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BUSINESS PROCESS IMPROVEMENT OF THE ORDER-TO-DELIVERY CYCLE

by

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Executive Summary

Grundfos is considered to be one of the world's largest pump manufacturers. Poul Due Jensen founded Grundfos in 1945 in Denmark. It grew to become a global organisation. Grundfos South Africa (GZA) was established in 1992 and is responsible for sales in Africa. The organisation experienced massive growth over the last ten years. The current business processes are unable to support this growth which has led to inefficiency. Problems and issues arise in the day-to-day activities of the order-to-delivery cycle and this affects customer service negatively.

This project addressed the inefficiencies, lack of standardised processes and recurring problems in the cycle and sets the baseline for process improvement and standardisation.

An initial investigation phase was conducted to understand the order-to-delivery cycle, the Grundfos environment and to do research into the key concepts involved in process improvement. The theory of process maturity was used to determine realistic improvement goals for the project. Research included the principles of business process improvement (BPI) and business process reengineering (BPR). Both approaches include phases for process mapping, performance measurement, and implementation. In the literature study process mapping notations were analysed and the notation used for the project was selected, taking into account Grundfos standards and personnel maturity in interpreting process maps.

Employees and managers were interviewed to develop a high-level understanding of the order-to-delivery cycle. From this a cause-and-effect analysis was conducted to identify all the factors that contribute to the problem. This analysis indicated that open group sessions were necessary to gather input from employees regarding the problems that they experience. Work sessions were held with stakeholders and role players to give them an opportunity to voice their concerns and to identify problems in those parts of the process that they are responsible for. These problem statements were collected, analysed and prioritised. The process related problem statements that were within the scope of the project were identified and provided a key input to the project.

Documentation was developed for the order-to-delivery cycle including detailed hierarchical models of all the relevant processes. The level 1 process identification is based on Porter's value chain activities. The level 2 process models define the order-to-delivery cycle and are grouped under the relevant level 1 processes to create a value chain perspective of GZA.

The process models represent the best practices selected from the current activities performed by employees. The cause-effect and process problem analysis was used to develop process changes and improvements in areas where best practices were lacking. These were verified with management. The process models will provide employees with a guideline to ensure consistency in process execution and will serve as the baseline for future process standardisation, optimisation as well as information system initiatives. The models highlight the interaction between the processes required to achieve GZA's purpose – providing goods to the customer in an effective, efficient and predictable manner.

Process performance measurement is important to determine whether processes are performing to expectation, to manage the processes and to identify opportunities for improvement. Measures were developed that will enable managers to monitor the performance of the new processes. Key performance indicators (KPIs) were developed to monitor the whole order-to-delivery cycle. The real improvement in the order-to-delivery cycle will be realised and achieved after the new processes have been implemented. An implementation strategy was developed to guide GZA through the implementation phase. The strategy also includes change management guidelines.

In summary, GZA wants to improve customer service by improving the order-to-delivery cycle. The processes in the cycle were defined, documented and changed to eliminate known problems. The process models will provide the baseline for continuous improvement. The processes will be measured and reviewed regularly against the process measures and key performance indicators to trigger further management action. The project's deliverables will contribute significantly to GZA's understanding of their processes in general and the order-to-delivery cycle in particular. It can further be used as a template for similar projects.

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1. Introduction

1.1. Background of Grundfos

Grundfos is one of the largest global pump manufacturers. Grundfos originates from Denmark and was founded in 1945 by Poul Due Jensen in Bjerringbro (Grundfos Management A/S, 2013). The company started as a one-man operation and grew to a global group that is represented in various countries including South Africa (Grundfos Management A/S, 2013). The Grundfos Group consists of 80 companies located in more than 55 countries across the world, with the head office situated in Denmark (Grundfos, 2013). Figure 1 represents a breakdown structure of the Group.

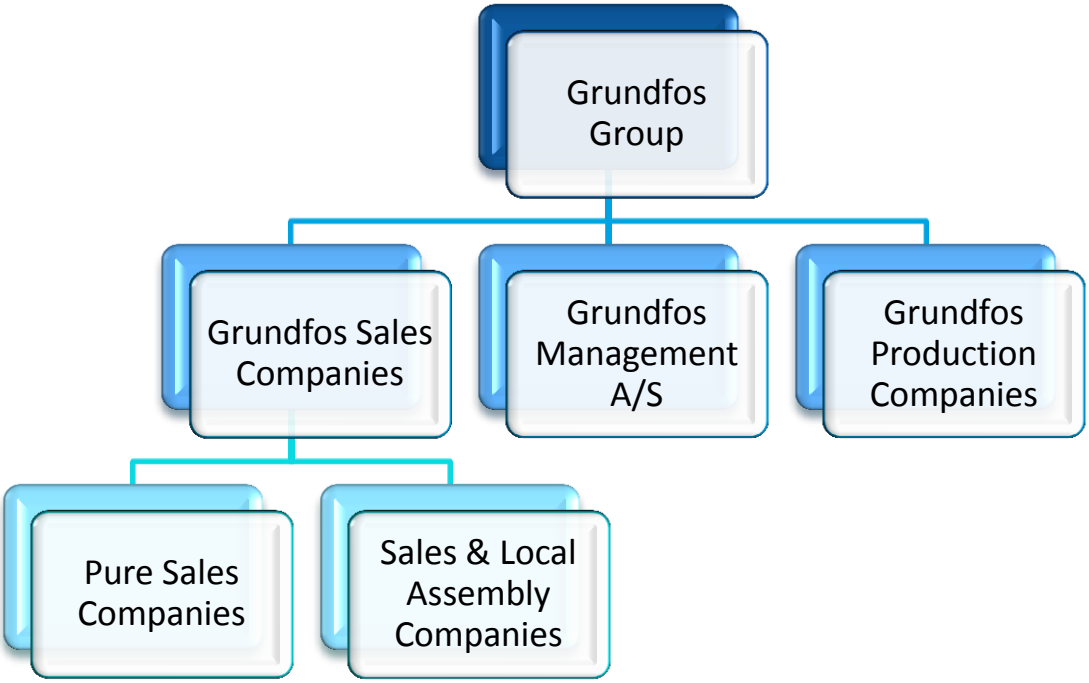

Figure 1: Grundfos Group structure.

The Grundfos Group consists of three types of companies. Grundfos Management A/S is the parent company of the Group and is located in Denmark. Grundfos production companies manufacture wide ranges of pumps, and the Grundfos sales companies source products from the production companies. Grundfos sales companies are subdivided into two groups – pure sales companies and sales companies that do local assembly.

The main objective of Grundfos is to make water accessible. Grundfos produces circulator pumps used for heating, air-conditioning, and ventilation in offices, houses and other buildings (Grundfos, 2013). They also supply centrifugal pumps for various industry applications, water supply, sewage, and water treatment (Grundfos, 2013).

Grundfos South Africa (GZA) focuses on sales in Africa and supplies pumps to more than 43 countries (Grundfos, 2013). GZA was established in 1992 and grew to the company it is today with approximately 105 employees. GZA is an example of a sales and local assembly company according to the Grundfos Group structure. Figure 2 shows the organisational structure of GZA.

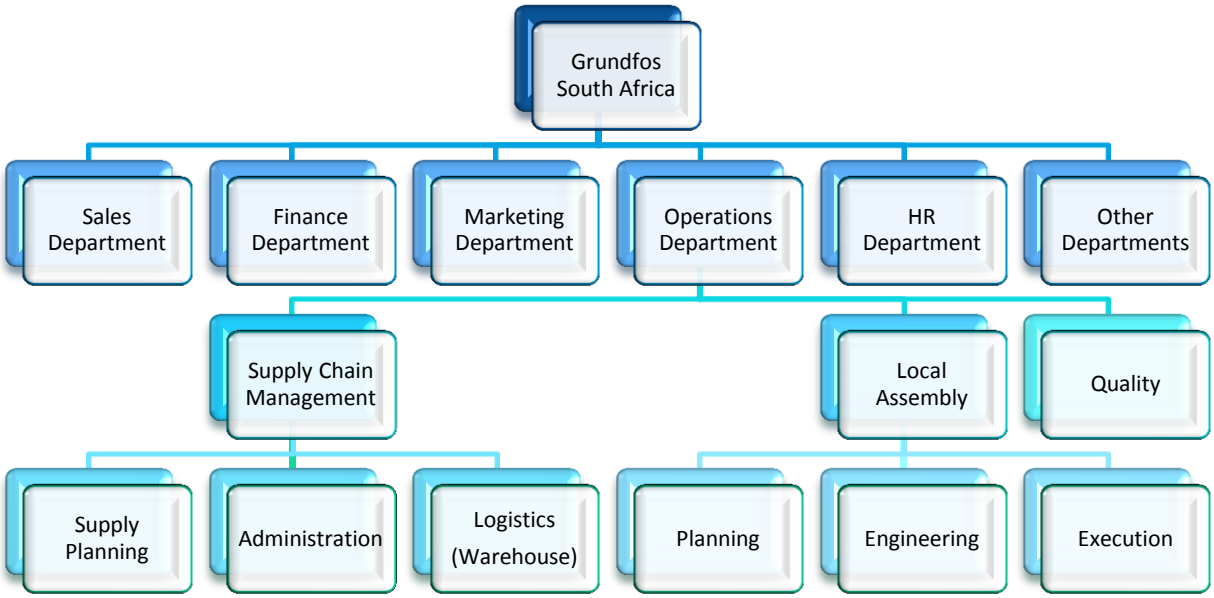

Figure 2: Organisational structure of GZA

The sales department is the primary business function, as it provides the interface between GZA and its customers. The operations department works with the sales department to fulfil customer orders. The operations department includes warehousing activities, inbound and outbound logistics activities and the management and execution of local assembly.

GZA is experiencing problems with the current business processes of the sales and operations departments. The business processes in each department affect the operation and performance of the other department. The inefficiency of the business processes in these departments has a significant impact on customer service and satisfaction.

1.2. Problem Statement

GZA experienced magnificent growth in their sales over the last 10 years. Figure 3 depicts the sales growth since 1992. The steep increase in sales resulted in expanded operations; thus available resources and business processes are unable to support the sales function effectively. Significant problems were observed in the processes of the sales and operations departments leading to inefficiency and a drop in customer service levels.

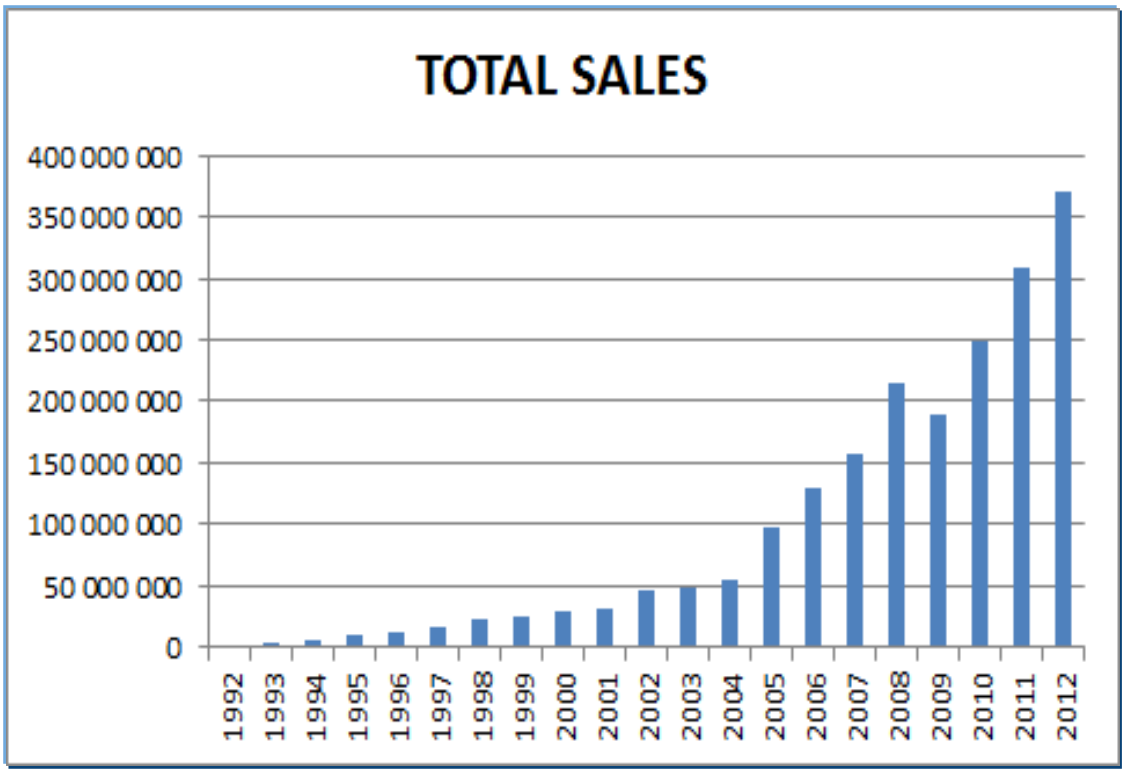

Figure 3: Past sales figures of GZA

The order-to-delivery cycle is the key process that plays a critical role in meeting and satisfying customer demand. The order-to-delivery cycle of GZA stretches across the sales and operations departments.

Observation of the day-to-day operation and activities of GZA indicated that problems and issues occur regularly due to ineffective and inefficient business processes that are interpreted differently by various role players. Further investigation and consultation with managers highlighted that the current business processes are out-dated, not managed effectively and that there are no process performance measures in place. The existing process documentation is incomplete and does not support or represent the current way of working. This results in processes that cannot be managed effectively and are not standardised, which means that every employee completes the same task differently.

Without standardised processes for the order-to-delivery cycle problems arise regularly, creating process failures that affect customer service. Observation indicated that employees are uncertain of the manner in which to address issues when they occur, leading to more problems, since the issues are not resolved.

There are communication gaps between the departments and the respective role players. This contributes to the problems and inefficiencies. Management acknowledges that responsibility and accountability are unclear throughout due to the lack of proper and optimised process design and documentation.

Needs Requirement

After careful observation and investigation, it became clear that GZA requires proper process documentation that can be used by employees to complete their day-to-day activities and by managers to control the processes and supervise their employees. GZA management launched a project that will deliver process documentation to address the problems and issues in the order-to-delivery cycle and highlight process integration and communication between role players. The process documentation should include improvement suggestions for the processes in the order-to-delivery cycle and employees at all organisational levels should be able to understand it. This documentation should provide the baseline for process standardisation and continuous improvement. Measurements are required by management to assist in identifying performance and operational issues that must be addressed.

1.3. Project Aim

GZA wants to address the issues and problems they face in order to continue to grow in the future. They want to launch the strategic initiative of *Operational Excellence* in order to achieve the needed growth. The Denmark based parent company Grundfos Management A/S sets the mandate that GZA needs to be ISO 9001:2000 certified before the end of 2013. These two initiatives are the end goals once the current issues are resolved.

This project is one of the key steps to prepare GZA for ISO 9001 certification. ISO 9001 is a standard developed by the International Organisation for Standardisation (ISO) (WebFinance Inc., 2013) and it is part of the ISO 9000 group of standards (ACS Registrars , 2010). It is an internationally acknowledged standard for quality management systems in order to manage a business efficiently and enhance customer satisfaction (ACS Registrars , 2010). To define their quality management system, GZA must acquire information from all their departments and determine the focus processes of the new system (ACS Registrars , 2010). GZA selected its order-to-delivery cycle to be analysed, clearly defined and documented as a first step in preparation for the ISO 9001 certification.

The aim of this project was to address the inefficiencies, lack of standardised processes and problems that arise in the sales and operations departments of GZA by documenting the processes in the order-to-delivery cycle. The problems that GZA employees experience were identified and those that were process related were addressed in the process documentation. These clearly documented processes and the process changes that were designed to solve the problems will form the baseline for future improvement of the order-to-delivery cycle.

It was further imperative to identify the main KPIs (performance measurements) in the order-to-delivery cycle and to set initial performance goals. These KPIs will be used to measure the process performance and provide information to use in decision making for continuous improvement.

The process documentation will allow GZA to standardise its processes to ensure that every employee completes the process tasks in the same way. A change management and implementation strategy was constructed to guide GZA with further implementation and standardisation of the new processes. The project provided recommendations for future improvement initiatives.

1.4. Project Scope

Grundfos offers various products, solutions and services to its customers. GZA provides the following products and services to local and international customers:

- Off-the-shelf products: These products are sourced from Grundfos production companies in other countries. They are sold to customers as-is, with no customisations required. They will be referred to as finished goods or stock-keeping units (SKU's) for the purpose of this project.
- Customised products: These products can be classified as make-to-order products, because they are slightly customised according to customer requirements. This product type will be referred to as an assembly, and when production is completed it will be classified as an assembled finished good.
- Complex solutions: These are engineered-to-order products and they are usually the result of a project. These products are complex assemblies because they are not the result of slight customisation.
- Supply of spare parts, repair and maintenance services.

The different products, services and locations of customers divide GZA into different order-to-delivery cycles. These order-to-delivery cycles can be categorised as:

- Local sales: This order-to-delivery cycle is responsible for providing finished goods and assemblies to customers in South Africa.
- Export sales: This order-to-delivery cycle is responsible for providing finished goods and assemblies to international customers mostly in Africa.
- Projects: This order-to-delivery cycle is responsible for providing complex solutions for projects.
- Service: This order-to-delivery cycle is responsible for the sale of spare parts and it includes the repair and maintenance of products.

Some of the processes in the different order-to-delivery cycles are the same, but for the purpose of this project the cycles were viewed as independent of each other. The order-to-delivery cycles for local and export sales overlap and have nearly the same processes, but export sales require more documentation. Documentation of the order-to-delivery cycle for local sales will lead to improvement and it will also affect the performance of export sales. Due to time constraints, the scope of this project was limited to the order-to-delivery cycle for local sales. In this document the order-to-delivery cycle for local sales will only be referred to as the "order-to-delivery cycle" and it will be the only cycle discussed and analysed. This project will serve as the baseline for improvement of the other order-to-delivery cycles.

The project concentrated on the processes that form part of the order-to-delivery cycle within the operations department. These processes were documented and the improvement initiatives focused on enhancing their performance. Figure 4 is a visual presentation of the high-level order-to-delivery process and it indicates the scope of the project.

