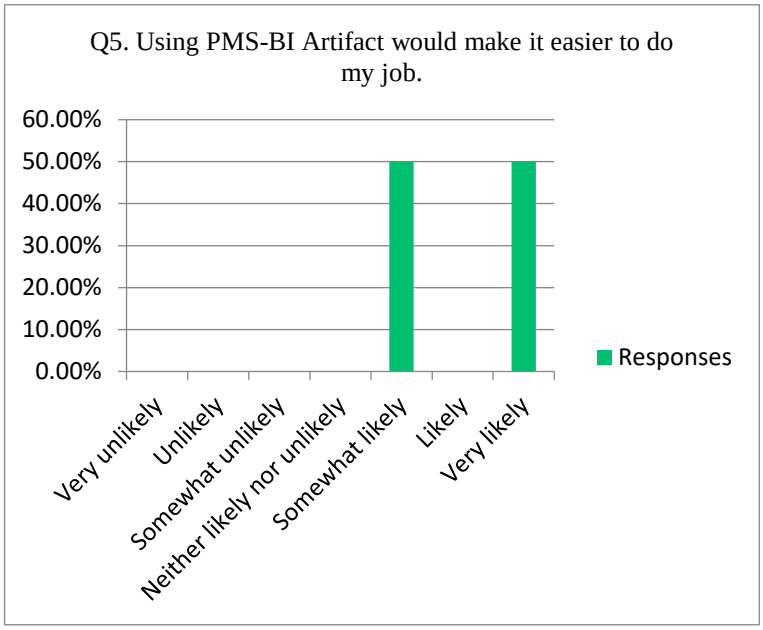
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	0.00%	0
Neither likely nor unlikely	0.00%	0
Somewhat likely	16.67%	1
Likely	50.00%	3
Very likely	33.33%	2
	Answered	6
	Skipped	0



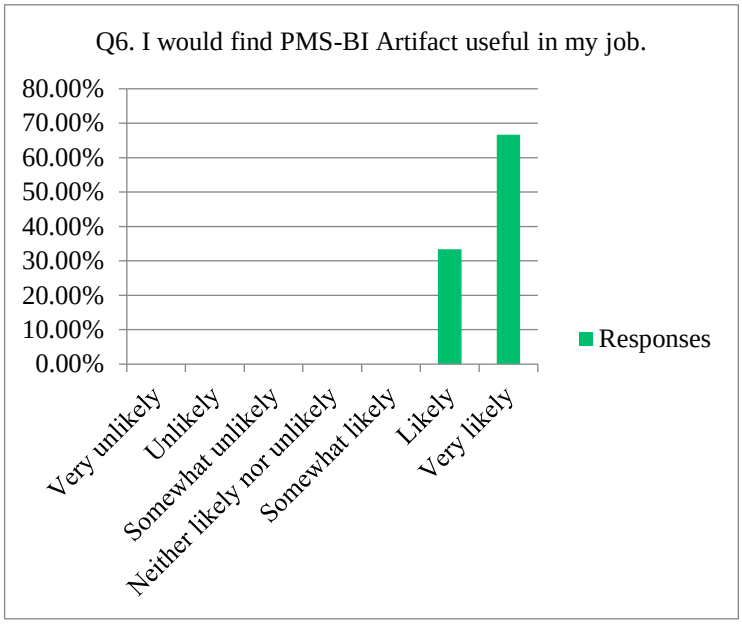
Q4. Using PMS-BI Artifact would enhance my effectiveness on the job.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	0.00%	0
Neither likely nor unlikely	16.67%	1
Somewhat likely	16.67%	1
Likely	33.33%	2
Very likely	33.33%	2
	Answered	6
	Skipped	0



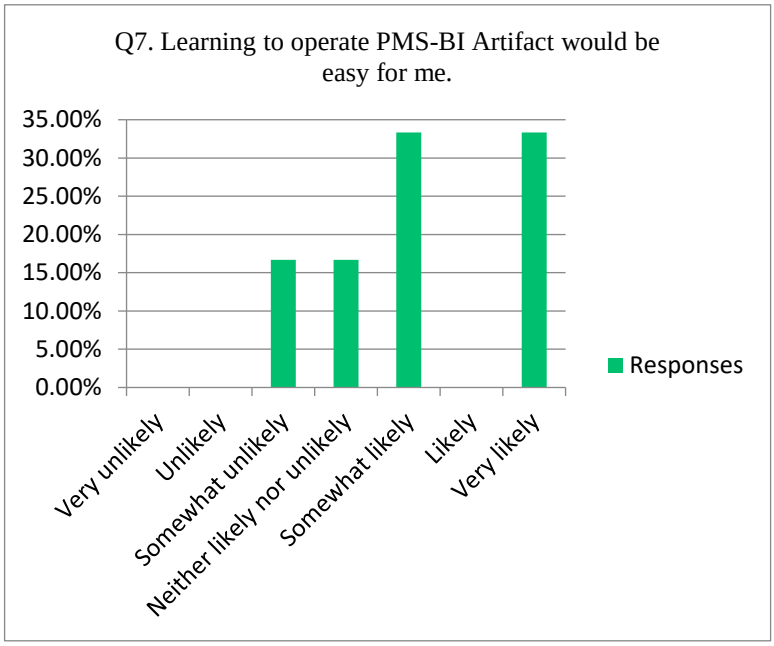
Q5. Using PMS-BI Artifact would make it easier to do my job.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	0.00%	0
Neither likely nor unlikely	0.00%	0
Somewhat likely	50.00%	3
Likely	0.00%	0
Very likely	50.00%	3
	Answered	6
	Skipped	0



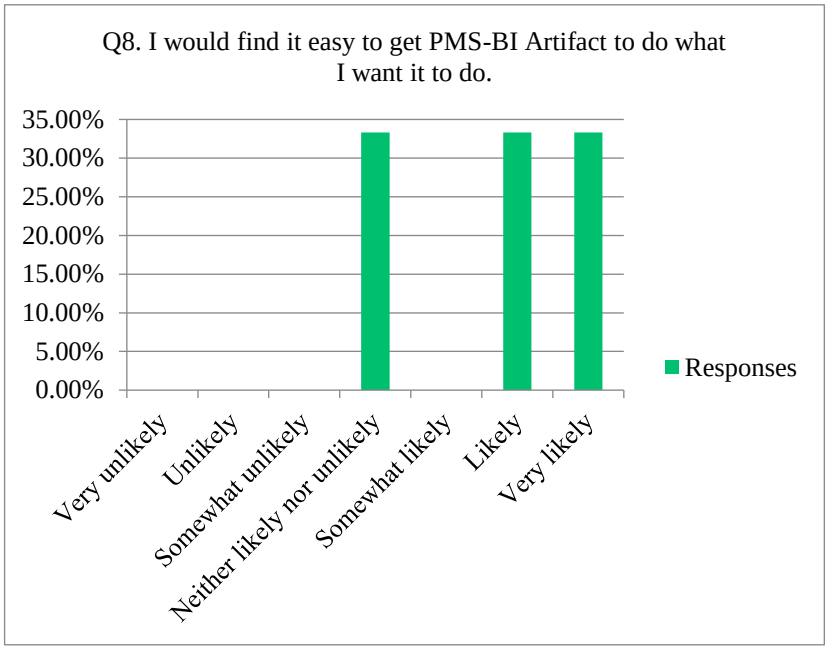
Q6. I would find PMS-BI Artifact helpful in my job.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	0.00%	0
Neither likely nor unlikely	0.00%	0
Somewhat likely	0.00%	0
Likely	33.33%	2
Very likely	66.67%	4
	Answered	6
	Skipped	0



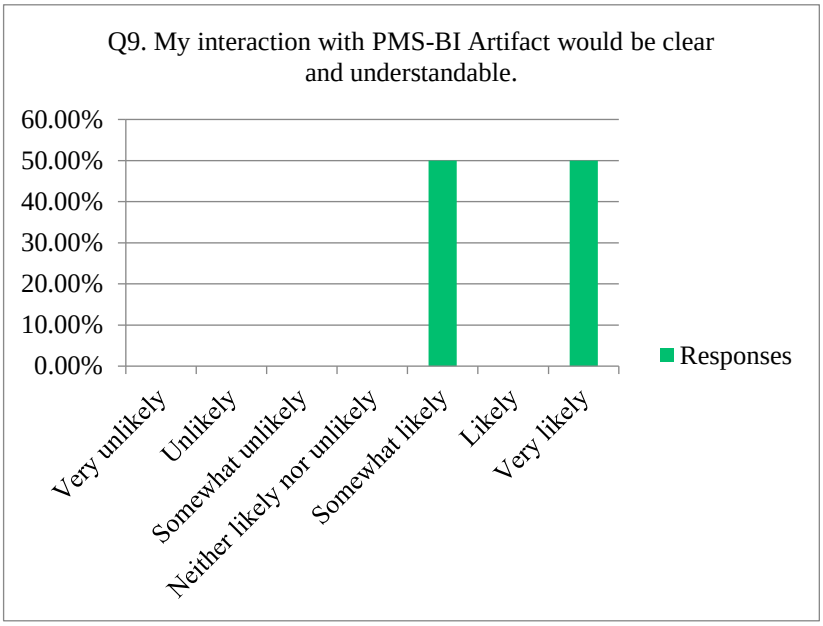
Q7. Learning to operate PMS-BI Artifact would be easy for me.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	16.67%	1
Neither likely nor unlikely	16.67%	1
Somewhat likely	33.33%	2
Likely	0.00%	0
Very likely	33.33%	2
	Answered	6
	Skipped	0



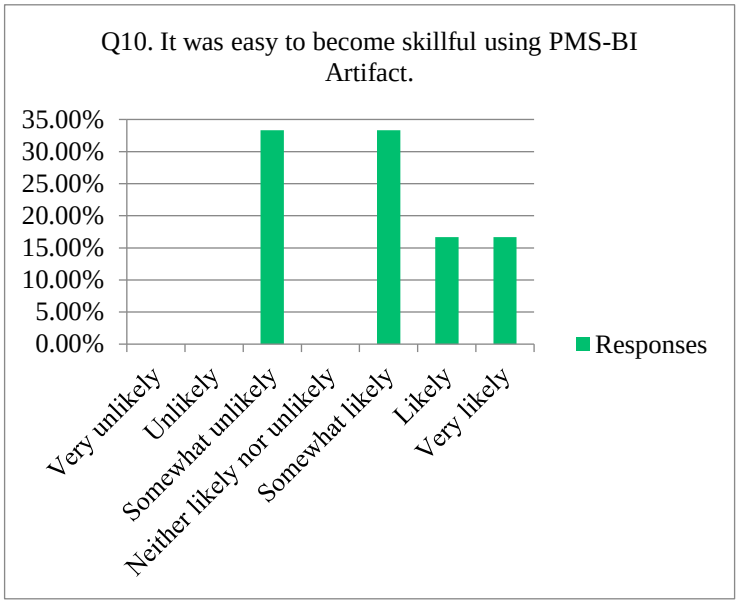
Q8. I would find it easy to get PMS-BI Artifact to do what I want.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	0.00%	0
Neither likely nor unlikely	33.33%	2
Somewhat likely	0.00%	0
Likely	33.33%	2
Very likely	33.33%	2
	Answered	6
	Skipped	0



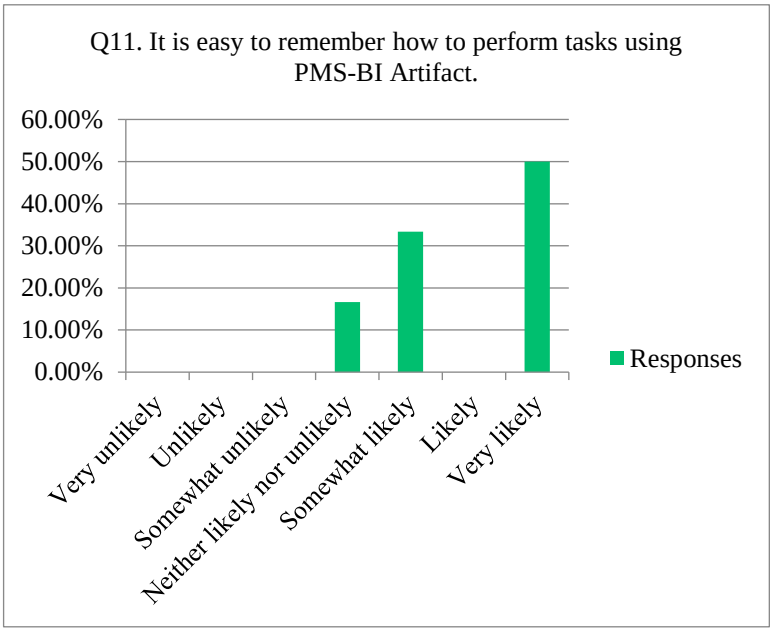
Q9. My interaction with PMS-BI Artifact would be clear and understandable.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	0.00%	0
Neither likely nor unlikely	0.00%	0
Somewhat likely	50.00%	3
Likely	0.00%	0
Very likely	50.00%	3
	Answered	6
	Skipped	0



