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THESIS

Topic: The development of a maturity model to evaluate and update a performance measurement system's lifecycle in the operations and logistics sector

Submitted by: Lynn Peters

S1480766

l.peters-1@student.utwente.nl

Supervisor: Dr. Aldís G. Sigurdardóttir

Second supervisor: Dr.ir. Petra Hoffmann

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Abstract

The purpose of this paper is to develop a maturity model that enables the evaluation and enhancement of a performance measurements systems lifecycle for the operation and logistics department at an organisation of choice. Focusing on the design, implementation and usage of a performance measurement, success-factors and necessities for each phase are identified to form the maturity model. The success-factors and necessities were first identified in literature before being validated by a single case study. The following features were identified as leading for maturity:

Design: origin of the measures, variation in the measures, pro-active oriented, regular updating of the measures and documentation of measures.
Implementation: documentation of implementation process, method of data gathering, method of data analysing, availability of data, data consistency, data reliability, data validity and the use of innovative technologies.
Use: complete set of relevant measures, organisational commitment, perceived benefits of usage, pro-active usage of results to facilitate decision making, strategy enhancement, strategy validation and the use of results to track and enable progress.

Additionally, the case study was used as an empirical test for the implementation of the developed maturity model. From the case study, it can be concluded that phases of PMS lifecycle are interconnected but the maturity model does enable the evaluation and identification of improvement opportunities. Strengths of the maturity model include the focus on the entire lifecycle instead of only the design, involvement of employees throughout the PMS lifecycle and the ability to align needs and identify improvement opportunities. The focus on logistics and operations limits the use of the performance measurement systems maturity model to the specific sector.

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I proudly present my thesis on performance measurement systems evaluation and enhancement in the operations and logistics sector. I hope you enjoy reading it!

Abbreviations

BI&A - Business Intelligence & Analytics

BSC – Balanced Scorecard Approach

CMM - Capability Maturity Model

DW – Data Warehouse

ETL – Extract, Transform and Load

KPI – Key Performance Indicator

MBR – Monthly Business Review

MIS - Management Information Systems

PMQ – Performance Measurement Questionnaire

PMS – Performance Measurement System

QBR – Quarterly Business Review

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1. The ever-changing economy and more demanding competitive environments require fast decision making and pro-active management, hence, the need for evaluating and updating of performance measurement models.

With the current global shift to the BRIC countries, Brazil, Russia, India and China, trends such as the need for organisations to collaborate globally with multi-cultural networks, which were in the early stage of development a few years ago, now seem to be accelerating (Tetsufumi, 2009; Yamakawa et al. 2009; Chesbrough & Garman, 2009; Hansen & Birkinshaw, 2007; Pisano & Verganti, 2008). The emerging need to collaborate globally transfers into a significant visible impact on distribution, logistics, purchasing, and supply management. Therefore, there is an increased need for supply chain management (Gunasekaran et al., 2004). Furthermore, customer requirements continuously change, demanding more customer specific products and services with lower costs. Responding to these changes requires endless improvements to gain and maintain competitive advantage. To obtain this continuous improvement, performance information should be up-to date, dynamically available and accurate to facilitate decision making (Cai et al., 2008; Nudurupati et al., 2011). In the current knowledge economy there are many ways to measure and report performance and activities related to performance. To gather information on performance, organisations large or small, public or private, are interested in developing and deploying performance measurement systems (PMS) (Bitici et al., 2002). The goal of the performance measurement system is to track past performance and enable continuously enhancement of future performance of the organisation. Only through tracking performance using PMS's organisations can maintain or achieve and ensure the status of high-performance organisations (Keong Choon, 2013). As a result of the fast-paced economy with high competition levels in which organisation nowadays operate, more is and can be demanded by customers and suppliers. Therefore, organisations benefit from fast decision making and a pro-active and responsive management style, which can be enabled by an updated performance measurement system. Hence, the PMS is required to keep up with the changing economy and evolve at the same fast pace. (Nudurupati et al., 2011). While the advantages and development of PMSs have been identified in previous literature starting in the late 20th century, it is safe to assume that most companies have an existing a PMS in place (Gutierrez et al., 2015). However, new circumstances, changing environments, evolvement of strategies and new technologies

require updating existing performance measurement systems regularly (Bitici et al., 2006; Nudurupati & Bitici, 2005).

1.1. Research motivation

Whereas there is a surplus of literature available for the design of a PMS, there is significantly less information available on updating the PMS (Bititci et al., 2006; Bourne & Neely, 2000; Kennerley & Neely, 2003; Nudurupati & Bititci, 2005). Subsequently, there are numerous conceptual frameworks on supply chain performance management, while there is a lack of case studies and consequently empirical analysis of performance metrics and measurements in a supply chain environment (Gunasekaran et al., 2004). Furthermore, literature fails to provide an explicit understanding of how the development of a performance matrix is influenced and impacted by already existing metrics (Lohman et al., 2004). In literature, the development of a performance measurement system is in most cases done via a "green field approach" (Lohman et al., 2004), which does not take the existing performance measurement systems into consideration as it focusses on a completely new PMS design. Besides, there is little discussion on how to change the current performance measurement system to avoid a complete redesign of the PMS (Kennerley & Neely, 2002; Braz, 2011). Avoiding designing a new PMS would be financially attractive and more time efficient (Lohman et al., 2004).

1.2. Research gap

As identified by Bourne et al. (2000) a PMS has a lifecycle of three stages, the design, implementation and use, which will be discussed in greater detail in the literature review. Where there is an increasing amount of literature available for the design of a PMS, there is significantly less information available on implementation and using of the PMS, let alone on the updating of a PMS (Bititci et al., 2006; Bourne & Neely, 2000; Kennerley & Neely, 2003; Nudurupati & Bititci, 2005). Advantages of a PMS will be greatly diminished when not implemented or used correctly, therefore equal attention should be paid to the three phases. Hence, additional research needs to be performed on updating a performance measurement system, including the implementation and usage of a PMS (Bititci et al., 2012; Taylor &Taylor, 2013). However, to find and implement improvement in a PMS lifecycle, one must first evaluate and research the existing system, which will identify the areas in need of updating. The aim of this paper is to close the research gap on how an existing PMS can be evaluated and updated in the field of operations and logistics. Operations and logistics is chosen to facilitate

the emerging need to collaborate globally, which transfers into a significant visible impact on distribution and logistics (Gunasekaran et al., 2004). Hence, the increased importance of logistical and operational performance.

1.3. Research question

The research problem leads to the following research question for this paper:
"How can an existing performance measurement system's lifecycle for operations and logistics be evaluated and updated in terms of design, implementation and use?"

1.4. Scope of the research

The paper focusses on the supply chain field, specifically the operations and logistics department. However, the research is not limited to a specific industry as aims to provide a generalized model that will be applicable across industries.

1.5. Practical relevance

This paper is going to provide insights on how companies can improve their performance measurement systems, avoiding a complete redesign when updating a PMS. Improving the current PMS would in most cases be less time consuming in comparison to designing and implementing a new PMS (Lohman et al., 2004). Furthermore, according to Gunasekaran et al. (2004) many companies don't maximize their supply chains potential because of the lack in development of performance measurement and metrics to analyse and maximize effectiveness. Hence, this paper will fill the gap of evaluation and updating of a performance measurement system.

The output of this paper will consist of a maturity model that can be implemented by organisation to evaluate the already existing performance measurement system where lower maturity equal improvement opportunities. Furthermore, the research will provide new insights that can be applied to improve and increase maturity of PMS systems at companies and spread awareness on issues with the existing PMS. The use of the case study is two-fold. First of all, the literature findings for the maturity model can be validated and enhanced based on practical findings. Secondly, the case study conducted will provide as an example of how the PMS can be enhanced with the use of the developed framework.

1.6. Relevance for Company X

As Company X will serve as an example with a case study on the implementation of the developed maturity model. Therefore, Company X's current PMS will be evaluated against success factors of a PMS, as identified in literature, where improvement opportunities are identified and solutions to enhance the current PMS are provided.

2. Structure of the paper.

In the next chapter, the current literature on a PMS lifecycle will be discussed, focusing on the specifying the definition, features and success-factors for each phase. Proceeding with the methodology: further explaining the research and the details on the case study that will be conducted for empirical evidence. Afterwards, the findings of the literature review will be transformed into a maturity model. Which enables a PMS to be evaluated on maturity, where low performance will indicate improvement opportunities. The maturity model will then be implemented by the means of a case study at Company X. Subsequently, the findings of the case study will be discussed, concluding how Company X's PMS can be enhances according to the maturity model. For the conclusion, the results of the case study will be combined with the literature review to answer the research question. Afterwards, opportunities for future research, limitations and contribution to literature and practice of this research will be discussed.

3. Literature review on the performance measurement systems' lifecycle

3.1. PMS is the development of performance indicators as a means to benchmark and evaluate performance, validate and formulate strategies, provide feedback of past performance and identify improvement opportunities.

Performance measurement has been defined as *the development of indicators and collection of data to describe, report on, and analyse performance* (Marshall et al., 1999, p. 13).

Performance measurement requires a target or goal as a benchmark to evaluate the measurements and improvement opportunities for business performance can be discovered (Kaplan & Norton, 1996; Bititci et al., 1997; Nadzam & Nelson, 1997; Kueng et al., 2001; Kanji, 2002; Ittner et al., 2003; Serrat, 2010). The measurements monitored, also known as key performance indicators (KPI's), capture the essence of organisational performance and are the foundation of measuring performance (Gunasekaran et al., 2004). While traditionally most

performance measurement systems where based on costing and accounting systems (i.e. financial measures), performance in supply chain requires non-financial measures as well to provide a well-rounded view on performance (Andersson et al., 1989; Flapper et al., 1996; Fortuin, 1988; Fransoo et al., 2000**;** Bhagwat et al., 2007)**.**

Furthermore, a PMS can be used to formulate a strategy or to add specific operational targets in comparison to current performance (Bisbe & Otley, 2004; de Haas & Algera, 2002). Performance measurement, when done correctly, provides feedback and information about meeting customer expectations as well as strategic objectives. Underperformance in targets reflects and displays areas in need of improvement (Chan, 2003). Consequently, monitoring past performance helps to plan the future by providing relevant information to decision makers (Neely et al., 1996; Neely, 1998).

In literature, multiple PMS frameworks exists (Folan & Browne, 2005; De Toni & Tonchia, 2001), proving valuable information on the design of a PMS. However, since the focus in this paper is on the complete life cycle and evolvement or improvement of existing PMS, there is a need for a procedure rather than a structure. Which is sparse current literature (Folan & Browne, 2005). The advantage of the model developed by Bourne et al. (2000) is the combination of reviewing measures while considering both the design as well as the implementation and usage of the PMS. Rather than solely focusing on the design of the system, which is the limitation of the other literature as mentioned in the research gap. Therefore, the framework of Bourne et al. (2000) is chosen as guideline for this paper, the framework will be discussed in detail in the next section.

3.2. The performance measurement system's lifecycle consists of a design, implementation and use phase.

The framework of Bourne et al. (2000) proposes 3 phases, which can be used for the further development of a performance measurement system. These three steps are as follows (figure 1):

1. *The design of the performance measures*
2. *The implementation of the performance measures*
3. *The use of performance measures*

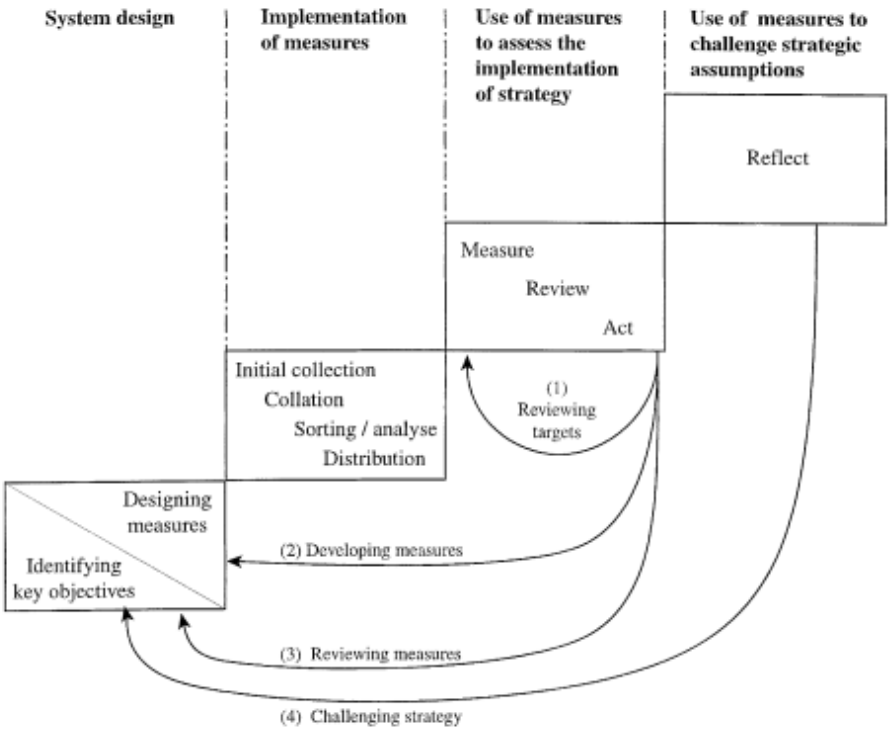

Figure 1. Phases of developing a performance measurement system (Bourne et al. (2000)

Starting with the design of a PMS, across literature the main argument is that the design and therefore measures should be derived from the company's strategy (e.g. Fortuin, 1988; Keegan et al., 1989; Dixon et al., 1990; Bitton, 1990; Lynch & Cross, 1991; Maskell, 1989; Wisner & Fawcett, 1991; Kaplan & Norton, 1992). Bourne et al (2000) stated that the main purpose of the design phase is identifying the key objectives to be measured and designing the measures.

The second step is implementation, which Bourne et al. (2000) refers to as "*the phase in which systems and procedures are put in place to collect and process the data that enable the measurements to be made regularly" (page 758)*. This step includes choosing the data sources used to measure the KPI's, as well as the calculations or procedure to get to the correct measurement entity.

The third step, the use of PMS, is split into two main goals by Bourne et al. (2000). The first goal is to measure the success of the implementation of the company's strategy. Secondly, a PMS can be used to test the validity of the strategy and its assumptions. To accomplish these goals meetings are needed, meetings are necessary to implement the feedback gathered from the measures and to transform them into actions.

3.2.1 Sub-questions

Bourne et al. (2000) lifecycle phases form the basis for the sub-questions.

- *What is a PMS design and which features should it include to make it successful?*
- *What are common PMS design frameworks and what are the main characteristics of these frameworks and how these can help the design of a PMS?*
- *As the design consist of performance measures, what are common performance measures in operations and logistics?*
- *What is the definition of a PMS implementation and which features make a PMS implementation successful?*
- *Which current development in technologies influence PMS implementation that can enhance the implementation phase?*
- *What is meant with the usage of a PMS and which purposes serves a PMS?*
- *What are the drivers and barriers of successful usage of a PMS and how can these be overcome?*

3.3. The design of a PMS reviews the company's strategy and objectives, internal and external needs to be translated into a diversified set of performance measures with corresponding targets, feedback loops and documentation.

According to Bourne's framework (2000) the design phase includes the identification of key objectives of the PMS as well as the design of the measures. However, while almost all literature regarding PMS mention well known design frameworks, a definition of what a constitutes as the design of a PMS is lacking. As stated by Franco-Santos (2007), the majority of researchers in the business field, does not specifically define what they are referring to when using the phrase PMS. The same can be concluded for a PMS design. Whereas, Bourne et al. (2000) gives a short and vague description on design, stating that a designs main purpose is identifying the key objectives to be measured and designing the measures, other literature concerning the PMS lifecycle fails to mention definitions of each of the phases in a PMS lifecycle (e.g. Nudurupati et al., 2011; Neely et al., 1995; Taticchi, 2010). Therefore, a definition of the design phase will be constructed in this section. To do so, the common features of a PMS design will be discussed (Nudurupati et al., 2011; Bourne et al., 2003) and arguments on which features a PMS design should include will be formulated (Vitale & Mavrinac, 1995; Kaplan and Norton, 1996; Braz, 2011).

Across literature there is the common belief that the design should include measures derived from the firm's strategy, as they can measure the success of implementation of the strategy (Vitale and Mavrinac, 1995; Kaplan and Norton, 1996). Additionally, the design should include feedback mechanisms for the results of the measures, which should be used to test the validity of the strategy (Eccles and Pyburn, 1992; Kaplan and Norton, 1996; Feurer & Chaharbaghi, 1995). Feedback from the measures should furthermore be used to inspire actions based on discrepancies between the set targets of the measurements and the actual outcomes of the measurements, which means the design should include targets for the measures as well as feedback loops (Globerson, 1985). The design should seek a pro-active mind-set to enabling fast factual and dynamic information to facilitate decision making and continuous improvement (Gunasekaran et al., 2004), rather than a means to monitor performance (Neely et al., 2000).