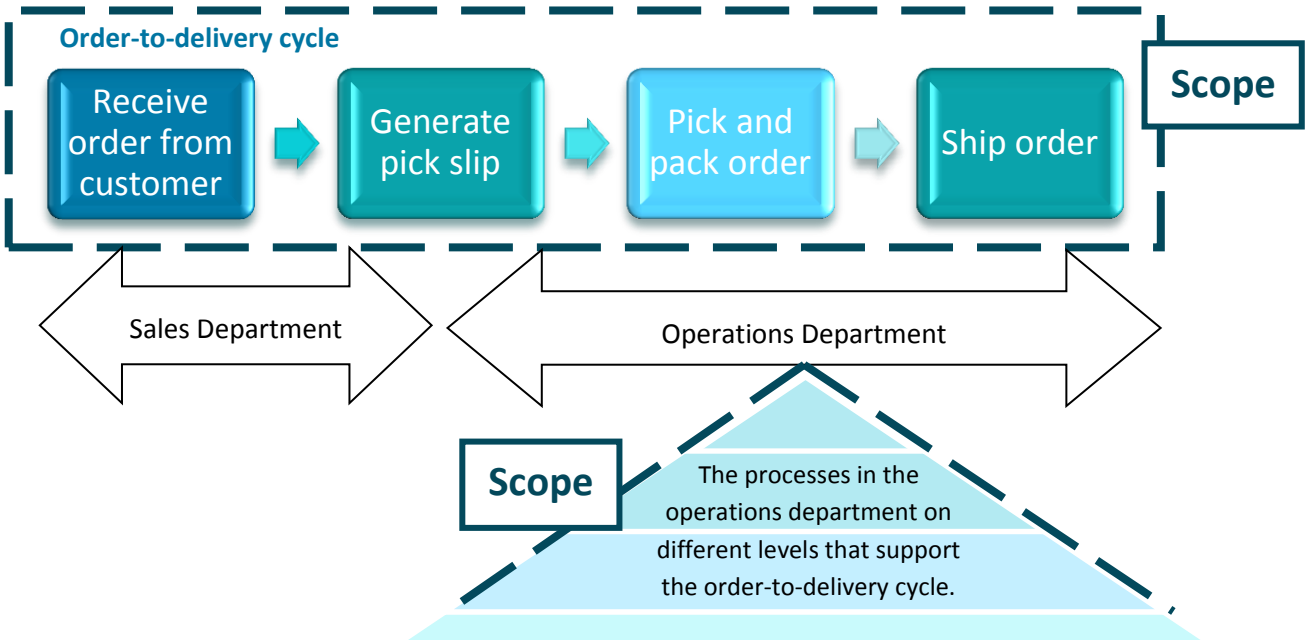

Figure 4: High-level order-to-delivery cycle, visually indicating the scope of the project

Improving the order-to-delivery cycle was part of the project, but redesigning the entire process was beyond the intended scope. Documentation of the processes can lead to future improvement and standardisation of the order-to-delivery cycle. The extent of the improvement initiative was defined during the research phase.

1.5. Project Approach

In addition to defining and documenting the current order-to-delivery cycle, this project:

- addressed the problems experienced by the employees of GZA;
- determined how to measure the performance of the process; and
- defined a change management strategy for the implementation and standardisation of the documented order-to-delivery cycle.

The project consisted of the following project life cycle phases:

Phase 1: Definition and Investigation

The scope and objective of the project were defined during this phase. The phase consisted of gaining a clear understanding of the order-to-delivery cycle and identifying the processes in the cycle. The key problems experienced by GZA were identified through a cause-and-effect analysis. Information was obtained through interviews with employees and managers. The deliverables for this phase were a preliminary high-level process map of the order-to-delivery cycle and a cause-and-effect analysis.

Phase 2: Research

Research was conducted to determine appropriate methodologies and principles for improving business processes. The concept of process maturity was investigated to determine the maturity of GZA's processes. Various process mapping notations were identified and investigated. It was important to gain an understanding of process performance measurement and change management. The deliverable for this phase was a literature study summarising the results of the research.

Phase 3: Current Process Measurement

The maturity of the order-to-delivery cycle was used as a basic measure to define the performance of its processes. This indicated the appropriate improvement goals to be obtained through this project. The deliverable for this phase was a defined performance level of the current order-to-delivery cycle.

Phase 4: Current Process Analysis

A detailed problem analysis was conducted during this phase. A meeting with all the stakeholders and role players of the order-to-delivery cycle was held, where each person had the opportunity to state the problems that they experience. The problems were prioritised and the new design of the order-to-delivery cycle should address the selected problems. The current processes were analysed by constructing preliminary process models to understand how the processes interact and influence each other. The deliverables for this phase were identified problems to address with this project and preliminary process models.

Phase 5: Process Improvement

The processes in the order-to-delivery cycle were mapped. The selected problems were addressed by incorporating improvements during the documentation activity. This resulted in a new design for the order-to-delivery cycle, but the amount of redesign was limited to addressing the problems. The new design of the processes was verified and finalised through a pilot run, followed by approval from GZA's management. The deliverable for this phase was completed and approved process documentation.

Phase 6: Process Control and Evaluation

Performance measures (KPIs) were identified for future monitoring and controlling of the order-to-delivery cycle. A high-level change management and implementation strategy was constructed to provide GZA with assistance during future implementation and standardisation of the new process. The project closed with an evaluation of the new process design and documentation to determine if improvement was achieved. The deliverables for this phase were identified KPIs, a change management strategy and process evaluation and validation results.

Figure 5 displays the life cycle phases of the project and the required deliverables of each phase.

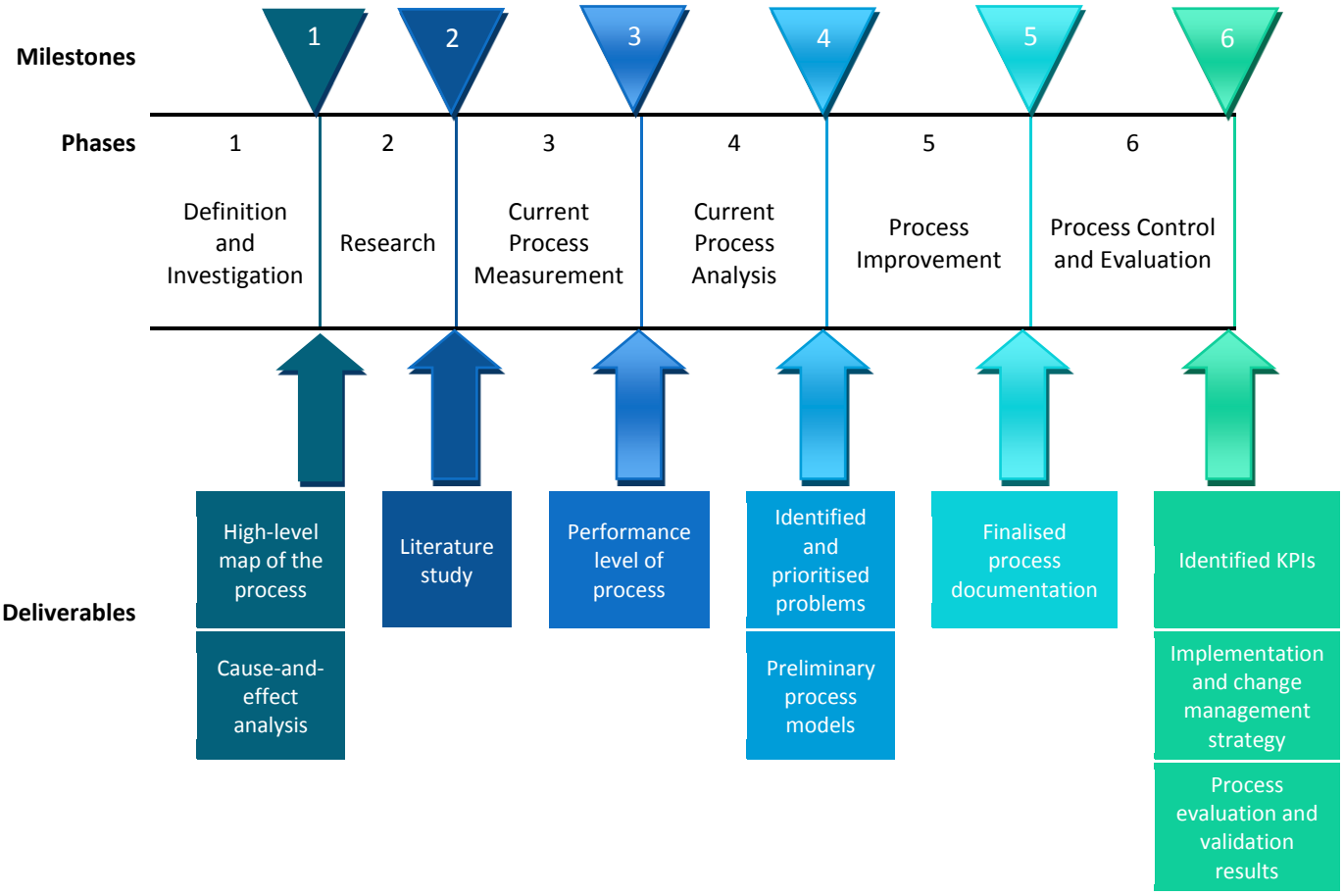

Figure 5: Life cycle phases and deliverables of the project

2. Business Process Change Principles

A process is a group of activities that receives input and adds value, which transforms the input into output for customers (Harrington, 1991, p.9). A business process is a set of logically related activities that use organisational resources to support the objectives of the organisation (Harrington, 1991, p.9). The order-to-delivery cycle of GZA can be viewed as one big business process that stretches across departments.

Business processes are more important than production processes if an organisation wants to ensure competitiveness and efficiency (Harrington, 1991, p.x). Harrington (1991, p.17) states that business processes were initially developed quickly to ensure immediate customer service and as the business environment changed, these processes were not updated. These inefficient, time-consuming and out dated processes led to the development of several approaches to change and improve business processes. Various principles, methodologies and concepts exist that can be used to facilitate these improvement initiatives.

The order-to-delivery cycle of GZA requires change and improvement if the company wants to stay competitive and improve its customer satisfaction. A starting point for the project was to understand the concept of Porter's value chain and the importance of having a value chain perspective in an organisation. The principles of process maturity and application of maturity models are explained. The maturity of GZA's processes was assessed to determine the extent of improvements applied to the processes. This section further discusses existing approaches and models that focus on change and improvement of business processes. Approaches, techniques and concepts that are imbedded in process change, like process mapping, performance measurements and change management, are also discussed.

2.1. Porter's Value Chain

Porter (1985, p.36) states that every organisation consists of a set of activities that are performed to design, market, produce, deliver and support its product. These activities form a high-level representation of how an organisation converts inputs into outputs with the purpose to deliver value to its customers. The collection of these activities is called a value chain, which stretches across multiple business functions (Investopedia, 2013).

Porter was the first to introduce the concept of defining a value chain as a tool to assess the activities performed by the organisation, with the view to identify the sources of competitive advantage. Porter identified the standard interrelated activities performed by most organisations and constructed a generic value chain framework (Michail, 2011). Figure 6 exhibits Porter's framework of value chain activities.

Porter divided the activities in the value chain into two categories. The primary activities are responsible for the creation of the product, its sale and distribution to customers and the after-sale services for maintenance and repair. These activities add value to the product (Michail, 2011). The support activities are performed to provide assistance for the primary activities to take place (Michail, 2011).

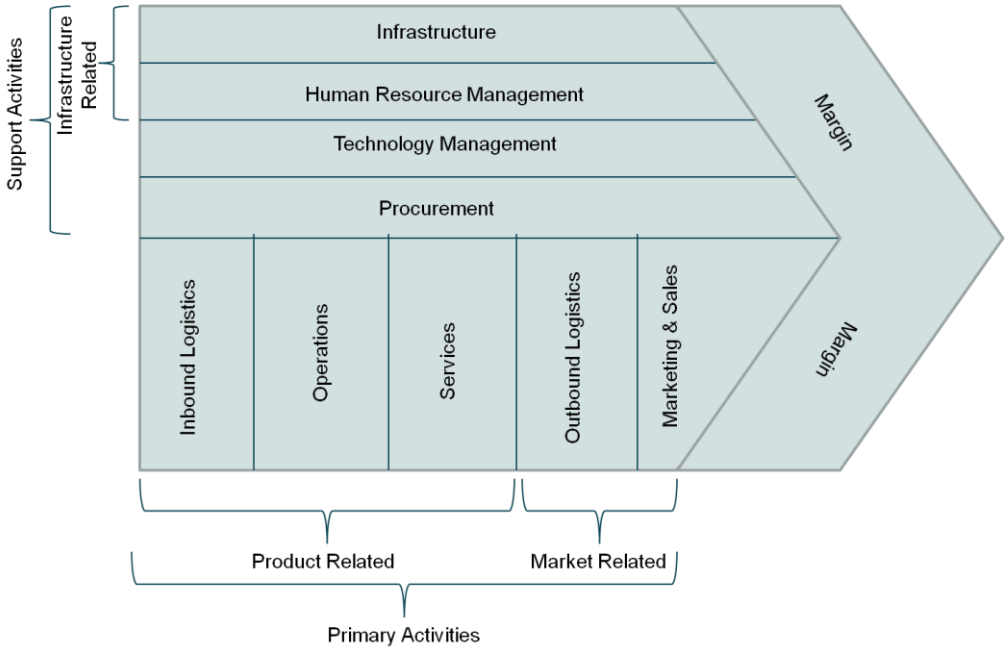

Figure 6: Porter's value chain activities (Sasha, 2011)

Figure 6 illustrates that Porter further classified the primary activities as product- and market-related activities. Product-related activities add value to the product, whereas market-related activities are performed to transfer the finished product to the customer. Figure 7 and Figure 8 explain the primary and support activities in further detail.

Primary Value Chain Activities	
Inbound Logistics	Inbound logistic activities involve all the processes or activities involved in receiving, storing and distributing the raw materials, components, and parts used in the production process.
Operations	Operations are defined as the processes or activities that are part of manufacturing, assembly, packaging, and testing to transform inputs into the final product.
Outbound Logistics	These activities are for the transfer of finished products to the customers via warehousing, order fulfilment, transportation, and distribution management.
Marketing and Sales	Marketing activities include the advertising, channel selection, product promotion, selling, product pricing, and retail management. The activities are performed to make sure that the products are transferred to the targeted customer groups.
Service	Service activities are all those activities associated with maintaining product performance after the product has been sold. These are activities like installation, training, maintenance and repair.

Figure 7: Primary value chain activities (Michail, 2011)

Support Activities	
Procurement	This is the purchasing activity to acquire the correct inputs to be transformed into finished products. It occurs in many parts of the organisation with the purpose to support the main functions to carry out their activities.
Technology Management	These activities are concerned with managing, information processing and the development and protection of "knowledge" in a business. It also supports activities such as research and development, process automation and process design.
Human Resource Management (HRM)	HRM involves activities in relation to recruitment, training, development, promotion, incentives, and payment of people working for an organisation.
Firm Infrastructure	These activities involve the structures and routines of the organisation and its management, planning, accounting, finance, and quality control mechanisms.

Figure 8: Support value chain activities (Michail, 2011)

2.1.1. Porter's Value Chain and GZA

Wolf (2003) defines a value chain as the largest possible process in an organisation, because it includes all the processes that contribute to a major output. A value chain perspective indicates how all the processes from different business functions contribute to achieving a certain output. GZA has no defined value chains and defines itself according to functional departments.

The order-to-delivery cycle of GZA can be defined as a value chain. The processes that form part of the order-to-delivery cycle were categorised according to Porter's value chain activities. These generic value chain activities were used as a framework to develop the new high-level design of the order-to-delivery cycle. This will move GZA's focus from functional departments to a value chain and interdepartmental perspective.

2.2. Business Process Maturity

The customers of today have higher requirements and expectations than ever. Organisations are taking the journey towards process and business excellence to improve the quality and performance of their business processes (Van Looy et al., 2011). Various step-by-step road maps to assist organisations with their ambitions to improve their business processes have been proposed. These road maps are called business process maturity models (BPMMs) and they provide support to improve process maturity and capability (Van Looy et al., 2011). The focus will be placed on process maturity.

Process maturity is defined as "the extent to which a process is explicitly documented, managed, measured, controlled and continually improved" (Federal Aviation Administration cited in Van Looy et al., 2011). A mature process is well defined, repeatable, measured, and continuously analysed for improvement (Tutorialspoint, 2013). The maturity of an organisation's processes determines whether the organisation can be defined as mature or immature. Table 1 indicates the different characteristics of mature and immature organisations (Tutorialspoint, 2013).

Table 1: Characteristics of mature and immature organisations

Mature Organisations	Immature Organisations
• Inter-group coordination and communication • Practices consistent with processes • Work completed according to plan • Processes updated and improved regularly • Clearly defined roles and responsibilities • Systematic and documented processes in place • Define themselves according to value chains across functional departments	• Processes change during projects • Approved and finalised processes are ignored • Reactive instead of proactive • Unrealistic budget and schedule • Most goals are not achieved • No objective measure of quality • Define themselves in terms of functional departments

The total maturity of an organisation is directly linked to the maturity of its processes. The maturity of the processes in an organisation is based on levels or stages (Harmon, 2004). There are various process maturity models available and different methods to use and apply these models. For the purpose of this project, it is only required to define the maturity of GZA's order-to-delivery cycle according to any process maturity model. Harmon's approach to evaluate the maturity of business processes will be discussed.

2.2.1. Business Process Maturity Model

Harmon (2004) explains an approach to evaluate business process maturity based on the categories defined in the capability maturity model (CMM). CMM was developed by the Software Engineering Institute (SEI) at Carnegie Mellon University in Pittsburgh in the USA (Tutorialspoint, 2013). It was originally developed to measure the maturity of software development processes, but at a later stage models for other disciplines were also created, like People CMM, Software CMM and Systems Engineering CMM.

It was difficult to integrate these models; thus the CMM successor, the Capability Maturity Model Integration (CMMI) was designed with a more mature set of guidelines and it can be applied to more disciplines. CMMI is defined as "a process improvement model that is used to rate the maturity of organisations' processes" (JCSE, 2013). The applications, assessments and evaluation possibilities of CMMI stretch far wider than just process maturity, but for the purpose of this project these applications will not be discussed.

Both CMM and CMMI models define the maturity of processes according to the same five levels or stages. Harmon's evaluation (2004) uses the same categories, but he suggests using a less formal and time-consuming way to determine the maturity level of an organisation. The maturity levels are numbered 1 through 5 and they are respectively classified as initial, repeatable, defined, managed and optimising (Tutorialspoint, 2013). Table 2 gives an overview and characteristics of each level.

Table 2: Maturity level description

Maturity levels, characteristics and descriptions
Level 1: Initial
Organisations are immature with processes that are ad hoc, chaotic and undefined **(Harmon, 2004)**. These organisations do produce products that work, but often over commit and abandon processes in times of crisis **(Tutorialspoint, 2013)**.
Level 2: Repeatable
Organisations at this level have focused and defined some of their processes, but sub-processes and activities are undefined or not detailed. The incomplete descriptions usually limit how well organisations manage their processes. Some processes can produce predictable results, whereas others are not under control **(Harmon, 2004)**.
Level 3: Defined
Level 3 organisations have completely defined and documented all their existing processes. Organisations have control over their processes and can easily determine the point of the mistake if something goes wrong. This level focuses on developing comprehensive and integrated descriptions of processes. These organisations have established some measures, but their management and measurement systems are incomplete **(Harmon, 2004)**.
Level 4: Managed
This level focuses on developing comprehensive and integrated process measurement and management systems. Organisations at level 4 align the measures of sub-processes and processes to assure that the value chain is functioning correctly to meet the goals of the organisation. Measurement systems should be hierarchical, interlocking with each other and produce high-quality measures **(Harmon, 2004)**.
Level 5: Optimizing
Process optimization can only occur after all processes are well defined, managed and measured regularly. Optimization takes place when the manager and the employees performing the process are working together to improve the process. **(Harmon, 2004)**.