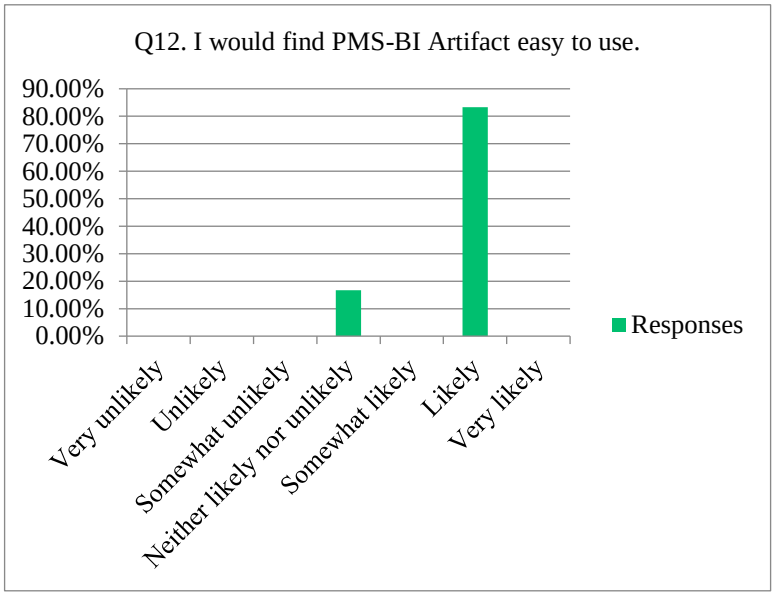
Q10. It was easy to become skillful using PMS-BI Artifact.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	33.33%	2
Neither likely nor unlikely	0.00%	0
Somewhat likely	33.33%	2
Likely	16.67%	1
Very likely	16.67%	1
	Answered	6
	Skipped	0



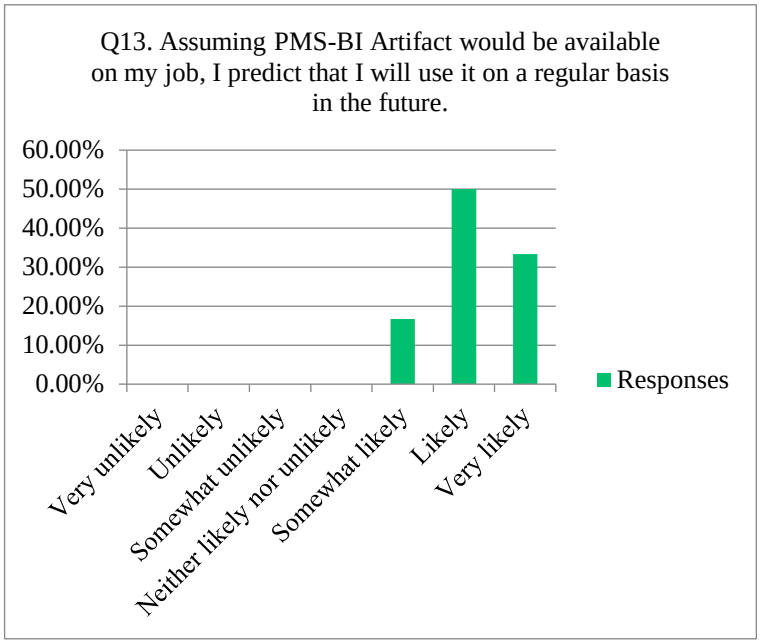
Q11. It is easy to remember how to perform tasks using PMS-BI Artifact.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	0.00%	0
Neither likely nor unlikely	16.67%	1
Somewhat likely	33.33%	2
Likely	0.00%	0
Very likely	50.00%	3
	Answered	6
	Skipped	0



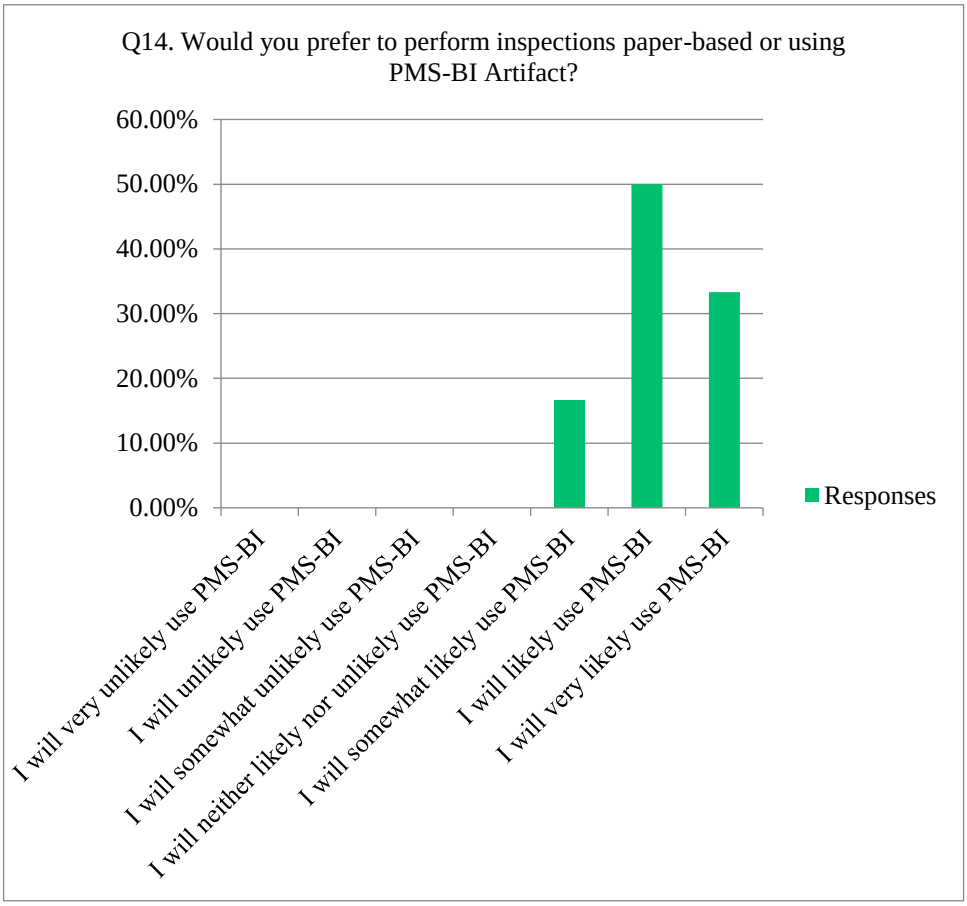
Q12. I would find PMS-BI Artifact easy to use.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	0.00%	0
Neither likely nor unlikely	16.67%	1
Somewhat likely	0.00%	0
Likely	83.33%	5
Very likely	0.00%	0
	Answered	6
	Skipped	0



Q13. Assuming PMS-BI Artifact would be available on my job, I predict that I will use it regularly in the future.		
Answer Choices	Responses	
Very unlikely	0.00%	0
Unlikely	0.00%	0
Somewhat unlikely	0.00%	0
Neither likely nor unlikely	0.00%	0
Somewhat likely	16.67%	1
Likely	50.00%	3
Very likely	33.33%	2
	Answered	6
	Skipped	0



Q14. Would you prefer to perform inspections paper-based or using PMS-BI Artifact?		
Answer Choices	Responses	
I will very unlikely use PMS-BI	0.00%	0
I will unlikely use PMS-BI	0.00%	0
I will somewhat unlikely use PMS-BI	0.00%	0
I will neither likely nor unlikely use PMS-BI	0.00%	0
I will somewhat likely use PMS-BI	16.67%	1
I will likely use PMS-BI	50.00%	3
I will very likely use PMS-BI	33.33%	2
	Answered	6
	Skipped	0


Q14. Would you prefer to perform inspections paper-based or using PMS-BI Artifact?
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
I will very unlikely use PMS-BI
I will unlikely use PMS-BI
I will somewhat unlikely use PMS-BI
I will neither likely nor unlikely use PMS-BI
I will somewhat likely use PMS-BI
I will likely use PMS-BI
I will very likely use PMS-BI
Responses

PMS-BI Artifact Document

Package Introduction

This package aims to provide instructions and guidance on designing and using a performance management system based on business intelligence in your organization.

This package consists of two documents and a spreadsheet:

- An execution summary document
- An imaginary company cases
- A spreadsheet containing the analysis tools

Following the instructions, you will be allowed to:

- Assess your current performance management system
- Find out the weaknesses of your current system
- Follow a systematic approach to improve your system
- Adding or improving the necessary modules based on the assessments - Using the system
- Maintaining and evolving the system

PMS-BI Executive Summary

A PMS-BI is a performance measurement and management system based on business intelligence tools and techniques. This document provides guidance and necessary information to implement and use a PMS-BI effectively. We call the PMS-BI system and the guidance document the "artifact." This artifact is designed following the characteristics and constraints of an SME. Following the proposed steps, you can investigate your current performance measurement and management system and improve it by systematically adding BI tools and techniques. The modular design of the proposed system allows you to select and implement only the necessary parts and gradually evolve your performance measurement and management system.

This document starts with an introduction to the architecture of the PMS-BI and dissects it into its subsystems and proposes performance measurement and management activities and their sequences throughout a year. Then it presents a PMS-BI lifecycle which consists of adoption decision, acquisition, implementation, use, maintenance, and evolution phases. These phases walk you through a systematic approach from the adoption to the evolution stages of a PMS-BI system. Different tools and guidance are provided in each phase to facilitate the process. This document concludes with a summary of the values and benefits of using it for SMEs.

PMS-BI

A performance management system comprises three subsystems: **Plan**, **execute**, and **control**. These subsystems work together to conceptualize the company's strategies, translate these strategies into actionable objectives and goals, measure the individual and team's performance toward achieving these goals and control the actions through timely feedback and performance reports. Integrated Business Intelligence (BI) systems make this process more efficient and effective. BI allows leaders to have a more comprehensive view of the internal and external environment, which lets leaders have complete control over the company's performance. Managers can benefit from this integrated system by better understanding the strategies and objectives and controlling their team's performance toward the company's overall objectives. These systems also provide a more democratized and decentralized information system in which employees can better understand the objectives and goals, define and pursue their own development goals, and ultimately feel themselves contributing to the organization's overall success.

This section will introduce the subsystems and propose performance measurement and management activities.

PMS-BI Architecture

A Performance Management System (PMS) is a set of managerial activities to measure and manage the company's and individuals' performance. A typical PMS comprises a three-step cycle. This cycle starts with the planning activities, continues with the execution process and ends with the control procedures. By reviewing the past year's outcome, this loop continues to evolve each year.

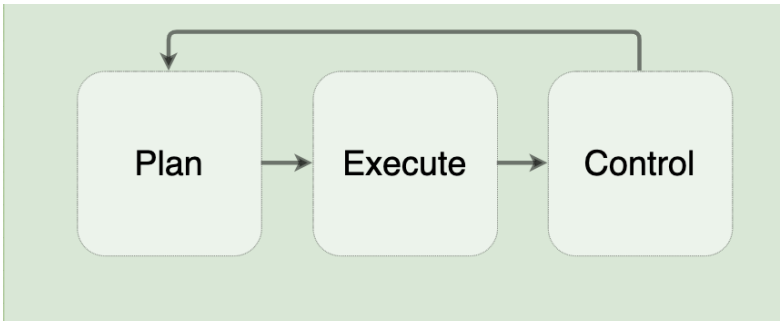


Figure A- 3: A PMS Cycle

Performance management is usually built on top of an information technology layer. This layer consists of interconnected systems such as the legacy organizational systems and the business intelligence and analytics platforms. In this artifact, we consider business analytics (BA) as a part of the business intelligence (BI) system.

The data also comes from a data layer consisting of internal data and can be connected to capture and transfer external data.

Different users also interact with this system differently and throughout different stages. Leaders, managers and employees are connected directly to the PMS layer. They are also involved with the operation and management of the other layers, but for the sake of simplicity, we focus on their relationship with the PMS layer.

After adding the BI and data layer and the system players, the comprehensive and simplified system design is as follows.