Diversity in measures should also be considered, as measures should be included from multiple perspectives. Firstly, the design should include measures in all elements; internal, external, financial, non-financial (Neely et al., 2005). Secondly, the design should include measures that relate to the short- and long-term objectives of the firm (Neely et al., 2005). Thirdly, the measures should relate to both the strategic, tactical and operational levels of decision making and control within an organisation (Gunasekaran et al., 2004).

During the design process, the whole organisation should be involved, as measures should be designed throughout the organisation, from employees to senior management (Neely et al., 2000). Simultaneously, the design should also be integrated throughout the organisation, both horizontally as vertically (Neely et al., 2005).

A performance measure, as described by Braz et al. (2011), is not limited to a formula and a target, but should include the objective of measure, frequency, scope of data source, calculation and the person responsible for data collection. Hence, this process needs to be documented, which is part of the design process. Secondly, documentation is needed to ensure that the measures are understandable for all parties involved with the PMS (Gunasekaran et al., 2004). Lastly, during the development of measures and overall design, reliability and validity of information gathered should also be taken into consideration, which can be enhanced by thorough documentation (Gunasekaran et al., 2004).

Based on the features and objectives of a PMS design following definition is developed by the researcher: "*The design of a PMS reviews the company's strategy and objectives, internal and*

external needs to be translated into a diversified set of performance measures with corresponding targets, feedback loops and documentation."

As the phases of design, implementation and use are conceptual and intertwined, the phases can overlap since not all measures are implemented and used at the same rate (Bourne et al., 2000). However, for an individual measure, the sequence to follow would be design, implementation followed by use (Bourne et al., 2000). Also, inserting feedback loops, gathering information to check the validity of the strategy, objectives and review of individual measures, should inspire changes that alter the lifecycle of a PMS continuously.

For revising and evaluating the current design, the previously mentioned features should first be checked for inclusion. Furthermore, with an existing and operating PMS the feedback loops implemented should provide information on the performance of the current system. To ensure an up to date PMS, feedback should be gathered for re-evaluating the purpose and usefulness of the KPI's in the current design, which can change with changes in strategy or stakeholders needs (Bourne et al., 2000). Obsolete or useless performance measures should then be removed, however, removing performance measures is an action that not all organisations are comfortable with (Waggoner et al., 1999; Neely, 1999; Kennerly & Neely, 2002).

Subsequently, changes in strategy, customers and stakeholders needs or the firm's competitive environment can lead to the need for supplemental measurements because of incompleteness of the measures (Bourne et al., 2000). Therefore, the organisation should set and review actions for continues improvement of the design, such as scheduling regular meetings with senior management and other employees responsible and involved with the performance measurement systems (Bourne et al., 2000). During these regular meetings performance measures can be added or removed from the existing design. Subsequently, there should be a review and possibly alteration of measures to challenge strategic objective or vice-versa (Bourne et al., 2000). Hence, the completeness of measures should be re-evaluated structurally (Wisner & Fawcett, 1991; Dixon et al., 1990; Lingle & Schiemann, 1996; Bourne et al., 2000). The goal of the performance measurement system is to enhance the performance of the organisation, therefore continuous improvement in the measures should be expected. Improvement should be seen in the results of the performance measures and by accomplishing targets. Additionally, similar to the measures, targets of organisations should be adjusted to external and internal changes. Therefore, reviewing and resetting targets and standards should be part of the periodical review and updating of the PMS (Ghalayini & Noble, 1996).

3.4. PMS design frameworks can be categorized in 'needs led', 'audit led' and 'model led' approaches.

Instead of providing a definition of a PMS design, commonly well-known frameworks are mentioned instead (Nudurupati et al., 2011; Neely et al., 1995; Taticchi, 2010). The following section will dive deeper into the well-known frameworks.

Different frameworks can be used to design a performance measurement system. However, comparison between the PMS design frameworks in literature is a difficult task, given the differences in systems (Bourne et al., 2003). Approaches differ from brief tasks descriptions such as developed by Sink (1986) to only partially published consultancy frameworks (Kaplan & Norton, 1996; Davies & O'Donnell, 1997). Bourne et al (2003) provided a categorization of these processes. Three distinctive categories where established, which are 'needs led', 'audit led' and 'model led'.

Needs led refers to a top down approach where the customer, business and stakeholder needs are identified and used as the basis for the measurements. The main goal of PMS systems with a needs led approach is to measure the achievement of satisfying the needs of said groups. The balanced scorecard is an example of this approach (Kaplan et al, 1996; Kaplan, 1994).

Secondly, the *audit approach* is a bottom up approach which starts with an audit of the existing performance measurement system by an individual or group which are usually consultants to the company. The information is collected to alter the current matrix in place. An example is the Performance Measurement Questionnaire (PMQ) by Dixon et al. (1990).

The *model led approach* uses theories and models as the standard for the design of a new performance measurement system. ECOGRAI developed by Bitton (1990) is an example of the model led approach.

An overview with examples of frameworks for each approach can be found in table 1 (Bourne et al., 2003).

Needs led	Audit led	Model led
Approach where stakeholders' needs are the foundation for the design - Balanced scorecard approach[1] - Managing with Measures[2] - Total Cycle Time[3] - Getting the measure of your business[4] - Performance drives[5]	*Approach where existing PMS is the foundation for the design* - PMQ[6] - IPDMS[7] - Reference Model[8]	*Approach where models are theories are the foundation for the design* - ECOGRAI [9] - Fraunhofer[10]

Table 1. A categorization of approaches to develop a PMS from Bourne et al. (2003)

For each approach, the most known framework, based on the number of citations per framework will be further explained to give more insights in the differences and strengths and weaknesses associated with the approach and framework.

Balanced Scorecard Approach

The Balanced Scorecard (BSC) is according to Braz (2011), the most frequently applied framework for the design of a PMS, implemented by firms worldwide to translate strategic objectives to performance measures. The most important and significant feature of the BSC is the four different perspectives analysis for the development of measures. These four perspectives are: financial, customers, internal processes and innovation and learning (Kaplan & Norton, 1992).

[1] Kaplan & Norton, 1996
[2] Andersen Consulting, 1999
[3] Thomas & Martin, 1990
[4] Neely et al., 1996
[5] Olve et al., 1999
[6] Dixon et al., 1990
[7] Ghalayini et al., 1997
[8] Bititici et al., 1998
[9] Bitton, 1990
[10] Krause & Mertins, 1999

To develop a PMS design, the BSC starts with interviews of senior management to answer questions associated with the different perspectives (Kaplan & Norton, 1992). The questions asked are as follows:

I. *How do customers see us? (customer perspective)*
II. *What must we excel at? (internal perspective)*
III. *Can we continue to improve and create value? (innovation and learning perspective)*
IV. *How do we look to shareholders? (financial perspective)*

The answers to these questions result in perspective goals, to which then measures are assigned to set goals that indicate the performance towards the set goals. To avoid information overload, only a limited amount of measures are used, as it is more commonly to add additional measures when consultants or employees make useful suggestions (Kaplan & Norton, 1992).

Performance Measurement Questionnaire

As the name indicates, this approach uses a questionnaire as an approach for evaluating an existing PMS and its performance measures, while simultaneously looking for potential new measures (Dixon et al., 1990). The focus of a PMS lies on identifying and designing measures that appraise, reinforce and reward improvements in performance (Dixon et al., 1990). However, these measures need to evolve when needs change, and will therefore be in need of updating.

The PMQ approach focusses two subsections, the first section's goal is to evaluate the current PMS and specific areas for improvement via given scores (Dixon et al., 1991). Secondly, respondents are asked to give a score on the extent that in their opinion achieving excellence in a particular measure is of importance for the company in the long term, specifying on which areas the company in their opinion should focus (Dixon et al., 1991).

Hence, the first step would be to design a questionnaire and questions that will ultimately provide information on both sub-goals. Therefore, the developer of the questionnaire should already identify the possible improvement areas, in order to address these in the questionnaire (Dixon et al., 1991). Once this is done, the developer or senior management can spread the questionnaire along to a wide range of employees.

ECOGRAI

ECOGRAI is developed by the GRAI organisation, hence the name ECOGRAI. The GRAI method develops Production Management Systems based on elaborate specifications of firms. When the GRAI Production Management System is in use, the companies requested to know the performance of the system as well as the organisation's performance, which explains why ECOGRAI was developed (Doumeingts et al., 1995).

ECOGRAI is a PMS method where a performance indicator system (PIS) is implemented, commonly in industrial organisations (Ducq et al., 2005). The method uses an approach that considers physical-, information- and decision-making systems in the development of measures (Bitton, 1990). First, performance indicators are established and then specification sheets are developed to describe these measures, these sheets include information such as indicators, concerned actors, required information and processing information. For the implementation phase, the performance indicators will be supplemented by a decisional software tool (Ducq et al., 2005).

Using GRAI grids software, a detailed analysis of the manufacturing system is captioned by splitting the manufacturing functions (e.g. quality, production and maintenance) (Ducq et al., 2005). Subsequently, activities are reviewed at strategic, tactical and operation level so decision variables can be established (Bourne et al., 2000; Bitton, 1990). The decision variables together with strategic and manufacturing objectives are the base of the design and performance indicators. This process of design includes a top-down approach, decomposing objectives of the strategy to objectives for operational levels. However, during the process a participative mind set is needed to involve different functions and hierarchical levels. Hence, involving future users of the design and implementation as well as senior management (Ducq et al., 2005). ECOGRAI uses only limited number of indicators, as it does not in particular use these indicators for performance measurement, as the main purpose is the search of action and decision variables, on which decision-makers can act to reach objectives (Ducq et al., 2005).

3.5. While literature acknowledges that performance measures are the basis for a PMS design, examples and overviews of performance measures are missing.

In the previous sections, it evidential that measures should be derived from strategic objectives and goals. However, these strategic objectives differ across firms, industries and sectors within

a company. Hence, the measures used will differ. Furthermore, inequality in measurements leads to a metric that does not represent the complete picture of the performance of the company (Kaplan & Norton, 1992). The goal of the design is to find a balance between the use of financial and non-financial measures and internal and external needs (Andersson et al., 1989; Flapper et al., 1996; Fortuin, 1988; Fransoo et al., 2000**).** Maskell (1991) seconds the need for variation in measures and suggests that financial performance measurements are more useful in terms of strategic decisions and external reporting, but non-financial measures are better suited in cases of day to day manufacturing and distribution operations. Selecting a wide variation of measures for multiple purposes would become easier when examples of performance measures are provided.

Furthermore, a PMS designed by an external party, changes in the firm's strategy or competitive environment could cause an incomplete set of performances measures (Braz, 2011). Therefore, when updating a PMS, the completeness and relevance of KPI's should be checked.

However, the question rises, even if one has extensive knowledge and done research on designing a PMS, how do you define the right KPI's for the objectives? One would assume that for each department, e.g. operations, there would be a complete list of KPI's that would be applicable to that department. This list could then be used to filter the measures which are applicable to the strategic objectives of the company. While it is established in literature that performance measures are the basis for a PMS design (Bourne et al., 2000; Nudurupati et al., 2011; Neely et al., 1995; Taticchi, 2010), examples and overviews of performance measures are not provided in literature on a PMS's design. Hence, this section will combine literature on performance indicators that can be used for the design of a PMS in the operations and logistics sector.

The following gathering of performance measures consist of contributions from Meindl & Chopra (2013), Bragg (2011), Muchiri & Pintelon (2008), Huang & Keskar (2007), Hofman (2004), Müller (2011), Kasilingam (1998) and Krauth et al. (2005).

Financial & general	Shipping & delivery	Warehousing
- Revenue - Transportation cost to the warehouse - Transportation cost to the customer - Capacity utilization - Overall distribution cost - Number of deliveries - Number of orders - Number of customers - Number of new customers - Number of returning customers - Market share - Number of markets penetrated - Labour utilization - Total supply chain costs - Loading capacity - Order management costs - Import duties - Export duties - External party costs - Fixed assets costs - Variable assets costs - Performance measurement costs - Administrative costs - Penalties costs - Non-controllable expenses - Taxes and subsidies - Value added services - Cash to cash cycle time - Supply chain response time	- On time delivery performance - Transportation fill rate - Information systems costs - % shipped without errors - Average shipping time to warehouse - Avery delivery time to customer - Transportation price - On time shipping - Average delivery planning time - Delivery planning costs - CO2 emissions - Social responsible alternatives of transportation cost - Modes of transportation and associated costs - Number of shipments - Geographical spread of deliveries - Origin of products - Destination of products - Supply quality - Supply lead-time - Fraction of on-time deliveries - Supplier reliability - Delivery reliability - Order received complete - Orders received on time to commit date - Orders received on time to required date - Oder received defect free - Customer returns - Returns to supplier - Availability of products - Flexibility in schedules - Percentage of demand met - Percentage of purchase orders released with full lead-time - Deliveries made in full - Package cycle time - Units received	- Number of units in inventory - Goods availability - Inventory costs - Inventory accuracy - Inventory value - Inventory to sales ratio - Inventory turnover - Average backorder length - Storage cost per item - Obsolete inventory percentage - Percentage of inventory > x days old - Percentage of returnable inventory - Cash-to cash cycle time - Average days in inventory - Inventory turns - Average replenishment batch size - Average safety inventory - Seasonal inventory - Fill rate - Fraction of time out of stock - Obsolete inventory - Volume contribution of top 20 percent SKU's and customers - Hold time - Quality issues - Fill Rate Scrap expenses - Utilization fill rate - Put-away cycle time - Scrap percentage - Average picking time - Picking accuracy for assembled products - Order lines shipped per labour hour - Percentage of Warehouse stock locations utilized - Square footage of warehouse storage space - Storage density percentage - Inventory per square foot of storage space - Average pallet inventory per SKU capacity - Processing time
Service & satisfaction	**Innovation & IT**	**Information**
- Service cost - Realized orders vs. planned orders - Failed orders - Customer satisfaction - Society satisfaction - Employee satisfaction - Number of accidents - % of absent employees - Overtime hours - Number of customer complaints - Number of society complaints - Number of supplier complaints - Social corporate responsibility - Customer service costs - Transparency for customers - Information sharing with customers - Responds time - Product variety - Recycling of waste - Reputation of the company - Order flexibility - Order cancelation - Participation in charitable activities - Number of employees employed - Working conditions - Labour utilization	- Development of innovative technologies - Use of innovative technologies - Number of new products - % of employees with IT training - IT systems in use - Information systems costs - Information availability - Availability of IT equipment - Cost associated with innovations - Average costs for new product development - Average time for new product development	- Up to date performance information - Effectiveness of delivery invoice methods - Quality of delivery documentation - Information systems used - Information availability - Information accuracy - Forecast horizon - Frequency of update - Forecast error - Seasonal factors - Variance from plan - Ratio of demand variability to order variability

Table 2. Overview of KPI's in logistics and operations in literature that can be used for the design of a PMS

This table includes a wide variation of different performance indicators that could be used for a PMS in the area of logistics and operations. However, it is importance to note that the usage of the performance indicators is not limited to the ones mentioned above as this table provides an example rather than a complete list. The list is provided as a guideline that can be helpful in determining relevant performance indicators.

3.6. The success of the implementation phase is dependable on the documentation of performance measures, data creation, data collection, data analysis and information distribution method.

The design phase is followed up by the implementation phase. The implementation phase is defined as the phase that focusses on the development of procedures to select, collect, process, analyse and disseminate data for the performance measures (Neely et al., 1996; Bourne et al., 2000). Information needed for implementation is commonly subtracted from management information systems (MIS), which makes MIS incremental to the implementation stage (Garengo et al., 2007; Nudurupati et al., 2011). Where the design phase is commonly executed externally or by senior management, the implementation phase is commonly done by employees. Hence, when updating the design or implementation it is important to make employees aware (Ukko et al., 2007). Since individual performance measures can be implemented before the complete design is finished and designing and altering the existing design is a continues process, there is an overlap between the different stages (Bourne et al., 2000; Braz et al., 2011). The strength of the implementation is dependable on the design, as poorly defined performance measures can lead to misunderstanding on what should be measured and how it can be measured (Schneiderman, 1999). Therefore, clearly defining and recording the definition of the performance measurement is the start for successful implementation (Bourne & Wilcox, 1998; Neely et al., 1996). After designing the performance measure, there are four steps in the implementation phase; data creation, data collection, data analysis and information distribution (Bourne et al., 2000; Kennerley & Neely, 2003; Marr and Neely, 2002; Nudurupati & Bititci, 2005). The design and implementation steps should all be explicitly documented (e.g. a manual) (Bourne & Wilcox (1998); Neely et al., 1996). This document should at least include:

- The definition of the performance measure
- The data and data source needed for this performance measure
- The analyzation and calculation process for the performance measure

- The interpretation of the outcome for this performance measure
- Information distribution of the results of the performance measure
- Actions needed concerning the result of the performance measure (e.g. feedback loops, comparing outcome to the target and implementing solutions)

The four steps in the implementation phase; data creation, data collection, data analysis and information distribution all have barriers that can obstruct successful implementation (Bourne et al., 2000; Kennerley & Neely, 2003; Marr and Neely, 2002; Nudurupati & Bititci, 2005). First, the data creation and data collection for performance measures is interconnected with and other systems that a company uses (e.g. ERP). The interconnectedness stems from the sharing of input, where a PMS and other systems used in the organisation require the same data input. Furthermore, the results of a PMS can also be used as input for other systems, making these systems dependable on the PMS (Tonchia & Quagini, 2010). In the occurrence of sharing input, double work should be prevented by enabling either the PMS or the other system to extract data from the other source to ensure efficiency (Tonchia & Quagini, 2010).