Organisations with level 1 maturity have an immature mastery of their processes, whereas organisations at level 5 are viewed to have a fully matured mastery over their processes. Figure 9 visualy represents the maturity levels of processes and explains how organisations react at certain levels.

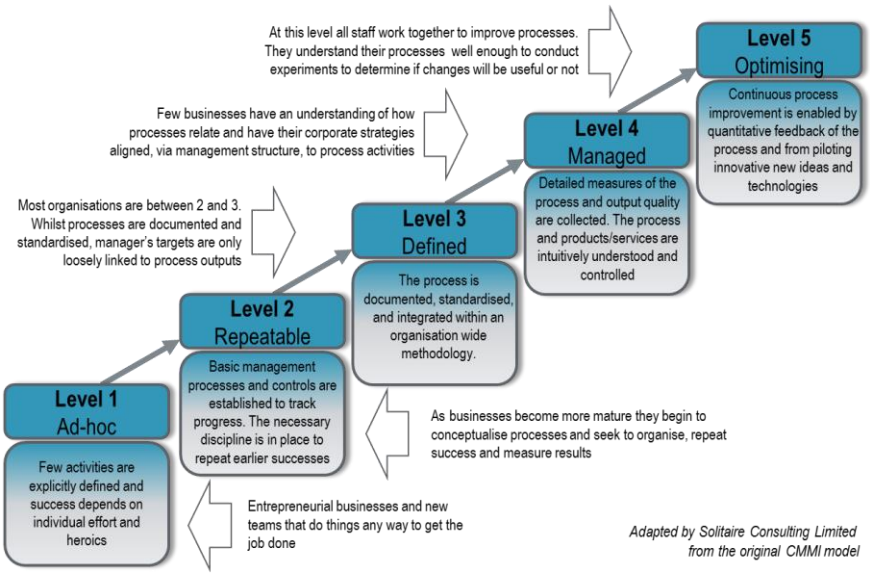

Figure 9: Process maturity levels of the CMMI model (Every, 2012)

Harmon (2004) states that this evaluation of process maturity is not a formal methodology, but simply an informal approach for managers to quickly determine the maturity of the business processes for which they are responsible. The objective of this informal analysis is to shift the focus of employees towards a process-orientated perspective. This evaluation is effective to determine the current state of business processes and identify the next target for process improvement (Harmon, 2004).

2.2.2. Process Maturity of GZA's Order-to-Delivery Cycle

The first step for improvement of the order-to-delivery cycle of GZA was to determine the maturity of the process. The maturity level indicated the current state of the process and assisted with identification of realistic objectives for improvement. The improvement objectives influenced the decision of the improvement approach applied during the project.

The maturity level of GZA's order-to-delivery cycle was classified to be between the process maturity levels 1 and 2, *initial* and *repeatable*. Some processes were defined as *repeatable,* but most processes were at the *initial* maturity level. Some of the key processes in the order-to-delivery cycle are defined on a high-level basis, but the documentation is out-dated and incomplete. The out-dated process documents result in the processes not being enforced or managed and each employee completes the process in a different way. This causes processes to appear ad hoc and out of control, and it makes it difficult to define process measures.

The goal of this project was to provide the process documentation necessary to improve the order-to-delivery cycle's maturity to level 2 *repeatable*, and prepare GZA to achieve a level 3 maturity. This involved defining all the processes in the cycle, integrating these processes and suggesting possible process measures. It was beyond the scope of the project to physically partake in implementation and standardisation of the processes. An implementation strategy was constructed to guide managers to achieve process standardisation and further improvement. A realistic goal for the project was to define and integrate the processes in the order-to-delivery cycle through documenting the processes and providing the foundation to GZA to reach a level 2 maturity.

2.3. Approaches for Business Process Change and Improvement

There are various approaches and methodologies available for process improvement, with all of them claiming to be the best way to achieve a similar goal (Gershon, 2011). Organisations should select the approach that agrees with their improvement objectives. Gershon (2011) states that organisations should first understand the principles and goals of the approaches they are considering and then select the best one for achieving their objectives. Business Process Improvement (BPI), Business Process Re-engineering (BPR) and Six Sigma's DMAIC model were the approaches considered for this project.

Harrington (1991, p.20) defines BPI as an approach to assist organisations with improving the way their business processes operate by increasing their efficiency and effectiveness. Hammer and Champy define BPR as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed" (as qouted by Chase & Jacobs, 2011, p. 497). Both approaches achieve improvement through redesign, but BPI promotes incremental improvement where BPR supports radical improvement (Zellner, 2011).

Six Sigma is defined as a "disciplined, data-driven approach and methodology for eliminating defects in any process – from manufacturing to business processes" (iSixSigma, 2013). Six Sigma applies scientific management methods, tools and techniques to improve business processes by focusing on improving the quality of process outputs (Gershon, 2011). The Six Sigma methodology provides a model for process improvement, namely the DMAIC model (Chapman, 2011). These approaches, methodologies or models were investigated and one was selected for this project.

2.3.1. Business Process Improvement

Business processes tend to become inefficient and ineffective when changes in economic, political, commercial, and social conditions occur and companies require improvement in their processes in order to adapt to these changes (Coskun et al., 2008). Various methodologies, models and tools were developed as the demand for improving business processes increased; thus different BPI methodologies exist today (Zellner, 2011). The BPI methodology designed by Adesola and Baines (2005) was considered for this project. Their model-based and integrated process improvement (MIPI) methodology provides a step-by-step process to make knowledgeable, consistent and efficient changes to business processes (Adesola & Baines, 2005). Table 3 discusses the steps in the methodology.

Table 3: BPI methodology by Adesola and Baines (2005)

Model-based and integrated process improvement (MIPI) methodology
Step 1: Understand Business Needs
This phase focuses on developing strategic objectives, analysing competitors, observing the current processes, and prioritising processes that need to change. Measurable targets and process objectives are also determined during this phase.
Step 2: Understand the process
Define and determine the scope of the process to be improved. Collect information regarding the process and model the AS-IS process.
Step 3: Model and analyse the process
Analyse the process, verify and validate whether the model represents the current process. Measure the performance of the defined AS-IS process.
Step 4: Redesign the process
This phase focuses on benchmarking the current process and determines where to focus during redesigning. Model the TO-BE process, and determine the performance measurements of the new process.
Step 5: Implement the new process
The purpose of this phase is to develop the implementation and change management plan and communicate the change to employees.
Step 6: Assess the new process
Measure the performance of the new process and determine the level of improvement.
Step 7: Review the new process
This phase focuses on improving the performance of the new process by setting targets and developing plans to achieve these targets.

The first step in the methodology is to identify the problematic processes of the business and select the process to be improved. The second step consists of understanding the process through mapping the sequence of the activities and determining the AS-IS process model. The process is improved and the changes are documented by creating a TO-BE process model. The new process is implemented and performance measurements are developed to analyse and asses the new process. The last step in the methodology reviews the new process to determine if there is room for improvement.

BPI provides an approach to bring about significant improvement in the efficiency and effectiveness of business processes and it ensures that the improvements are maintained in the future (Harrington, 1991, p.24). The key components to improve business processes are support from management, using a defined BPI methodology, developing a measurement system and focusing on the process (Harrington, 1991, p.25).

2.3.2. Business Process Re-engineering

Business Process Re-engineering (BPR) is considered as a possible solution to business problems (Hammer & Champy as cited in Muthu, et al., 1991). The methodology aims for total business reinvention by designing the process from scratch and focuses on the redesign of value added processes (Muthu et al., 1991). Like BPI, there are various methodologies for BPR that have been developed from the initial work of Hammer and Champy. The BPR methodology created by Muthu, Whitman and Cheraghi (1991) was considered for this project. Table 4 briefly explains the activities in the methodology.

Table 4: BPR methodology by Muthu, Whitman and Cheraghi (1991)

A Consolidated BPR Methodology
Activity 1: Prepare for reengineering
The objectives of this activity are to determine if there is a need for reengineering, establish a cross-functional team, and understand the customer requirements.
Activity 2: Map and analyse the AS-IS process
The objective of this activity is to understand and analyse the present process and identify the value-adding processes through modelling the AS-IS processes.
Activity 3: Design the TO-BE process
This activity comprises of developing alternative TO-BE processes to the current situation, which will fit the strategic objectives of the organisation. Complete a Trade-off Analysis to select the best TO-BE process for implementation.
Activity 4: Implement the reengineered process
Construct a transition plan to go from the AS-IS to the reengineered process and implement the new process.
Activity 5: Improve the process continuously.
The purpose of this phase is to apply continuous improvement to the new process through monitoring the progress and results and developing a feedback loop where the process is remapped, re-evaluated, and redesigned.

The BPR methodology activities show resemblance to the steps of the BPI methodology. The first activity includes understanding the process environment, gathering customer requirements and information on the process. The second activity focuses on developing AS-IS process maps in order to understand and analyse the current processes. The next activity focuses on re-engineering and improving the process by creating the TO-BE process, followed by the activity to implement the process. The last activity focuses on continuously improving and monitoring the new process.

BPR is the methodology to use when the organisation requires a dramatic improvement in their business processes to enhance their competitiveness. BPR focuses on improving process efficiency and quality (Business Process Reengineering, 2013). Both BPI and BPR approaches indicate the importance of designing the new process to have a cross-functional perceptive instead of trying to improve each department or business function individually (Hammer & Champy, 1993, p.20).

2.3.3. Define Measure Analyse Improve Control Model

The Define Measure Analyse Improve Control model, also known as DMAIC, is a data-driven improvement cycle used for improving, optimising and stabilising business processes (iSixSigma, 2013). Define, measure, analyse, improve and control are the five phases of the model (iSixSigma, 2013). Figure 10 displays and discusses the phases in the DMAIC cycle. DMAIC is the process improvement model used in the Six Sigma methodology, which was originally applied in manufacturing and process control environments (Parker, 2012). DMAIC can be used independently from Six Sigma as a framework for other improvement initiatives.

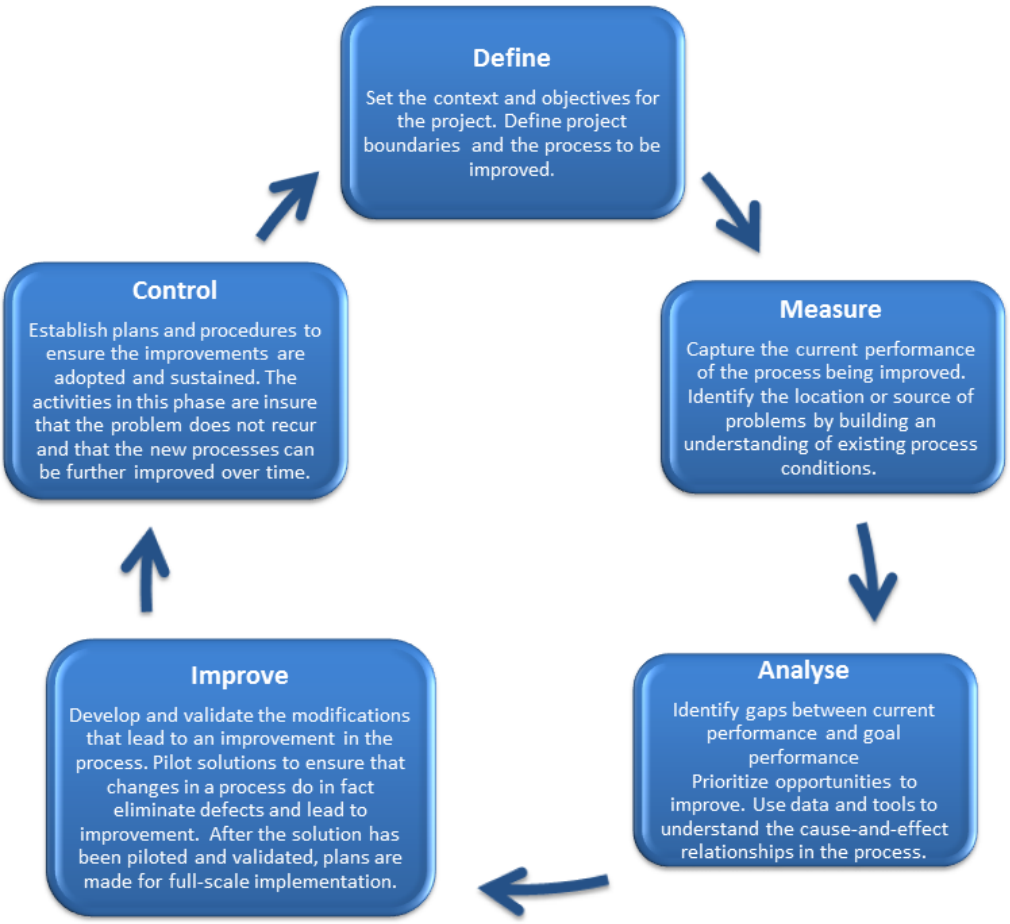

Figure 10: Define Measure Analyse Improve Control cycle for process improvement (Parker, 2012)

The DMAIC cycle starts with the *define* phase where the project objectives boundaries are defined. The *measure* phase consists of collecting data and determining the current performance of the process – this can include defining key metrics of the process, depending on process type and project objectives (Parker, 2012). The *analyse* phase lists the causes to the problems and prioritises the problems to be addressed. The *improve* phase identifies creative solutions to the problems and the *control* phase aims to sustain the improvements. The DMAIC steps provide a proven road map for any process improvement initiative (Rever, 2013).

There are various methodologies for process improvement, but organisations have to define their chosen methodology clearly in order to have a consistent approach for all their process improvement projects. The complexity of the process selected for improvement, the amount of improvement required and the project objective will also play a role in this decision. BPR and BPI methodologies are mostly used when an organisation's established and defined processes need to be redesigned for the organisation to stay efficient and competitive (Business Process Reengineering, 2013). Caudle (as cited in Lee & Chuah, 2001) stated that some processes will only need incremental improvement, others will demand a radical change and revamp through re-engineering or some will require a combination of approaches. All these aspects were considered during the methodology selection for this project.

2.3.4. Improvement Methodology for GZA

The project focused on documenting processes which will lead to future improvement of the order-to-delivery cycle. A methodology for process improvement provided a framework to guide the completion of this project. The chosen methodology had to support the improvement goals and the severity of the problems experienced due to the inefficiency of the process.

The previous section regarding process maturity determined that the order-to-delivery cycle of GZA has a maturity between level 1 and 2. The research indicated that process maturity should gradually advance from one maturity level to the next. GZA is not process orientated and few of their processes are defined. The objective of this project was to set the foundation to improve the process maturity of the order-to-delivery cycle to level 2.

Through research of process maturity, and case studies where BPI and BPR approaches were applied, it can be concluded that these approaches are usually selected when business processes are clearly defined and standardised. A pure BPI or BPR methodology was not be suitable because the business processes of GZA are ad hoc and undefined at this stage. It was difficult to define the AS-IS process; thus this project only defined the TO-BE process which GZA should implement.

The order-to-delivery cycle requires incremental improvement to move from one maturity level to the next. The DMAIC model was used as a framework for this project. It is a very flexible approach and its iterative nature will ensure that a repetitive improvement cycle will be established for future improvement initiatives in GZA. Some of the concepts of BPI and BPR were included in the suggested framework. Figure 11 shows the unique DMAIC cycle phases for this project.

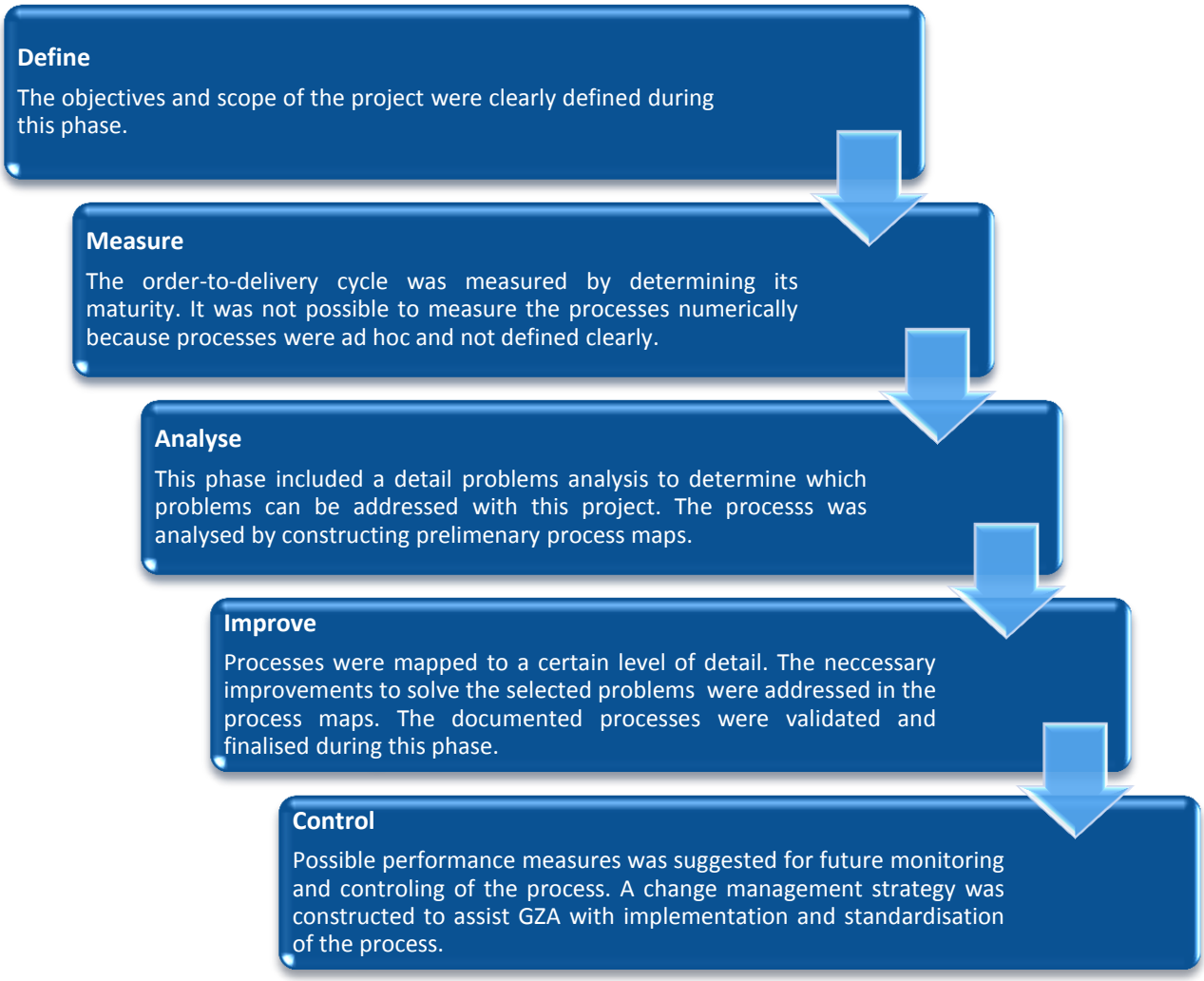

Figure 11: Define Measure Analyse Improve Control cycle for the project

2.4. Process Mapping

The BPI and BPR methodologies have a phase or step where the current business process is analysed and captured. This is referred to as process mapping and it provides important tools for evaluating, understanding, improving and redesigning a process (Hunt, 1996, p.2). Hunt (1996, p.1) states that process mapping is a method to visually identify and analyse the current AS-IS business process, identify the opportunities for improvement and develop the TO-BE (desired) process. Process mapping entails the development of a model that indicates the relationships between the tasks, people, data, and objects responsible for creating a specific output (Biazzo, 2001). The model is a diagram, process map or flow chart explaining the process from beginning to end by defining the activities and sequence in the process (Harrington, 1991, p.86). The model consists of shapes and arrows to graphically describe the workflows in the organisation (Reynolds, 2013). It provides a tool to understand and change the process in order to improve the company's competitive position (Hunt, 1996, p.6)

The terms "process mapping" and "process modelling" are sometimes used interchangeably and in some references authors give a clear distinction between the two terms. Process mapping defines the roles and procedures of the process, while process modelling focuses on the optimisation of the business processes and describing the business and economic rules (Appian, 2010). For the purpose of this study these two terms will be viewed as similar terms.