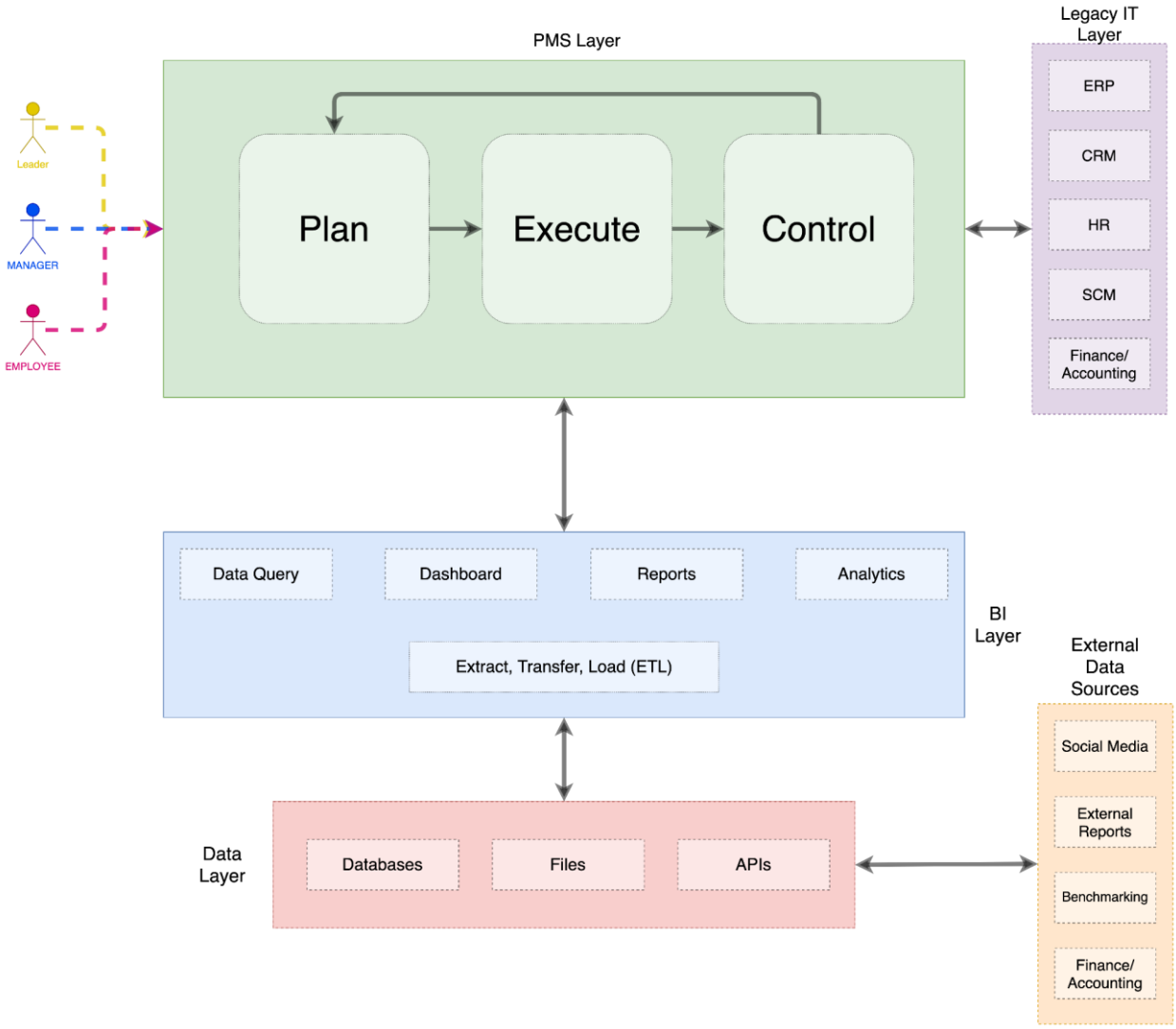


Figure A-4: PMS-BI information system

PMS-BI Subsystems

Plan

The planning subsystem consists of three main components: Prerequisites, annual, and quarterly. These components are the managerial activities needed to prepare and plan the performance management procedure.

Prerequisite planning

Prerequisite planning is a managerial activity that involves leaders and managers. This component usually takes place along with the annual planning. Its components are Strategic planning and Work definition.

Data query, visualization and generated reports are the BI functions guiding the leaders and managers to make better decisions and set more accurate strategic plans. The previous year's performance also defines the work definition.

Annual planning

The annual planning consists of activities and processes to review and prepare the "Objective setting" and "Personal development planning" components. Leaders and managers are usually involved in this component.

Leaders and managers use visualization, reports and analytics to set objectives based on the strategic plans and other inputs. The individual activities also guide the personal development plan.

Quarterly planning

The quarterly planning mainly consists of quarterly objective setting. Managers and Employees are involved in this activity every quarter.

Analytics, visualization, and reports are inputs that help managers and employees make better decisions and set more effective and efficient objectives.

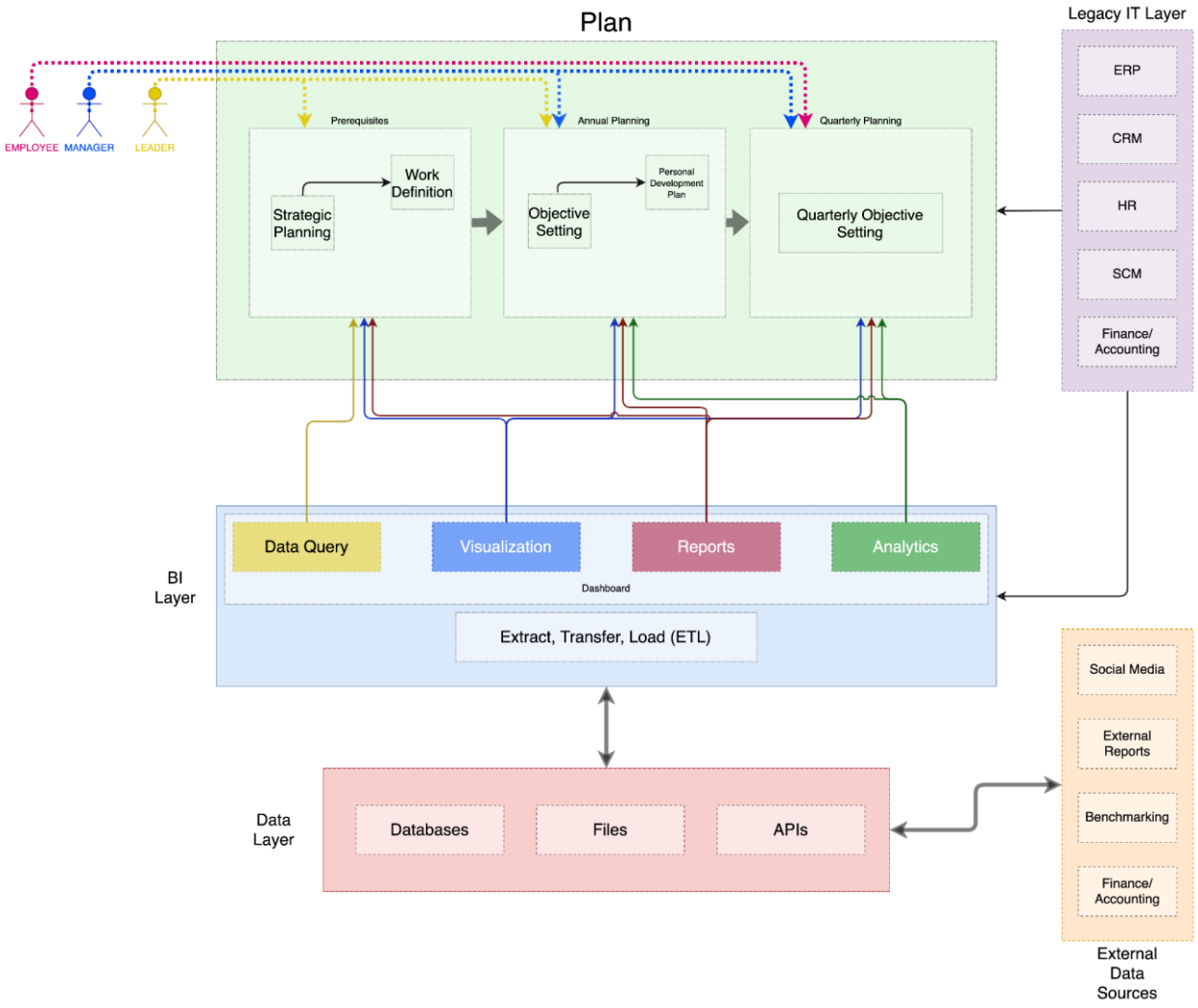


Figure A-5: Plan subsystem and connections to other layers

Execute

An execute system consists of Design, Build, and Measure cycles. Each component also comprises different activities and processes.

Design

The performance measurement and management execution subsystem is an ongoing process that starts by reviewing and understanding leaders' strategic goals and objectives. Then KPIs or OKRs are designed by translating the objectives into the measures and setting targets.

Build

The Build subsystem then creates and maintains the report format and reporting procedure. This report is shared with the leaders and other managers periodically. Another activity in the build

phase is building and implementing the KPIs or OKRs and the user interfaces. The user interfaces can be BI dashboards, graphics, and charts.

Measure

KPIs or OKRs are measured in the measure phase, and the user interface is maintained. Employees and IT personnel work together to keep the process running smoothly and update the dashboards and measures regularly based on the manager's feedback.

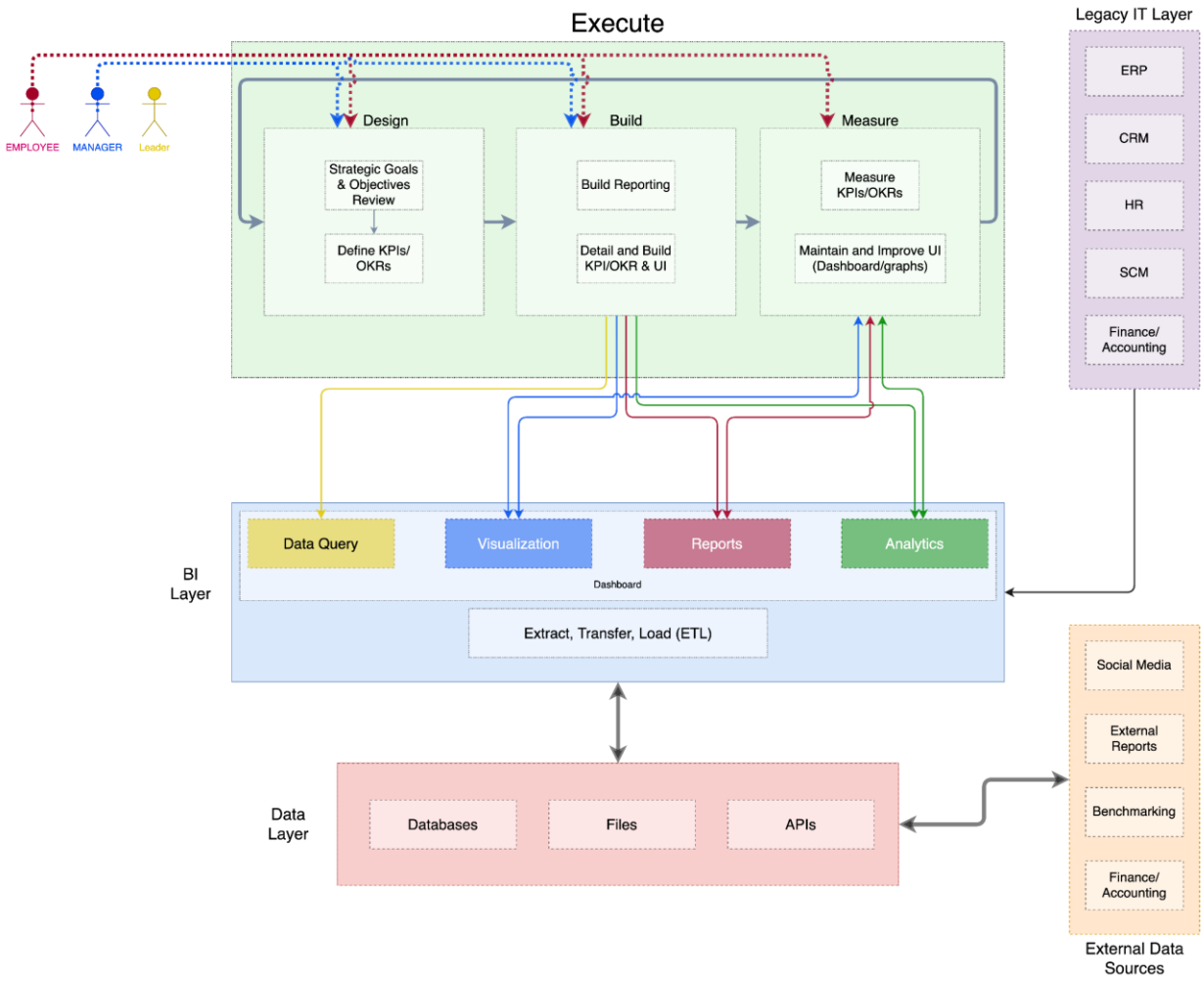


Figure A-6: Execute subsystem and connections to other layers

Control

The control subsystem consists of the Employee review and reward process, Performance feedback.