Secondly, there are multiple problems associated with data collection. First and foremost, organisations experience difficulties with gathering the right information, as information is scattered between different sources (e.g. databases). This results in firms consuming much time on data gathering (Garnett, 2001; Prahalad & Krishnan, 2002). Furthermore, different sources mean that data can be stored in different departments and formats, duplicating some data and making data hidden (Garnett, 2001; McNurlin & Sprague, 2002). As the data is accommodated by different departments, it is likely that data is also updated by different departments, questioning the consistency and validity of the data (Garnett, 2001). The same issue can occur when multiple employees of the same department are responsible for updating the data, making responsibility unclear (Garnett, 2001). A barrier identified by Bitici et al. (2002) is that data can be dependable on data from different sources (e.g. total delivery costs are dependable on the costs every style of transportation used). Data for different modes of transportation can be stored in different locations or across employees. Hence, when the cost of one mode of transportation changes, the party responsible for the total costs needs to be aware in order to change the total delivery cost. Concluding, dependable data can result in incorrect data, finger pointing for mistakes and a closed communication and management style (Bititci et al., 2002). Furthermore, this can lead to a lack of right information for employees responsible for data collection, and ineffective communication between the right people at the right time (McNurlin

& Sprague, 2002). Additionally, problems can be experienced with inconsistency in the data, as data gathered from outside the organisation is inconsistent with view and data within the company, specifically on subjective performance (Van der Stede et al., 2006; White, 1996). Data storage can thus cause problems with data not being available dynamically and obstructs managers to make fast and data supported decisions (Garnett, 2001; Prahalad & Krishnan, 2002).

As discussed before, the design of a PMS exists of a variation of measures, these can be subjective measures as well as objective measures (White, 1996). While the data collection for objective measures is straight forward and based on facts, subjective measures are based on opinions and perceptions, which is harder to quantify and benchmark, making a subjective performance measure more difficult (White, 1996). But since the use of both subjective and objective non-financial results in a more extensive PMS which will lead to better performance (Nudurupati et al., 2011). A common issue for organisations is that their PMS design is historical, static and not dynamic enough to be subjected to changes in the internal and external environment (Nudurupati & Bititci, 2000; Kueng et al, 2001; Marchand & Raymond, 2008), which results in the information provided by measures not being up to date, relevant and or accurate (Nudurupati et al., 2011). New technological developments such as Management Information Systems (MIS) and Business Intelligence & Analytics (BI&A) provide opportunities for dynamic bulk data collection and analyzation to overcome the current challenges associated with the implementation of a PMS (Van Der Stede et al., 2006).

3.7. Business Intelligence & Analytics processes such as Data Warehouse (DW), Extract, Transform and Load (ETL) and data visualization combined with Management Information Systems have the technological advantages to overcome challenges with data creation, data collection and data analysis while facilitating decision making.

Recent changes in information technology (IT) provide solution to the challenges associated with the implementation phase and opened new doors for improvement of the performance management implementation. The biggest opportunities lie in information management systems, business intelligence and analytics and big data (Chenhall & Langfield-Smith, 2007; Nudurupati & Bititci, 2005; Nudurupati et al., 2011).

First, integrated management information systems can support operations with data collecting, sorting, maintenance and reporting (Marchand & Raymond, 2008; Marr & Neely, 2002; Nudurupati & Bititci, 2005; Nudurupati et al, 2011).

The second opportunity is to implement Business Intelligence and Analytics (BI&A), which is defined by Chen et al. (2013, page 1166) as; *"The techniques, technologies, systems, practices, methodologies, and applications that analyse critical business data to help an enterprise better understand its business and market and make timely business decisions. In addition to the underlying data processing and analytical technologies, BI&A includes business-centric practices and methodologies that can be applied to various high-impact applications such as e-commerce, market intelligence, e-government and security.*"

Focusing on the BI&A processes, a distinction can be made between 3 phases; 1. Gathering and storing of information, 2. Processing and analysing the information, 3. The usage of information for decision making. (Shollo, 2013)

The analytics section of BI&A revolves around technologies that are grounded in data mining and statistical analysis, which rely on the commercial technologies such as Data Warehousing (DW) and Extract, Transform and Load (ETL) (Chaudhuri et al. 2011). Looking at the barriers identified for successful implementation in the previous section (e.g. data availability, responsibility, real time, consistency and data centralization), BI&A can diminish these barriers by the development and management of a Data Warehouse and Extract, Transform and Load. Where in the Data Warehousing focusses on phase 1 of BI&A; the gathering and storage of information, ETL is implemented in phase 2 of BI&A; the processing and analysing of the data (Chaudhuri et al. 2011). A DW is one large database that reaches across departments and storages all data in the same location where multiple employees can simultaneously update and extract information (Chaudhuri et al. 2011, Keim et al., 2008). Therefore, data in a DW is easily accessible, diminishing time is spend on data gathering, and data is dynamic and more reliable. Hence, DW eliminates the issues with decentralized information storage and consistency. Extract, Transform and Load is an analysation tool that extracting and transforming data automatically (Granlund, 2011; Rom & Rohde, 2006). Hence, ETL is less time consuming then a manual process and ETL is less prone for errors and thus more reliable and consistent.

Furthermore, the data collection of organisations has increased over the past year, as organisations are now able to captor sensor data and social media data enabling a wider variety

of measures. Hence, the amount of data continuously increases. Nowadays, big data and big data analytics are used to describe the data collection of organisations, which range in size from terabytes to exabytes and contain complex information (Chen et al., 2012). Terabytes and exabytes of data brings complexity to data storage, data analysis and data visualization, which increases the need for BI&A tools.

After the data processing and analysing, the next step for which business intelligence can be used in a PMS is facilitation of decision making. For decision makers it is incremental that a PMS extracts dynamic information to facilitate pro-active decision making. The combination of management systems with DW and ETL will contribute to dynamic data availability and dynamic analysation (Keim et al., 2008). Combining MIS with DW and ETL provides databases with analytic capabilities which support decision making, planning and control (Berry et al., 2009; Elbashir et al., 2008; Granlund, 2011; Rom & Rohde, 2006; LaValle et al., 2010). Advanced analysis of BI&A includes scenario planning, which provides the opportunity to anticipate and test decisions related to performance indicators and to foresee the consequences plus the predicted impact, hence making the PMS more effective (Schläfke et al., 2013). To further facilitate decision making BI&A can be used data visualization (Abai et al., 2015; Schollo, 2013). Data visualization consist of interfaces that enable the user to interpret the data for decision making. Hence, data visualization also belongs to phase 3 of BI&A, the usage of information for decision making. Examples of BI&A data visualization that can help facilitating decision making the development of dashboards, charts and reports. (Abai et al., 2015; Schollo, 2013).

In conclusion, BI&A processes such as DW, ETL and data visualization tools combined with MIS have the technological advantages to overcome identified barriers of the implementation phase and improve the data collection, data analysation and data visualization of the PMS's implementation phase (Burns & Vaivio, 2001). However, one of the obstacles to the implementation of BI&A is the lack of understanding how it can help improve business and performance (LaValle et al., 2011).

3.8. A PMS can be used for testing and validation of the strategy, enhancing the performance by finding improvement opportunities, decision facilitation and providing accountability.

The success of a PMS usage lies in what an organisation does with the measurements of performance information (Davenport & Prusak, 1997; Eccles, 1991; Hill et al., 1993; Prahalad & Krishnan, 2002). Hence, the use phase of a PMS. The use phase of a PMS refers to the review of the performance indicators and the agreement to actions based on these measurement results. Therefore, regular meetings are required which should involve senior management and managers who are responsible for the performance being measured (Bourne et al., 2000). In these meetings, the information gathered from the measures should be used to test the validity of the strategy and the assumptions associated with the strategy (Eccles & Pyburn, 1992; Kaplan & Norton, 1996; Feurer & Chaharbaghi, 1995). Testing and validation of the strategy in combination with enhancing the performance, decision facilitation and providing accountability are the key objectives of a PMS (Melnyk et al., 2014; Artz et al., 2012; Gunasekaran & Kobu, 2007). By providing a factual background decision making is facilitated (Melnyk et al., 2014; Artz et al., 2012; Gunasekaran & Kobu, 2007).

Performance enhancement can be achieved via various approaches. The process of enhancing performance is also defined as the process of quantifying the efficiency and effectiveness of action (Neely, Gregory, & Platts, 2005). In current business environments, sharing information and pro-actively seeking opportunities of improvement is part of daily operations to maintain and gain competitive advantage. Using a performance measurement system can help to find improvement opportunities, identify bottlenecks and identify strengths of an organisation (Aedo et al., 2010; Gunasekaran & Kobu, 2007). Secondly, a PMS provides data for external and internal comparison and benchmarking (Neely et al., 1996). Furthermore, a PMS produces a history of past performance for each measure. This enables the tracking of progress, while providing information and direction to plan future performance (Gunasekaran & Kobu, 2007, Aedo et al., 2010). A PMS provides information on how decisions made in the past have translated into the performance results of the organisation (Neely et al., 1996; Gunasekaran & Kobu, 2007). Lastly, performance measurement can be used for cultural change by facilitating a more open and transparent communication and focussing on strategic objectives which are displayed in the PMS design (Meekings, 1995; Gunasekaran & Kobu, 2007).

3.9 Senior management commitment and perceived benefits of a PMS are incremental for successful usage of a PMS.

There are two main drivers for a successful usage of a PMS, starting with the perceived benefits of a PMS. From designing, implementing, using and updating the PMS, success in all stages is more likely to be achieved when there are high perceived benefits from using a performance measurement system (Bourne, 2001). The second driver is senior management commitment, as they are responsible for organisational management and should set the tone for the usage and importance of performance measurement (Eccles, 1991; Hope & Fraser, 1998; Meekings, 1995).

When senior management commitment and therefore support is low, the situation works vice-versa: it becomes a barrier (Bititci et al., 2002; Bourne & Neely, 2000; Feeny & Plant, 2000; Hudson et al., 1999; Davenport & Prusak, 2000). The lack of senior management commitment will lead to employees not understanding the objectives and benefits of using a PMS. Consequently, there is a lack motivation for correct implementation which could cause change-management issues and diminish the usefulness of a PMS (Bourne & Neely, 2000; Nudurupati & Bititci, 2005). However, the resistance of employees can be overcome by training and education them on the importance and potential benefits of a PMS (Battista & Verhun, 2000; Marchand et al., 2000; Markus & Tanis, 2000; Orlikowski, 1996; Waddell & Sohal, 1998). The lack of senior management commitment is also linked to the barrier of usage throughout the organisation. Where a PMS should be used for decision making in all levels of the organisation, lack of senior management commitment and drive could prevent the PMS from being used throughout the organisation (Chuu, 2009; Feeny & Plant, 2000; Kennerley & Neely, 2002; Orlikowski, 1996).
Additionally, when senior management uses the PMS as a command- and control mechanisms, employees of the organisation will be dis-engaged and the pressure on performance may also lead to credibility and reliability issues (Davenport et al., 2010; Harrison & McKinnon, 1999; Lebas & Weigenstein, 1986).

Another important barrier is the lack of action after measuring performance, as only providing information on performance is not sufficient to improve organisational performance. The success of a PMS lies in what happens with the results of the measures; how is the information used to enhance performance (e.g. to identify problem areas and improvement opportunities)

(Davenport & Prosak, 1997; Eccles, 1991; Hill et al., 1993; Prahalad & Krishnan, 2002). The lack of action concerning the performance results therefore decreases the perceived benefits, which is considered the main reason why many executives see PMS as a short-lived phenomenon (Bititci et al., 2002; Marchand et al., 2000).

To sum up, for successful usage of a PMS there needs to be senior management commitment and high perceived benefits for a PMS (Bourne et al., 2000, Eccles, 1991; Hope & Fraser, 1998; Meekings, 1995). When senior management is committed and educated on the benefits of a PMS and shares this knowledge, it is more likely that there is less resistance from other employees in the company (Bourne & Neely, 2000; Nudurupati & Bititci, 2005). The benefits of a PMS are dependent on the actions taken in regard to the measured performance (Battista & Verhun, 2000; Marchand et al., 2000; Markus & Tanis, 2000; Neely & Bourne, 2000; Nudurupati & Bititci, 2005), where meetings with all parties involved in the PMS lifecycle are a good example for proactive usage of a PMS (Bourne et al., 2000). This vicious circle is displayed in figure 2.

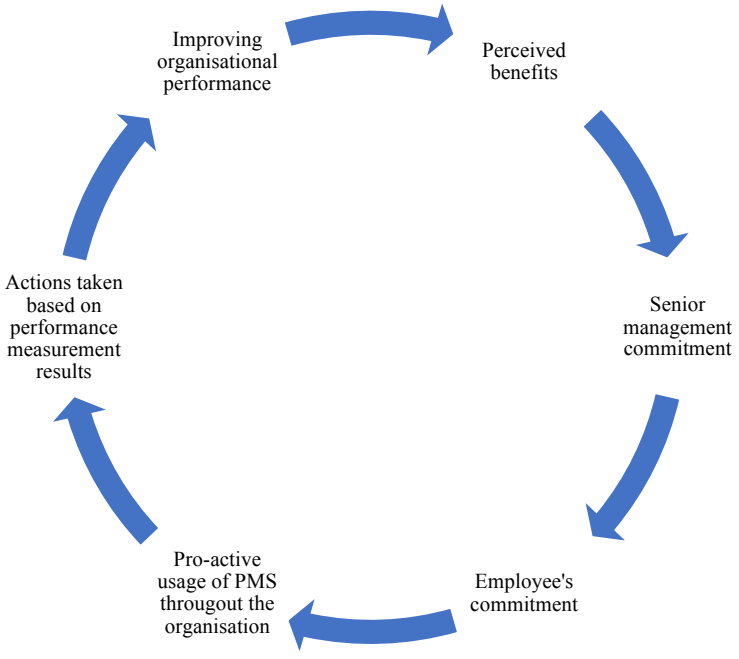

Figure 2.Positive vicious circle for use of the PMS

However, when there are low perceived benefits or a lack of senior management, the vicious circle leads to disengaged employees and lack of usage and action concerning performance measures (Davenport et al., 2010; Harrison & McKinnon, 1999; Lebas & Weigenstein, 1986).

Subsequently, the perceived benefits are low, and the PMS usage is short lived (Bititci et al., 2002; Marchand et al., 2000) (figure 3).

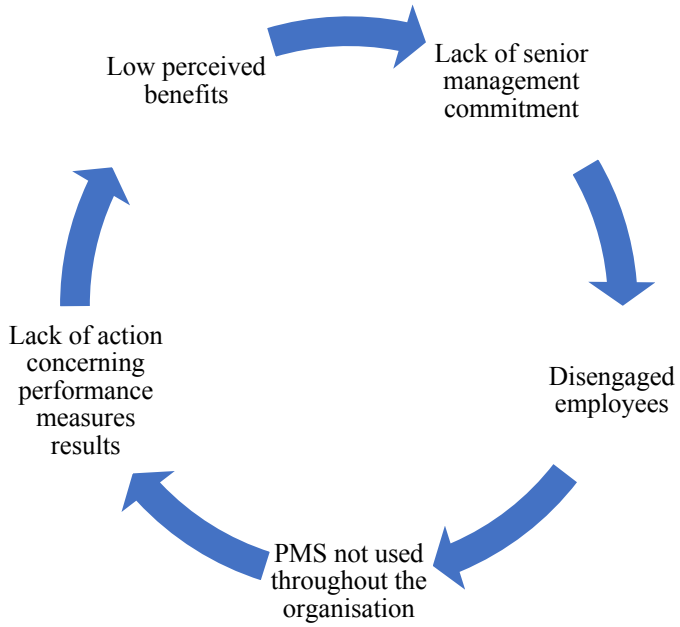

Figure 3. Negative vicious circle for usage of a PMS

The usage of a PMS is dependable on the design and implementation of a PMS. The everchanging internal and external factors are the drivers for the continues changes that should be made to evolve, improve and enhance the PMS's design (Lohman et al., 2004). Where measures in the design of the PMS should be updated to remain relevant in the new environment, and no longer relevant measures should be deleted from the PMS' design. Not adding new performance measures in relation to the environmental changes can cause the incomplete information to facilitate decision making (Bititci et al., 2001; Kennerley & Neely, 2002). Whereas not updating the design according to the latest strategic objective diminishes the use of a PMS for validation of the strategy (Bititci et al., 2001). Hence, for optimizing the usage of a PMS the design and implementation should be updated.

4. A maturity model for PMS will be developed by a literature review which will be validated and extended by a single case study.

4.1 Research purpose

To close the research gap on the improvement and evaluation of performance measurements in the operations and logistics sector a maturity model will be developed. A maturity model will enable the identification of performance gaps and improvement opportunities in an existing PMS (Bitici et al., 2013). Furthermore, a maturity model would enable benchmarking and

comparison of performance measurement system of various organisations (De Bruin et al., 2005). However, the main purpose of this paper is to identify improvement opportunities in existing PMSs rather than benchmark companies' PMSs.