Various process mapping notations exist. Each notation addresses a certain need or requirement and each has its advantages and disadvantages. The process mapping notation used depends on:

- the modelling tool available;
- the purpose of the process model;
- the scope of the process under consideration; and
- the standard notation used by the organisation.

The methodologies and notations commonly used are various forms of flowcharts, the Integrated Definition (IDEF) modelling languages, the Business Process Modelling Notation (BPMN) and Event-Driven Process Chains (EPC) (Ingram, 2013). This literature study provides an overview of the most popular process mapping notations available in order to provide the reader with a background on the different diagrams and notations that were considered for this project.

2.4.1. Flow charts

Flow charts were introduced in 1921 by the Gilbreths and quickly became an industrial engineering tool to present information regarding processes (Gilbreth, 1921). Flow charts consist of a variety of symbols representing different activities (Madison, 2005, p.19). Flow charts should not be cluttered with symbols that no one will recognise and the process should be represented with the most common shapes (Reid, 2012). Table 5 explains the most regularly used symbols in flow charts.

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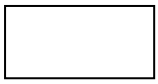
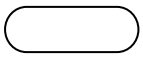
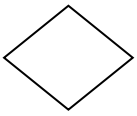
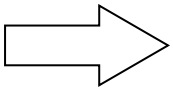
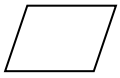
Table 5: Flow chart symbols

Symbol	Name	Explanation
	Activity or process	Activities are represented by a box and the description includes a verb (Cinergix Pty. Ltd., 2013)
	Terminator or terminal	Terminators indicate the start and end points of the process (Hebb, 2013)
	Decision or conditional	The decision object is used to represent a question and two arrows leave the object, representing the direction for "yes" and "no" separately (Cinergix Pty. Ltd., 2013)
	Storage	This object contains a noun and indicates when goods are being stored (Hebb, 2013).
	Movement or transportation	The fat arrow indicates that goods are being transported (Harrington, 1991, p.96).
	Inspection	The big circle indicates that the output of the process is being evaluated for quality purposes (Harrington, 1991, p.96)
	Delay	The delay symbol indicates a waiting period in the process (Hebb, 2013).
	Data	The data symbol shows the inputs and outputs of a process.
	Connector	Connectors are used to jump between sub-processes and move to another part of the process (move between flow charts) (Hebb, 2013).
	Document	This symbol shows when a document is produced (Hebb, 2013).
	Direction of flow	The arrow indicates the direction of flow between activities (Madison, 2005).

It is important not to clutter the flowchart with all the different symbols. The symbols mostly used for mapping business processes are the activity, terminator, decision and flow symbols (Reid, 2012). Cobb (2005, p.34) gives guidelines for constructing process maps:

- Identify the primary users of the process map and design the map to meet their requirements.
- Define the objectives of the process and focus on the activities that influence these objectives.
- Design the process map to be simple, understandable, and easy to use.
- Do not clutter the process map with unnecessary detail.

Some process mapping concepts and principles are valid for most notations. Process hierarchy (decomposition) and swim lanes are important principles that improve the readability and usability of process maps.

Process Hierarchy

Cobb (2005, p.24) explains that process mapping consists of a high-level process definition and detailed flow charts. The high-level process definition consists of determining the scope, objectives, inputs, and outputs of the process (Cobb, 2005, p.25). Functional decomposition is used to break the top-level process up into core processes, which reduces the complexity of the overall process (Cobb, 2005, p.25). Each core process is broken down into lower levels of detail creating a process hierarchy (Cobb, 2005, p.26). Functional decomposition is complete when all the objectives of the process have been addressed in the lowest level of the process hierarchy (Cobb, 2005, p.27). Detailed flow charts are constructed of the bottom level processes through identifying the activities that take place and their sequence (Cobb, 2005, p.33). Figure 12 shows the concept of process hierarchy.

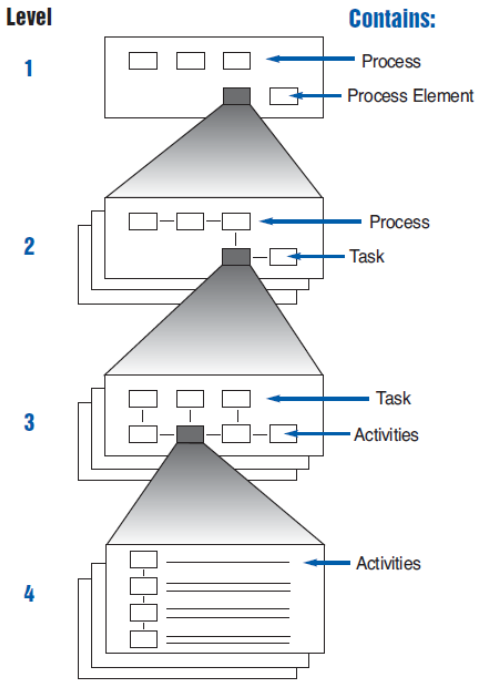


Figure 12: Representation of functional decomposition (Supply-Chain Council, 2006)

Swim Lanes

Swim lane-based process mapping is a technique where the activities are arranged in horizontal or vertical bands and each band represents a specific role (Khadye, 2006). Swim Lanes indicate the roles on the process map and state who is responsible for each activity in the process (Reid, 2012). These are also referred to as cross-functional process maps, where the activities performed by a specific business function are arranged in the swim lane for that business function (Wayne State University, 2013)

Flow charts are tools to understand business processes. Their main purpose is to document the process and identify the improvement opportunities (Harrington, 1991, p.112). Harrington (1991, p.112) states that the improvement does not come from drawing the flow charts, but by analysing them.

2.4.2. Integrated Definition Methods

Integrated Definition Methods (IDEF) is a family of modelling languages (Ingram, 2013). IDEF was first called the ICAM (Integrated Computer-aided Manufacturing) programme initiated by the United States Air Force to develop a process mapping technique and language (Hunt, 1996, pp.98-99). IDEFØ and IDEF3 are the two IDEF modelling languages relevant to this project.

In 1993, the National Institute of Standards and Technology (NIST) first released the IDEFØ methodology as a standard for functional modelling (Knowledge Based Systems, Inc., 2010). It is created to model the activities, decisions and actions of an organisation (Knowledge Based Systems, Inc., 2010). IDEFØ uses "box and arrow" graphics. The box illustrates the process or function and the arrows entering and leaving the box indicate the interfaces to and from the process (Hunt, 1996, p.99). Figure 13 displays the basic language rules for an IDEFØ model.

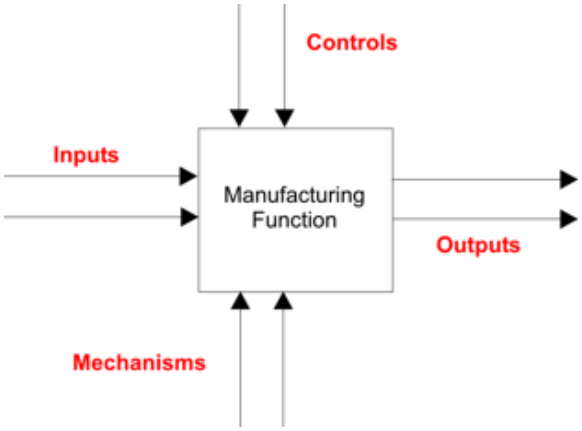


Figure 13: IDEFØ syntax (Knowledge Based Systems, Inc., 2010)

IDEF3 is defined as the process description capturing method and it provides a mechanism for documenting processes, captures precedence relations between situations, and expresses knowledge about how the process works (Knowledge Based Systems, Inc., 2010). IDEF3 is designed to capture process knowledge and to document descriptions of sequences of activities in the process (Mayer et al., 1995). IDEF3 can also be used to facilitate business improvement and system development (Mayer et al., 1995).

2.4.3. Business Process Modelling Notation

The Business Process Modelling Notation (BPMN) is a graphical notation used to illustrate the steps in business processes and it describes the end-to-end flow of processes (Object Management Group, 2013).The main goal of BPMN is to provide organisations with a standard notation that is understandable by all business users (White, 2004). An objective of BPMN development was to develop a notation that uses simple graphical elements, but supports the complexity of business processes (White, 2004).

The BPMN notation elements are similar to the symbols used for flowcharts. BPMN uses a small set of elements divided into four basic categories. This helps the readers to easily recognise the basic elements and understand the diagram (White, 2004). Additional variation and information can be added to each type of element in order to keep the diagram understandable and support the complexity of the process. Table 6 indicates and briefly explains the four basic categories of elements used in BPMN.

Table 6: The four categories of BPMN elements

Category	Description
Flow objects	Flow objects are the core objects used in a process model. There are three flow objects. An *event* is something that occurs during the flow of the business process. An *activity* represents work that has to be performed. A *gateway* represents decisions and is responsible for divergence and convergence of the sequence flow (White, 2004).
Connecting objects	Connecting objects are responsible for connecting flow objects and indicating the relationship and sequence between them (White, 2004).
Swim Lanes	This concept is applied in various notations. Swim lanes visually organise the elements into categories to illustrate the role players and their responsibilities (White, 2004).
Artefacts	Artefacts provide extra flexibility and complexity to process models. Artefacts add more details about how the process is performed and show the inputs and outputs of activities (White, 2004).

The different elements in each category will not be discussed in detail. The most important elements are events, activities, gateways, sequence flow and swim lanes. Figure 14 displays the basic elements used in BPMN.

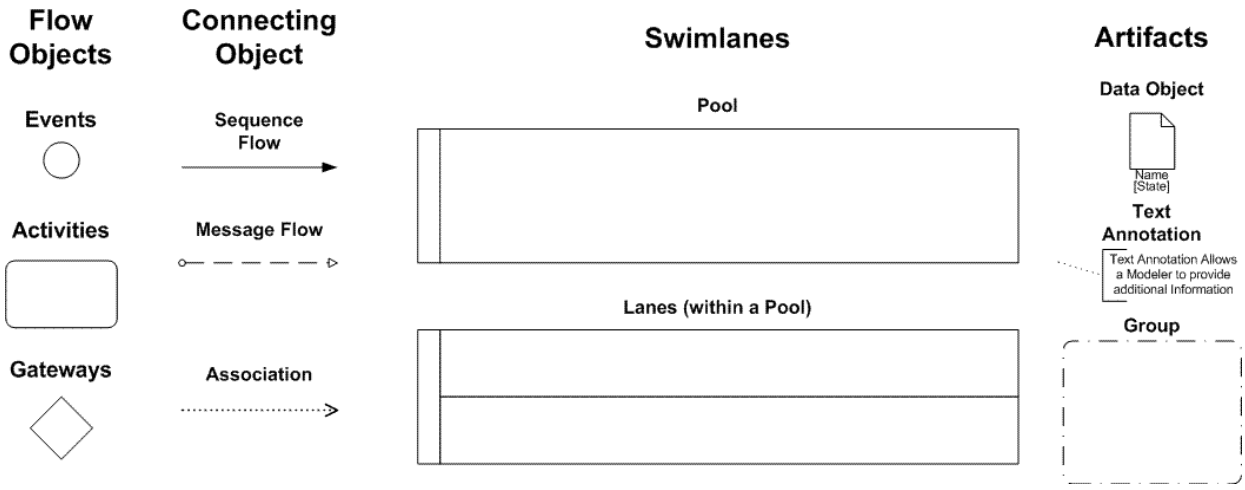


Figure 14: Elements of BPMN (White, 2004)

2.4.4. Event-driven Process Chain

The Event-driven Process Chain (EPC) methodology provides a modelling language to describe business processes (ARIS Community, 2012). EPC was developed by Scheer, Keller and Nüttgens in 1992 and today it is the process modelling technique used in the leading ERP and business process engineering tools, SAP R/3 and ARIS (Van der Aalst, 2010). EPC is also supported by other process modelling tools like Visio.

EPC describes the operational sequence of processes and its notation is easy to understand (ARIS Community, 2012). Table 7 indicates and discusses the basic elements used in an EPC.

Table 7: Event-driven Process Chain Elements

Element	Description
Function	A function represents an activity or task that needs to be executed (Van der Aalst, 2010).
Event	An event defines the condition before and after a function has been executed and provides the link between functions (Van der Aalst, 2010).
Control flow	Control flows create a chronological sequence between events, functions and other elements by providing the connection between these elements (Ardhinata & Lukstin, 2012).
Logical connectors	Logical connectors explain the relationship between functions and events by providing the rules when control flow paths split or join (Ardhinata & Lukstin, 2012).

The figure below displays the basic and other elements used to create Event-driven Process Chains.

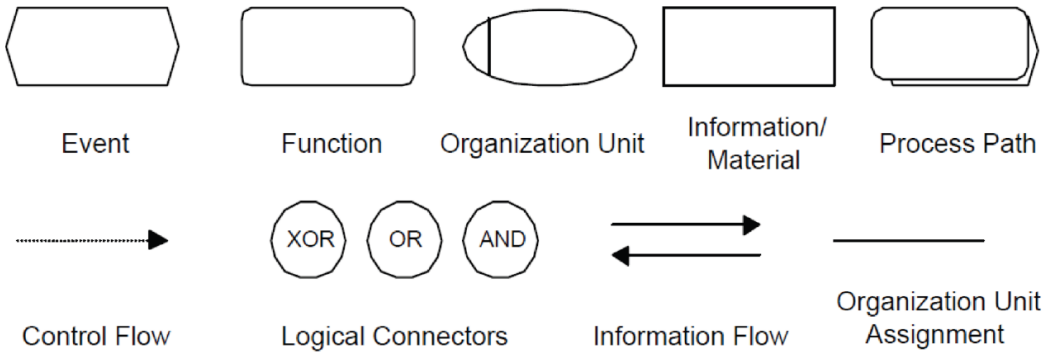


Figure 15: EPC modelling elements (Ardhinata & Lukstin, 2012)

An Event-driven Process Chain starts and ends with an event element. An event defines the conditions that have to be met to start or end a process or function (ARIS Community, 2012). The EPC notation offers many techniques for modelling and analysing processes and assists with identifying improvement opportunities (ARIS Community, 2012). EPC is usually used to model the lowest level of process hierarchy, but it can be used in many industries.

2.4.5. Process Mapping Conclusion

Process mapping plays a key role in understanding the current process and identifying the areas for improvement. The process mapping notation selected for this project had to align with the project objectives. The goal was to define and document the order-to-delivery cycle of GZA to ensure process standardisation. The process models had to contain a certain level of detail in order for employees to understand the process and the activities.

The process modelling notation is the "language" used to document the processes. The process modelling tool is the program used to construct the process model. There are various modelling tools available, like ARIS, Enterprise Architecture, Bizagi and MS Visio, but these tools are expensive. It is important that GZA has access to the tool, in order to make future changes and improvements to the process documentation. The only tool available was MS Visio, thus Visio should support the notation selected. The criteria used to select a notation are displayed in Table 8. The criteria were derived from process modelling notation requirements defined by Münch *et al*. (2012, pp.113 - 115).

The IDEF modelling languages are complex and difficult to understand. The process models constructed with these modelling languages are not easy to read and most people are not familiar with these notations. The IDEF modelling languages were not suitable for this project due to their complexity and the requirement that all levels of employees should be able to understand the documentation.

Event-driven Process chains are easy to construct and users generally read and understand them easily. BPMN and basic flowcharts are similar and both are easy to understand. Employees from the different departments and from different organisational levels were consulted to determine which notation they understood the best. A process was modelled with EPC and BPMN and employees had to vote for the notation they preferred and understood the best. Figure 16 displays the process represented by EPC and BPMN, used to consult employees and indicate the difference between the two notations. The majority of employees selected BPMN because they were familiar with the symbols.

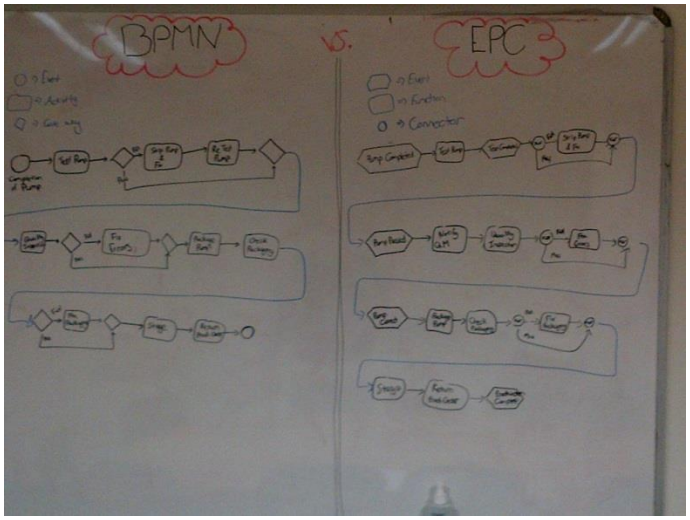


Figure 16: Different modelling notations displayed to GZA employees

Table 8: Process mapping notation selection criteria

Criteria	Criteria Discussion	Modelling Notation
Notation supported by modelling tool available	The modelling tool available for this project was MS Visio.	Visio does not support BPMN.
Purpose of the process maps	The process maps will serve as documentation to define and standardise the processes to achieve process improvement.	Flowcharts, BPMN and EPC will achieve this goal.
Scope of the process	The order-to-delivery cycle of GZA is a complex process with various sub-processes and different roles that perform the activities. A modelling notation that supports process hierarchy and swim lanes was required.	EPC is used at the lowest level of the process hierarchy and it does not support swim lanes. IDEFØ supports hierarchy, but not swim lanes. BPMN and flowcharts support both requirements.
Intelligibility	This is the most important criteria, because it will have an impact on the implementation and standardisation of the mapped processes. The process maps will be used by employees at all levels of the organisation with various levels of education. The process maps should be easy to understand and follow.	IDEFØ is too complicated to understand. Employees found it easier to understand BPMN and flowchart symbols.
Formality	Formality is required to support communication between departments.	All the notations provide formality.
Re-usability and consistency	The notation should be re-usable for employees to continue with the documentation effort. The method used to apply the notation should be consistent.	All the notations meet this requirement.