Employee Review and Reward

The employee feedback component reviews the individual employee performance and rates them based on the work definition and performance achievements. Managers are actively performing the review and set rewards based on that. It uses visualization and data query to review the performance and the individual achievements.

Performance Feedback

The performance feedback component consists of team and department performance review and feedback and the performance report creation and update. Managers and leaders do the ongoing review and give feedback to the employee. They use visualization, reports, and analytics as decision support tools and reflect the performance in reports.

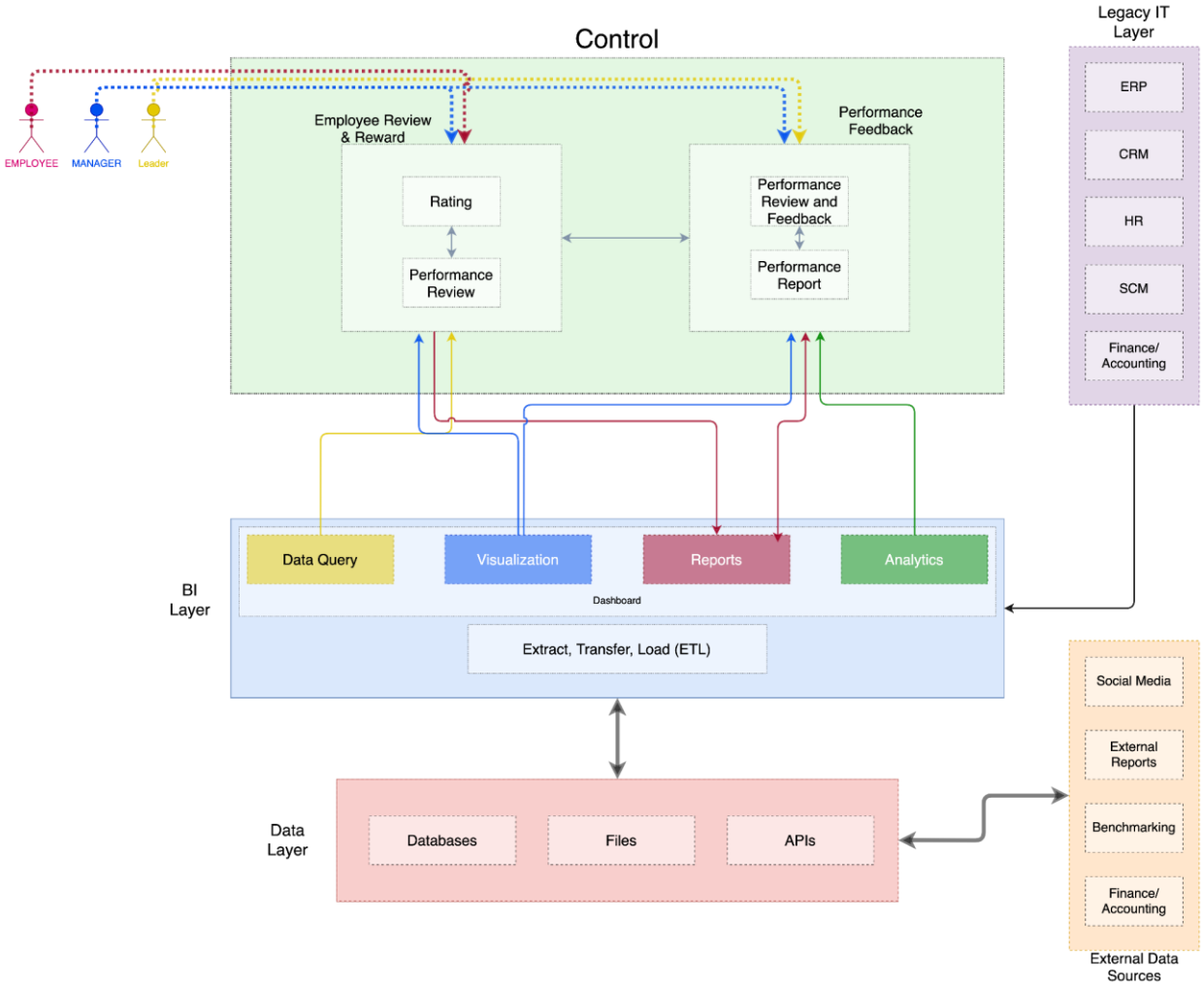


Figure A-7: Control subsystem and connections to other layers

Activities

In this section, we will explain the main activities and their timelines.

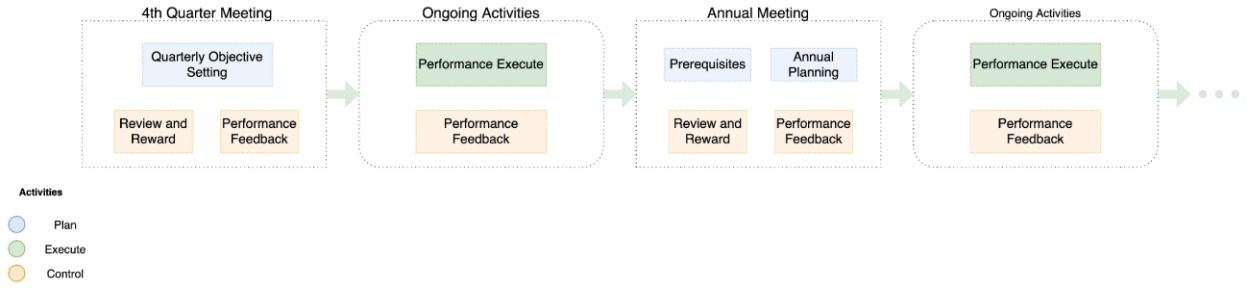


Figure A-8: Performance measurement and management activities throughout a year

Annual Meeting

A few days before starting the annual meeting, or on the same day, prepare for the leader's prerequisite meeting. This meeting is about understanding and creating the company's strategic planning. Usually, the leaders are only involved with this activity. Senior managers can be added to this meeting if their experience and knowledge are necessary for more effective strategic planning. The second important activity is work definition. Work definition is essential in case new roles and responsibilities need to be introduced to the company in the coming year.

The next stage is holding the annual performance meeting. The annual performance meeting can be part of the company's annual meeting or can be held in a separate meeting. The main activity of this meeting is to set the performance objectives and review and define the personal development plans. The input for this stage comes from the team's performance reports and reviews that are part of the control subsystem. Personal performance reviews and reward reports are also gathered from the control subsystem to help work definitions and objective settings.

Ongoing Activities

There are also ongoing activities for performance measurement and management. The performance execution, performance review, and feedback activities are done throughout the year, and everyone is involved. These activities are related to real-time performance measurement, monitoring and ensuring that the company operates efficiently and effectively toward strategic goals and objectives.

Quarterly Meetings

The activities in the quarterly meeting are primarily concerned with the quarterly objective review and setting an objective, giving the performance feedback to the managers and reviewing employee performance. Setting rewards are activities from the control subsystem.

PMS-BI Life Cycle

The PMS-BI life cycle consists of six phases. These phases are as follows.

Adoption decision, acquisition, implementation, use, maintenance, and evolution. Each phase consists of different activities and processes. Multiple tools and documents have been created and suggested for each phase to help leaders and managers understand and implement the process successfully.

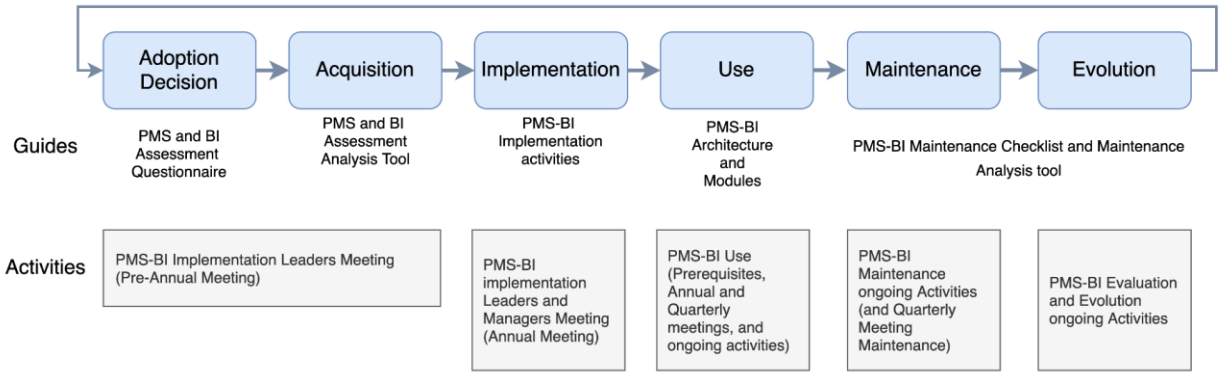


Figure A-9: PMS-BI life cycle

Adoption Decision Phase

In this phase, leaders question the need for an improvement to the current system or the adoption of a new system that addresses the business challenges and improves the operations toward achieving the strategic goals. This decision phase includes the definition of system requirements, their goals and benefits, and an assessment of the impact of adoption at a business and organizational level.

This artifact guides leaders in assessing their current PMS and analyzing their BI systems' readiness.

PMS-BI Assessment

Before using the system, the assessment questionnaire helps companies spot issues in their current system and highlight the places that need improvement. The PMS-BI assessment consists of two main parts. The PMS assessment and BI assessment. The PMS assessment questionnaire shows which part of the company's current PMS needs improvement and which module must be modified or implemented. The BI assessment outlines the company's BI system readiness and illustrates the weaknesses.

You can find the PMS-BI assessment questionnaire in the "Appendix" section.

Acquisition Phase

This phase comprises the PMS-BI module selection that best fits the organization's requirements. The "assessment analysis tool" outlines the aspects of current PMS to be improved.

An external consultant can facilitate this selection by providing guidance and information. Factors such as return on investment, training for the managers and employees, and maintenance services also need to be analyzed.

PMS-BI Assessment Analysis Tool

The PMS-BI assessment tool is a simple table that translates the questionnaire results into recommended improvements. These improvements are also linked to the corresponding PMS-BI modules, which can be selected in the "Acquisition phase" and are candidates for potential implementation.

The PMS-BI assessment questionnaire and assessment analysis tool are in the "Appendix" section.

Implementation phase

After selecting the modules to be implemented or the aspects of the current system to be improved, the leaders should make the decisions and plan for the implementation. The "PMS-BI Implementation Activities" chart shows the decisions and essential activities necessary to implement the new PMS-BI and their sequences.

You can find the "PMS-BI Implementation Activities" in the Appendix section.

Use phase

After completing the implementation phase, the company will move forward to the use phase. The use phase consists of subsystem activities and modules. These modules and activities are described in the PMS-BI architecture, and more explanations are provided in the "Module explanation" section in the Appendix.

Maintenance phase

The maintenance phase consists of ongoing activities to find the issues and plan for improvement.

"PMS Maintenance Checklist" shows the maintenance criteria, the corresponding questions to be answered and the modules that need improvements.

This checklist can be used every quarter to understand the quality of the current system and the aspect of the system which needs improvements.

The "PMS-BI Use and Maintenance Checklist" can be found in the Appendix.

Evolution phase

After implementing the system and getting feedback from users and managers, the executive team must prepare a document that highlights the pros and cons of the system and how this system can be improved. The "Use and Maintenance Checklist" can be used for this purpose.

Leaders must then document and review the activities in this checklist quarterly and annually.

Values of the Artifact

This artifact adds value to the PMS system of the companies in many ways.

Easy to use

This artifact is easy to implement and use. Guidelines, processes and procedures recommended in this artifact walk the users through the necessary steps to introduce the system and use it in total capacity or a limited pilot test.

This artifact's simplistic approach is tailored to SMEs' requirements and restrictions. The characteristics of SMEs, such as lack of overall experience in using large-scale and holistic performance measurement and management systems, limited time and budget and rapid growth, make it critical only to adopt a system that requires less cumbersome and sophisticated procedures. One of the most critical factors in the acceptability and usefulness of systems is how easy they are for the users.

Cost

This artifact is designed to cut unnecessary expenses or rely excessively on external sources such as long-term consultations and acquiring large-scale software and tools. SMEs can start using this system by acquiring annual subscriptions to a few tools and applications. Other costs are internal and can be managed easily. Small companies and startups can benefit from this low-budget system.

Communication

One of the main problems of SMEs related to performance measurement and management is unclear and inadequate communication between teams or departments. Utilizing the integrated dashboard and collaborating applications makes it easier for users to communicate the objectives and have better communication over the performance of their teams and the company's overall performance. Moreover, collaboration tools such as Miro help companies communicate their strategies and objectives more efficiently and effectively.

Holistic PM

This artifact helps companies have a better and more holistic approach to the performance measurement and management of the company. Communicating tools and mediums provide a place for conversations with departments and define objectives that efficiently measure the activities and operations needed to achieve the company's strategic goals. Different departments now share and communicate their KPIs and get feedback from other departments and the leading team.