4.2. Development of maturity model

The development of a PMS maturity model combines the concepts of process capability and maturity. Capability maturity models have been previously used to assess, measure, and improve organisational critical core processes (Garrett & Rendon, 2005). Where processes capability is defined as the inherent ability of a process to produce planned results (Ahern et al., 2001), maturity is defined as the measurement of effectiveness or capabilities in a specific process (Dinsmore, 1998).

Is it common for maturity to be described in levels, where the levels equals the organisational capabilities. The various levels of maturity represent an evolution of organisational improvement, ranging from ad hoc practices to a state of continuous improvement (Curtis et al., 2001). Hence, a process capability maturity model in this paper refers to a roadmap for implementing the vital practices for performance measurement systems. To identify the level of maturity, it identifies essential elements that make a PMS effective. Based on these essential elements, a path from an ad hoc, immature process to a disciplined, mature process with improved quality and effectiveness is developed (Curtis et al., 2001).

The proposed Business Process Maturity Model by De Bruin & Rosemann (2005) identifies factors based on the success factors and essential elements, which are the independent variables. Subsequently, the dependent variable which is the business process maturity relies on the success of the independent variables. Which in this case, the independent variables are the three phases of a PMS lifecycle; design, implementation and use. The dependent variable is the PMS. This model is visualized in figure 4.

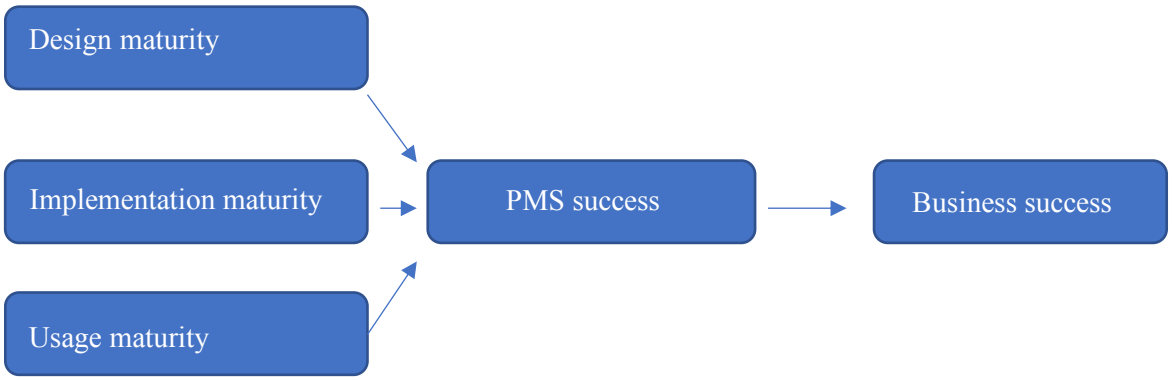

Figure 4. Business Process Maturity Model for performance measurement systems derived from De Bruin & Rosemann (2005).

The model is based on the assumption the higher maturity in each of the PMS lifecycle phases will be reflected in higher levels of success in PMS. Where the process success (i.e. PMS success) is translated in actual business success (De Bruin & Rosemann, 2005).

4.3. Development of maturity stages

Uses the maturity model developed by Paulk et al. (1993), named the Capability Maturity Model (CMM). The CMM is selected as the foundation for the classification of maturity stages as it provides a framework for organizing a continuous process into five maturity levels. The five stages are visualized in figure 5.

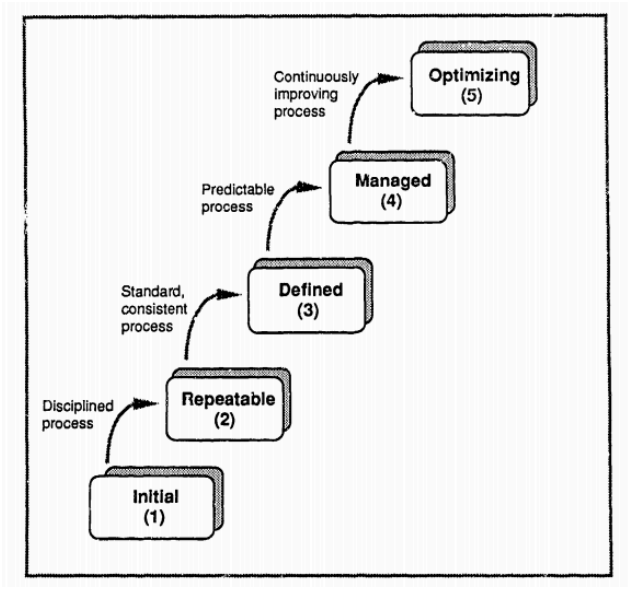

Figure 5. Capability Maturity Model stages (Paulk et al., 1993)

In the CMM model Stage 1, the initial stage, is an unrepeatable process without documentation (Paulk et al., 1993), which in case of a PMS would translate no clear design, which would make

assessment impossible. Hence, this stage is excluded from the developed maturity model, leaving four stages. The four remaining stages define an ordinal scale where the maturity of an existing PMS can be evaluated for its capability. The differentiation in levels can help organisations prioritize improvement efforts accordingly (Paulk et al., 1993). The actual maturity of each phase is dependable on the necessities and success factors identified in literature review and case study.

4.4. Research approach

For the development of new models and theories, case studies are primarily used (e.g., Benbasat et al., 1987; Gersick, 1988; Harris & Sutton, 1986; Van de Ven, 1989). A case study is term that refers to an event, an entity an individual or even unit of analysis (Yin, 1984). It is an empirical research method that investigates a certain phenomenon in real life environment using multiple sources. It does not focus on an entire organisation itself but rather on a particular issue (Anderson, 2005). Using an indictive logic and a variety of methods, primarily qualitative data will be gathered to develop relevant and testable theories (Eisenhardt & Graebner, 2007; Fisher, 2007; Roth, 2007; Voss, 2010). As there is existing literature on a PMS lifecycle, the use of a priori research will contribute to the initial building of the maturity model (Bourgeois & Eisenhardt, 1988; McCutcheon & Meredith, 1993; Voss, 2010). The priori research will be tested by a case study, when the results of the case study match the results of the existing theories of the literature review higher levels of external validity can be reached (Barratt et al., 2011). To develop a maturity model on performance measurement, the case study needs to provide detailed information on existing performance measurement systems. Therefore, Dyer and Wilkins (1991) argue that single case would be best suited as a single case study enables the studies enable the researcher to capture in much more details in comparison to multiple case studies.

In conclusion, the first step in the development of a maturity model is a literature review on the existing theories on performance measurement systems. Based on the literature review, success factors and essential elements of a PMS lifecycle are identified which form the basis for the maturity model. This maturity model will then be tested by a single case study at Company X.

The results of the case study will be matched to the findings of existing theory to enhance and validate the maturity model. Furthermore, the case will have a descriptive purpose; it shows

how the maturity model can be implemented and used at an organisation. The research model used in visualized in figure 6.

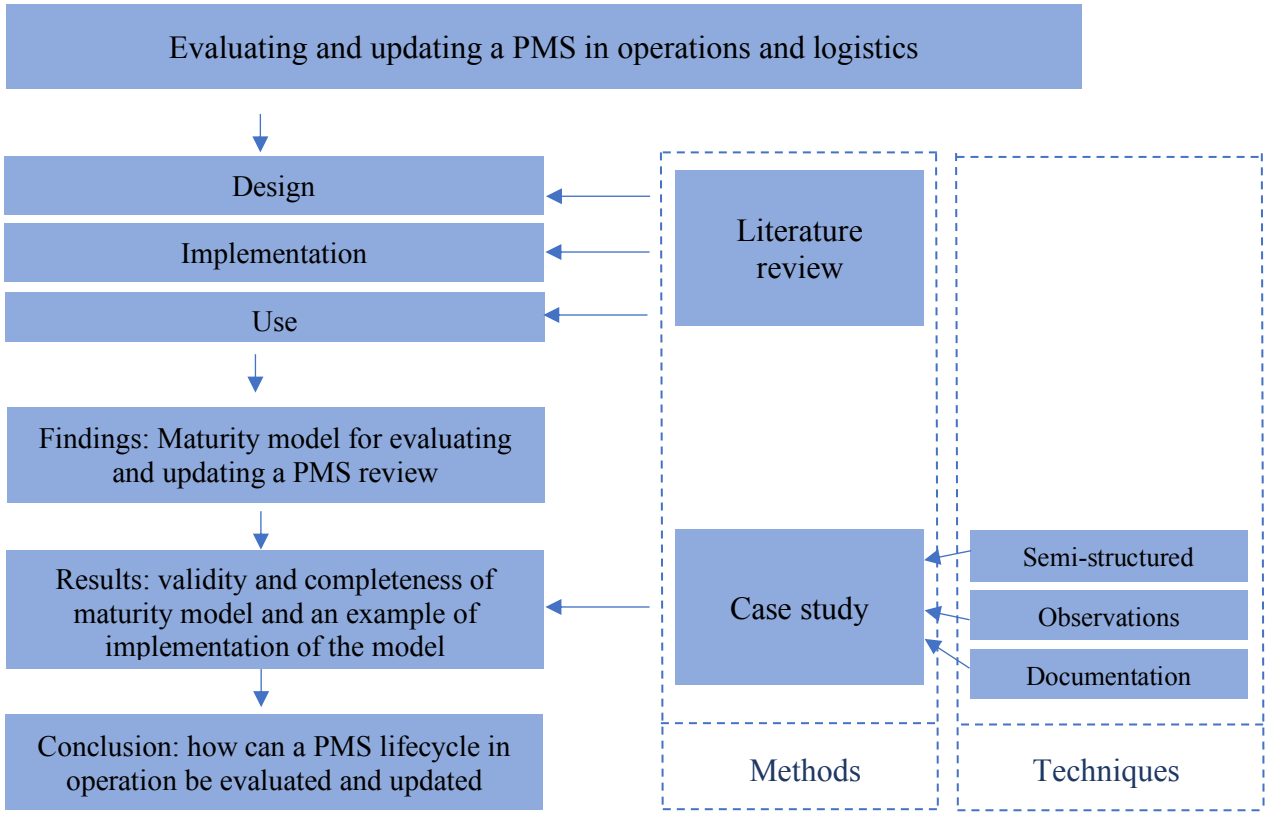

Figure 6. Research model on the evaluation and updating of a PMS in operations and logistics

4.5. Analysis of the literature review

The development of the maturity model started with a literature review that gathered knowledge from academic papers that have important implications for the design, implementation and use of a PMS (Griffith, 1999). During the literature research over 200 articles were reviewed to provide an academic background to identify necessities and success factors for a PMS lifecycle.

Search terms used for finding academic literature that could provide answers to the sub-questions included, but are not limited to; *performance measurement, performance measurement systems, performance management, performance measurement life-cycle, performance measurement frameworks, performance measurement design, performance measurement implementation, functions of performance measurement, use of performance measurement, evaluation of performance measurement, maturity of performance measurement, maturity of business processes, development of maturity models, performances measures in logistics, performance measures in operations, developments in data analysing technologies,*

developments in data storage technologies, Business Intelligence, Business Intelligence and Analytics, Data Warehousing and Management Information Systems in performance measurement.

A wide range of literature was found, this includes literature developed in the early stages of PMS development (e.g. Bitton, 1990; Neely et al., 1996) to recent technologies that can update and enhance a PMS (e.g. Taylor & Taylor, 2014; Shollo, 2013). Findings throughout the last two decades are used simultaneously to provide a complete and clear understanding of a PMS lifecycle for evaluation. Based on the literature review, a preliminary maturity model was made which will be tested, validated and updated during the case study.

4.6. Selection of case study

Before starting the case study, a case company needs to be found where the research can be conducted. Given the opportunity, this case study utilizes a theoretical and biased sampling approach where the case is chosen for theoretical reasons (Glaser and Strauss, 1967; Meredith, 1998; Eisenhardt, 1989; Yin, 1989). A biased sampling approach in this research means that a case company was chosen according to the following criteria;

1. Organisation with an existing PMS
2. PMS that includes the phases of design, implementation and use
3. Full disclosure and cooperation on all information regarding the PMS for purpose of the research

The case company selected is Company X, as a leading company in its own industry it was chosen as the results can in the future be used for benchmarking purposes (Choi and Hong, 2002; Fisher, 2007).

4.7. Information on case company (Confidential)

4.8. Approach for case study

The approach for the case study will be derived from the approach that Dixon et al. (1990) used for the Performance Measurement Questionnaire (PMQ). In the PMQ framework managers are provided a questionnaire proving feedback on the importance of the current performance measures in place and to identify main improvement areas of the organisation. However, during this research instead of a questionnaire, semi-structured interviews will be used as the main

source of information. The use of semi-structured interviews instead of questionnaire has multiple advantages. First, a questionnaire misses the opportunity to ask for further explanation and to explore different issues that may occur during the process to increase reliability and validity of the research (Ryan et al., 2009). Secondly, the purpose of the case study is to validate and extend the finding from the literature research, a questionnaire would be able to validate the findings from the literature research but not to provide additional information to extend the findings. Hence, a questionnaire would not be suited to test the completeness of the maturity model. Besides semi-structured interviews, observations and documentation will be used. The multiple methods are used for the purpose of data triangulation (e.g., Eisenhardt, 1989 ; Choi and Hong, 2002). Using multiple data sources provides increased reliability of data (Benbasat et al., 1987; Boyer and McDermott, 1999; Hyer et al., 1999 ; Leonard-Barton, 1990), and a stronger and more complete overview of the situation analyzed (Benbasat et al., 1987; Eisenhardt, 1989; Voss, 2010).

4.9. Data collection techniques

4.9.1. Semi-structured interviews

The main source of information concerning the collection of data on the current status quo for the case study at Company X are semi-structured interviews. Interviews, in this particular case study, are used to gather background information on the processes and to gather the knowledge of individuals, experts, within Company X (Harrell & Bradley, 2009). Reasons to in person interview for data collection include the opportunity to evaluate the validity of the interviewee's answer (Gordon, 1975). Furthermore, it can ensure completion of the answers and information requested and therefore also comparability, since the interviewer oversees the questions and use this power to ensure the scheduled questions are asked and answered by all the participants (Bailey, 1987). Thirdly, one on one interviews ensure that the respondent is unable to receive assistance during the duration of the interview, which would bias the answers given (Bailey, 1987). Lastly, in person interviews can increase the interest and confidence in the project, given the increased visibility the interviewee's experience (Barriball & While, 1994).

To extract the needed information, multiple versions of interviews can be used, from unstructured to semi-structed to structured. Whereas structured interview follows a strict regime on the question and answers pattern, and unstructured interviews may lack comparison

possibilities, semi-structured is chosen as the best option for this study. Semi-structured interviews are described by Newcomer et al. (2015, page 493):

"Conducted conversationally with one respondent at a time, the semi-structured interviews employ a blend of closed- and open-ended questions, often accompanied by follow-up why or how questions. The dialogue can meander around the topics on the agenda—rather than adhering slavishly to verbatim questions as in a standardized survey—and may delve into totally unforeseen issues."

The usage of semi-structured has multiple advantages, the imperative reasons for this research are;

- Semi-structured interview allows a switch in languages. The initial language in which the interview will be conducted is English, however, as most interviewees have Dutch as a native language, which, when needed can allow to further explanation of the question or answer in Dutch. This will be allowed for better understanding, more integrity and to limit the language barrier during interviews (Word, 1977; Henley 1979).
- To increase the completeness, validity and reliability of the answer (Gordon 1975; Austin, 1981; Bailey, 1987)
- Allows for clarification of answers, or issues raised by respondents (Hutchinson & Skodal Wilson, 1992)
- Can help to clear up any inconsistencies that arise during the interview(s) (Barriball & While, 1994)
- The setting and structure of a semi-structured interviews allows interactive opportunities which can establish the need for accurate information, as this can be emphasized and explained, and therefore reduce the risk of socially desirable answers (Patton, 1990).

Having established why semi structured interviews will be used, the next section will explain who will be interviewed. In practice, information on the complete process from design to use should be included for completing the maturity model. Therefore, diversity of employees and function are included in the selection of interviewees, as it ensured that every phase is represented in the interviews. In some cases, employees are involved in multiple phases of the PMS, which is indicated in figure 3. During the process of information gathering, in some cases more questions or unclarity arose therefore the interviewees were asked to have follow-up

interviews when necessary. Hence, the total duration of interviews differs per case. The questions asked during the interviews are derived from literature findings, which are displayed in the interview guide in appendix 1. For additional information, reliability and validity purposes, during the interview implementors are asked to show the process of implementation. Table 3 provides a visual representation of employees interviewed.