The analysis of the notations against the criteria specified in Table 8 indicated that the IDEF modelling languages and EPC were not suitable for the project. The IDEF modelling languages are too complex and EPC does not support the use of swim lanes to differentiate between the activities of different role players. The employees of GZA were most comfortable with BPMN and flowchart symbols. MS Visio does not support BPMN; thus flowchart symbols were used to construct the process models for the order-to-delivery cycle.

The management of GZA decided that a formal notation for this project was not necessary. They required that the process models should be detailed, easy to understand and the notation should be applied consistently. The BPMN elements and the flowchart symbols are very similar. Management suggested that a notation based on basic flowchart symbols and BPMN principles should be developed for this project. The notation will be discussed in the Section 4.2, *Customised Process Mapping Notation.*

2.5. Process Performance Measurement

Companies should be able to measure the performance of their processes and operations if they want to achieve improvement (Lohman et al., 2004). The BPI and BPR methodologies indicated that measuring the process before and after it has changed is critical to determine if improvement has been achieved.

A performance measure is a quantitative indicator that assesses whether the business is meeting its objectives (WebFinance, 2013). Parmenter (2010, p.1) stated that four types of performance measures exist. Table 9 gives an explanation of these measures.

Table 9: Four types of performance measures

Performance Measure	Explanation
Key Result Indicators (KRIs)	KRIs are the result of many activities and give an overall description of the condition of the business. KRIs do not indicate where improvement opportunities exist and they are usually measured monthly or quarterly (Parmenter, 2010, p.2 & 9).
Result Indicators (RIs)	These measures are used to summarise the results of activities and are usually financial measures. They are measured over shorter time periods, like daily or weekly (Parmenter, 2010, p.3 & 10).
Performance Indicators (PIs)	PIs indicate whether the business is aligned with its strategies and they focus on the result of a specific activity (Parmenter, 2010, p.3 & 10).
Key Performance Indicators (KPIs)	KPIs focus on the aspects of total business performance that are crucial for current and future success, they are monitored frequently and they should indicate what to do to improve performance (Parmenter, 2010, p.4 & 10). KPIs are timely and prepared in real time (Parmenter, 2010, p.13).

It is important to have a small number KPIs in order to ensure that management, executives and employees focus on achieving the most important measures (Reh, 2013). Kaplan and Norton suggested that a maximum of 20 KPIs should be used for the entire organisation (cited in Parmenter, 2010, p. 12). Parmenter (2010, p.12) recommended that the 10/80/10 rule best describes the total number of measures for an organisation. The rule suggests that an organisation should have a maximum of 10 KRIs, a total of 80 RIs and PIs and 10 KPIs.

It is important for companies to develop the right performance measures that will make a difference to their performance (Parmenter, 2010, p.41). Parmenter (2010, p.41) suggests using the Balanced Scorecard as an approach to align the measures with the organisation's strategies (Parmenter, 2010, p.16).

2.5.1. Balanced Scorecard

The Balanced Scorecard is an approach that aligns and translates the stategies of an organisation into a set of performance measures (Kaplan & Norton, 1996, p.2). The approach presents a structure for a strategic planning and measurement system (Kaplan & Norton, 1996, p.2). Kaplan and Norton (1996, p.2) suggested that organisational performance should be measured across four areas: internal business processes, learning and growth, customers, and financial.

The measures for internal business processes focus on those processes that affect customer service and they highlight new processes that need attention in order to meet organisational objectives (Kaplan & Norton, 1996, p.27). The learning and gowth perspective identifies the gaps between an organisation's people, systems and procedures, including the measures that show how to close these gaps in oder to achieve long-term growth and improvement (Kaplan & Norton, 1996, p.28). The customer perspective identifies the market segments and measures outcomes that indicate whether the company strategy is well-defined (Kaplan & Norton, 1996, p.26). The financial measures indicate whether the financial objectives were achieved and what the economic consequences are of decisions made (Kaplan & Norton, 1996, p.25).

Parmenter (2010, p.16) included two more perspectives to the Balanced Scorecard: employee satisfaction and environment/community. Parmenter (2010, p.17) states that the satisfaction of staff should be closely monitored, because the hapiness of employees has a direct impact on customer service. The environment and community perspective includes implementing green initiatives, minimising waste and having a positive impact on the community (Parmenter, 2010, p.17). Figure 17 shows the six perspectives of a Balanced Scorecard.

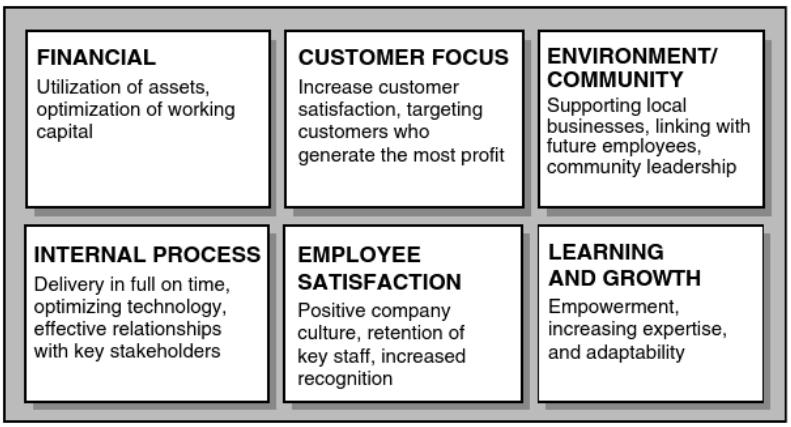


Figure 17: Parmenter's six-perspective Balanced Scorecard (2010, p.16)

2.5.2. Performance Measurement Conclusion

Performance measurement plays an important role in effectively managing processes and the whole organisation (Parsons, 2011). Developing the right KPIs to measure the performance of the order-to-delivery cycle was an important deliverable to ensure future monitoring and management of the processes. The concept of the Balanced Scorecard was applied, but it will measure the key processes instead of the traditional four areas defined by Kaplan and Norton.

2.6. Change Management

Change is inevitable and it will not fade away (Paton & McCalman, 2008, p.5). The two main drivers of change are technology and globalisation (Albrecht & Sack, 2000). Organisations and their managers are assesed upon their ability to successfully manage change (Paton & McCalman, 2008, p.5). Hayes (2002, p.11) defines change management as the modification or transformation of organisations to sustain or increase their effectiveness and competitiveness.

All BPI and BPR approaches include a phase where the improved or reengineerd process is implemented. This phase requires proper planning of the implementation strategy and involvement of the people affected by the change. Various change management models exist and can be used to achieve change successfully (Normandin, 2012). Three change management models were investigated.

2.6.1. Process Models for Change Management

An approach for change management is to consider change as a process model (Hayes, 2002, p.51). Successful change is permanent (Lewin cited in Hayes, 2002, p.52). Lewin developed a basic model to make change permanent (cited in Hayes, 2002, p.52). Figure 18 represents the three stages of Lewin's model.

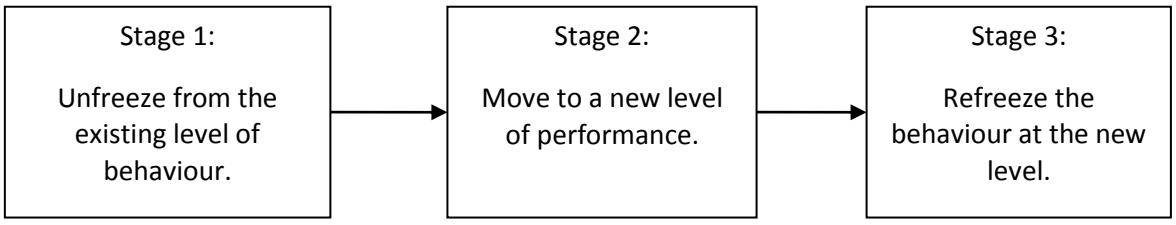


Figure 18: Lewin's three-stage model of change (Hayes, 2002, p.52)

Hayes and Hyde (cited in Hayes, 2002, p.54) constructed a process model based on the stages of Lewin's model. The model provides a framework for the process to manage change and developing a change strategy (Hayes, 2002, p.54). Figure 19 visually represents the stages in the model and Table 10 explains the fundamentals of each stage.

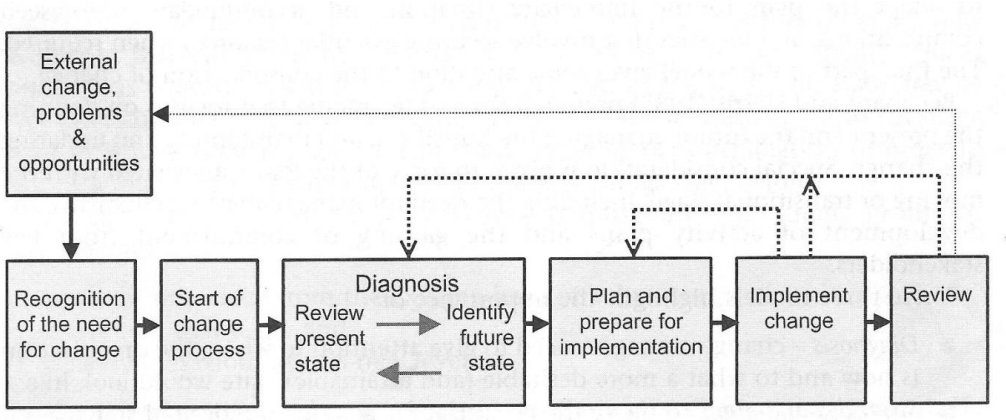


Figure 19: Hayes and Hyde's change management process model (Hayes, 2002, p.54)

Table 10: Stages in the change process model developed by Hayes and Hyde (cited in Hayes, 2002, p.54 – 57)

Stage	Name	Explanation
1	Recognition	The process is initiated when it is recognised that a change is required to support new internal conditions and external events.
2	Start the change process	The change process starts when the need for change is transformed to a desire for change. This involves identifying someone to manage the change and take the responsibility to drive the process.
3	Diagnosis	This phase consists of identifying and understanding the current state of the organisation and developing a vision of its future state.
4	Prepare and plan for implementation	Conduct an analysis of the current and future states, identify the gaps between the two states, and include them in the implementation plan. It is important that the plan should address the political and cultural dimensions and prepare the people for the change.
5	Implement change	The plan from the previous stage has to be implemented.
6	Review and consolidate	This phase consists of monitoring and controlling the on-going activities of implementation and refreezing (Lewin's model) the new state after it has been achieved.

It is important that the change management strategy should include the people issues that affect the change process (Hayes, 2002, p.57). Hayes (2002, p.57) considers and addresses the following people issues in his model:

- stakeholder management and the role of leadership;
- communication;
- training and development;
- motivating others to change; and
- giving individual support to employees to help with the change.

Strategies that accommodate the people issues and address the cultural and political dynamics of the organisation will be successfully implemented (Hayes, 2002, p.58).

2.6.2. Kotter's Change Model

Kotter states that change is necessary for organisations to adapt to the shifting conditions of the business environment (2012, p.1). In the past, organisations have made various errors during change initiatives, which have disappointing results and leave employees frustrated (Kotter, 2012, p.3). Kotter based his change model on the identified errors that undermine transformation and change efforts of organisations (2012, p.24). Figure 20 visually represents the eight steps in Kotter's model.

Figure 20: Kotter's eight-step change model (Paull, 2012)

A successful change initiative goes through each of the eight steps. The first four steps are considered as warm-up activities to communicate the need for change and receive buy-in from employees and managers. Kotter states that a change initiative will not be successful without completing these steps (2012, p.25). The new practices are introduced during steps five to seven and step eight anchors the change in the corporate culture of the organisation (2012, p.24). Table 11 elaborates and explains the eight steps in Kotter's model.

Table 11: The eight phases in Kotter's change model

Step	Name	Explanation
1	Establishing a sense of urgency	It is easier for change to happen if the whole company wants to change. A sense of urgency to change and the initial motivation is created during this step (Mind Tools, 2013).
2	Creating a guiding coalition	People need to be convinced that change is necessary and this is achieved through strong leadership. A team of change leaders is constructed during this step. The team's function is to build urgency and momentum around the need to change (Mind Tools, 2013).
3	Developing a vision for change	The change vision is created to inspire action and guide the action to achieve change. The vision must be feasible, flexible, focused, and easy to communicate (Mind Tools, 2013).
4	Communicating the vision for buy-in	The vision is communicated throughout the organisation to ensure that it is accepted by the majority. The vision must be communicated frequently and through effective communication channels (Mind Tools, 2013).
5	Empowering broad-based action	This step focuses on identifying and removing the barriers and obstacles that cause change resistance (Mind Tools, 2013).
6	Generating short-term wins	Create short-term targets with visible results that are easy to achieve. This will motivate employees and build momentum for the change (Mind Tools, 2013).
7	Build on the change	This step focuses on building and improving on previous successes. It is important not to stop the change after a few successes and declare victory too early (Mind Tools, 2013).
8	Anchoring the changes in corporate culture	The change is embedded into the company culture during this step. Efforts are made to ensure that the change becomes part of the core of the organisation (Mind Tools, 2013).

Kotter's model covers all the bases and aspects that are required for successful change. Kotter provides a roadmap for achieving organisational change of any size (Richards, 2013). Change is achieved because each step builds on the previous step and possible roadblocks or obstacles are identified and addressed throughout the process. Kotter's change model provides depth, detail and guidance to deliver and facilitate change (Mind Tools, 2013).

2.6.3. Systems Approach to Change Management

The systems approach to change management analyses change situations by viewing the problem as a system (Paton & McCalman, 2008, p.101). The intervention strategy model (ISM) applies systems thinking to effectively manage change (Ackoff cited in Paton & McCalman, 2008, p. 101). Paton and McCalman (2008, p.106) describe an intervention strategy as the methodology to intervene in the operations of the current processess of the system.

The ISM consists of three basic phases that will ensure successful systems intervention. These phases are definition, evaluation and implementation (Paton & McCalman, 2008, p.108). Intervention starts with "problem initialisation"; the necessity for change has been identified and the process to manage the required change is activated (Paton & McCalman, 2008, p. 108). The definition phase requires an analysis and an in-depth study of the change situation (Paton & McCalman, 2008, p. 108). The evaluation phase consists of generating and evaluating possible solutions (Paton & McCalman, 2008, p. 108). The implementation phase includes the development of action plans to implement the desired solution (Paton & McCalman, 2008, p. 108). Figure 21 illustrates the basic phases of the IMS.

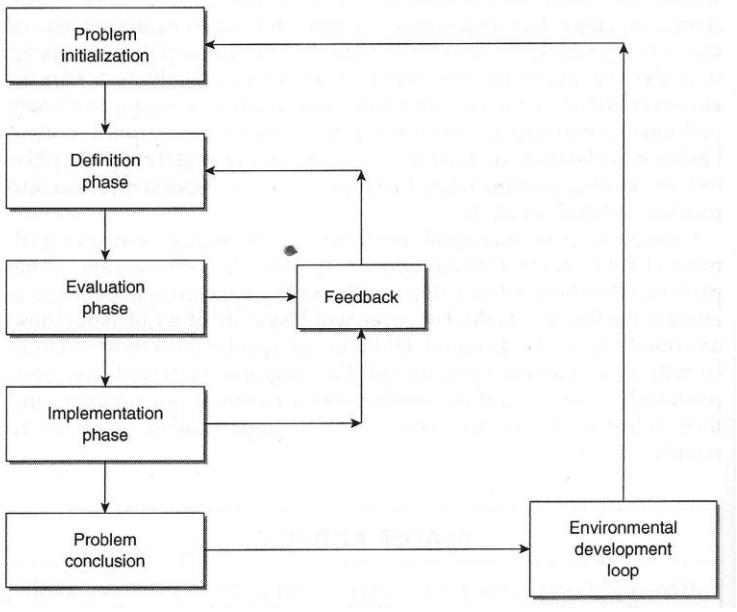


Figure 21: The high-level phases of the intervention strategy model (Paton & McCalman, 2008)

2.6.4. Change Management Conclusion

Change management was an important aspect to consider in the project. Only the successful implementation of the improved order-to-delivery cycle will result in real improvements for GZA. Physical implementation of the new processes was not within the scope of the project, but defining an implementation strategy to guide the management of GZA with implementation was crucial. One of the change management models discussed was selected for the project.

The change management model by Hayes and Hyde describes the change process from the point of recognising the need for change to implementing and reviewing it. The intervention strategy model (ISM) described by Paton and McCalman considers the change process to start at problem definition and end at solution implementation. These models are high-level and do not provide guidance for delivering and facilitating the change.

Kotter's model provides the key steps to ensure successful change and is a great starting point to develop a change strategy (Swe, 2011). The model focuses on employee buy-in and communication to ensure success. The steps provide guidance for any change initiative.

Kotter's model was selected for this project. The model was used as the foundation to define the implementation strategy to guide GZA with the future implementation of the new design for the order-to-delivery cycle.

3. Problem Investigation

GZA experiences inefficiencies in their business activities that are part of the order-to-delivery cycle. These inefficiencies can be explained by the lack of:

- up-to-date process documentation;
- process management strategies; and
- performance measurements.

The order-to-delivery cycle was first analysed on a high-level basis to understand how the processes influence each other. The problems in the processes were identified though a cause-and-effect analysis followed by a meeting with employees who play key roles in the process. The problems were organised and prioritised to determine the problems to be addressed in this project.

3.1. Current Systems and Methods

GZA uses SAP P20 R3 as their ERP system to manage their purchasing and sales functions. They do not have a warehouse management system in place, which contributes to the problems they experience. High-level documentation of the order-to-delivery cycle does exist but it is out dated and incomplete. The out dated process documents result in processes not being enforced and there are no tools or methods in place to manage and control the business processes.

3.2. Process Overview

The first step of a process improvement initiative is to understand the scope of the process (Seath, 2008). A SIPOC diagram was used to gain a high-level understanding of the order-to-delivery cycle at GZA and determine the boundaries of the process. A SIPOC diagram is a tool used to represent a process at a high-level and understand the scope of the process (American Society for Quality, n.d.). SIPOC is an abbreviation for suppliers, inputs, process, outputs, and customers (iSixSigma, 2013). The SIPOC diagram (see Figure 22) describes and identifies the suppliers, inputs, outputs, and customer of the order-to-delivery cycle.