Systematic Approach

This artifact is designed with the purpose of modularity and scalability. The systematic approach to performance measurement, management, and business intelligence makes it easier for companies to select and implement the modules they need and focus on the critical processes for a successful performance management activity. This artifact guides SMEs to implement, maintain and evolve their performance measurement and management systems.

Scalability

This system is also highly scalable. SMEs require more flexibility and scalability to adapt the system to its ongoing and evolving characteristics. Companies can pick many other combinations of the modules which are more suitable to their situation and growth stage.

Summary

This artifact is designed to give users a better and deeper understanding of the PMS in their company and help them improve their performance management system by introducing BI tools and platforms. The proposed instructions and procedures are designed specifically for SMEs and consider small and medium-sized enterprises' characteristics, requirements and restrictions. Moreover, the system's modular architecture allows companies to select and combine the components based on their needs and create a customized PMS system. This artifact also helps leaders select and add required BI tools and applications.

Appendix (Artifact Package Appendix)

PMS Process Flowchart

This flowchart shows the recommended steps and decisions for implementing the PMS-BI system.

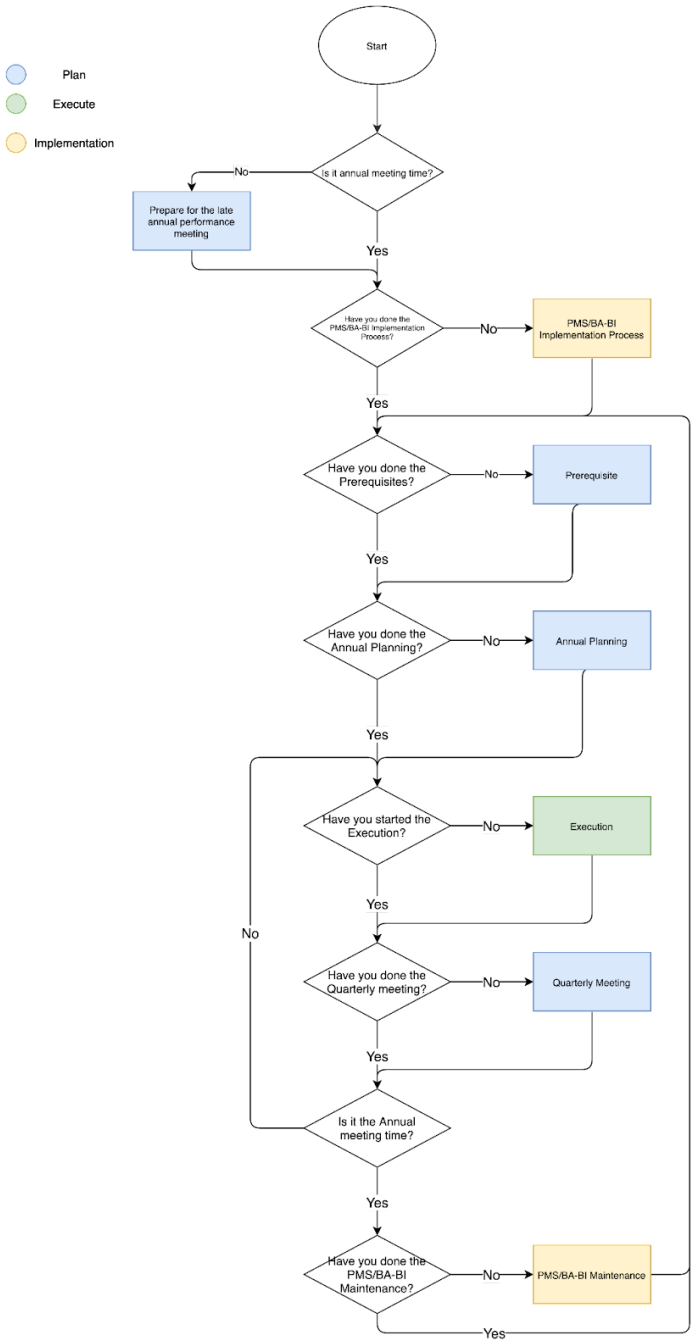


Figure A-10: PMS Process Flowchart

PMS-BI assessment questionnaire

This questionnaire consists of two parts. The first part assesses the performance management system, and the second assesses the business intelligence system.

Answers can be on a standard five-level scale.
for instance:

0: Strongly Disagree; 1: Disagree; 2: Neutral; 3: Agree; 4: Strongly Agree

PMS Assessment

Plan

Performance Measures:

1- Measures derived from the company's strategies.
2- The company’s operations are linked to the strategic goals.

Performance Measurement System:

3- All stakeholders are considered in our PMS
4- PMS is easy to implement and run.
5- PMS is aligned with our strategies.

PMS Development

6- PMS facilitates strategy development.
7- PMS facilitates long-term and short-term planning.
8- Managers are committed to the PMS development.
9- Employees involved and support the PMS
10- IT supports the PMS
11- PMS roles are assigned, and responsibilities shared
12 PMS procedures are clearly defined and described
13- Measures stimulate continuous improvement and proper behaviour
14- PMS is periodically evaluated
15- PMS has a facilitator
16- PMS has a maintenance procedure
17- PMS has a performance revision procedure

Execute

Performance Measures

1- Measures are simple to understand and use.
2- Measures are clearly defined, and their purpose is explicit.
3- Measures are relevant and easy to maintain
4- Measures’ data are easy to collect
5- Measures provide fast and accurate feedback
6- Measures are monitoring past performance
7- Measures guide future performance
8- measures promote integration
9- Measures have defined formula and source of data

PMS

10- PMS is flexible, rapidly changeable and maintainable

11- PMS is balanced (internal/external, financial/non-financial)

12- PMS is synthetic

13- PMS shows causal relationships

14- PMS is graphically and visually effective

15- PMS is Incrementally improvable

16- PMS is linked to a rewarding system

17- PMS is integrated with IS

PMS Development

18- Measure targets are systematically set

19- PMS roles are assigned, and responsibilities shared

Control

Performance measures

PMS

1- PMS stimulates continuous improvement

2- PMS provides accurate and fast feedback

PMS Development

3- PMS Information shared and results communicated

4- PMS has linked performance to compensation and reward procedure

BA/BI Assessment

Organization perspective

1- We have an adequate budget to implement BA/BI tools.

2- Senior managers support the BA/BI activities.

3- We have a competent BA/BI project manager.

4- We have skilled and knowledgeable staff/team/managers to implement and run the BA/BI tools and techniques.

5- We have a clear business vision and plan regarding the BA/BI implementation and use.

6- We have enough experience and cooperation with a BI supplier.

BA/BI Process Perspective

7- We have a well-defined business problem and process

8- We have well-defined users' expectations and information requirements.

9- We adequately adjusted the BA/BI solution to users' business expectations and requirements.

10- We have effective change management and a willingness to accept change processes.

Technology Perspective

11- Our BA/BI system is well integrated with other systems (e.g., ERP, CRM, HRM,...)

12- We have high-quality data about our activities and operations.

13- Our BA/BI system is flexible and responsive to users' requirements.

14- We have access to appropriate technology and tools.

15- Our BA/BI system is user-friendly.

PMS-BI Assessment Analysis Tool

After collecting the answers to the assessment questionnaire and counting the responses, the following tool can be used to highlight the modules from the PMS-BI system which need improvements or can be added to the current system.

The left part of the tool includes the questions from the assessment tool, and the right part shows the related modules. For example, if question number 10 (IT supports the PMS) gets a low score by aggregating the responses from all participants, by following the row, you can realize that the following modules need to be improved or added to the current system:

- PP1
- PP3
- PA3

This tool is provided in the attached spreadsheet.

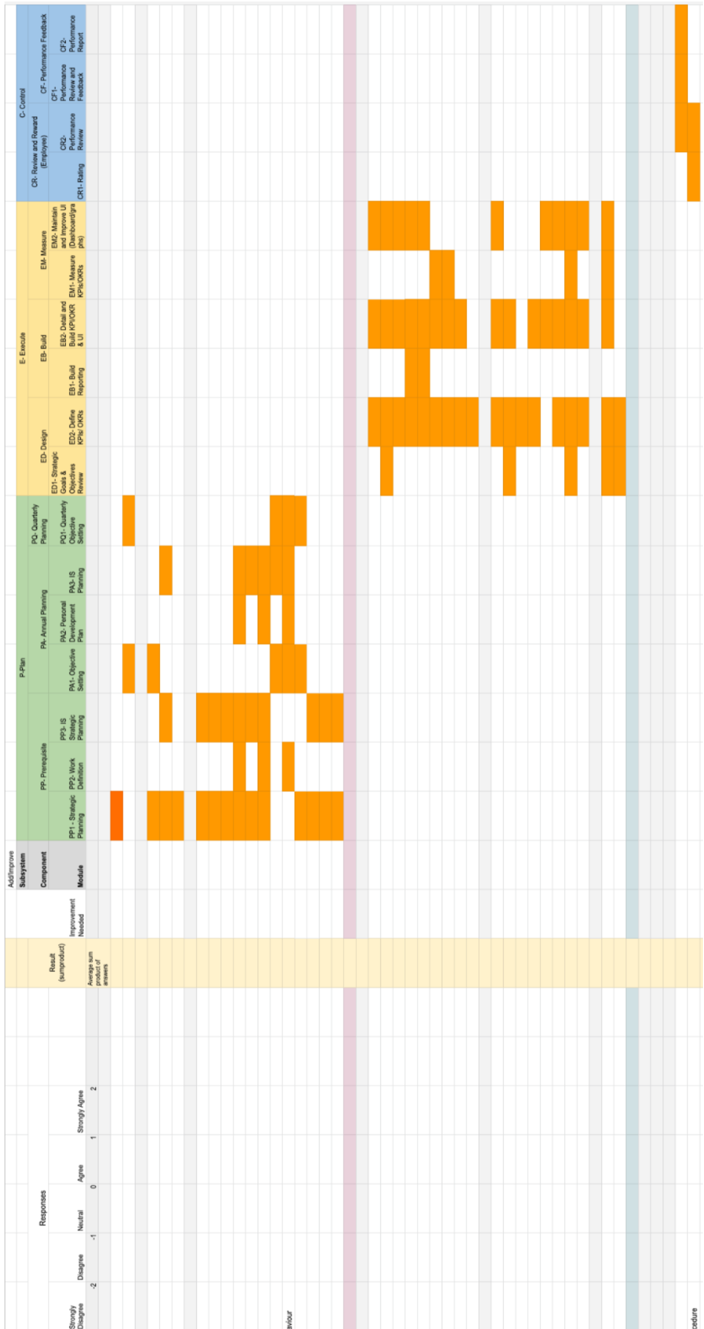


Figure A-11: PMS-BI Assessment Analysis Tool

PMS-BI Implementation Activities

This graph shows the recommended activities regarding the implementation of the PMS-BI system.

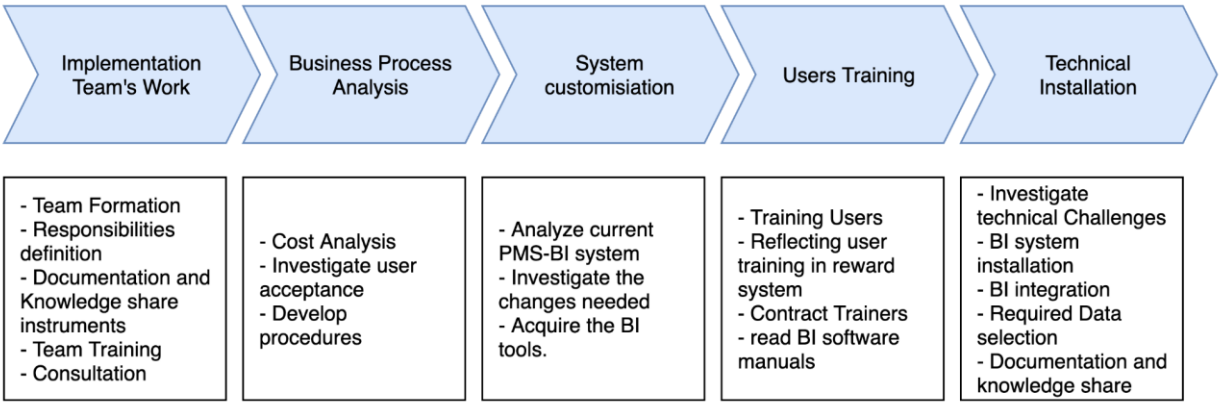


Figure A-12: PMS-BI Implementation Activities

PMS-BI Maintenance Checklist

This checklist can be used to assess the quality of the current running PMS-BI system.