Case #	Respondent's function	Involved phases of PMS	Number of interviews	Total duration of the interviews
1	Inventory analyst (1)	Implementation, use	2	1 hour 30 min
2	Inventory analyst (2)	Implementation, use	2	1 hour
3	Inventory analyst (3)	Implementation, use	1	30 min
4	Inventory analyst (4)	Implementation, use	1	30 min
5	Outbound analyst (1)	Implementation, use	3	1 hour 45 min
6	Outbound analyst (2)	Implementation, use	2	1 hour 30 min
7	Manager EMEA	Design, use	4	4 hours 30 min
8	Director EMEA	Use	1	1 hour
9	Senior Director EMEA	Use	1	1 hour
10	Global Director	Design, use	1	1 hour 30 min

Table 3. Overview of interviews conducted

4.9.2. Observations

Observations seek "real world" information, relying on the preservation and authenticity of the phenomenon's occurrence (Grove, 1992). In this case study observations are gathered during a 5-month period, where the researcher will be part of the daily operations. Observations were made during meetings, in which the results and use of the PMS are discussed. Two different meetings are categorized; meeting with senior management and meetings with the implementors and users of the PMS. Furthermore, the process of implementation and use was observed, an example of which is the calculation and data gathering of measures. As part of the interview, after the interview participants were asked to show the process of implementation,

which is combined with the actual process of implementation. The process of use is hard to quantify, since this is done continuously and non-structurally, therefore these are categorized merged. Categorization of observations is displayed in table 4.

Observation	Phase impacted	Audience	Number of observations	Total durations	Related to interview case #
Meeting: discussing of results of the PMS	Use	Senior management and manager	1	1 hour 30 min	-
Meeting: discussing of results of the PMS	Use	Analysts as implementors and manager	4		-
Implementation of measures	Implementation	Inventory analyst	2	2 hours 30 min	1
Implementation of measures	Implementation	Inventory analyst	1	45 min	2
Implementation of measures	Implementation	Inventory analyst	1	30 min	3
Implementation of measures	Implementation	Inventory analyst	1	30 min	4
Implementation of measures	Implementation	Outbound analyst	2	3 hours	5
Implementation of measures	Implementation	Outbound analyst	1	1 hour	6

Table 4. Categorization of observations during the research

4.9.3. Documentary sources

Besides information from employees, an analysis of different documents which provide key information on the phenomenon PMS will be made (Mogalakwe, 2009). Documentary sources in this case study include; manuals, spreadsheets, presentations and reports used for the implementation and use phase of the PMS.

4.10. Data analysis

An empirically oriented comparative method will be used to analyse the empirical data gathered and decipher important causal patterns (Ragin, 2014). However, first the data gathered in the interviews needs to be systematically summarized, therefore a content analysis as described by Erlingsson and Brysiewicz (2017) will be used. Their content analysis consists of the following four steps:

1. *Condensation*: shortening the text while preserving the meaning
2. *Code:* One or two words that describe the condensed meaning
3. *Category:* Grouping together codes on content or context. Sub categories can be developed when there is an excess of codes in one category. The category explains what can be found in the data.
4. *Theme:* Combination of different categories, expressing data on an interpretative level.

Subsequently, a causal generalization and comparison analysis will be executed. Causal generalization in this paper has the main aim to create a gulf between abstract, non-empirical work, which in this case is the design, implementation and usage of PMS in existing literature, to practice as used by Company X (Ragin, 2014). Ragin build his theory qualitative comparative analysis (QCA) based on Mills' (1843) method of agreement and the indirect method of difference. The method of agreement argues that if two or more cases of the phenomenon have a circumstance in common, this circumstance would then be the cause or effect of the phenomenon researched (Mills, 1843). Vice versa, when a circumstance in one example leads to the phenomenon, while another circumstance in the example does not, the difference is the cause or effect of the phenomenon (Mills, 1843).

Given the fact that there are only a small number of interviews in this case study, conventional statistical techniques are limited which led to the choice of a qualitative research method. QCA is used because it can pinpoint cross-case patterns by comparison, while respecting the diversity and heterogeneity of each individual case (Ragin, 2008; Rioux & Ragin, 2009). The QCA will be implemented to identify consistencies and differences between data sources, cross-analysing them to identifying patterns and causations within the process of PMS at Company X. Furthermore, the comparison method will also be used to identify inconsistencies or improvement opportunities between the case study and literature review.

4.11. Reliability and validity

The variation in information sources enables data triangulation, where the data provided by various data sources can be compared to test the reliability of the provided information. For example, the information provided in interviews will be checked and validated by other interviews as well as observations and documentation. Furthermore, questionable, contractionary or unfunded data will be dismissed from usage e.g. when interviews are contradicted by observations or documentation, the data derived from the interview will be disregarded. Hence, the multiple data sources in combination with the comparative research method improves the reliability (Ragin, 2014).

The validity of the research is dependent on the respondent's willingness to participate in the interview and the willingness to provide the needed information (Barriball & While, 1994). As participants provide information about a process, which is factual information, it is expected that the participants are willing to share knowledge. The semi-structured interviews ensure that the interviewer has the possibility to ensure completeness and validity of the information. As argued by Treece and Treece (1986), to increase validity of the data collected, the interviewer should have knowledge in the area. This theory is adhered to, since the researcher has previous knowledge working with Company X and started conducting interviews after the preliminary literature research. Furthermore, the use of multiple data sources and the comparative research method (Ragin, 2014) will enhance the validity of the research.

5. The findings of the literature review on success factors for performance measurement systems led to the development of subcategories and the identification of key practices. Based on the literature findings an interview guide was developed which enabled the validation and extension of the literature review by the means of a case study.

5.1. Findings of the literature review

In the literature review, success factors, necessities, barriers and drivers have been identified for the design, implementation and use of a PMS. For each phase of the PMS lifecycle key practices are divided into sub-categories that together define the maturity of the phase. The findings of the literature review and subsequently the following distinction of sub-categories with key practices is displayed in table 5.

Phase	Subcategory	Key practices
Design	Origin of the measures	- Derived from strategy - Availability of data considered - All organisational levels involved - Within firms' control
	Variation in the measures	- Variation of perspectives - Financial and non-financial measures - Long + short term measures - Exclude conflicting measures
	Pro-active oriented	- Test the validity of the strategy - Includes feedback loops - Aims to improve not monitor - Provides dynamic information
	Updating the design	- Review of the measures - Review of completeness measures - Review of targets
	Documentation of measures	- Includes definition - Includes purpose of measure + PMS - Includes data collection method - Includes data analyzation method
Implementation	Documentation of measures	- Includes definition - Includes purpose of measure + PMS - Includes data collection method - Includes data analyzation method
	Data gathering	- Amount of sources used - Sources spread across departments - Clear responsibility of updating data - Time spend on gathering of data
	Data analysing	- Manually vs. IT systems - Complexity of analysing - Time spend analysing data
	Availability of data	- Dynamic available - Complexity - Limited availability (e.g. department)
	Data consistency, reliability and validity	- Consistent with external factors - Reliability checks - Standard procedure for consistency
	Innovation	- BI&A - DW - ETL - Stages that include IT

Use	Updating of measures	- Review of the measures - Review of completeness measures - Review of targets
	Organisational commitment	- Perceived benefits - Senior management commitment - Usage throughout organisation
	Pro-active	- Actions based on results - Results used for future planning - Periodical meeting for reviews
	Strategy	- Used for validation of strategy - Used for updating of strategy
	Enhancement of operations	- Open and transparent communication - Cultural change - Provide accountability - Identifying strengths and weaknesses - Better understanding of processes
	Progress	- Save past performance - Enabling progress - Tracking progress - Benchmarking, comparison internally and externally

Table 5. Findings and categorization of literature research

The findings of the literature research are used as the fundament for the gathering of data for the case study. Therefore, the findings have been transformed into an interview guide that can be found in Appendix I.

5.2. Findings of case study

As discussed before, a combination of semi-structured interviews, documentation and observations during a 5-month period will provide the information needed to provide additional information and validation of the sub-categories and success factors identified for each phase in the literature review. Table 6 will provide an overview on which data sources are used for each subcategory, where X indicates the inclusion of the data source. Additionally, these findings are later in this paper used to complete and test the implementation of the maturity model.

Category	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Observations	Documentation
Origin of the measures							x			x		x
Variation in the measures	x	x	x	x	x	x	x	x	x	x	x	x
Pro-active oriented design	x	x	x	x	x	x	x			x	x	x
Updating the design	x	x	x	x	x	x	x	x	x	x	x	
Documentation of measures	x	x	x	x	x	x	x			x	x	x
Data gathering	x	x	x	x	x	x	x	x	x	x	x	x
Data analysing	x	x	x	x	x	x	x				x	
Availability of data	x	x	x	x	x	x	x				x	x
Data consistency, reliability and validity	x	x	x	x	x	x	x	x	x	x	x	x
Innovation in implementation	x	x	x	x	x	x	x	x	x	x	x	
Organisational commitment	x	x	x	x	x	x	x	x	x	x	x	
Pro-active usage	x	x	x	x	x	x	x	x	x	x	x	x
Link to strategy	x	x			x	x	x	x	x	x	x	x
Enhancement of operations	x	x	x	x	x	x	x	x	x	x	x	x
Usage for progress	x	x	x	x	x	x	x	x	x	x	x	x

Table 6. Data sources for each of the subcategories of the case study

In the following section, first an introduction to performance measurement at Company X will be given. Afterwards, the findings for each subsection of the preliminary literature research will be reviewed and explained.

Performance measurement at Company X

Company X uses two performance measurement systems, a monthly and a quarterly business review, which will be referred to as Monthly Business Review (MBR) and Quarterly Business Review (QBR).

There are two main differences between the MBR and QBR review, namely the audience and the occurrence. Starting with the audience, for the MBR the performance results of the previous month are shown to customer operations within Company X's Europe quarters. At the QBR, results are reviewed and shared with the different operational teams of Company X across the globe and global senior management. For Company X's global operations, a distinction is made between 3 regions, Asia, North America and Europe Middle East. During the QBR, among others, the performance is reviewed and benchmarked against each other and targets. Secondly, as the names indicate, the MBR is a monthly review of the performance of the previous month, whereas the QBR is scheduled only once every quarter. In essence, the MBR is a monthly internal version of the QBR, with the same measures. Hence, since the design, implementation

phase of the MBR and QBR are identical, the maturity model will be completed once. As both findings of the PMSs usage result from the same design and implementation, the multiple functions of usage for both PMSs are combined for the usage-phase findings.

5.2.1. The design phase of Company X includes measures from multiple perspectives and reviews the strategy but lacks proper documentation.

Origin of the measures

Early 2017, the global headquarter of Company X started with the development of a collective PMS, which is referred to as the Quarterly Business Review (QBR) (Case 10). Before 2017, every sub region of Company X, which are Europe Middle East Africa, Asia and North America, had their own version of a PMS (Case 10; Case 7). However, these regional PMSs differ in design and the results where for regional use only. Hence, in 2017 the need for a collective PMS was identified and executed, The PMS of the mother corporation was used as a starting point for Company X's first PMS. Thereupon, the individual PMSs of every region where reviewed for similarities and strengths and altered subsequently (Case 10; Case 7). Afterwards, the findings and original design were reviewed in meetings with management of all regions and feedback was gathered. Hence, not all hierarchical levels where involved in the process of designing the PMS (Case 10). This method deviates from literature's best practices, where performance measures are directly derived from strategy. However, as each sub region of Company X, and the parent company share the same operations and logistics strategy, the measures still reflect the strategy (Case 10; Observation; Documentation). During a testing phase of the global PMS, further alterations where made with regards to availability of data and usefulness of measures (Case 10). All the measures in the original and current design are within the firm's control, which is advanced given the use of third-party logistics companies (Case 10; Case 7; Observations).

Variation of the measures

The current PMS design focusses on the internal, customer and financial perspective measures perspectives of the balanced scorecard approach, missing the focus on the innovation & learning perspective (Documentation). Hence, it can be concluded that the design consists of financial as non-financial measures. Furthermore, cross checking interviews with observations prove that measures are related to strategic (Case 8; Case 9; Case 10; Observations), tactical and operational decision making (Case 1 till 7; Observations). However, the main focus is on operational decision making. While there are measures specifically for either long term or short-

term objectives, these are not clearly identified in documentation or presentation of results, as these are solely known by the specific implementor, manager and intermittently by senior management (Case 1; Case 2; Case 4 till 9). There are small contradicting measures, for example, the cost of transportation and the in-transit time, however these are taken into account when setting targets (Documentation; Case 5; Case 6; Case 7).

Documentation on performance measures

In general, there is little to no documentation on the performance measures (Observation; Documentation). The main sources of information are a presentation of results and a spreadsheet which contains a small but not explicit definition of the measure and cryptic description of calculation (Documentation). However, during the interviews, when asked for the step by step approach of implementation, it was made clear that the provided instructions in the current manual are not sufficient for reproduction of the results (Case 1 till 6), as specific steps are completely omitted from documentation (Documentation). Furthermore, the purpose of the PMS, locations for data collection and updating procedures are altogether omitted from documentation (Documentation, Case 1 till 7). As an example; while the manual provides a description that delivered on time is defined as delivered on the requested delivery date, it does not provide any information on the data source or where this information can be found (Case 5).

Pro-active design

The design of Company X's PMS can be considered pro-active oriented. Firstly, there are feedback loops in place in terms of regular quarterly and monthly scheduled meetings, where the results are discussed, and future actions and improvements are planned (Observation). Furthermore, throughout the operations and logistics department the PMS is used for decision making, this is shown when delivery performances where not up to standard, as indicated in the PMS, and improvement opportunities where directly investigated (Case 5 till 9, Observation). As mentioned, the PMS is partly used for monitoring performance, however this monitoring is used to identify the right opportunity when to take action (Case 1; Case 5; Case 6; Case 7; Observation). Where the PMS is lacking in terms of pro-activeness is the dynamic decision making. The measures require extensive data gathering and data analysing, which is time consuming, hence it is less suited for near real time decision making (Case 1; Case 5; Case 6; Case 7; Observation). As this problem belongs to the implementation phase of the PMS, it will be further discussed in this section.

Updating the design

The updating and enhancement of the current design is done non-structurally and informal (Case 7; Case 10). However, that does not mean that it is not encouraged, as at the end of meetings questions regarding improvements will be asked (Case 7; Case 10; Observations). However, feedback is dependent on individual's expertise, willingness and eagerness to improve and share his or her view (Case 1; Case 7; Case 10). Which is general is limited to few employees, as most lack confidence, interest or time to voice improvement in the PMS design and stick to the status quo (Case 1; Case 5; Observation). Subsequently, when suggestions for improvements are made, these are actively taken into consideration and discussed before contingent implementation (Case 1; Case 7; Case 10). For example during an interview when asked about reviewing the design of the measures; *"I do feel that adjustments can be made to update the design, as a current performance measure I am calculating is lacking in validity, when I discussed this with my manager he was open for feedback and encouraged me to suggest a new calculation, but with my current schedule I just don't have the time. I do feel that I am the only one who reviews my measures so extensively."* (Case 1). This is in line with the more common answers which were "*No, I did not review the calculations as these were provided to me by my manager and I trust his calculations"* (Case 5).

While there is no time frame for resetting and reviewing of targets, these are actively adjusted to changes in performance, circumstances or strategy (Case 7; Case 10; Observation). For example, when switched to different transporters, the lead time and target will be revised, or when a measure has performed significantly above target for a longer period of time, the standard will be set higher for future reference as the possibilities and opportunities are discovered (Case 6; Case 7).

5.2.2. The lack of documentation in combination with a manual process make Company X's PMS's implementation phase complex and time consuming.

Data gathering

The data gathering process for the measures is a complex process, mostly because of the variety of data sources (Case 1 till 6). The data sources used for the implementation of the PMS are information systems, business intelligence, email communication and shared documentation via online platforms (Case 1 till 6). The data source used is dependent on the measure (Case 1 till 6). Complicating the process even further is the fact that some implementors are reliable on

others to provide them with correct information and lack access to all data sources and storage locations as these are scattered between locations and departments (Case 3 till 5, Observation; Documentation). For example, while observing the implementation process *"Sorry, this is as far as we can do today, for the next part I first have to receive an email from our third party logistics partner with information and they have yet to respond to my emails" (Case 5) or "I can show you how the process works but you cannot do it yourself as only I have access to this system" (Case 1).* However, since implementors of specific performance measures are responsible for gathering the data but also analysing the data, there is a clear understanding of responsibility (Case 1 till 7). In conclusion, in general the process is complex but not necessary time consuming, however the complexity of data gathering makes it prone to mistakes, as a result the process can become time consuming.

Data analysing

All but one performance measure on warehousing, are analysed manually (Case 1 till 6). Business intelligence is only used for analysing and visualizing one measure, furthermore the use of business intelligence and information systems are limited to data gathering (Case 4). The manual process for data analysing is complex, as data is gathered from different sources and then combined for analysing (Case 2; Case 5; Case 6). As the performance presentation is given every three months, the data gathered and analysed is over the past three months, consist of a large quantity of data (Case 1; Case 2; Case 5; Case 6; Observation). Then different steps, such as ensuring only data within the control of the firm is used or system errors are manually erased are needed before the calculation of measures (Case 5). Subsequently, calculations are likewise done manually (Case 1; Case 2; Case 5; Case 6; Observation). Considering that data analysing is done without a manual for guidance, it must invariably be done by the same analysts (Case 1 till 6; Documentation). Which causes issues: *"I know the complete process of calculation, and my direct colleague knows the basics, however, when I go on holiday and the calculations have to made I have to schedule a couple hours in advance to refresh my colleague how the calculations are made, but even then I usually check them when I come back because there is a considerable chance mistakes were made"(Case 1), "I am the only one who know how to calculate these measures, so when I am out of office the team has to wait until I get back to get the results, but I usually then make them in advance so the QBR can take place as scheduled" (Case 6).* The manual labour in combination with complex and error prone calculations are reasons that the data analysing process is time consuming (Case 1; Case 5; Case 6).