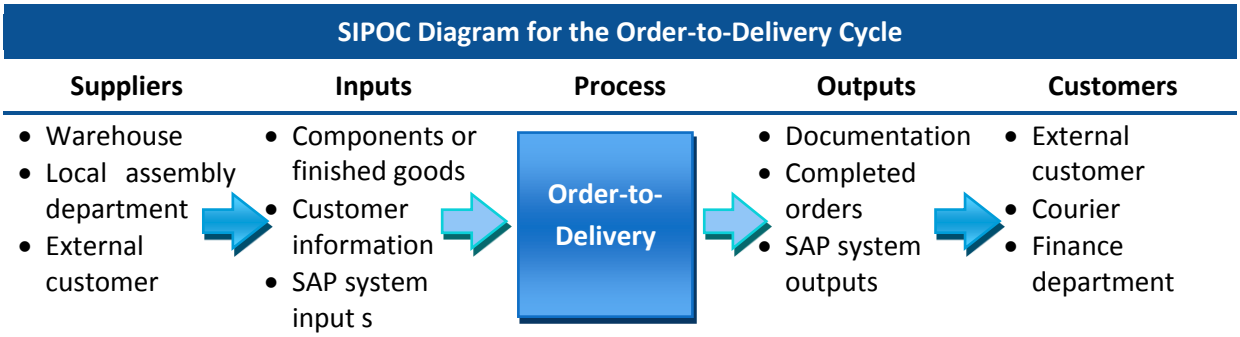


Figure 22: SIPOC diagram for the order-to-delivery cycle

The suppliers of the order-to-delivery cycle are the external customers, logistics (warehouse) and local assembly departments (see Figure 2 for organisational structure of GZA). The external customers provide information on the products they want to order, delivery information and personal details. The warehouse supplies off-the-shelf products or the local assembly department provides assembled products. The SAP system requires certain input information to load and process the order of the customer. After completion of the process, the external customer or courier will receive the packed product with the relevant documentation. Customers can collect orders, send their couriers to collect, GZA can provide the delivery service or use couriers to deliver products to customers. The financial department receives all the documentation to verify collection and payment from the customer.

3.3. Cause-and-Effect Analysis

A cause-and-affect analysis is used to identify and sort the theories on possible causes of a problem (Kannan, 2005). The cause-and-effect diagram (also known as a fishbone diagram) is a tool used to visually display the potential causes of a certain problem (Simon, 2010).

The cause-and-effect diagram (see Figure 23) served as a primary analysis to determine the potential reasons for the low customer satisfaction, which GZA is experiencing. The causes were grouped into six categories that affect the low customer satisfaction. The six categories are: the SAP system, people, materials or stock, management, environment and the process. These categories were derived from the usual categories grouped according to the 6 M's: man, machines, methods, materials, measures and Mother Nature (SmartDraw, 2013).

The cause-and-effect analysis indicated that various causes contribute to the low customer satisfaction. The scope of this project cannot address all the issues and only focused on the causes that Fall under the process category. The analysis gave a broad perspective of the issues that affect the order-to-delivery cycle, but did not highlight the specific problems and errors related to the process. An in-depth analysis or problem identification was required to identify the issues, errors and problems experienced by GZA employees who perform or are effected by the processes and activities in the order-to-delivery cycle.

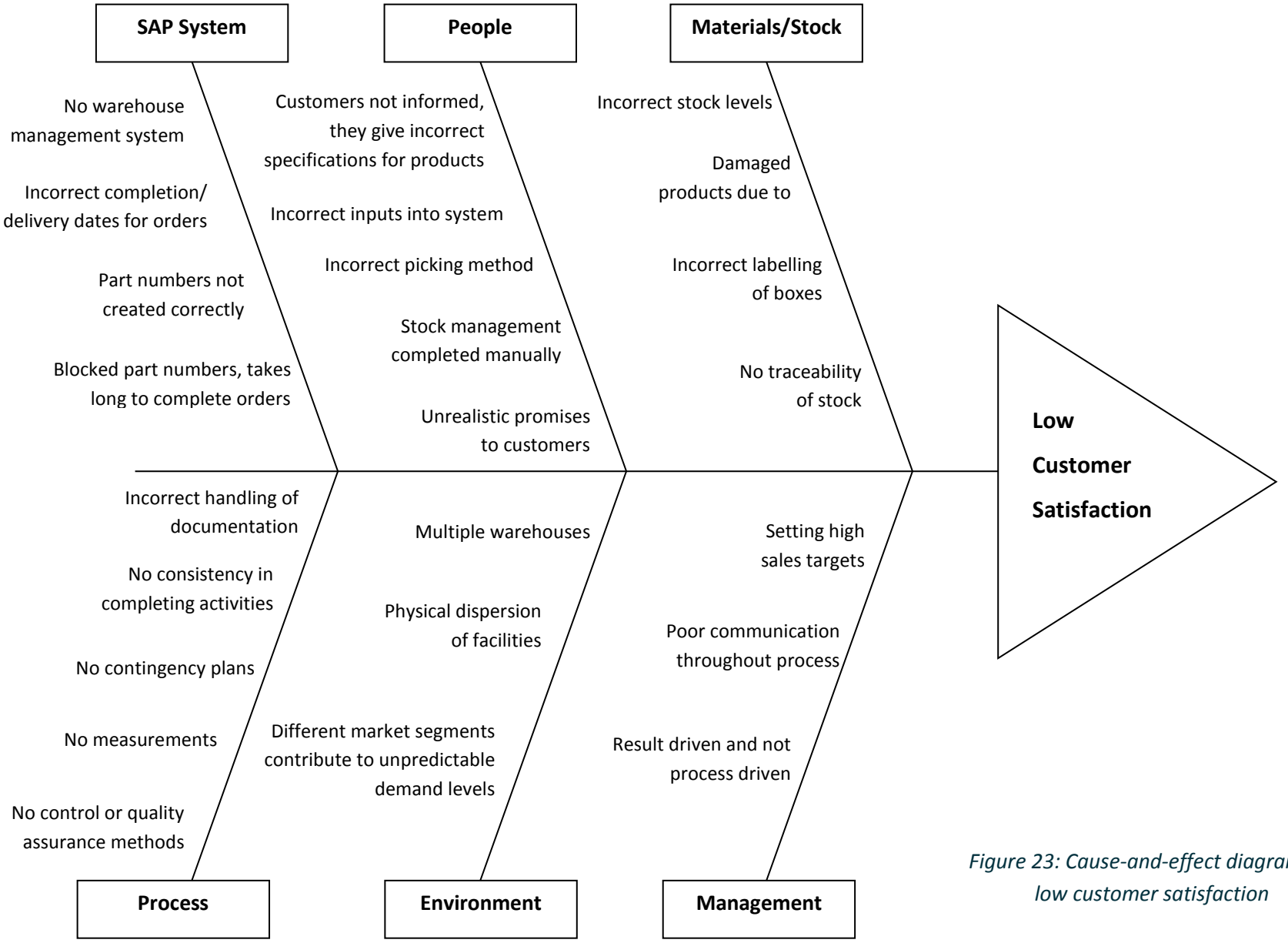


Figure 23: Cause-and-effect diagram for low customer satisfaction

3.4. Current Process Description

An important step for defining and improving a complex business process like GZA's order-to-delivery cycle was to gain a high-level understanding of the process (Furey, 1993). The order-to-delivery cycle consists of processes that are required to fulfil a customer order. This project classifies these processes as the *key processes* in the order-to-delivery cycle. The interaction between the key processes explains the order-to-delivery cycle on a high-level basis. The order-to-delivery cycle was mapped using the key processes to analyse the cycle and identify where the inefficiencies and problems originate from. No employee in the organisation has a clear understanding of the handover points between the key processes. The activities of the key processes and the handover points between these processes became clear after extensive interviews with employees and constructing primary process models of these processes.

The high-level process map of the order-to-delivery cycle indicated the sequence of the key processes and how they interact with each other. The high-level analysis identified all the roles of the employees who are responsible for performing the activities in the order-to-delivery cycle.

3.4.1. Employee Roles

The order-to-delivery cycle stretches across departments, meaning that various employee roles take part in the process. Each role is responsible for completing certain tasks, but currently the responsibilities of certain roles are not clearly defined and tasks are completed by different roles.

The various roles in the order-to-delivery cycle and their primary responsibilities were identified. Only the roles that are responsible for performing and completing tasks in the process are explained. Table 12 indicates the different departments involved in the order-to-delivery cycle and roles of the employees that perform the activities. Refer back to Figure 2 for the organisational breakdown of GZA.

Communication between the various roles is important because it marks the point where the key processes interact and where the processes have cross-functional boundaries between departments. A clear understanding of the roles involved in the order-to-delivery cycle made it easier to understand how the key processes are inter-connected.

3.4.2. High-level Process Description

The high-level description of the order-to-delivery cycle highlighted some of the key processes and explained the interaction between these processes. The complexity of the entire order-to-delivery cycle is reduced in the high-level explanation, but the detail design of the processes discussed in the next section covers all aspects of the cycle. See Figure 24 for a high-level process map of the current order-to-deliver cycle. Figure 25 indicates the grouping of the key processes according to the main business activities.

Table 12: Description of the roles in the order-to-delivery cycle

Role	Description
Sales Department	
Internal sales representative	This role serves as the bridge between GZA and the customer. The sales representative receives the enquiry from the customer, gives the customer a quotation and places the order on SAP.
Operations Department	
Local Assembly	
Planning	
Production planner	The production planner creates the new part number and the Bill of Material (BOM) for a new assembly. He is responsible for creating the production order, checking for component availability and confirming the completion of the production order.
Execution	
Assembly technician	This role refers to any employee who is part of the physical assembly of a product.
Assembly team leader	The team leader manages the assembly technicians and serves as the communicator between the assembly technician and the production planner.
Quality controller	The quality controller is responsible for doing the final visual check before an assembly is ready for dispatch.
Packaging personnel	The packaging personnel are from another company that provides on-site packaging services to GZA. They are responsible for building crates and packaging the assembled goods.
Supply Chain Management	
Supply Planning	
Supply planner	The supply planner is responsible for purchasing finished goods from Grundfos production companies (also referred to as Group suppliers) or purchasing components from non-Group supplies (also referred to as local suppliers).
Admin controller	The employee in this role is responsible for verifying goods receipt on the system after incoming goods or material have been received by the warehouse.
Logistics (Warehouse)	
Inbound supervisor	The inbound supervisor is responsible for receiving and checking incoming goods.
Outbound supervisor	The outbound supervisor is responsible for managing the outbound of orders. He receives the pick slips, hands them over to the pickers, and schedules the orders that have to be delivered by GZA.
Outbound administrator	The outbound administrator prints the delivery notes and labels after picking and collects the documents after the goods have been dispatched to verify that the goods have been issued.
Picker	The picker receives the pick slip from the outbound coordinator and goes to collect (pick) the required part numbers from the shelves. He is also responsible for final packaging and taking the completed order to the dispatch area.
Receiver	The receiver unloads the inbound shipments and unpacks the containers.
Packer	The packer collects the inbound goods and takes them to the allocated bin location.
Quality controller	The quality controller checks the quality of the inbound goods and ensures that the correct goods are picked for local assembly.
Outbound controller	The outbound controller checks the orders before dispatching and is responsible for handling the paperwork when the orders are dispatched.
Stock controller	The stock controller is responsible for locating and investigating missing stock. He adjusts and scraps stock if necessary.
Driver	The driver delivers orders to customers or delivers and collects subcontracted components for assembly.
Finance Department	
Account receivables (AR) controller	The employee in this role is responsible for releasing accounts if they have been credit blocked and completing invoices for customers after goods have been dispatched or delivered.

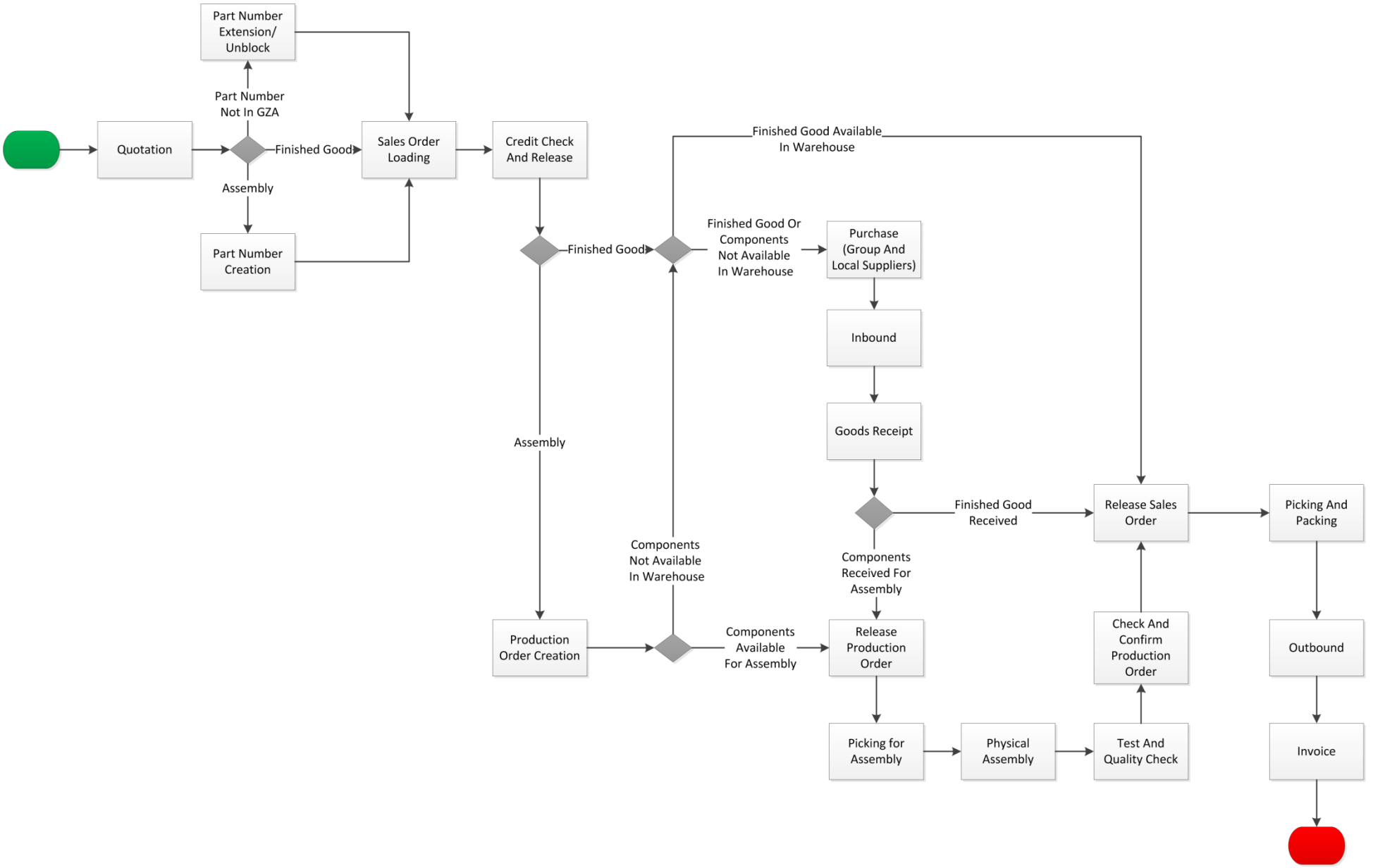


Figure 24: High-level process map of the order-to-delivery cycle

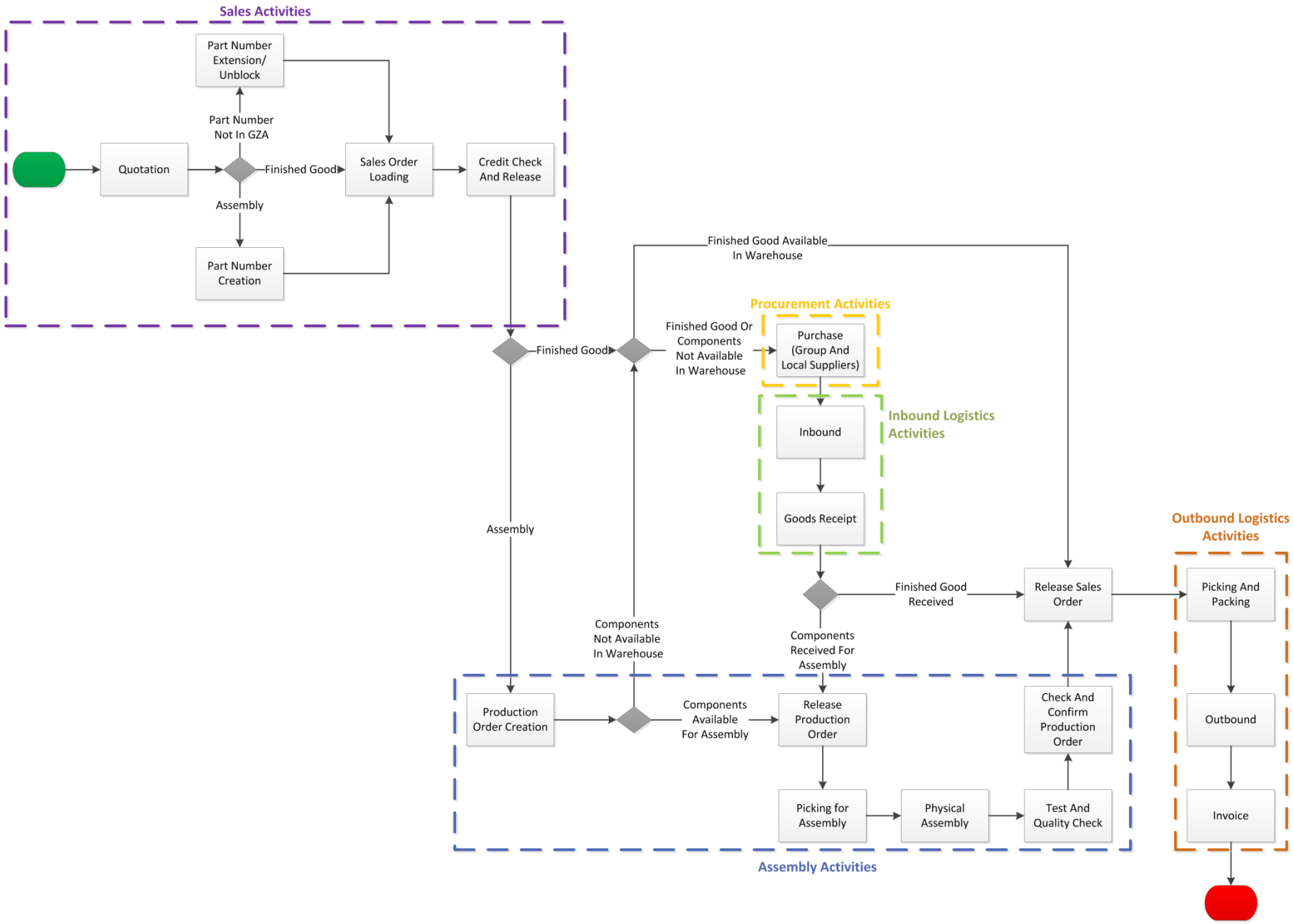


Figure 25: High-level process map indicating the main business activities

The process starts when an internal sales representative receives a call or email from the customer requesting a finished good or an assembly. The sales person sends a quotation to the customer and receives a purchase order in return. This is represented by the *Quotation* process in Figure 24. All finished goods, assembled finished goods and components for assembly are defined by a part number in the system (SAP). The term part number will be used when referring to the finished good or component on the system.