Table A-2: PMS-BI Maintenance Checklist

Measure	Questions	Answer	Modules
Individuals involved/evaluated	Are all employees involved in the system? Does the system evaluate all employees?		PP2 PA2 ED2 EB2 CR CF
Quality of KPIs/OKRs	Are indicators motivating the correct behaviour? Are KPIs measurable? Are KPIs affordable? Are the objective sets for KPIs attainable? Are KPIs meaningful to all parties?		ED1 ED2 EB2

Quality of information	Is the information adequate? Is the information accurate? Does it answer the questions correctly? Does it reflect the performance timely?		EB1 EM2 CF
Quality of follow-up actions	Does the system lead to necessary follow-up actions regarding development activities or improved processes?		C
Quality of performance discussion meeting (Confidential survey)	Is the manager helpful feedback? Has the manager made resources available so that the employee can accomplish the developmental plan objectives? How relevant was the performance review discussion to one's job? To what degree have developmental objectives and plans been discussed?		CR CF
System satisfaction (Confidential Survey)	Is the system easy to use? Is the system maintainable? Is the Response time acceptable? Does it Function as expected? Does it provide adequate privacy and confidentiality?		E
Overall cost/benefit ratio or return on investment (ROI)	Is the ROI of the system as predicted?		PP

	Is the ROI of the system acceptable?		
Unit-level and organization-level performance	Does the system increase the performance of the organization? Does the system increase the performance of the unit? Does the system increase the performance of the individuals?		P E C

PMS-BI Maintenance Analysis Tool

This tool analyses the responses to the PMS-BI Maintenance Checklist and highlights the modules from the PMS-BI that need to be maintained.

In the left panel, you must provide the most important or the summary of the answers and select the aspects of the systems that need maintenance, and on the right panel, you can find the corresponding modules.

Figure A-13: PMS-BI Maintenance Analysis Tool

Modules Description

This table briefly explains the modules, involved rules with each module, related BI functions, a short description of the module, valuable tools and applications, and informative guides you can use to design or implement each module.

Table A-3: Modules Description

Subsystem	Module	Components	Involved Roles	Related BI function	Description	Tools	Guides
P-Plan	PP-Prerequisite	PP1 - Strategic Planning	Leader	Data Query, Visualization, Reports	Reviewing and defining strategies	Miro, Mural, LucidSpark, LucisdCharts, Draw.io	SWOT, SOAR, 5 Ps, PESTEL
		PP2- Work Definition			Reviewing and defining work definitions	Google Doc, Nuclino, Quip, Notion.so	Work Definition Templates
		PP3- IS Strategic Planning			Reviewing and defining the strategies for IS	Miro, Mural, LucidSpark, LucisdCharts, Draw.io	
	PA-Annual Planning	PA1- Objective Setting	Leader, Manager	Visualization, Reports, Analytics	Setting overall company objectives	Miro, Mural, LucidSpark, LucisdCharts, Draw.io	OKR Templates, MBO Templates
		PA2- Personal Development Plan			Developing personal plans for employees	Google Doc, Nuclino, Quip, Notion.so	
		PA3- IS Planning			Planning for IS	Miro, Mural, LucidSp	IS Planning

					implementation and use	ark, LucisdCharts, Draw.io	templates
	PQ-Quarterly Planning	PQ1-Quarterly Objective Setting	Manager, Employee	Visualization, Reports, Analytics	Reviewing quarterly objectives and setting new ones if needed	Miro, Mural, LucidSpark, LucisdCharts, Draw.io	
E-Execute	ED-Design	ED1-Strategic Goals & Objectives Review	Manager, Employee		Review the strategic goals and team objectives	Miro, Mural, LucidSpark, LucisdCharts, Draw.io	OKR Templates, MBO Templates
		ED2-Define KPIs/ OKRs			Define KPIs	Klipfolio MetricHQ	
	EB-Build	EB1-Build Reporting	Manager, Employee	Data Query, Visualization, Reports, Analytics	Build performance reports	Klipfolio, Qlik, PowerBI, Tableau, SAP	
		EB2-Detail and Build KPI/OKR & UI			Buil KPIs in dashboards and import data	Klipfolio, Qlik, PowerBI, Tableau, SAP	
	EM-Measure	EM1-Measure KPIs/OKRs	Employee	Visualization, Reports, Analytics	Measure and monitor the performance	Klipfolio, Qlik, PowerBI, Tableau, SAP	
		EM2-Maintain and Improve UI (Dashboard/ graphs)			Maintain the dashboard and Improve it	Klipfolio, Qlik, PowerBI, Tableau, SAP	
C-Control	CR-Review	CR1-Rating		Data Query,	Review employee	Klipfolio, Qlik,	

	and Reward (Employee)		Leader, Manager, Employee	Visualization, Reports	and team performance and rate them	PowerBI, Tableau, SAP	
		CR2- Performance Review			Review team and company performance	Klipfolio, Qlik, PowerBI, Tableau, SAP	
	CF- Performance Feedback	CF1- Performance Review and Feedback	Leader, Manager	Visualization, Reports, Analytics	Review performance and control it by giving feedback	Klipfolio, Qlik, PowerBI, Tableau, SAP	
		CF2- Performance Report			Report performance to managers and leaders	Klipfolio, Qlik, PowerBI, Tableau, SAP	

Imaginary Company Scenario

Introduction

Shopi's co-founder, Moe, owns a start-up with 25 employees. He is a senior software engineer with some certificates in business administration and project management. His company developed an online loyalty software. Their main target customers are e-commerce owners. Currently, they have around 300 premium paying customers and around 5000 essential customers. Shopi follows the Management By Objective (MBO) procedure to define objectives and measure company performance. Their performance measurement and management go well, but recently they have found some problems and sought a solution.

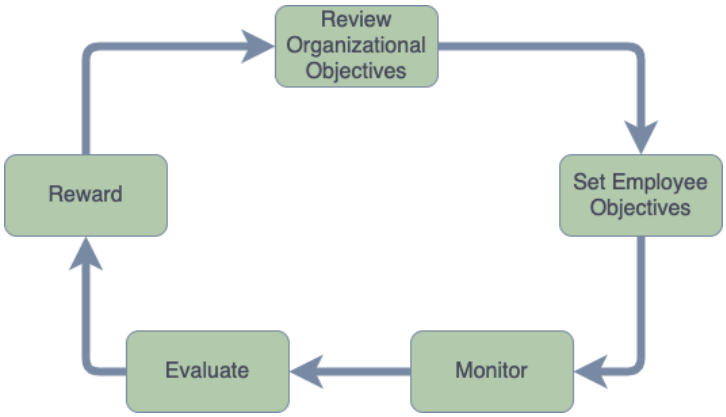


Figure A-14: MBO Cycle

MBO allowed them to set meaningful objectives and measure their performance toward achieving the goals. To follow the MBO principles, each department in Shopi uses different tools and applications to gather the data, turn it into information, and measure and manage its performance. Managers understand the company's overall objectives and translate them into their departmental goals. They also monitor their team's performance and give feedback to their team members. The performance evaluation helps leaders revise the objectives and set proper compensations and rewards.

Case Description

Shopi, a start-up in a fast-paced industry, understands the importance of performance measurement and management. Moe, the company's leader, tried to implement the MBO he was introduced to in one of the management training sessions he participated in.

Their performance measurement and management process are as follows:

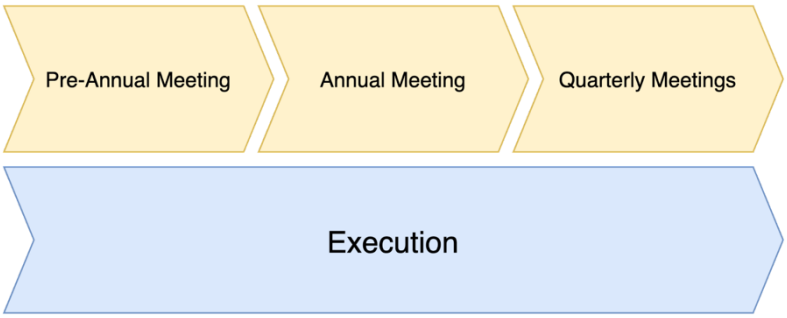


Figure A-15: Performance measurement and management process in Shopi

Pre-Annual Meeting

The MBO starts as early as November, with executives and managers on board to brainstorm the previous year's performance and next year's updated objectives. Recently, they have hired an external consultant to facilitate this meeting.

They review reports from different departments and highlight the critical aspects to focus on.

This meeting takes place inside the company's site. Moe, the sales and marketing team director, product team director, HR director, finance team director and three senior managers participate in this meeting.

Annual Meeting

The annual meeting is held at the beginning of the year. In this meeting, the situation of the company and its progress toward the past year's goal is reviewed, and the plans for the next year have been made. The leaders review the reports directly from the departments and investigate the excel files and reports exported from salesforce and accounting software.

Year around execution

After defining the objectives for the next year, team leaders and managers create relevant KPIs to measure their team's performance over the next year toward achieving the goals. Each team is flexible in collecting data and measuring performance using their tools and reporting formats. Some managers also set rewards and compensation plans for their entire team.

Quarterly Meeting

In quarterly meetings, leaders and managers review the teams' performance and give feedback. The reports and BI dashboards are also reviewed.

Control Process

Shopi has two levels of performance control. The first level is at annual and quarterly intervals, where leaders review the performance of the teams and make decisions about the plans based on the performance of each team. Moreover, the second level of performance control is at the team's level. Based on the ongoing performance of their team members and the team, managers and team leaders make the relevant decisions.

Problem

After running the MBO process for three consecutive years, Moe and other leaders reported a few problems. Some of these problems are recurring, while many others only occur once. The most critical reported problems are as follows:

- Although Shopi uses BI tools such as PowerBI and Tableau, they are limited to a few departments such as sales and marketing. However, finance and other departments still use traditional MS Excel, and MS Access approaches to store the data and monitor the KPIs. This caused siloed information in departments and less prevalent **communication** between departments.
- Some KPIs are linked to strategic goals, but others are customized based on user interests. The MBO suggests building KPIs based on the strategic objectives, but the procedure is unclear and not followed by all users.

- There is no direct **integration** between the PMS and the BA/BI systems.
- The employees do not share knowledge about the PMS and BA/BI. There are skilled and knowledgeable employees who act individually, and there is no simple mechanism to **share the knowledge**.
- The rating and **reward** system is not transparent and sometimes causes employee confusion.
- Leaders feel they do not have enough **control** over the company's performance.
- Some managers believe they are **spending** too much on the tools.
- Some employees believe the **training** is inadequate and do not know how to measure their performance.

Solution Development

After searching for a solution to the abovementioned problems, Moe found our artifact and tried to implement it. Although some consultants and facilitators can be hired to guide the company in following the steps, Moe decided to facilitate it personally and hire the external facilitators only if needed. Moe has documented the whole process in his diary.

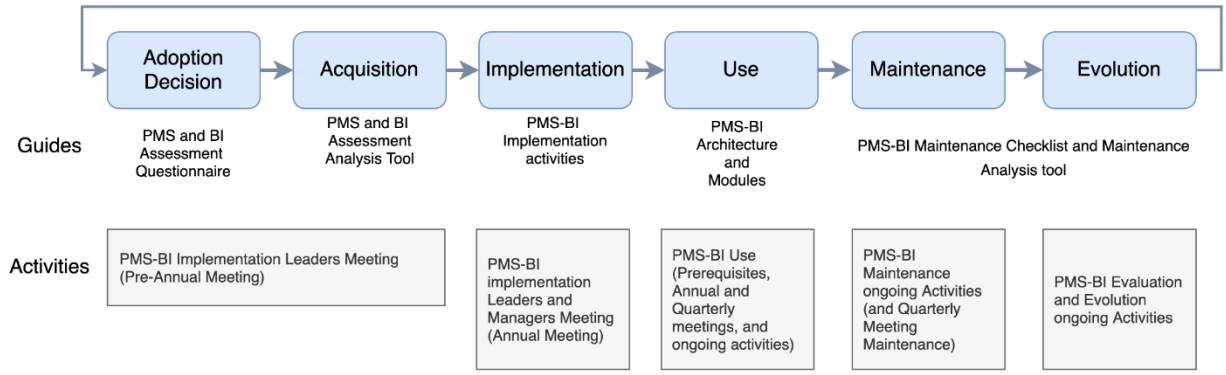


Figure A-16: PMS-BI Implementation Process Steps

This is his diary:

- 20 Feb 2021 (Adoption Decision)

Today we started reading and discussing the artifact over Slack. Finance and sales department leaders are willing to give it a test, while other department leaders are not much interested in adopting it. They believe it is unnecessary to change the current system, which may cause further problems.

- 25 Feb 2021 (Adoption Decision)

After lengthy discussions with the leadership team, all departments are convinced that we need an improvement, and this artifact can be implemented for the next year in a pilot mode. We agreed only to use 50% of the resources to implement this new system; if the improvement is considerable, we can fully implement it for the next fiscal year.