Availability of data

While data in the system is available dynamically, the analyzation process needed to use the information to facilitate decision making is obstructing dynamic use (Case 1 till 7; Observations). Furthermore, access to the data is dependable on individuals and their corresponding departments and their restrictions to data sources (Case 1 till 7; Observations). For example, in case 2, the main data source is emails with the billing for transportation costs, this data is available at any time, but only to the specific person receiving the emails. Furthermore, to get the complete overview, all the data first has to be combined for calculations. Hence, the performance measures results are not available dynamically. While for other cases, the information can be extracted from information systems at any time, analysation steps still have to conducted to have results that can facilitate decision making (Case 4; Case 5; Case 6; Observations). Hence, data availability is dependent on data analyzation which is a complex process for which specific knowledge is required and limited to person in charge, as the process is not documented, making actual data output of measures not available dynamically.

Data consistency, reliability and validity

The performance measurement has some issues with reliability, validity and data consistency (Case 1; Case 7; Case 10; Observations). First, there are no feedback loops or security checks to ensure reliability and validity of the results derived from measures (Documentation; Case 7; Case 8; Case 9). This is solely done when outliners or differences in expectations are identified by senior management (Case 7; Case 10). Furthermore, reliability is limited by reason of inconsistency, as every step is done manually and prone for errors and exceptions (Case 1 till 6). Additionally, for every measure, there is a professional responsible for analysing the measures and this individual is the sole person contains all the information and expertise concerning the measure (Case 1 till 6; Observations). Hence, the implementor is also the user of the information (Observations; Case 7). Which raises possibilities to manipulations, as this professional is responsible and held accountable when underperformance occurred, there is a risk involved by providing this individual calculate their own performance, which can be altered to hide underperformance (Case 7; Observation). However, while this is a flaw in the use of the design, this is currently not occurring and therefore not a problem (Case 1 till 6, Observations). The lack of documentation or other persons with information on calculations limit the possibilities of detecting manipulations to the data (Observation; Documentation; Case 7).

During the interviews, multiple employees expressed their concern about the validity of the measurement, saying it could be improved, or when the validity was questioned by the researcher the validity could not be ensured (Case 1 till 6). An example was case 5, while observing the calculation of measures, questions arose concerning the validity which were answered by *"I don't know why we calculate it this way, this is what I learned when I first started and have been doing it this way ever since, so I assume it is correctly otherwise ask the manager"*.

In addition, the PMS compares multiple regions, however due to lack of documentation the consistency and reliability of the measures cannot be ensured (Documentation; Observation; Case 7 till 10). As identified during global meetings and interviews, while the design of the measures is the same and globally appointed, there is no documentation on analysing and calculations (Observation; Documentation; Case 7; Case 9; Case 10). Hence, between regions the same performance measures' calculations differentiate, meaning comparisons made are unfunded and should be considered invalid limiting the use of the PMS (Observation).

It should be noted that despite the issues identified there is consistency in analysts for the performance measures and consistency in moment of calculations, as calculations are made every first week of the quartile (Observation; Case 1 till 7).

Innovation

While currently business intelligence and information systems are used for data gathering, the use of business intelligence for analyzation and visualization is limited, as it currently only used for the analyzation and visualization of one performance measure (Observation; Case 1 till 7). As the advantages are known within the organisation, specifically with the users of business intelligence and senior management (Case 1; Case 4; Case 7 till 10). Therefore, it would be presumed that business intelligence would be further adapted into the performance measurement process. However, a barrier to further implementation of business intelligence is the lack of identification of issues with the current data analysing approach by senior management (Case 7 till 10). As the senior management lack involvement in the implementation phase and feedback loops are informal and approximately non-consistent, this is not communicated (Case 7 till 10). When asked, senior management could not describe the

procedure of data gathering and analysing or explain how complex and time consuming the process is (Case 7 till 10). Hence, the need for business intelligence is not identified.

5.2.3. Due to high organisational commitment, Company X's PMS's is used for a wide variety of purposes.

Organisational commitment

Senior management commitment to the performance measurement is high, as the preparation of the PMS results are high on the priority list (Observation; Case 1 till 10). The importance of use is stretched throughout the department, making sure it is horizontally integrated for decision facilitation (Case 7 till 9). Furthermore, because the PMS provides accountability to individual implementors and users, it provides responsibility and is partially used as a control mechanism (Case 7; Observations). However, this ensures participation and commitment of employees involved in the process (Case 3 till 6; Observations). During the interviews it was confirmed that all employees say the measuring, tracking, internal and external benchmarking of performance as the use of the PMS (Case 1 till 6; Observations). Secondly, the improvement opportunities were also identified as a main purpose of the PMS (Case 1 till 6). Thirdly, facilitating decision making was identified as a purpose of the PMS, however, this answer was provided less straightforward and more in underlying answers and especially in observations of usage (Case 1 till 6; Observations). Not identified purposes by implementors of the PMS is the opportunity to validate and update strategy and strategic assumptions (Case 1 till 6), while senior management was aware of this advantage of the PMS (Case 7 till 10).

Pro-active usage

As all hierarchical levels of the organisation are involved in the lifecycle of the PMS, the investment is indicated by the priority of discussing the monthly results during team meetings and quarterly during global meetings (Observations; Case 1 till 10). Hence, all the employees are updated on current performance (Observations; Case 1 till 10). Given that each professional implements the measures related to their function, they have full ability to use the information to look for improvement opportunities and support their decision making (Case 1 till 6). Furthermore, inspired by senior management, underperformance by differentiation from targets automatically leads to searches for causes and actions as call-outs during meetings will made from managers to the individuals responsible (Observations; Case 1 till 7). As mentioned before, there are structured monthly and quarterly reviews of the results of the performance measures to discuss past performance and improve future performances (Observations).

Strategy

Concerning the strategy, the use of the PMS could be enhanced (Observation). While the results are used for validation of the strategy and strategic objectives the strategy is not adjusted to the results of the performance measures (Case 7 till 10; Observations). As stated in the design section, measures represent the strategy and targets are identified to objectify the strategy (Documentation; Case 7; Case 9; Case 10). Validation of the strategy is realized by achieving the set targets (Case 7 till 10). As mentioned previously, the achievement of targets is a big priority of the operations department (Observations; Case 1; Case 2; Case 5 till 10). Hence, if during meetings measure results indicate that targets are not reached, immediate feedback is asked, and action is taken to prevent reoccurrence of the issue (Observations; Case 1; Case 2; Case 5 till 10). While the strategy is not adjusted to the results of the performance measures, when the strategy is adjusted, this will be adjusted in the performance measures as well (Case 7 till 10).

Enhancement of operations

Regarding the enhancement of operation, the results are actively shared (Observation; Case 1 till 10). However, this is between teams and regions all working in the supply chain logistics and operations department, excluding all other departments (Case 7; Case 9; Case 10). As the culture of the organisation is performance oriented and as can be concluded from the previous sections, the usage of the performance measurement system is up to the literature standards, it does not warrant a cultural change (Observation; Case 1; Case 6; Case 7; Case 10). Furthermore, it provides accountability, as the implementor of the measures is also the user of the measures, whom is responsible and accountable in case of underperformance (Case 1 till 10). The PMS results in combination with the discussion at monthly and quarterly meetings leads to a better understanding of processes and progress. During meetings, updates which include changes made in current processes and how these changes did or did not lead to improvements are explained by the responsible parties. (Observations; Case 6; Case 7). An examples is *"During team meetings we discuss the current performance for each area, for example I present the results for the outbound team. Here I show what the current performance is in comparison to our target, when the current performance is not up to the set standard, I will provide background information on the cause and will provide opportunities and actions that I took to make sure the performance for the next month or quarter are better. The team will then provide me with feedback and help me think of other alternatives to improve the performance.*

Sometimes, even if there are no problems with current performance but we did find opportunities to improve, these will also be discussed with the team." (Case 6). Hence, during the meetings and discussing of the results, strengths and weaknesses in current performance are identified (Observations; Case 6; Case 7).

Use for progress

The QBR is thoroughly used for progress tracking and enabling (Case 1 till 10; Observations; Documentation). As continuously improvement opportunities are investigated which are used to facilitate decision making enhancing performance (Case 1 till 7; Observations). Since the performance measures are presented monthly and quarterly, these results in the form of presentations are saved, therefore backtracking past performance and tracking the progress is enabled (Case 4 till 10; Documentation). Furthermore, there is extensive benchmarking of the results as these are compared to the results of each region, industry best practices and previous performances (Case 7 till 10; Observations; Documentation). Hence, in terms of progress all functionalities are used in the current PMS of Company X.

5.3. The case study validated the literature findings and provided examples that will be used for identification of the maturity stages.

During the case study, the validity and completeness of these subcategories is confirmed. Where the initial model had similar categories across phases (e.g. documentation in the design and implementation phase and updating of measures in design and use phase) counting them double was found to alter the validity of the model in the case study. As the subcategory would be counted double (once in both phases), the subcategory would bias the overall score of the maturity model. While in literature, there is a distinct gap between the phases of a PMS lifecycle, in practice this distinction was hard to make as most activities are intertwined and interconnected. What can be learned from this case study is that it is important to focus on all the phases of a PMS lifecycle, but rather than using the maturity model to find one phase to enhance, it is important to search for areas (subcategories) of underperformance, as this will subsequently enhance the phase's performance as well as overall performance. The combined knowledge of the literature review and case study (e.g. observation of improvements) together formed the basis for the description of each stage of the subcategories.

6. The in literature and case study found key activities are the basis for a four-stage maturity model on a PMS lifecycle.

6.1. The developed maturity model for evaluation and enhancing a PMS's lifecycle with four stages of maturity.

Based on the literature findings, which were validated and given empirical relevance through the case study, a maturity model for the evaluation of PMSs in the operations and logistics sector is developed (figure 9).

The stages are defined based on the similarity of best practices according to literature and the framework of Paulk et al. (1993). Subsequently, four phases of maturity for a PMS are developed:

Stage 1: The PMS is based on financial measures not taking into considering the multiple perspectives where the process is not documented properly and processes such as data analysing and data gathering are done manually. Where commitment and the perceived benefits of the PMS are low and therefore the PMS is not used for its intended purposes. Hence, the PMS is outdated and underdeveloped and is desperate need of updating, a complete new PMS could be considered.

Stage 2: In stage two of maturity there PMS takes into consideration multiple perspectives e.g. external and internal, however the measures are mostly financial. Subsequently, there is little documentation on the design an implementation process and the implementation phase is done manually. The complete overview of purposes of a PMS is not identified and thus the PMS is not used to its full potential. Hence, the PMS is in need of updating, as is it fails the literature standards.

Stage 3: The measures are derived from strategy and include most, if not all perspectives: the internal, customer, innovation & learning and financial perspective. Furthermore, the measures selected are reviewed over time to re-evaluate the completeness and usefulness. The design and implementation process are documented to great extent. Whereas the implementation phase uses IT for data gathering and data analysing, making it faster and easier, it is not completely automated. Afterwards, the PMS is used throughout the organisation to facilitate decision making and enhance performance. Furthermore, the are used to validate the strategy. While the PMS is considered mature, there is still room for improvements to optimize the PMS that should be considered.

Stage 4: The measures are derived from strategy and include the internal, customer, innovation & learning and financial perspective. The measures selected are structurally reviewed to re-evaluate the completeness and usefulness. The design and implementation phase are documented in great detail. The implementation process is automated via IT processes making it fast, reliable and consistent. Afterwards, the PMS is used throughout the organisation to facilitate decision making and enhance performance. Furthermore, the are used to validate and update the strategy. Hence, the PMS has a high maturity, with only minimal improvement opportunities.

Phase	Subcategory	Questions	%	Stage 1	Stage 2	Stage 3	Stage 4
				0-25%	26-50%	51-75%	76-100%
Design	Origin of the measures	Are measures derived from the firm's strategy? Is the availability of data considered when designing the measures? Are all levels of the organisation involved when developing measures? Are all measures selected within the control of the firm?		Measures are derived from strategy, but other factors are not taken into account.	Senior management decides the measures based on available data and strategic objectives.	Measures are derived from the strategy and designed throughout the organisation taking into account what is within the control of the firm.	Measures are derived and to test the validity of the strategy, all levels of the organisations are involved in the process of designing the measures, taking into account the control and data availability of the organisation.
	Variation in the measures	Does the design include internal, customer, innovation & learning and financial perspective measures? Does the design include financial and non-financial measures? Does the design include short- and long-term objectives? Are there measures conflicting another, if yes, how is this handled? Are there measures relating to both the strategic, tactical and operational levels of decision making and control?		Only financial measures from an internal perspective.	Financial and non-financial measures are implemented in relation to multiple perspectives however not all. No attention is given to the distinction between short- and long-term goals and conflicting measures.	There is no use of contradicting measures, and all perspectives are taking into account as well as the long- and short-term goals but all measures are related to the operational level of decision making.	All perspectives are taken into account, as well as the strategic, tactical and operational levels of decision making and long- and short-term goals. The measures that are contradicted are identified and carefully evaluated.
	Pro-active oriented	Does the design include feedback from the measures, to test the validity of the strategy? Does the design should include a feedback loop, which inspires actions based on discrepancies between the set targets and actual outcomes? Is the PMS designed to inspire improvement rather than a means to monitor? Does the design enable fast factual and dynamic information to facilitate decision making and continuous improvement?		There is no set periodical review for feedback, this is done non-systemically and few and far in between. As the PMS is mostly used for monitoring.	Even though the improvement opportunities and facilitation in decision making is the goal of the PMS and large gaps between actuals and targets are cause for action, the design does not enable dynamic information or feedback to the test the validity for the strategy.	The design includes feedback for the strategy and inspires actions and improvements based on results, the design lacks features that enable dynamic information or feedback.	Feedback are loops are implemented and there is a pro-active mindset always looking for improvement opportunities according to the PMS. The PMS is also used for decision making and to check the validity of the strategy.
Design & Use	Updating the design	Are measures periodically re-evaluating concerning the purpose and usefulness deleting those which are no longer useful? Is the design periodically re-evaluating concerning		There is no systematic review in place for the PMS its measures and targets.	Where targets are reviewed when achieved or when circumstances change, the process of changing and	Periodically the targets and measures are re-evaluated according to circumstances, usefulness and completeness.	Every half year the targets and measures are re-evaluated according to circumstances, relevant and completeness.

		completeness of the KPI's, e.g. coincide with changes in strategy? Are targets reviewed and reset e.g. when achieved or circumstances change? Evaluate and challenge the strategic assumptions			deleting measures can be considered non-existent.	Measures are then deleted or added.	Measures are then deleted or added. The measures are used to check, challenge and validate and in case needed change the strategy.
Design & impleme ntation	Documenta tion of measures	Is there a documentation e.g. a manual which include a clear definition of each performance measure, including purpose, data collection and calculation methods, update and monitoring mechanisms and related procedures?		Little to no documentatio n.	There is general documentation defining each measure and the calculations.	There is documentation on the definition, purpose, data collection and calculation methods.	The whole process is documented and explained, and this data is available for all employees.
Design		Average score:					
Impleme ntation	Data gathering	How many different data sources are used? Are the data sources spread across departments? How much time is spent on data gathering? Is it clear who is responsible for data gathering and data updating?		Data gathering is complex and time consuming, as data is spread across sources and departments	Data is spread across departments with different data sources which makes data gathering time consuming. However, it is clear who is responsible for gathering and updating the data but given the	Data is not spread across department, but it is spread across data sources. Time spend on gathering is not long but could be minimized. While it is clear who is responsible for updating and gathering the data.	Data gathering takes little to no time since it can be extracted from one large database which makes it easy and quick. Furthermore, it is clear which person is responsible for updating and data gathering, or this is done via business intelligence or other IT systems.
	Data analysing	How is data analysing done? Manually of via IT systems? Can you show/explain the process of data analysing? How much time would you say data analysing takes?		All data analysing is done manually, where a lot of manual steps are needed for a complex and time-consuming analyzation.	Data analysing is done manually, but processes are well documented where data transforming is not necessary, making analysing uncomplicated however it remains time consuming.	While data analysing is done by information system, there is still manual labour needed to complete the implementation of the PMS.	Data analysing is done via information or business intelligence systems, with little to no manual labour making the process simple and fast, suitable for all users in search of information.
	Availability of data	Is the data needed for available at a moment notice? The data is available for everyone whom uses the PMS, not depending on function or department? Can you explain the process from gathering the data, to having the data available for analysing are there intermediate steps before the data is ready for analysing?		The data is not dynamically available, also availability is limited to specific individuals making it complex and time consuming.	Data can be gathered at any time for decision making, however, this is a time consuming, complex process with many steps with limited availability in terms of users.	While the data is available at any moment, without actions in between to make it suitable for analysing, it is only available to certain individuals.	Everyone whom uses the PMS has access to the data needed for implementation, the data can be extracted from systems at any time giving dynamic data for decision making without unnecessary steps.
	Data consistency , reliability and validity	Is data consistent with data gathered outside the organisation? How is reliability and validity of the measurement ensured? Is the reliability and validity of outcomes of the measures checked? (e.g. random checks) For consistency purposes, is there a standard process for implementation of the measures, certain person responsible?		There are no procedures set to check and ensure the validity and reliability of the measures.	Non-structurally reliability of the data is checked internally as well as externally. A described procedure for implementation is used for consistency.	When deemed necessary (e.g. by feedback), random checks are done to ensure reliability and validity of the measures. As specific individuals are responsible for implementation consistency is ensured. Who will follow detailed procedures which improve consistency.	Structural procedures such as random checks and re-evaluation of implementation of measures ensure reliability and validity of data. Consistency is ensured by thorough documentation and accountability of implementation for specific employees.
	Innovation	Describe the usage of innovation and new technologies for the PMS?		Innovations in technologies are not used	Advantages for innovation in technologies are known by senior	Advantages for innovation technologies are known within the	The advantages are known within the company; therefore, business intelligence is