The decision node in Figure 24 indicates that one of the three routes can be followed. If the customer requests a finished good and if there are no system errors, the internal sales representative can load the order onto SAP. This is represented by the *Sales Order Loading* process. If the customer wants a customised product (GZA classifies these products as assemblies), the system considers it to be a new finished good item and a new part number has to be created. The production planner is responsible for creating a new part number and this is represented by the *Part Number Creation* process. The sales order can only be loaded after the part number has been created. Sometimes part numbers are unavailable and system errors occur; GZA classifies these part numbers as blocked or non-extended. GZA blocks part numbers from their system if they have not bought or sold the part number in the last two years. This means that the part number is still produced and available at other Grundfos companies, but it has not recently been sold by GZA. If the customer requests a part number that is blocked, the internal sales representative has to notify the production planner who will execute the *Part Number Extension/Unblock* process. After this process is completed the internal sales representative can proceed with loading the sales order. SAP completes a credit check of the customer's account after the sales order has been loaded. If there is a credit block on the account, the finance department is notified to release the credit block. This process is represented by the *Credit Check and Release* process in Figure 24. All accounts are eventually released and the process can continue as normal.

The type of order will determine the next phase in the process. The decision node after the *Credit Check and Release* process indicates that finished goods and assemblies follow different routes. The route for finished goods will be discussed first. The next decision node determines the route based on whether the required part number is available in the warehouse or out of stock. If the part number is in stock, the internal sales representative can release the sales order. This is represented by the *Release Sales Order* process in Figure 24. Sales orders can only be released if all the part numbers (finished goods) required for the sales order are available in the warehouse or if the assembly is completed and ready for packing. Releasing the sales order triggers the pick slip to print in the warehouse and pickers can collect the finished goods for packing and shipping.

The purchasing and inbound activities are activated if the requested finished goods or components for assembly are not available in the warehouse. If any part number is out of stock, it has to be purchased from Group or non-Group suppliers. Group suppliers are Grundfos production companies and they supply finished goods and specialised components for assembly. Non-Group suppliers provide motors, baseplates and other generalised components for assembly. There are *Purchase (Group)* and *Purchase (Local)* processes for the different supplier types, but in Figure 24 they are grouped together as one *Purchase (Group and Local Suppliers)* process to simplify the high-level process. The supply planner places the purchase order, completes the necessary documentation and communicates the delivery of the order to the warehouse. When the order arrives at the

warehouse, the shipment is checked against the purchase order and packed away. This is represented by the *Inbound* process in Figure 24. After arrival of the order, the goods are checked into the system and this is represented by the *Goods Receipt* process. The decision node after the *Goods Receipt* process illustrates the different routes for finished goods and components for assembly that have arrived. If finished goods arrive, the sales order is released and the pick slip is printed. If components required for assembly arrive, the production order can be released and the assembly activities can continue.

If the customer originally requested an assembled finished good, the *Assembly* route is followed at the decision node after the *Credit Check and Release* process. The production planner has to take the planned order (created when the part number was created) and has to change it to a production order. This is represented by the *Production Order Creation* process in Figure 24. The system runs an internal MRP (Material Requirements Planning) against the Bill of Materials (BOM) for the production order to check if all the components for the assembly are available. This is represented by the decision node after the *Production Order Creation* process. If all the part numbers are available, the production planner can release the production order. This is represented by the *Release Production Order* process. If certain part numbers are not available, the *Purchase (Group and Local Suppliers), Inbound* and *Goods Receipt* processes have to be followed. The production order can be released after the parts arrive and the assembly activities can continue.

If the production order is released, the *Picking for Assembly* process can start. The production order indicates the part numbers required and the part numbers have to be picked from the warehouse. If all the components have been received, the *Physical Assembly* process can start. The order is completed by assembling the customised product. After the assembly is completed, it goes through the *Test and Quality Check* process to ensure that the completed assembly operates correctly and conforms to the customer's specifications. If the assembly is correct, it is packaged and placed in the staging area and the production order is returned to the production planner. The production planner checks whether all the parts on the production order have been used and corrects the stock levels on the system if other parts were used. The completed production order is then confirmed on SAP and the internal sales representative is notified. The sales order can be released and a pick slip will print in the warehouse.

The *Picking and Packing* process starts when the pick slip prints in the warehouse office. The outbound supervisor gives the pick slip to a picker. The picker goes to the shelves or to the production staging area to collect the finished good. He returns the pick slip to the outbound supervisor and the outbound supervisor prints a delivery note and packing stickers. The picker completes packing the finished product and transports it with the documents to the dispatch area.

There are different transportation modes for outbound logistics at GZA. The customer can send his courier or his own driver to collect his order. GZA can use courier services or their own drivers to deliver the order to the customer. For every transportation mode the delivery note should be signed by the customer or the courier. The signed delivery note serves as proof of delivery and is returned to the warehouse office where a post goods issue is completed and the part numbers are checked out of the system. This is represented by the *Outbound* process in Figure 24.

All the documents are given to the finance department for the *Invoice* process. The order-to-delivery cycle is viewed as complete when the customer has been invoiced. The high-level process map is only used for explanatory purposes and to indicate the basic flow of the order-to-delivery cycle. This high-level process map was also used to identify the problems in the order-to-delivery cycle.

3.5. Problem Identification and Analysis

This section discusses the procedure followed for identifying the problems and indicating which problems will be solved by this project.

3.5.1. Procedure for Problem Identification

A critical success factor for any process improvement initiative is to actively involve and consult the managers involved in the process and the employees who perform the tasks in the process (Al-Mashari & Zairi, 1999). The success of the process documentation depends on the buy-in and support from the department managers and employees of GZA. It is important to identify the problems experienced by managers and employees from all organisational levels and all departments that play a role in the order-to-delivery cycle.

A meeting based on the principles of a Joint Application Development (JAD) session was conducted to engage with and receive inputs from the managers and employees affected most by the problems in the order-to-delivery cycle. JAD is a methodology originally used for information system design projects, which involves highly structured, facilitated workshops with the stakeholders, end users, software architects and developers (Knowledge Structures Inc., 2004).

The objective of the meeting (informal JAD session) was to determine the problems in the order-to-delivery cycle. The session was attended by 13 employees and managers from different departments. Most of the roles identified earlier in this section where represented in the meeting. The session started with background information on the project and a high-level description of the order-to-delivery cycle, followed by an explanation of the objective of the meeting.

The high-level order-to-delivery cycle was divided into four main categories and it was displayed on the video projector (see Figure 26). Each person was supplied with a pile of sticky notes with a different colour assigned to each department. Employees were instructed to write the problems on the sticky notes and paste the problem in the category where they are experiencing the issue. Figure 27 shows how employees pasted their sticky notes on the white board.

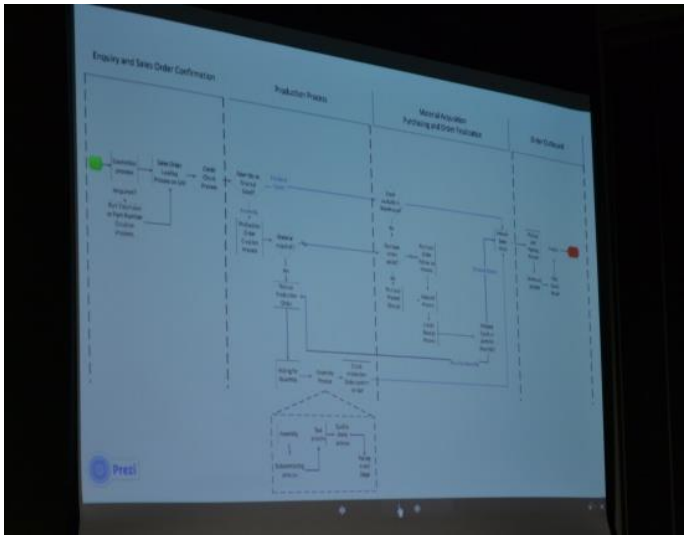


Figure 26: High-level order-to-delivery cycle displayed on projector

Figure 27: Employees placing the sticky notes where they experience the problems

The employees identified more than 70 problems. Figure 28 shows the problems identified by employees and where they experience the problems. The employees identified the symptoms of problems, but the problems had to be grouped to understand from where they originate. This is done to determine which processes have the major problems. An affinity diagram was created with the sticky notes to organise the problems. An affinity diagram is a business tool used to organise the ideas into groups generated in a brainstorming session (Productivity Quality Systems, 2013). Figure 29 displays the affinity diagram of the problems.

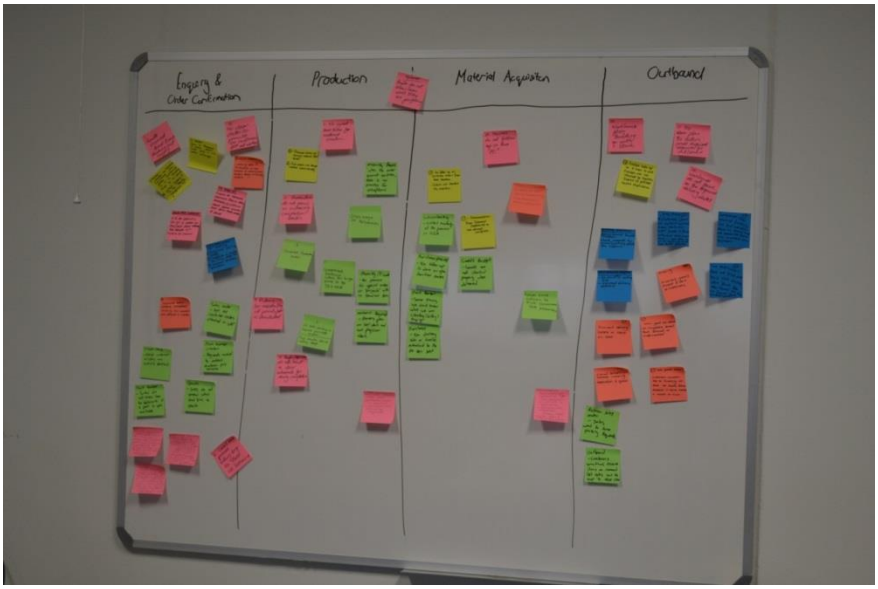


Figure 28: The problems identified by employees where they experience the problems

Figure 29: Affinity diagram of the problems experienced by the employees

The session revealed a huge amount of problems in the order-to-delivery cycle. Figure 29 indicates that some areas have more problems than others. Some problems were experienced in multiple processes and by different people, while other problems are outside the scope of the project. A detailed analysis and sorting of the problems was required.

3.5.2. Identified Problems

The JAD session highlighted the fact that the order-to-delivery cycle is inefficient and that there are a lot of problems and errors that occur. These problems were analysed according to the type of problem and whether the solution to the problem is included in the scope of the project. Two main types of problems were identified, namely process problems and master data problems.

Master Data Problems

Master data problems occur because the master data in the SAP system is incorrect. These problems are outside the project scope, but they have a significant effect on the order-to-delivery cycle. The incorrect master data causes the following issues:

- Incorrect lead times and incorrect promise dates
- Incorrect delivery addresses of customers
- Sales orders which are released too late, causing late deliveries
- Availability-to-Promise (ATP) check which is also incorrect

The identification of these problems resulted in the initiation of an internal GZA project to fix the master data. The completion of the internal project will also improve the performance of the order-to-delivery cycle.

Process Problems

There are various process-related problems due to a lack of training, processes that are not defined or process rules that are not enforced. The important problems were identified, summarized and discussed. For this project the process-related problems were categorized according to their impact and how they will be solved. The four problem categories are:

- Frequent process failures
- Undefined process problems
- Neglected process problems
- Outside scope process problems

The frequent process failures are the situations that have the biggest effect on the performance of the order-to-delivery cycle. These situations have a big impact because there are no instructions or processes in place for employees to follow if these situations occur. The frequent process failures will be addressed by clearly documenting the processes that should be followed should they occur. The frequent process failure that has the biggest impact on the whole order-to-delivery cycle is when customers change their requirements or cancel their orders. The major problems occur when the customer wants to change his order after the pick slip has been released. Internal sales representatives make changes to the sales order without communicating the changes downstream. The sales order is released again and a new pick slip prints, which results in duplicate picks, duplicate shipments that must be returned and low stock levels. Table 13 discusses the frequent process failures and their effects.

Table 13: Frequent process failures that cause problems

Frequent Process Failure	Description	Effect
Changed customer requirements	The customer changes the order after a pick slip has been printed. The sales order is adjusted and a new pick slip is printed. There is no communication downstream. (Downstream is considered to be the direction of flow towards the end of the order-to-delivery cycle)	Pick slips are duplicated and double picks occur. This causes multiple shipments and low stock levels.
Zero picks	A specific part number cannot be found in the warehouse. This means that the part number is out of stock, while the system shows that stock is available.	Zero picks result in late deliveries. This is not communicated to internal sales representatives and customers are not informed. The process to follow is unclear.
Returns from customers and to suppliers	This happens if products and components ordered from suppliers are incorrect and they have to be returned or if customers send products back.	The process is unclear and it is not a priority to book the products back into stock. This causes delays to credit customers.
Cancelled orders	This occurs when a customer cancels his order. The major problems occur if it is a special order produced at a Grundfos production company or if it is an unusual product ordered from Denmark of which GZA does not keep stock on a regular basis.	The procedure and rules for returning the product is unclear and the product becomes a slow stock mover.
Communication to customer if order is delayed	Customers complain that they do not receive notice if their orders are delayed. There is no communication between departments regarding this issue.	This has a significant impact on customer satisfaction.
Missing inbound shipment	This occurs when goods have arrived, but they have not been checked into the system. The system shows that a purchase order exists with a past delivery date.	Sales orders and production orders cannot be released. The inbound supervisor has to be notified and the goods have to be located. A goods receipt has to be performed.
Past delivery date purchase orders	This occurs because purchase orders are not properly followed up to ensure that the supplier received the purchase order. This occurs mostly for non-Group suppliers.	When sales orders are loaded, the system indicates that goods have been ordered, but the purchase order is past its delivery date. The supply planner has to follow up on the purchase order and must determine the reason why the order has not been delivered.

Undefined process problems arise because certain activities and parts of the processes are not clearly defined; thus the processes are not completed correctly. Neglected process problems occur because certain defined tasks in the processes are not always performed by employees. The completion of these tasks is not enforced by managers. The problems in these two categories were solved by clearly defining the tasks in the processes, thus creating improved processes. The problems in these two categories are listed in Table 14 and the process where the problem occurs is also identified.

Table 14: Process-related problems summarised according to the problem categories

Problem Category	Process	Problem
Undefined-process problems	Picking	Incorrect goods picked and shipped, because there are no defined checking tasks.
	Inbound	There is no action plan for goods that arrive at inbound, and required directly for outbound. Goods are packed away and the lead times for picking increases.
	Sales Order Loading	The customer placing the order does not have an account with GZA and this creates a delay during the process.
	Picking for Assembly	It is not a priority to pick for assembly and this causes a delay with physical assembly. The handover of components between the warehouse and local assembly departments is unclear.
Neglected-process problems	Various	Documents are not attached to the sales order on SAP; documents arrive late or are incomplete.
	Purchase	There is no follow-up on purchase orders. This results in goods arriving or not being delivered in time. The entire downstream process is delayed.
	Inbound	Shipments that arrive are not checked and verified.
	Various	There is a lack of communication between departments as the processes cross departmental boundaries. Urgency of sales orders are not communicated downstream and completion of production orders are not communicated back to sales.

The last problem category consists of problems that cannot be solved with clear process documentation. The solutions for these problems are not included in the scope of this project, but these problems need attention as well. Table 15 describes the outside-scope problems and possible solutions.

Table 15: Process-related problems outside the project scope

Problem	Possible Solution
Internal sales representatives do not check the shipping instructions when they load the sales order and they cannot change the default delivery address if customers request a different location.	Give full SAP training to all internal sales representatives.
Internal sales representatives cannot determine if a part number exists at GZA before they start loading the sales order.	Train internal sales representatives.
Most customer accounts are credit blocked and this causes delays if the sales order has to be released quickly.	Generate daily reports of the credit blocked accounts in order to provide the internal sales representative with the information earlier.
Customers come to collect their orders directly after they placed the order. Not all orders are immediately processed or there may be other delays in the process. This causes that orders are not ready for the customers when they arrive for collection. This has a significant effect on customer service.	Clearly define terms and conditions for customers regarding order collection.
There is no agreed lead times for part number creation if the customer requires assembled finished goods.	Create service level agreements for the local assembly department to adhere to.

This project aimed to address the problems in the first three categories by clearly defining the processes through process models or proposing the right activities to ensure that the issues are addressed correctly.

4. Order-to-Delivery Cycle Design

The main aim of this project was to document the processes in the order-to-delivery cycle and suggest an improved design of the processes. The process documentation will provide GZA with the means to improve the order-to-delivery cycle if they implement and manage the suggested process designs. This project addressed the process-related problems experienced by employees by clearly defining tasks and procedures to reduce errors and improve efficiency.

This section discusses the process documentation and the new design for the order-to-delivery cycle. There is not an extreme difference between the new design and the current activities which employees are performing. It will be stated clearly if an improvement or change was made. This section explains each process in detail: the process hierarchy design of the order-to-delivery cycle and the notation used for the process models.

4.1. Order-to-Delivery Cycle Hierarchy

The order-to-delivery cycle is a complex process that stretches across the sales and operation departments of GZA. The concept of process hierarchy was used to describe and reduce the complexity of the order-to-delivery cycle. Process hierarchy is the functional decomposition of the top-level processes into core processes to reduce the complexity of a process. The order-to-delivery cycle is decomposed into three levels. The first level (top-level) is represented by the core business activities required for the order-to-delivery cycle to function properly. The second level consists of the processes that originate in the order-to-delivery cycle and the third level is the activity level where the activities of each process are modelled. Process hierarchy provides an easy method for the user to navigate through the process documentation. The layout of level 1 and level 2 processes is explained further.

4.1.1. Level 1 Processes

The top-level processes are derived from the generic business activities defined by Porter's value chain. The primary activities and secondary activities of Porter's value chain that are relevant to the order-to-delivery cycle were used in the level 1 design of the cycle. The value chain activities used for the level 1 design are *Sales and Marketing*, *Procurement*, *Inbound Logistics*, *Operations* and *Outbound Logistics*. These activities provide a broad explanation of the order-to-delivery cycle. The processes that form the order-to-delivery cycle are grouped according to the relevant value chain activities.

Sales and Marketing represents the processes that are responsible for quoting the customer, processing the sales order and interacting with customers. *Procurement* represents the processes that are responsible for interacting with suppliers and purchasing finished goods from Grundfos production companies (Group suppliers) or components for assembly from non-Group suppliers. *Inbound Logistics* represents the processes that support the arrival of inbound shipments or any incoming goods. *Operations* represent the processes that are required to produce an assembled product and process production orders. *Outbound Logistics* represents the processes that are responsible for the outbound of goods from the warehouse. This includes picking, dispatching and returning goods to suppliers.

The order-to-delivery cycle for local sales is now described as a value chain. This will change GZA's point of view from functional departments to a value chain perspective. Figure 30 displays Porter's value chain activities as the level 1 processes of the order-to-delivery cycle and provides an overall view of the order-to-delivery cycle that will be used as a navigation page in the process documents.