I printed the "Executive Summary" document and hung it on my office's wall. Also, I sent the document to the team, and we started to follow the steps.

- 27 Feb 2021 (Acquisition)

  The "Design" and the "activities" sections gave us a quick system overview.

  Since we have already passed the annual meeting time, we prepared for the late annual performance plan meeting based on the "PMS Process Flowchart (On Executive Summary, Appendix P.12)." For this reason, we used the "PMS-BI Assessment Questionnaire (On Executive Summary, Appendix P.13)" to assess our current situation. All leaders answered the assessment questions.

  Then we used the "PMS-BI Assessment Analysis Tool (On Executive Summary, Appendix P.18)," a simple Excel spreadsheet, to understand the issues with the current system and the modules from the PMS-BI system to be implemented to fix them.

  PMS and BA-BI Assessment Results:

  The PMS and BA-BI Assessment results are in the Appendix section. (Appendix, Shopi PMS-BI Assessment Analysis)

  Based on the analysis result, although the current system is assessed to be weaker in some aspects, we decided to implement the whole system. Also, using the BA-BI Assessment Analysis (Appendix, Shopi BA-BI Assessment Analysis), we spot the places where we need improvements to have a more effective BA-BI system.

- 6 March 2021 (Implementation)

  Late annual performance plan meeting preparation:

  To successfully implement the new PMS-BI system, the "PMS-BI Implementation Activities (On Executive Summary, Appendix P.19)" suggested the following steps:

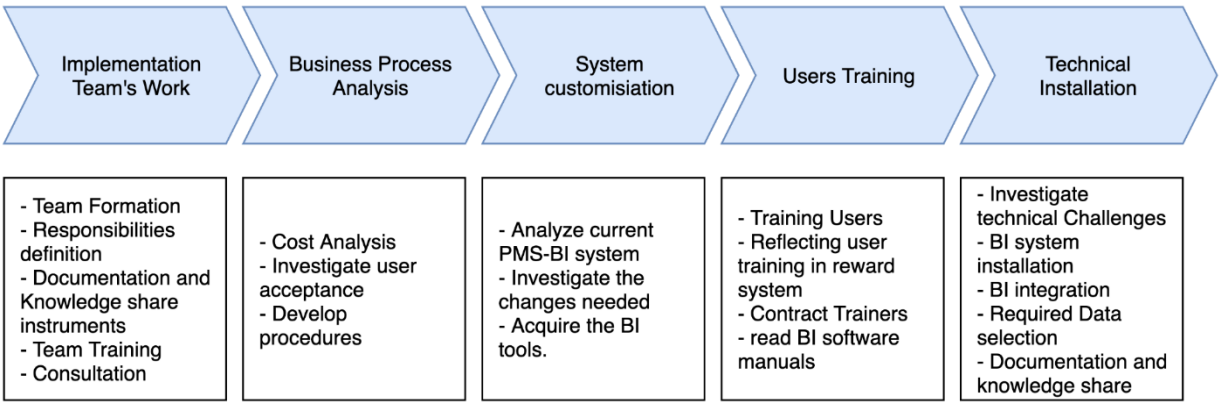


Figure A-17: PMS-BI implementation process

Implementation team's work:

- Team Formation: We formed a team consisting of me (Moe) and managers of all departments.
- Responsibilities definition: Based on the recommendations, each team member is responsible for implementing the performance measurement and management artifact in their respective teams. Integrating the team's data and KPIs in the Klipfolio cloud dashboard. Also, two knowledgeable employees will be responsible for the dashboard creation and maintenance.
- Documentation and Knowledge share instruments: After discussing with the team, the Google document has been selected for documentation purposes. Every team member should access the team's and company's performance management public drive.
- Team Training and Consultation: A consultant who worked with me (Moe) previously is responsible for training the managers and employees and consulting the team over the year. The contract should be prepared.

Business Process Analysis:

Before starting the meeting, one of the experienced managers was selected to review the business process analysis and create a list of BI software, compare them and define a business procedure to implement it.

- Cost Analysis: After reviewing different integrated cloud-based data analysis tools and business data analytic software, we decided to select Klipfolio (www.klipfolio.com). The responsible manager reviewed the software manually and developed a simple system customization document.

System customization

Before the meeting, the business process analysis documents are reviewed by managers. Documents have been shared with other managers to review and comment on.

- I (Moe) personally investigated the current PMS-BI system and highlighted the changes we needed. Since the current system is partially based on department BI, some requirements have already been implemented and used. Few departments have their database and PMS procedures, but they need to be integrated into the new system. A list of required changes is prepared. You can find the list of required changes to the current BI system in the Appendix. (Appendix, Shopi legacy system change requirements)

- The Klipfolio software is acquired for one year to be tested. We also coordinate the demo session with Klipfolio customer support to review the software and train our managers.

User Training

- All documents are shared with the management team, and I asked them to onboard their team members.
- A channel is created on Slack as a place to share the documents and discuss them with the employees.
- Klipfolio training videos and documentation are also shared with all employees.
- A certified Klipfolio partner is also contracted to train the managers and responsible employees.

Technical Installation

- The employees responsible for the BI system investigated the technical implementation challenges.
- They also integrated the current BA/BI system with Klipfolio. Klipfolio provided both API access and import/export to capture the data.
- Databases are also connected or imported to Klipfolio.
- A simple guide is also prepared by the team to be shared with other users.

After doing the above steps, we shared the documents with the management team and prepared for the meeting.

- 14 March 2021

Late annual performance plan meeting

After implementing the BI system, we moved to the "Use phase." Based on the system architecture and its modules, we decided to do the "prerequisite" and "annual meeting" activities in our late annual performance plan meeting.

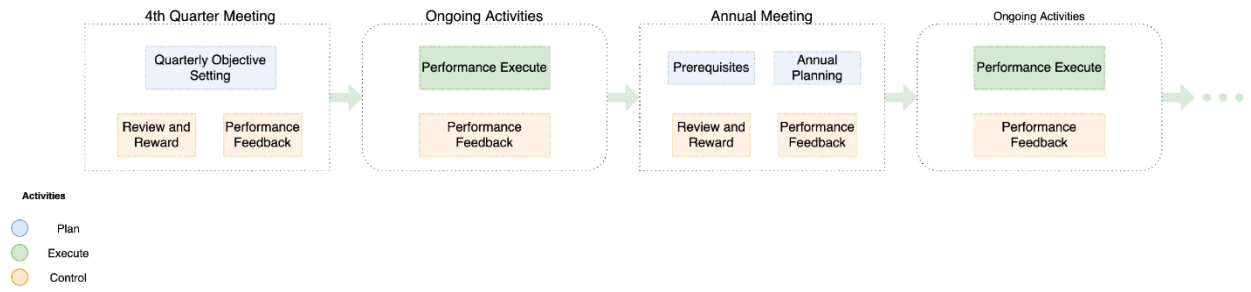


Figure A-18: The sequence of PMS-BI Activities

- Prerequisites: The prerequisite session consists of strategic planning and works definition.
- Strategic planning: We used SWOT to define our strategies and OKR methodology to review and define our strategic plan. We used Miro online application to collaborate and brainstorm, as recommended by the executive summary. Also, we used an OKR template on Miro to define the strategic objectives. (Appendix, Miro Strategic Planning and Objective Setting)
- Work definition: We reviewed previous job descriptions and made minor changes.
- Annual Planning: The annual planning process was as follows:
- Objective setting: Based on the strategies defined in the previous session, we set the company's and team's objectives. We used Miro to collaborate on this process.
- Personal development planning: Managers review each employee's development plan and make changes. This plan is directly linked to the teams' objectives and the company's overall objective.
- Review and reward: The previous performance review and reward system are investigated. All employees have created and shared a new template on Google Docs. Employees must complete the form themselves, and an optional peer will review their work. Managers also review the performance of the employees.

  We used Miro both for strategic planning and objective setting. You can find a copy of the document attached to this diary in the "Appendix, Miro Strategic Planning and Objective Setting" section.

- 25 March 2021

  The implementation is complete. Klipfolio has been configured and integrated with other legacy software through the built-in API and import/export technologies. Managers are responsible for defining KPIs and OKRs and building them on the Klipfolio shared dashboard. Klipfolio's MetricHQ is used as a source to find relevant KPIs.

  You can find a list of team KPIs in the Appendix section. (Appendix, Shopi's List of KPIs)

- 30 March 2021

  The dashboard is complete, and teams are started getting used to it. We are measuring the performance and monitoring it in real-time.
- 15 May 2021

After using the dashboard for one and a half months, we realized that it solved some of our issues.

- It made it easier to communicate the performance with managers and employees.
- Teams see each other's performance and communicate more efficiently.
- KPIs are relevant and are linked to the strategies.
- Siloed software is integrated.

We also decided to set up three TV sets to display the live dashboard in the company.

- 21 June 2021

Q3 Performance Meeting

We started the Q3 Performance Meeting. The Performance meeting consists of two parts. The first part was reviewing the Q1 and Q2 performance, setting new objectives for Q3, reviewing the performance evaluation and reflecting on the ratings and rewards. The second part was about reviewing the system and conducting the maintenance activity.

- Quarterly Objective setting: Each team prepared new objectives and brought them to the meeting.
- Rating and Reward (Control): The personal and team performance evaluation documents have been reviewed and reflected on the reward system.
- Performance review and feedback (Control): Overall performance of the company and team performance are reviewed. The generated report documents from Klipfolio and the live dashboard were used to analyze the performance. The output of this session was used to set new objectives.

PMS-BI Maintenance:

Based on the implementation process guideline, we use the "PMS-BI Maintenance Checklist" (On Executive Summary, Appendix, PMS-BI Maintenance Checklist, P.19) to evaluate the PMS-BI system. After answering questions, we found highlighted modules that need improvements. You can find the "PMS-BI Maintenance Checklist" and "PMS-BI Maintenance Analysis" in the Appendix section.

- 25 December 2021

Annual Performance Meeting

We held our annual meeting off-site in a hotel. All managers and team leaders presented their performance reports, and we discussed the performance goals and target achievements. The meeting process was as follows:

- Team leaders present annual team performance reports.
- Detailed reports reviewed.
- Personal improvement summary report presented by managers and reviewed by the team.
- Strategic goals reviewed and improvements suggested.
- New work descriptions were reviewed, and new job routines were added.

- Dashboards and online analyses for each team were presented and discussed.

Values of the Artifact

After two years of using this system, Shopi noticed improvements in different areas. These improvements are as follows.

- *Easy to use*

  The new system is easy to implement and use. Guidelines, processes and procedures recommended in this artifact walk the users through the necessary steps to introduce the system and use it in a limited pilot test.

  This artifact's simplistic approach is tailored to SMEs' requirements and restrictions. The characteristics of SMEs, such as lack of overall experience in using large-scale and holistic performance measurement and management systems, limited time and budget and rapid growth, make it critical only to adopt a system that requires less cumbersome and sophisticated procedures. One of the most critical factors in the acceptability and usefulness of systems is how easy they are for the users.

- *Cost*

  This artifact is designed to cut the unnecessary cost of excessive reliance on external sources such as long-term consultations and acquiring large-scale software and tools. SMEs can start using this system by acquiring annual subscriptions to a few tools and applications. Other costs are internal and can be managed easily. Small companies and start-ups can benefit from this low-budget system.

  Shopi not only did not pay more to acquire new tools and applications but also could unsubscribe from new tools by integrating their legacy tools into one dashboard. This helped them to reduce their annual expenses.

- *Communication*

  One of the main problems of SMEs related to performance measurement and management, which Shopi has also reported, is the unclear and inadequate communication between teams or departments. Utilizing an integrated dashboard such as Klipfolio’s makes it easier for users to communicate the objectives and have better communication over the performance of their teams and the company's overall performance. Moreover, tools such as Miro helped Shopi communicate the strategies and objectives more efficiently and effectively.

- *Holistic PM*

  This artifact also helped Shopi have a better and more holistic approach to the performance measurement and management of the company. Communicating tools and mediums provide a place for conversations with departments and define objectives that efficiently measure the activities and operations needed to achieve the company's strategic goals. Different departments

now share and communicate their KPIs and get feedback from other departments and the leading team.

- *Systematic Approach*
  This artifact was designed with the purpose of modularity and scalability. The systematic approach to performance measurement, management, and business intelligence makes it easier for companies to select and implement the modules they need and focus on the critical processes for a successful performance management activity. This artifact helped Shopi implement, maintain and evolve its performance measurement and management systems.

- *Scalability*
  This system is also highly scalable. Companies like Shopi require more flexibility and scalability to adapt the system to its ongoing and evolving characteristics. Shopi can pick many other module combinations more suitable to their situation and growth stage.