		Would you say, the advantages of for example business intelligence for PMS are known within the company? Please explain. For which part are IT advances (e.g. BI for data gathering, data analysing, visualization, decision making)		for implementation of the PMS as the advantages are unclear to the company.	management, but rarely used, if used only for data gathering.	company, however, usage is limited to data gathering and analysing.	used for data gathering, analysing, visualization and decision making.
Implementation		Average score: *incl. documentation of measures					
Use	Organisational commitment	What are the perceived benefits? (are these in line with section 5.8) (commitment across functions) Is the PMS used for decision making? If yes, only by senior management or throughout the organisation? Is the PMS used as a control mechanism?		The PMS is used a control mechanism, as the advantages of a PMS are not well within the company.	While most of senior management know the advantages of a PMS and use it for decision making, other hierarchical levels are unaware of the purposes of a PMS and see it as a control mechanism.	In all hierarchical levels the purposes and advantages of a PMS are explained and known, but the PMS is only used by senior management for decision making. However, the PMS is not perceived as a control mechanism.	In all hierarchical levels the purposes and advantages of a PMS are explained and known, which ensures use of the PMS with decision making rather than a control mechanism.
	Pro-active	What is done with the results of the performance measures? Is the direction of the future dependable on the results of the measures? Are the periodical reviews of the results where improvement opportunities are identified and discussed, and actions are developed?		While information concerning the measures is gathered, the information is not used for decision making or improving processes.	The PMS is used for identifying improvement opportunities but is not used for future guidance or decision making.	The PMS is used to facilitate decision making and improvement opportunities.	The PMS is used to facilitate decision making and improvement opportunities, where the PMS provides guidance for the future and inspires actions to be taken to ensure continuous improvement.
	Strategy	Are results used for validation of the strategy and strategic objectives? Is the strategy adjusted to the results of the performance measures?		The measures are not used for feedback or validation concerning the strategy.	Where the measures can be used for validation of the strategy there is no action taken to adjust measures or strategy according to current performance.	Measures are used for validation of the strategy, where measures are adjusted when the strategy is adjusted and not vice-versa.	The results are used for validation of the strategy, according to changes in the strategy or changes in the results of the measures the strategy or measures are adjusted accordingly.
	Enhancement of operations	Is the PMS used for the following purposes? If yes, please explain how. Open and transparent communication (results shared?) Cultural change Provide accountability Identifying strengths and weaknesses Better understanding of processes		The PMS is used for identifying strengths and weaknesses.	The PMS is used for identifying strengths and weaknesses and for a better understanding of the processes.	The PMS is used for identifying strengths and weaknesses providing a better understanding of the process where the results are shared throughout the operations department.	The PMS is used for identifying strengths and weaknesses providing a better understanding of the process where the results are shared throughout the operations department. Furthermore, it provides accountability and cultural change.
	Progress	Is the PMS used for the following purposes? If yes, please explain how. Save past performance Enabling progress Tracking progress Benchmarking, comparison internally and externally		The PMS is only used for one of the four purposes concerning progress	The PMS is only used for two of the four purposes concerning progress	The PMS is only used for three of the four purposes concerning progress	The PMS is used for all of the 4 purposes concerning progress
Use		Average score: *incl. updating design					
Total:		Average score of all subcategories					

Figure 7. The developed maturity model for performance measurement in operations and logistics

6.2. Implementing the maturity model; Company X's PMS is placed in stage 3 of the maturity model, where the implementation phase is in need of improvement and the use phase has a high maturity.

In this section, the results for each phase as well as the overall score for the maturity model for Company X will be explained based on the findings of the case study. Furthermore, the main improvement areas will be provided. Concluding, implementation of solutions to current incompetence will be discussed showing how the evaluation of a PMS can lead to enhancing a PMS. The completion of the maturity model is done by the researcher via an audit approach, as background information on performance measurement systems is needed.

The design of Company X's PMS is adequate

Based on the scores for each of the subcategories in the design phase, the average score is calculated. The design phase of Company X scored an average of 65%, placing the design phase in stage 3. Meaning, the design of Company X is decent but could still be further improved. While the strengths of the design are the variation is measures, as it includes measures from a variety of perspectives and financial as well as non-financial measures. The design focusses on pro-activeness, as it is developed to track performance, facilitate decision making as well as identify improvement opportunities. However, the design is underdeveloped in the area of documentation, as the documentation is considered abridged and inconclusive which also impacts the implementation.

Implementation is the weakness of Company X's PMS

Implementation is considered the weak spot of Company X's PMS, the subcategories scored an average of 39%, allocating implementation in stage 2. The lower score and placement in stage 2 implies that improvement is needed for the implementation phase, specifically in Company X's case it affects the use of the PMS. Innovation being the exception, data gathering, data analysing, availability of data and data consistency, reliability and validity were placed in stage 1 or two, indicating low maturity. However, the immaturity of this phase is mostly related to the lack of documentation. As this affects the subcategories of data gathering, data analysing and the data consistency, reliability and validity. The fact that there is no information provided on the data sources as a variation of data sources is used, makes the process complex. Combined with the lack of documentation on analysing steps grounds apprehension concerning the

reliability, validity and consistency of data. Hence, the maturity for implementation phase is low and the need for improvement of implementation is high.

High maturity in the use phase

The usage of the PMS for purposes identified in literature is done in great extent, placing the use phase of Company X's PMS in stage four with an average 83 percent of maturity. In this phase there are no subcategories considered underdeveloped or immature. Enhancing the usage phase of Company X's PMS can be done by using the PMS for updating to the strategy, as it currently only used for validating the current strategy.

Overall maturity of the PMS is placed in stage three

Overall, the maturity of the PMS is in stage three, the scores of the individual phase have an average of 62 percent. It can be concluded that the maturity of Company X's PMS is adequate, but there is still substantial room for improvement. While the design, except for documentation is performing well, the weak spot of the PMS is implementation. Because of non-documented processes and lots of variables in data gathering and analysing, the data consistency, reliability and validity should be questioned. Contrary, the use phase is further developed with a high maturity and is the PMS used for most in literature described purposes. However, the information derived from the performance measures is used for, among other purposes, decision making and identifying improvement opportunities, while it has flaws in terms of reliability and consistency. Therefore, it will diminish or contradict the actual advantages of use and performance enhancement because the decision is based on inaccurate numbers. This intensifies the need for further improvement in the implementation phase. The updating of the implementation phase should enhance the maturity of Company X's PMS from adequate to mature and shift the overall performance to stage 4.

Documentation, data gathering, and data analysing considered main improvement opportunities

As concluded, the main improvement areas identified are all part of the implementation phase of the PMS. The root for most issues is the documentation of measures. Furthermore, the wide variation of data sources and different locations and accessibility of these data sources could be improved enhancing the PMS' data gathering and therefore implementation. Subsequently, the data analysing is also in need of improvement, as this is an unreliable, complex and time-

consuming process. All three of the previous identified complications lead to inconsistency and unreliable data.

Manual and Business Intelligence & Analytics (BI&A) solution to improve implementation phase

While opportunities and advantages of the use of BI & A are identified by both employees and senior management, the current usage is limited. The main cause of minimal use is the lack of perceived problems with the current methods. Identification of these problems in combination with explanation of BI&A opportunities should inspire investment in BI&A. Examples of Business Intelligence that can be used for the specific problems with data gathering and analysing identified are Data Warehousing and Extract, Transform and Load. Where Data Warehousing can be implemented for data gathering and storage of information. ETL is implemented for the processing and analysing of the data. In a DW information is gathered in one larger system rather than across departments and sources where multiple employees are responsible for updating the data sources, hence DW eliminates the issues with decentralized information storage and consistency. Where Extract, Transform and Load diminish the issues with reliability, consistency and dynamically available as the extracting and transforming is not done manually but automatically which is less time consuming and more consistent and less room for errors. Concluding, Company X should invest in IT technologies and centralize the multiple data sources they currently use, solving the problems with data gathering and unavailability of data. Furthermore, the process of implementation is currently complex and time consuming, as a BI&A system is already in use for calculation of one of the measures, this should be extended to include all the measures eliminating the time, consistency and reliability issues and improving the overall performance of the PMS.

After advancing the implementation of measures to the BI&A system a manual should be developed. Development of the manual should be started after the expansion of the BI&A system, as this will change the process and a manual on the current processes would then not suffice. The manual should describe the definition of the performance measure, the data source and data gathering process as well as the analysing process, where all steps are explicitly documented. Furthermore, it should include the interpretation of the outcome, information distribution of results and actions needed. In conclusion, the combination of DW, ETL and documentation should eliminate most issues associated with implementation and continue to grow to stage 4 of maturity.

6.3. For successful implementation the maturity model background information on performance measurement systems is needed, and the use of multiple data sources for review of the company's PMS is preferred.

The completion of the developed maturity model on a PMS lifecycle provides a description and example of how the model can be implemented and used to identify improvement opportunities. During the process of completing the maturity model at Company X, it became that obvious that background information on performance measurement systems is needed in order to fill in the model. Whereas the model provides guidelines for identification of the stages, there multiple various and key activities for each of the subcategories leave room for interpretation of the phases. Hence, background information on PMS is needed to interpret the different stages and place the company in the right stage of maturity. Furthermore, extensive knowledge is needed on the company and its PMS lifecycle. Semi-structured interviews will not suffice to objectively asses a company's PMS on maturity as the reliability and validity needs to be checked. Additionally, observations were considered a large source of data as observations enable real observations for the implementation and use phase, providing a complete picture of the situation. With extensive information on the company's PMS as well as background information from literature on PMS best practices throughout the lifecycle as identified in this paper, the maturity model is straightforward to implement. The results of the maturity model provide besides evaluation and improvement opportunities, a means to get alignment between all parties involved in the process. The strengths of the maturity model lie in the inclusion of all employees throughout the PMS phases and their knowledge and feedback. Therefore, the following steps are advised when implementing the maturity model;

1. Familiarise yourself with background information on a PMS lifecycle (e.g. the different phases and key activities)
2. Investigate and set appointments for interviews with all (or as many as possible) persons working with the PMS, include employees of each phase; design, implementation and use.
3. Conduct semi-structured interviews according to questions indicated in each sub-section and interview guide
4. Gather observations and documentation, such as participating in meetings reviewing and discussing performance, reviewing documentation (e.g. manuals), watch

implementation processes for additional information and validation and reliability of information provided in the interviews.

5. Conduct follow-up interviews for clarification or discrepancies between the interviews, documentation and observations
6. Fill in the maturity model at once, taking into account the information from all data sources
7. After completing of the model, averages for all the phases should be calculated based on the scores of the subcategories. As all the phases have a different number of sub-categories the overall maturity should be calculated using the average of the scores of the three phases.
8. According to the results, the level of maturity can be identified as well as improvement opportunities for which recommendations should be made.

7. The maturity model can be used for enhancing existing performance measurement systems with an equal focus on all three phases of the life-cycle.

The maturity model for performance measurement systems in operations and logistics shows an alternative to a complete redevelopment of the PMS, which is indicated as a current research gap by Braz et al. (2011). Previous literature tends to focus on the design phase of the PMS and lacks information concerning the complete PMS lifecycle, which also includes an implementation and use phase (Bititci et al., 2006; Bourne & Neely, 2000; Kennerley & Neely, 2003; Nudurupati & Bititci, 2005).

A PMS lifecycle can be updated by identifying areas of underperformance and improving these areas. For identification of underperformance, evaluation is needed. To build an evaluation tool, the three phases of a PMS lifecycle were researched to identify success factors and key practices. The following features were identified to assess the maturity of a PMS lifecycle;

Design: origin of the measures, variation in the measures, pro-active oriented, regular updating of the measures and documentation of measures.

Implementation: documentation of implementation process, method of data gathering, method of data analysing, availability of data, data consistency, reliability and validity and lastly use of innovative technologies.
Use: complete set of relevant measures, organisational commitment, perceived benefits of usage, pro-active usage of results to facilitate decision making, strategy enhancement and validation and lastly the use of results to track and enable progress.

The identified features formed the basis for the maturity model that identified the following four stages of a PMS maturity (Paulk et al., 1993):

Stage 1: The PMS is based on financial measures not taking into consideration the multiple perspectives, such as; where the process is not documented properly; processes such as data analysing and data gathering are done manually; where commitment and the perceived benefits of the PMS are low and therefore the PMS is not used for its intended purposes. Hence, the PMS is outdated and underdeveloped and is in desperate need of updating, a completely new PMS could be considered.
Stage 2: In stage 2 of the maturity model, the PMS takes into consideration multiple perspectives (e.g. external and internal), however the measures are mostly financial. Subsequently, there is little documentation on the design and implementation process and the implementation phase is done manually. The complete overview of purposes of a PMS is not identified and thus the PMS is not used to its full potential. Hence, the PMS is in need of updating, as is it fails the literature standards.
Stage 3: The measures are derived from strategy and include most, if not all perspectives: the internal, customer, innovation & learning and financial perspective. Furthermore, the measures selected are reviewed over time to re-evaluate the completeness and usefulness. The design and implementation process are documented to great extent. Whereas the implementation phase uses IT for data gathering and data analysing, making it faster and easier, it is not completely automated. Afterwards, the PMS is used throughout the organisation to facilitate decision making and enhance performance. Furthermore, the performance measure results are used to validate the strategy. While the PMS is considered mature, there is still room for improvements to optimize the PMS that should be considered.
Stage 4: The measures are derived from strategy and include the internal, customer, innovation & learning and financial perspective. The measures selected are structurally reviewed to re-evaluate the completeness and usefulness. The design and implementation phase are

documented in great detail. The implementation process is automated via IT processes making it fast, reliable and consistent. Afterwards, the PMS is used throughout the organisation to facilitate decision making and enhance performance. Furthermore, the results of the performance measures are used to validate and update the strategy. Hence, the PMS has a high maturity, with only minimal improvement opportunities.

The empirical testing of the maturity model for PMS at the case study demonstrated the interconnectedness of the phases in a PMS lifecycle. Furthermore, the findings of implementing the maturity model identified the need for a focus on implementation, as a design alone does not make a PMS as a success. More focus on implementation is needed as it affects the usability of the PMS, in terms of use purposes for enhancing performances but secondly in terms of user-friendliness of the PMS. When the implementation phase is underdeveloped, it can compromise the reliability of results, diminishing the advantages that an organisation can gain using a PMS, which was displayed during the case study.

In conclusion, the developed maturity model can be used for evaluating and identifying improvement opportunities for an existing PMS in the operations and logistics sector.

8. The use of the PMS maturity model is limited to the operations and logistics sector.

There are multiple limitations to this research, first the framework is solely focused on the operations and logistics sector, therefore it can be insufficient to evaluate the PMS of other departments. In general, the PMS maturity model developed can provide a basis for the evaluation of PMS across sectors, however key activities for that sector might be excluded diminishing the completeness of the maturity model. Secondly, as performance measurement started gaining interest the end of the 20th century, there is a large timeframe between sources used and compared, which can lead to a biased comparison. However, this was taken into consideration, as earlier information, specifically for design features, is reviewed for applicability in the current present-day literature and practice. Combined with new findings and innovations, the earlier literature provides multiple perspectives. As mentioned before, there is a gap in information. While there is an endless supply of information on the design of a PMS, there is significantly less information on the implementation of a PMS, which limits the literature research on this topic. However, during the implementation of the maturity model at the case study, no issues where indicated concerning a lack of information. But considering the

fact that implementation is identified as a problem area and potential future research should be conducted in this area, new findings might be presented which will comprise the actuality of the developed maturity model. Furthermore, as the model has only been implemented once, the results of improvements are not quantitively tested. While it succeeded in evaluating Company X' PMS, there is a possibility that different organisations' PMS include features that will be overlooked in the assessment for maturity. Lastly, for business intelligence and analytics, multiple examples such as DW and ETL are mentioned that can help enhance a PMS, however, the improvement of a PMS is not limited to use of these forms of BI&A.

9. The paper contributes to theory by providing a means to evaluate and update a PMS in operations and logistics, defining and identifying the key activities for each phase of a PMS lifecycle and identifying the interconnectedness of phases.

Where there is already an increasing amount of literature available for the design of a PMS, there is significantly less information available on implementation and using of the PMS, let alone on the updating of a PMS (Bititci et al., 2006; Bourne & Neely, 2000; Kennerley & Neely, 2003; Nudurupati & Bititci, 2005). This paper contributes to current literature by clearly defining each phase of a PMS lifecycle. Furthermore, it extends current literature on performance measurement by providing a means to evaluate and update performance measurement systems in operations and logistics sector. Whereas most literature to date focusses on design, during the case study, it was concluded that even though design can be of high maturity, advantages of a PMS will be greatly diminished when not implemented or used correctly. Hence, it proves the interconnectedness of the design, implementation and use phase and the importance of each individual phase in the performance measurement systems' lifecycle. Furthermore, it combines literature from different fields to improve PMSs, such as innovations in technologies that help enhance the implementation phase of a PMS. In addition to identifying barriers and issues with current performance measurement systems, it provides solutions on how to overcome common issues and barriers with performance measurement.

10. Implementing the PMS maturity model will enable evaluation of an existing PMS lifecycle and identification of improvement opportunities. The maturity model gathers the knowledge of all parties involved in the PMS's lifecycle and aligns awareness for improvement opportunities.

The main contribution to practice of this paper is the maturity model which provides a means to evaluate any organisation's PMS. The research that eventually lead to the maturity model identified the success-factors and features for each phase a PMS lifecycle and provided examples of performance measures that can be used in the design of the PMS. Secondly, the paper includes a detailed step by step approach to implement the maturity model. Besides, the case study doubles as an example of how the maturity model can be implemented and used to evaluate and improve an existing PMS. Completing the maturity model will provide areas with underperformance and lower maturity which indicate improvement opportunities. Furthermore, the maturity model combines the knowledge of all hierarchical levels throughout the organisation and combines this information for a complete picture of the performance measurement system and its strengths and weaknesses. Additionally, improvement opportunities that might be overseen by senior management are now acknowledged and identified by interviewing implementors of the PMS as well. Hence, awareness of issues is spread, and the results of the maturity model can help get all parties involved with the PMS, designers, implementors and users aligned on necessary improvements. While the maturity model focusses on finding improvement opportunities, the literature review provides the know-how to implement improvement and solutions on how to overcome barriers and issues with PMS.

11. Future research can test the effectiveness and completeness of the PMS maturity model.

Future research can be done to test the effectiveness and completeness of the maturity model. When a larger quantity of organisations has implemented and used the maturity model for PMSs in operations and logistics, a quantitative analysis can be conducted. While this research identified improvement areas for Company X, future research can analyse the impact of improvements made on the maturity of Company X's PMS and the overall performance of Company X. Furthermore, implementing the maturity model can test the validity of the model

and identify if the implementation phase is considered a weakness across industries and organisations and further investigate how implementation can be enhanced by the use of innovative technologies. As the opportunities with business intelligence and innovative technologies continue to improve and innovate, in the future revising and updating the innovative technologies section of this paper and model should be considered to keep it up to date.

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13. Appendix I

13.1. Interview guide

For the semi-structured interviews with various employees of Company X, a selection of questions is provided. However, during the interview questions can be added for extra explanation and information if needed. Before the start of the interview, the purpose of the research and a short explanation about the paper will be given. It is made clear that interviewees can stop at any time during the process and all information shared will be handled anonymously and is limited to usage for this research. Depending on the preference of the interviewee, languages can be switched during the interview which will be translated by the researcher. Verbal permission for recording and using the information provided is asked and needed before proceeding with the interview.

General questions:

1. Can you tell me about yourself and your role in the company (function, gender, age, time with the company)
2. Are you familiar and involved with the performance measurement system?

3. In which ways do you contribute to the PMS and does the PMS contribute to your function? Please elaborate.
    a. Depending on the function, questions regarding the nature of the involvement will be asked

Questions regarding design:

4. Can you shortly explain the process of development for the design of the PMS?
5. Are measures derived from the firm's strategy?
6. Is the availability of data considered when designing the measures?
7. Are all levels of the organisation involved when developing measures?
8. Are all measures selected within the control of the firm?
9. Does the design include internal, customer, innovation & learning and financial perspective measures?
10. Does the design include financial and non-financial measures?
11. Does the design include short- and long-term objectives?
12. Are there measures conflicting another, if yes, how is this handled?
13. Are there measures relating to both the strategic, tactical and operational levels of decision making and control?
14. Is there a documentation e.g. a manual which include a clear definition of each performance measure, including purpose, data collection and calculation methods, update and monitoring mechanisms and related procedures?
15. Does the design include feedback from the measures, to test the validity of the strategy?
16. Does the design should include a feedback loop, which inspires actions based on discrepancies between the set targets and actual outcomes?
17. Is the PMS designed to inspire improvement rather than a means to monitor?
18. Does the design enable fast factual and dynamic information to facilitate decision making and continuous improvement?
19. Are measures periodically reevaluating concerning the purpose and usefulness deleting those which are no longer useful?
20. Is the design periodically reevaluating concerning completeness of the KPI's, e.g. coincide with changes in strategy?
21. Are targets reviewed and reset e.g. when achieved or circumstances change?
22. Does the design evaluate and challenge the strategic assumptions?

23. Is there a documentation e.g. a manual which include a clear definition of each performance measure, including purpose, data collection and calculation methods, update and monitoring mechanisms and related procedures?

Questions regarding implementation:

24. How many different data sources are used?
25. Are the data sources spread across departments?
26. How much time is spent on data gathering?
27. Is it clear who is responsible for data gathering and data updating?
28. Is the data needed for available at a moment notice?
29. The data is available for everyone whom uses the PMS, not depending on function or department?
30. Can you explain the process from gathering the data, to having the data available for analysing are there intermediate steps before the data is ready for analysing?
31. How is data analysing done? Manually of via IT systems?
32. Can you show/explain the process of data analysing?
33. How much time would you say data analysing takes?
34. Is data consistent with data gathered outside the organisation?
35. How is reliability and validity of the measurement ensured?
36. Is the reliability and validity of outcomes of the measures checked? (e.g. random checks)
37. For consistency purposes, is there a standard process for implementation of the measures, certain person responsible?
38. Describe the usage of innovation in and new technologies for the PMS?
39. Would you say, the advantages of for example business intelligence for PMS are known within the company? Please explain.
40. For which part are IT advances (e.g. BI for data gathering, data analysing, visualization, decision making)

Questions regarding use:

41. What are the perceived benefits? (are these in line with section ..) (commitment across functions)
42. Is the PMS used for decision making? If yes, only by senior management or throughout the organisation?

43. Is the PMS used as a control mechanism?
44. What is done with the results of the performance measures?
45. Is the direction of the future dependable on the results of the measures?
46. Are the periodical reviews of the results where improvement opportunities are identified and discussed, and actions are developed?
47. Are results used for validation of the strategy and strategic objectives?
48. Is the strategy adjusted to the results of the performance measures?
49. Is the PMS used for the following purposes? If yes, please explain how.
    a. Open and transparent communication (results shared?)
    b. Cultural change
    c. Provide accountability
    d. Identifying strengths and weaknesses
    e. Better understanding of processes
50. Is the PMS used for the following purposes? If yes, please explain how.
    a. Save past performance
    b. Enabling progress
    c. Tracking progress
    d. Benchmarking, comparison internally and externally

14. Appendix II

14.1. Completed PMS maturity model at Company X

Phase	Subcategory	Questions	%	Stage 1	Stage 2	Stage 3	Stage 4
				0-25%	26-50%	51-75%	76-100%
Design	Origin of the measures	Are measures derived from the firm's strategy? Is the availability of data considered when designing the measures? Are all levels of the organisation involved when developing measures? Are all measures selected within the control of the firm?	70	Measures are derived from strategy, but other factors are not taken into account.	Senior management decides the measures based on available data and strategic objectives.	Measures are derived from the strategy and designed throughout the organisation taking into account what is within the control of the firm.	Measures are derived and to test the validity of the strategy, all levels of the organisations are involved in the process of designing the measures, taking into account the control and data availability of the organisation.
	Variation in the measures	Does the design include internal, customer, innovation & learning and financial perspective measures? Does the design include financial and non-financial measures? Does the design include short- and long-term objectives?	80	Only financial measures from an internal perspective.	Financial and non-financial measures are implemented in relation to multiple perspectives however not all. No attention is given to the distinction between short-	There is no use of contradicting measures, and all perspectives are taking into account as well as the long- and short-term goals but all measures are related to the operational level of decision making.	All perspectives are taken into account, as well as the strategic, tactical and operational levels of decision making and long- and short-term goals. The measures that are contradicted are identified and carefully evaluated.

		Are there measures conflicting another, if yes, how is this handled? Are there measures relating to both the strategic, tactical and operational levels of decision making and control?			and long-term goals and conflicting measures.		
	Pro-active oriented	Does the design include feedback from the measures, to test the validity of the strategy? Does the design should include a feedback loop, which inspires actions based on discrepancies between the set targets and actual outcomes? Is the PMS designed to inspire improvement rather than a means to monitor? Does the design enable fast factual and dynamic information to facilitate decision making and continuous improvement?	75	There is no set periodical review for feedback, this is done non-systemically and few and far in between. As the PMS is mostly used for monitoring.	Even though the improvement opportunities and facilitation in decision making is the goal of the PMS and large gaps between actuals and targets are cause for action, the design does not enable dynamic information or feedback to the test the validity for the strategy.	The design includes feedback for the strategy and inspires actions and improvements based on results, the design lacks features that enable dynamic information or feedback.	Feedback are loops are implemented and there is a pro-active mindset always looking for improvement opportunities according to the PMS. The PMS is also used for decision making and to check the validity of the strategy.
Design & Use	Updating the design	Are measures periodically reevaluating concerning the purpose and usefulness deleting those which are no longer useful? Is the design periodically reevaluating concerning completeness of the KPI's, e.g. coincide with changes in strategy? Are targets reviewed and reset e.g. when achieved or circumstances change? Evaluate and challenge the strategic assumptions	70	There is no systematic review in place for the PMS its measures and targets.	Where targets are reviewed when achieved or when circumstances change, the process of changing and deleting measures can be considered non-existent.	Periodically the targets and measures are re-evaluated according to circumstances, usefulness and completeness. Measures are then deleted or added.	Every half year the targets and measures are re-evaluated according to circumstances, relevant and completeness. Measures are then deleted or added. The measures are used to check, challenge and validate and in case needed change the strategy.
Design & impleme ntation	Documenta tion of measures	Is there a documentation e.g. a manual which include a clear definition of each performance measure, including purpose, data collection and calculation methods, update and monitoring mechanisms and related procedures?	30	Little to no documentatio n.	There is general documentation defining each measure and the calculations.	There is documentation on the definition, purpose, data collection and calculation methods.	The whole process is documented and explained, and this data is available for all employees.
Design		Average score:	65				
Impleme ntation	Data gathering	How many different data sources are used? Are the data sources spread across departments? How much time is spent on data gathering? Is it clear who is responsible for data gathering and data updating?	40	Data gathering is complex and time consuming, as data is spread across sources and departments.	Data is spread across departments with different data sources which makes data gathering time consuming. However, it is clear who is responsible for gathering and updating the data.	Data is not spread across department, but it is spread across data sources. Time spend on gathering is not long but could be minimized. While it is clear who is responsible for updating and gathering the data.	Data gathering takes little to no time since it can be extracted from one large database which makes it easy and quick. Furthermore, it is clear which person is responsible for updating and data gathering or this is done via business intelligence or other IT systems.
	Data analysing	How is data analysing done? Manually of via IT systems? Can you show/explain the process of data analysing? How much time would you say data analysing takes?	25	All data analysing is done manually, where a lot of manual steps are needed for a complex and time-consuming analyzation.	Data analysing is done manually, but processes are well documented where data transforming is not necessary, making analysing uncomplicated however it remains time consuming.	While data analysing is done by information system, there is still manual labor needed to complete the implementation of the PMS.	Data analysing is done via information or business intelligence systems, with little to no manual labor making the process simple and fast, suitable for all users in search of information.

	Availability of data	Is the data needed for available at a moment notice? The data is available for everyone whom uses the PMS, not depending on function or department? Can you explain the process from gathering the data, to having the data available for analysing are there intermediate steps before the data is ready for analysing?	40	The data is not dynamically available, also availability is limited to specific individuals making it complex and time consuming.	Data can be gathered at any time for decision making, however, this is a time consuming, complex process with many steps with limited availability in terms of users.	While the data is available at any moment, without actions in between to make it suitable for analysing, it is only available to certain individuals.	Everyone whom uses the PMS has access to the data needed for implementation, the data can be extracted from systems at any time giving dynamic data for decision making without unnecessary steps.
	Data consistency, reliability and validity	Is data consistent with data gathered outside the organisation? How is reliability and validity of the measurement ensured? Is the reliability and validity of outcomes of the measures checked? (e.g. random checks) For consistency purposes, is there a standard process for implementation of the measures, certain person responsible?	35	There are no procedures set to check and ensure the validity and reliability of the measures.	Non-structurally reliability of the data is checked internally as well as externally. A described procedure for implementation is used for consistency.	When deemed necessary (e.g. by feedback), random checks are done to ensure reliability and validity of the measures. As specific individuals are responsible for implementation consistency is ensured. Who will follow detailed procedures which improve consistency.	Structural procedures such as random checks and reevaluation of implementation of measures ensure reliability and validity of data. Consistency is ensured by thorough documentation and accountability of implementation for specific employees.
	Innovation	Describe the usage of innovation in and new technologies for the PMS? Would you say, the advantages of for example business intelligence for PMS are known within the company? Please explain. For which part are IT advances (e.g. BI for data gathering, data analysing, visualization, decision making)	65	Innovations in technologies are not used for implementation of the PMS as the advantages are unclear to the company.	Advantages for innovation in technologies are known by senior management, but rarely used, if used only for data gathering.	Advantages for innovation technologies are known within the company, however, usage is limited to data gathering and analysing.	The advantages are known within the company, therefore business intelligence is used for data gathering, analysing, visualization and decision making.
Implementation		Average score: *incl. documentation of measures	39				
Use	Organisational commitment	What are the perceived benefits? (are these in line with section 5.8) Is the PMS used for decision making? If yes, only by senior management or throughout the organisation? Is the PMS used as a control mechanism?	85	The PMS is used a control mechanism, as the advantages of a PMS are not well within the company.	While most of senior management know the advantages of a PMS and use it for decision making, other hierarchical levels are unaware of the purposes of a PMS and see it as a control mechanism.	In all hierarchical levels the purposes and advantages of a PMS are explained and known, but the PMS is only used by senior management for decision making. However, the PMS is not perceived as a control mechanism.	In all hierarchical levels the purposes and advantages of a PMS are explained and known, which ensures use of the PMS with decision making rather than a control mechanism.
	Pro-active	What is done with the results of the performance measures? Is the direction of the future dependable on the results of the measures? Are the periodical reviews of the results where improvement opportunities are identified and discussed, and actions are developed?	90	While information concerning the measures is gathered, the information is not used for decision making or improving processes.	The PMS is used for identifying improvement opportunities but is not used for future guidance or decision making.	The PMS is used to facilitate decision making and improvement opportunities.	The PMS is used to facilitate decision making and improvement opportunities, where the PMS provides guidance for the future and inspires actions to be taken to ensure continuous improvement.
	Strategy	Are results used for validation of the strategy and strategic objectives? Is the strategy adjusted to the results of the performance measures?	65	The measures are not used for feedback or validation concerning the strategy.	Where the measures can be used for validation of the strategy there is no action taken to adjust measures or	Measures are used for validation of the strategy, where measures are adjusted when the strategy is adjusted and not vice-versa.	The results are used for validation of the strategy, according to changes in the strategy or changes in the results of the measures the strategy or

					strategy according to current performance.		measures are adjusted accordingly.
	Enhancement of operations	Is the PMS used for the following purposes? If yes, please explain how. Open and transparent communication (results shared?) Cultural change Provide accountability Identifying strengths and weaknesses Better understanding of processes	90	The PMS is used for identifying strengths and weaknesses.	The PMS is used for identifying strengths and weaknesses and for a better understanding of the processes.	The PMS is used for identifying strengths and weaknesses providing a better understanding of the process where the results are shared throughout the operations department.	The PMS is used for identifying strengths and weaknesses providing a better understanding of the process where the results are shared throughout the operations department. Furthermore, it provides accountability and cultural change.
	Progress	Is the PMS used for the following purposes? If yes, please explain how. Save past performance Enabling progress Tracking progress Benchmarking, comparison internally and externally	95	The PMS is only used for one of the four purposes concerning progress	The PMS is only used for two of the four purposes concerning progress	The PMS is only used for three of the four purposes concerning progress	The PMS is used for all of the 4 purposes concerning progress
Use		Average score: *incl. updating design	83				

Figure 8. *The completed maturity model for Company X's operations and logistics department*