Summary

This artifact helped Shopi, the imaginary company, move from a more traditional approach to a systematic and holistic approach that highly utilizes business intelligence and business analytics tools and techniques. The designed artifact helped Shopi gain a better and deeper understanding of its current performance measurement and management system and acquire the capabilities necessary for more systematic performance measurement and management. This artifact also helped them define their strategies and turn them into overall and departmental objectives. It also facilitates the KPI definition, performance execution, and control around the company. This artifact is designed to facilitate communication between teams and departments, being easy to implement and use, cost-effective and scalable.

Appendix

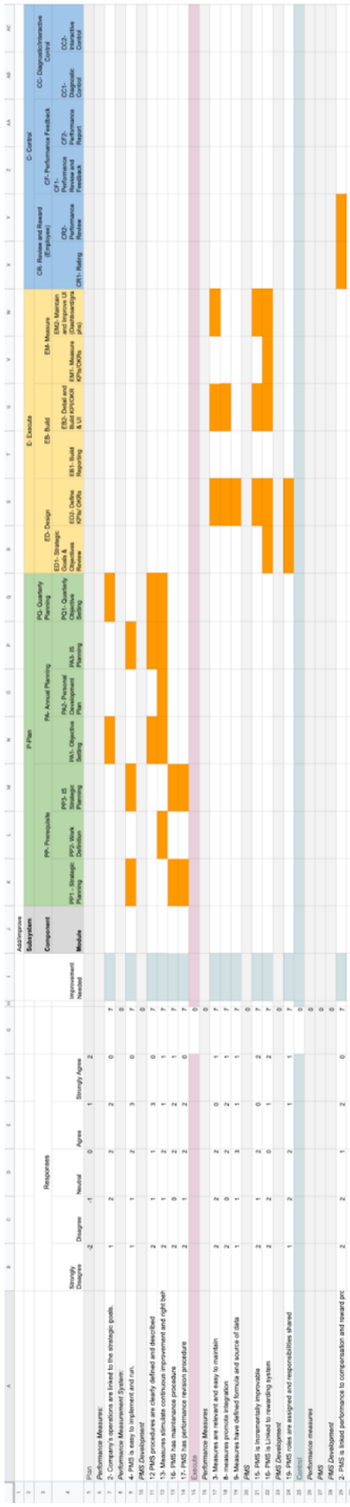


Figure A-19: Shopi PMS Assessment Analysis

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Result	Improvement Needed	Information System		
2	*Organization perspective*	-2	-1	0	1	2			IS Strategic Planning (Module: #PP3)	IS Planning(Module: #PA3)	IS Technology (Modules: #EB2, #EM2)
3	1- We have an adequate budget to implement BA/BI tools.	0	2	3	1	1	1				
4	2- Senior managers support the BA/BI activities.	0	1	2	2	2	5				
5	3- We have a competent BA/BI project manager.	1	3	2	1	0	-4				
6	4- We have sufficient skilled and knowledgeable staff/team/managers to implement and run the BA/BI tools and techniques.	0	2	3	1	1	1				
7	5- We have a clear business vision and plan regarding the BA/BI implementation and use.	1	2	2	1	1	-1				
8	6- We have enough past experience and cooperation with a BI supplier.	0	1	1	3	2	6				
9	*BA/BI Process Perspective*										
10	7- We have a well-defined business problem and process	2	2	1	1	0	-5				
11	8- We have well-defined users' expectations and information requirements.	1	1	2	2	1	1				
12	9- We adequately adjusted the BA/BI solution to users' business expectations and requirements.	2	2	1	2	0	-4				
13	10- We have effective change management and have the willingness to accept change processes.	0	1	3	3	0	2				
14	*Technology Perspective*										
15	11- Our BA/BI system is well integrated with other systems (e.g. ERP, CRM, HRM,...)	2	2	2	1	0	-5				
16	12- We have high-quality data about our activities and operations.	0	1	2	3	1	4				
17	13- Our BA/BI system is flexible and responsive to users' requirements.	1	2	2	1	1	-1				
18	14- We have access to appropriate technology and tools.	2	2	1	2	0	-4				
19	15- Our BA/BI system is user-friendly.	1	2	3	1	0	-3				

Figure A-20: Shopi BA-BI Assessment Analysis

Table A-4: Shopi Legacy System Change Requirements

Department	Tools	Changes	Description
HR	Bamboo HR	Connect the database to the Klipfolio Dashboard Review and fix the database schema	Use BambooHR API to connect it to Klipfolio Dashboard
Sales and Finance	Salesforce	Connect Salesforce to Klipfolio Dashboard Review and fix the database schema	Use Salesforce API to connect it to Klipfolio Dashboard
Marketing	Excel	Use the Salesforce Marketing Cloud platform Export the data into the Salesforce Marketing Cloud from Excel Review and fix the database schema	Acquire the Salesforce Marketing Cloud Platform and migrate the data from Excel, then connect it to the Klipfolio Dashboard using Salesforce API

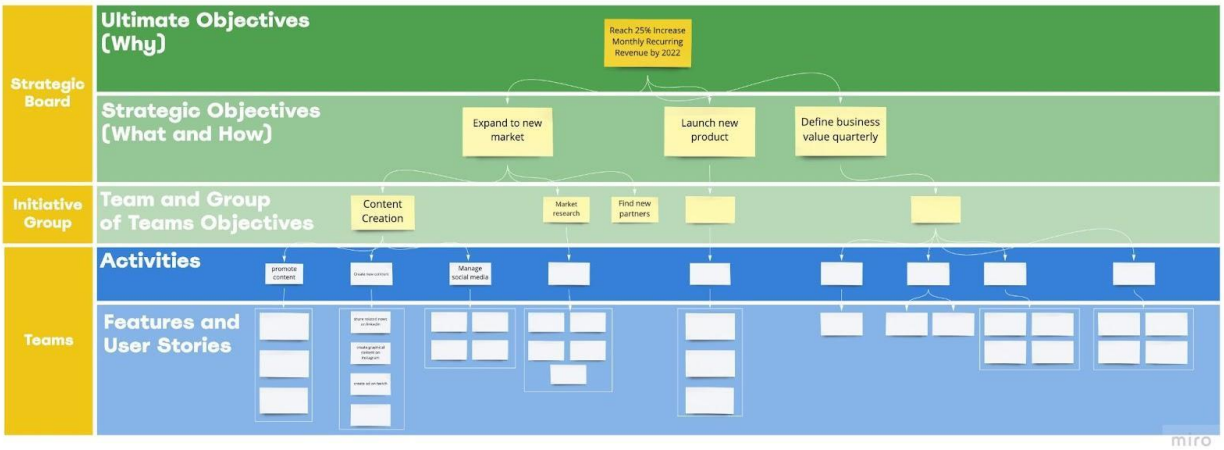


Figure A-21: Miro Strategic Planning and Objective Setting

Table A-5: Shopi's List of KPIs

Objective	Department	KPI	KPI Definition	Formula

Expand to new markets	Sales	Customer Acquisition Cost (CAC)	Customer Acquisition Cost (CAC) is a business's cost to acquire a new customer.	*f* Sum(Sales Costs + Marketing Costs) / Count(New Customers)
		Expansion Revenue as a Percentage of New Revenue	Expansion Revenue as a Percentage of New Revenue measures how much new revenue comes from expansion.	*f* Sum(Expansion Revenue) / Sum(New Revenue)
	Marketing	Percent New Users	Percent New Users gives the percentage of new users that visit a website out of the total number of users that have visited the website.	*f* Count(New Users) / Count(Total Users)
		Marketing Qualified Leads (MQL)	A Marketing Qualified Lead (MQL) is a universal metric used by marketing teams to measure the quality of leads they generate and pass to sales.	*f* Count(MQLs)
Launch new product	Product	R&D Productivity	R&D Productivity is a performance measure of how much new revenue is associated with dollars invested into R&D within a technology company.	*f* Sum(Current Year Revenue) - Sum(Previous Year Revenue) / Sum(Previous Year R&D Expenses)
		Product Qualified Leads (PQL)	Product Qualified Leads (PQL) measures the quality of potential customers by classifying them according to their actions and usage within the product platform.	*f* Count(PQLs)
	Marketing	Return On Marketing Investment (ROMI)	The Return On Marketing Investment (ROMI) metric measures how much revenue a marketing campaign is generating compared to the cost of running that campaign.	*f* (Sum(Attributable Revenue) - Sum(Campaign Investment)) / Sum(Campaign Investment)

Define business values	Operations	Enterprise Value (EV)	Enterprise Value is a comprehensive measure of a company's value.	*f* Sum(Market Capitalization) + Sum(Total Debt) – Sum(Cash and Cash Equivalents)
	Sales	Enterprise Value to Revenue Multiple (EV/R)	Enterprise Value to Revenue Multiple (EV/R) is a financial ratio used in company valuation that compares a company's stock value to its revenue for a given period.	*f* Sum(Enterprise Value) / Sum(Revenue)

Table A-6: Shopi's PMS-BI Maintenance Checklist

Measure	**Questions**	**Answer**	**Modules**
Individuals involved/evaluated	Are all employees involved in the system? Does the system evaluate all employees?	All employees are involved, and the system evaluates all employees. However, we made a few changes to the performance evaluation form on Google docs.	PP2 PA2 ED2 EB2 CR CF
Quality of KPIs/OKRs	Are indicators motivating the correct behaviour? Are KPIs measurable? Are KPIs affordable? Are the objective sets for KPIs attainable? Are KPIs meaningful to all parties?	KPIs are mostly measurable and affordable, and the objectives are attainable. However, a few unnecessary KPIs have been removed.	ED1 ED2 EB2
Quality of information	Is the information adequate? Is the information accurate? Does it answer the questions correctly? Does it reflect the performance timely?	Attained information is accurate and quickly reflected, but we need to tweak some KPIs and their definition to answer our questions more accurately.	EB1 EM2 CF
Quality of follow-up actions	Does the system lead to necessary follow-up actions regarding development	It is too soon to realize it.	C

	activities or improved processes?		
Quality of performance discussion meeting (Confidential survey)	Is the manager helpful feedback? Has the manager made resources available so that the employee can accomplish the developmental plan objectives? How relevant was the performance review discussion to one's job? To what degree have developmental objectives and plans been discussed?	It is acceptable. However, we made some changes to the performance meeting procedures.	CR CF
System satisfaction (Confidential Survey)	Is the system easy to use? Is the system maintainable? Is the Response time acceptable? Does it Function as expected? Does it provide adequate privacy and confidentiality?	The system is easy to use and maintainable. For some teams, the results are more favourable. Teams with less positive feedback have been alarmed.	E
Overall cost/benefit ratio or return on investment (ROI)	Is the ROI of the system as predicted? Is the ROI of the system acceptable?	Yes, the cost is as predicted. The cost structure is clear and as expected.	PP
Unit-level and organization-level performance	Does the system increase the performance of the organization? Does the system increase the performance of the unit? Does the system increase the performance of the individuals?	It is too soon to decide.	P E C

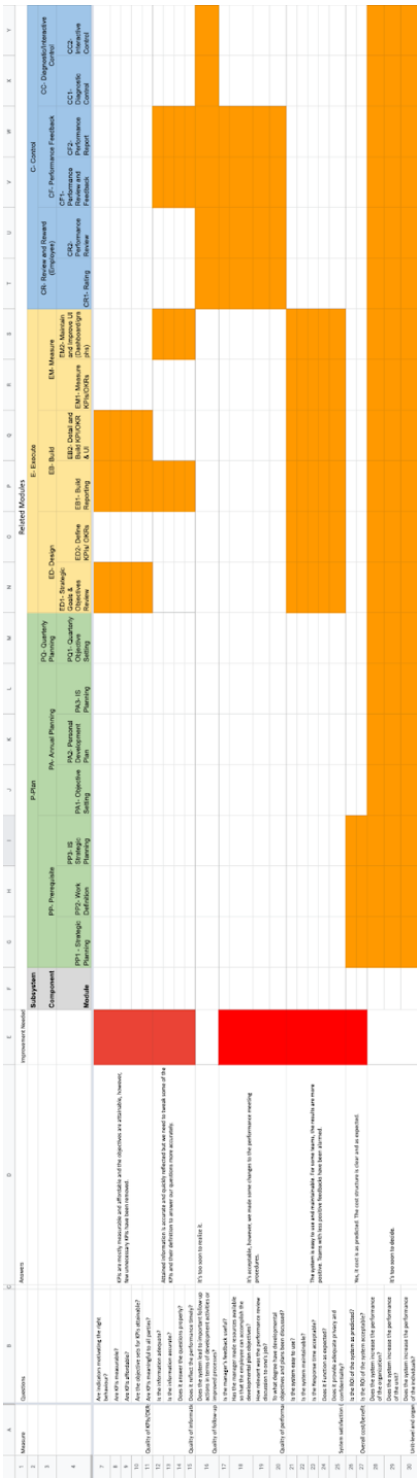


Figure A-22: Shopi's PMS-BI Maintenance Analysis