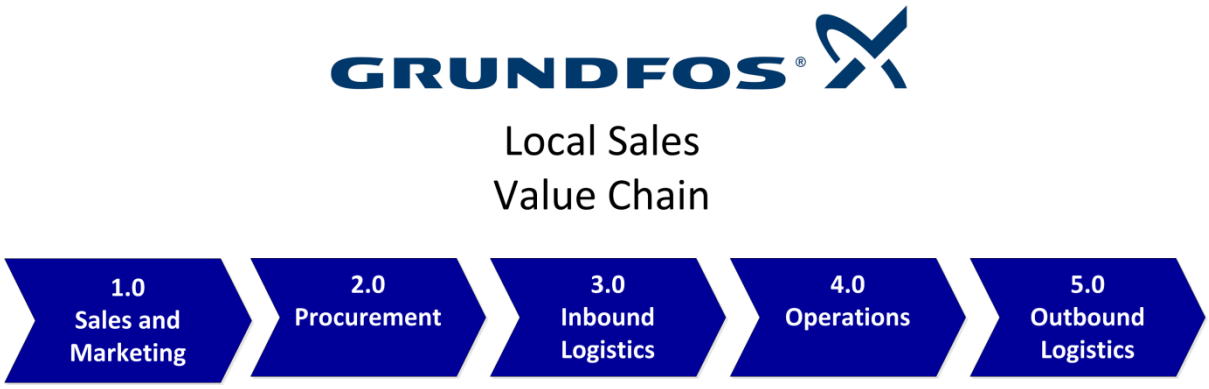


Figure 30: Level 1 processes for the order-to-delivery cycle

4.1.2. Level 2 Processes

The level 2 processes are the processes that shape the order-to-delivery cycle. All the processes identified in the order-to-delivery cycle are classified under one of the level 1 process categories. There are two types of level 2 processes identified for this project, namely:

- Key processes: These processes are necessary for the order-to-delivery cycle to achieve its purpose. The order-to-delivery cycle cannot function properly if one of these processes is left out or neglected. The key processes form the "perfect" order-to-delivery cycle with no problems or failures. In Figure 31 to Figure 35 these processes are coloured blue.
- Counteract processes: These processes address and define how to deal with the frequent process failures and problems identified during the problem investigation. Some of these processes operate independently, whereas others integrate with the key processes to assist with the problems that occur. In Figure 31 to Figure 35 these processes are coloured red.

The figures below indicate which level 2 processes are allocated to each level 1 process category. The level 2 processes are briefly explained according to each level 1 category.

Sales and Marketing Processes

The processes classified under *Sales and Marketing* are the processes that relate to the sales order or the processes that include interaction with the customer. The key processes are responsible for processing the sales order and the counteract processes are responsible for communication to the customer regarding delays and handling situations when the customer cancels his order or changes his requirements.

The *Quotation* process represents the direct interaction with the customer where the customer is quoted and a purchase order is received. The *Part Number Extension/Unblock* process occurs if there are errors with regard to the part number requested by the customer. Part numbers are blocked if they have not been stocked or sold over the last two years. The part number has to be unblocked before the *Sales Order Loading* process can continue. The *Sales Order Loading* occurs after the purchase order from the customer has been received. The sales order is loaded onto the system and an automatic credit check is conducted against the customer's account. The *Credit Release* process occurs if there is a credit block on the customer's account. The rest of the order-to-delivery cycle cannot continue unless the credit block has been released. The *Supply Type Decision* process serves as guidance for the internal sales representative to determine the next process in the cycle based on the method of supply. This process is subject to various conditions. The *Release Sales Order* process can only occur after the requested goods are available in stock. Various processes can occur before this process, but it is in this category because it relates directly to the sales order.

The *Outbound Delayed Order Notification* process is responsible for communication to the customer if the internal sales representative receives a notification from downstream in the order-to-delivery cycle stating that there is a delay in the process. Processes 1.8 through to 1.11 describe the actions if a customer cancels his order. There is a different process for every supply type. In the process *Cancelled Order Classification,* the internal sales representative receives a request from the customer to cancel his order. The *Cancelled Order Stock* process is responsible for cancelling the order if the goods are in stock. The *Cancelled Order Assembly* process is responsible for cancelling an order if the customer requested an assembled finished good (customised product) produced at GZA. The *Cancelled Order Buy-to-Order* process describes the actions if the customer requested a special product, and the customer cancels his order. A product is considered special if it is not standard stock at GZA or if it cannot be assembled at GZA. These products are produced or stocked at Group suppliers and if a customer cancels his order, the purchase from the Group supplier has to be cancelled as well. The *Changed Customer Requirements* process describes the actions if a customer notifies the internal sales representative of his changed requirements.

Figure 31 visually indicates the level 2 processes that are classified under *Sales and Marketing*. Figure 31 will act as a navigation page for the user of the process documents.

Figure 31: Level 2 processes classified under Sales and Marketing

Procurement Processes

The processes categorised under *Procurement* are the processes that relate to the purchasing of finished goods and components from Group or non-Group suppliers. The key processes are responsible for placing purchase orders at suppliers. The processes for purchasing from Group and non-Group suppliers are different. The integration between GZA and their Group suppliers are well developed due to the fact that all the Grundfos companies are required to operate on SAP. This ensures quick and efficient communication and problems do not occur regularly. More problems arise when purchasing from non-Group suppliers due to the lack of effective communication. Purchase orders have to be followed up due to delayed deliveries. The counteract processes are responsible for following up on late purchase orders and incorrect shipments.

The *Group Supplier Purchase* process is responsible for placing purchase orders at Group suppliers and handling the paperwork for inbound shipments. The *Non-Group Supplier Purchase* process is responsible for purchasing goods from non-Group suppliers. The *Purchase Order Follow-up* process is responsible following up on purchase orders that are past their requested delivery date. The *Incorrect Inbound Shipment Administration* process is responsible for handling the administration if incorrect goods arrive in an inbound shipment. Goods are considered incorrect if they are damaged, of a low quality, unwanted or in excess.

Figure 32 visually indicates the level 2 processes that are classified under *Procurement.* Figure 32 will act as a navigation page for the user of the process documents.

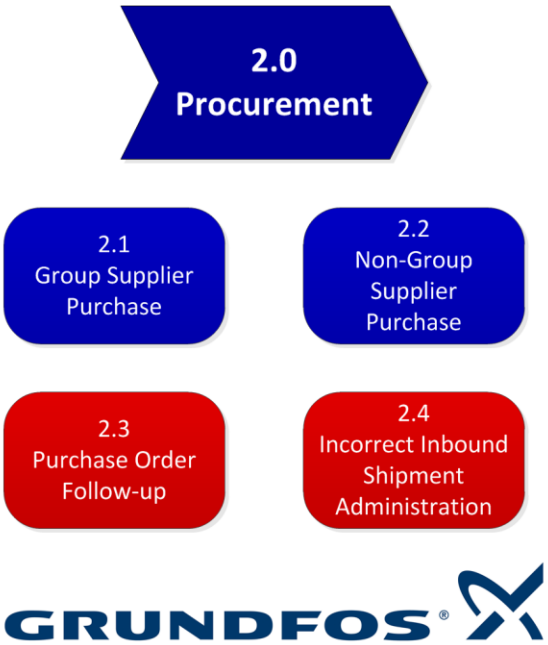


Figure 32: Level 2 processes classified under Procurement.

Inbound Logistics Processes

The processes that involve handling inbound goods are classified under *Inbound Logistics*. The key processes are responsible for unloading, checking and packing away the inbound shipment. The counteract processes are responsible for accepting returned goods from customers, locating misplaced shipments and handling incorrect shipments.

The *Inbound Shipment Arrival* process is responsible for unloading and staging inbound shipments. The *Inbound Shipment Check* process is responsible for checking the inbound shipment and determining the next process for the different situations. The *Inbound Shipment Pack Away* process is responsible for packing away or staging the correct goods from the shipment. The *Goods Receipt* process is responsible for checking the inbound goods into the system.

The *Customer Returns* process is responsible for all the actions required if a customer returns goods. The *Misplaced Inbound Shipment* process is activated when goods have arrived and are somewhere in the warehouse, but they have not been checked into the system. Processes 3.7 and 3.8 are activated during the *Inbound Shipment Check* process. The *Incorrect Shipment Acceptance* process is activated if incorrect inbound goods have been accepted. The *Inbound Shipment Repackaging* process is responsible for repackaging goods that have arrived with damaged packaging.

Figure 33 displays the processes that are part of *Inbound Logistics.* Figure 33 will act as a navigation page for the user of the process documents.

Figure 33: Level 2 processes classified under Inbound Logistics

Operations Processes

All processes that involve creating assembled finished goods are categorised under *Operations*. The key processes are responsible for creating the production order, picking the required components, completing the physical assembly, and conducting test procedures. The counteract process is responsible for the disassembly of a work-in-progress or completed assembled finished good.

The *Part Number Creation* process is activated when the customer requests a customised product, but the process has to occur before the sales order can be loaded. The *Production Order Creation* process is activated after the sales order has been created. This process is also responsible for checking the availability of components and the purchase processes are activated if required components are not in stock. The *Release Production Order* process is activated when all components are available. The production order prints and it is handed to the assembly technician. The *Picking for Assembly* process is responsible for picking the components required for assembly from the warehouse. The *Physical Assembly* process is responsible for all the actions that produce the assembled finished good. The *Subcontracting* process facilitates the activities if components have to be sent for modifications to subcontractors. This process is currently used for sending base plates to subcontractors for painting. The *Test and Quality Check* process is responsible for testing the completed assembly to determine if it conforms to the required specifications. The *Check and Confirm Production Order* process is responsible for confirming the completion of an assembly on the system when it is completed. The internal sales representative can only release the sales order after assembly is completed. The *Disassembly* process is responsible for the disassembly of work-in-progress or completed assembled goods when a customer cancels an order or changes his requirements.

Figure 34 displays the level 2 processes that are classified under *Operations*. Figure 34 will act as a navigation page for the user of the process documents.

Figure 34: Level 2 processes classified under Operations

Outbound Logistics Processes

All warehouse processes and the processes related to outbound goods are classified under *Outbound Logistics*. The key processes are responsible for picking goods from the warehouse, facilitating and managing the different transportation modes, and checking the goods out of the system after they have been dispatched. The counteract processes are responsible for handling the situations for zero picks and returning goods to suppliers. The order-to-delivery cycle ends when the customer receives an invoice.

The *Picking* process is responsible for picking goods from the warehouse, and the *Packing* process facilitates packing the goods, finalising shipping documents and staging the goods in the dispatch area. The *Outbound Decision* process guides the outbound supervisor to determine the next process based on the transportation mode requested by the customer. The *Outbound Grundfos Delivery* process describes the activities when a Grundfos driver delivers the goods to the customer. The *Outbound Grundfos Courier* process describes the activities if the courier service used by GZA makes the delivery to the customer. The *Outbound Collection* process describes the activities if a customer or the customer's courier comes to collect the goods at the warehouse. The *Outbound Administration* process is responsible for collecting the proof of delivery documents, checking the goods out of the system and delivering the goods to the finance department. The *Invoice* process is responsible for sending the invoice to the customer. The *Changed Order Administration* process facilitates the activities in the warehouse when a customer changes his requirements.

Processes 5.10 to 5.12 address the situation if goods cannot be found in the warehouse. The *Zero Pick Administration* process is activated when two pickers cannot find the stock. The stock controller conducts an investigation to locate the stock and if the goods cannot be found he adjusts the stock. The *Zero Pick Goods Found* process is activated when the goods have been found after the investigation. The order-to-delivery cycle continues as normal. The *Zero Pick Response* process is responsible for notifying the supply planner that goods have to be purchased after the stock has been adjusted. The *Supplier Return Preparation* process is activated when the decision has been made to return the incorrect goods to the supplier. This process is responsible for the administration behind the returns process. The *Supplier Return Execution* process is responsible for the physical return and outbound of the goods.

Figure 35 shows the processes that are grouped under *Outbound Logistics*. Figure 35 will act as a navigation page for the user of the process documents.

Figure 35: Level 2 processes classified under Outbound Logistics

The level 1 processes serve as categories for the level 2 processes. The level 1 and level 2 processes follow a numbering convention. The level 1 processes are numbered 1 through 5 and the number of the level 2 process depends on its level 1 process category. Each level 2 process can be identified by its unique number. The figures above indicate the numbering convention. This organises all the processes in the order-to-delivery cycle in a logical manner, to provide users of the process models with a framework to locate processes easily.

Each of the level 2 processes was modelled to document the activities in the processes. The process models provide a new design for each process. A modelling notation was developed to support the requirements of GZA. The modelling notation and design for each level 2 process will be discussed further in the section.

4.2. Customised Process Mapping Notation

A process mapping notation is considered to be the "language" used to visually communicate the process to the reader. Different process mapping notations were discussed and considered for this project. Basic flowchart symbols, BPMN, IDEFØ and EPC were qualitatively evaluated according to certain criteria. The tool that is available to construct the process models is an important factor to consider as it supports only certain process mapping notations. MS Visio is the tool used to construct the process models and it only supports IDEFØ, flowchart symbols and EPC.

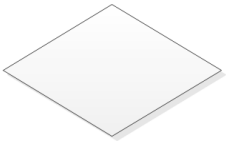
The goal of the process models is to provide GZA with process documentation to lead them towards process improvement and standardisation. The process models will be used by the employees to assist them with their daily tasks and provide guidance to follow the correct process. It is important that the notation should be easy to understand and follow. When asked to select the process mapping notation that they understand best, most employees preferred flowchart symbols.

Due to employee preference and the process modelling tool available for this project, it was decided to develop a notation based on flowchart symbols and BPMN principles that supports the objective of the project and GZA's needs. Table 16 defines the elements used in the process models of the order-to-delivery cycle.

The notation is very detailed and elements clearly indicate the activities that employees have to complete. The process models are constructed to indicate to the user how the processes follow one another. The *activity* element indicates the tasks that have to be completed by the role players or indicates that something happened. *Decision gateways* are used to indicate that the flow of the process splits and the user should follow the required flow path. The *process* element is used to indicate which process follows the current process. This method indicates how the processes interact and it clearly defines the handover points between role players. The concept of a *parallel gateway* was used from BPMN. This gateway indicates that both flow paths should be followed and they occur simultaneously. A *converging gateway* is used to indicate that two or more are joining before they enter another element.

This notation was developed to suit the needs of GZA. The notation is simple because it does not have many elements that clutter the process models. The notation provides detail to guide employees and give them clear instructions. The process models of the order-to-delivery cycle indicate how the processes interact with one another and it will serve as the baseline to improve and standardise the order-to-delivery cycle.

Table 16: Customized process mapping notation elements

Symbol	Name	Description
	Activity	The square indicates an activity that has to be performed by a role player. It always starts with a verb followed by a description.
	Decision gateway	It indicates that the flow of the process can go different ways. It contains a question and only one of the exiting flows can be chosen. The exiting flow lines have descriptions to indicate the condition of the exit flow selected.
	Process	A process is a rectangle with rounded corners. All the processes are blue and numbered. These correspond to the level 2 processes previously defined. These processes indicate how they follow on each other.
	Start	This indicates the start of the order-to-delivery cycle.
	End	This indicates that the order-to-delivery cycle has ended or cannot continue.
	Parallel gateway	This gateway indicates that the flow of the process splits, but the activities can be performed in parallel. There is no specific order. The exiting flow lines do not contain conditions.
	Converging gateway	This gateway indicates that two or more flows are converging to a single flow. This is to reduce confusion in the process models. This gateway is used instead of having two entering flows in an activity.
	Normal flow	The normal flow connects the elements in the process model and indicates the path of the flow.
	Connecting flow	Connecting flows are used to indicate that the end of a process links with the middle of another process.

4.3. Order-to-Delivery Process Design

The order-to-delivery cycle of GZA consists of various processes that interact with each other to achieve the main goal of delivering the required product to the customer. These processes are currently ad hoc, not properly defined and the problems and inefficiencies affect their overall performance. The new design of the processes incorporates the current activities and activities that will improve communication between different role players and address the process-related problems identified by employees. The new design focuses on how the different processes interact with one another and clearly defines how employees should address process failures.

The process model for each level 2 process defined will be discussed and explained briefly. Each process will be discussed in terms of an objective, overview, the roles involved and improvements made to the process. It is not within the scope of this project to define detailed process narratives. GZA will develop official documents with these process models and complete process narratives with clear work instructions.

The number assigned to each process discussed below, correlates with the numbering notation described in Section 4.1. The number allocated to each level 2 process in Figure 31 to Figure 35 was used below to easily link the description with process model.

4.3.1. Sales and Marketing Processes

The processes classified under *Sales and Marketing* are the processes required for placing a sales order and the processes that facilitate interaction with the customer. The internal sales person receives requests and purchase orders from customers that activate the order-to-delivery cycle.

1.1 Quotation Process

Objective

The objective of this process is to generate a quote for the customer in response to his enquiry and receive a purchase order as confirmation of the sale.

Overview

The order-to-delivery cycle is activated with this process when an enquiry from the customer is received. If the customer requests a finished good that is standard on the price list, then he is quoted directly. If the request is not a standard finished good then the internal sales representative has to identify a solution first. A quotation is set up and sent to the customer. If the customer accepts, a purchase order will be received. If the quote is not accepted then the internal sales representative has to determine the reason and re-quote.

Roles Involved

- Internal sales representative

Improvements

The improvements made to this process include the activity to check whether the customer has received the quote. There are many open quotations that have not been converted to sales orders. Interviews with internal sales representatives indicated that customers do not respond to quotations. Following up on quotations will ensure that the customer received the quote. Other improvements include the activities to deal with rejected quotations. These activities have not been clearly defined in the past. This will ensure that possible sales are not lost due to price or lead time problems and the paperwork filed will indicate reasons for lost sales. This can be analysed and recurring problems can be addressed.

See Appendix B for the *Quotation* process model.

1.2 Part Number Extension/Unblock Process

Objective

The objective of this process is to unblock a part number if it has not been stocked in two years or extending a part number from another Grundfos company to be available for sale at GZA.

Overview

This process is activated when the internal sales representative cannot load the sales order because of an error with the part number. An error with the part number can be either that the part number is blocked or the part number is not defined in GZA's system. A part number is blocked if it has not been stocked at GZA over the last two years. The production planner unblocks the part number and notifies the internal sales representative that the part number is available. Another reason for a block is if the part number is no longer manufactured in the whole of Grundfos (client level block), and if GZA does not have stock then the customer needs to be notified.

A part number needs to be extended if it has never been sold in GZA; thus it is not in the system. The production planner must first determine whether the part number is correct at the source, thereafter he can extend the part number. The internal sales representative is notified.

Roles Involved

- Internal sales representative
- Production planner

Improvements

Internal sales representatives do not understand what this process entails and they expect immediate feedback from the production planner. Interviews with the employees indicated that there are communication gaps between the two roles when the part number has been unblocked or extended. Improvements to the process include the communication activities. This will ensure that the sales process continues quickly.

A client level block means that the part number has been blocked across all Grundfos companies. The part number is not produced any more. The process if a part number has been blocked on client level and if there is stock available at GZA has not been defined in the past. Management of GZA decided that the part number should be sold to the customer if there is stock available at GZA. This will ensure order fulfilment and customer satisfaction.

See Appendix B for the *Part Number Extension/Unblock* process model.

1.3 Sales Order Loading Process

Objective

The objective of this process is to load the sales order on SAP.

Overview

The sales order is loaded on SAP. This can only occur if the part number is correct or if it has been created if the customer requests assembled goods. After the sales order has been loaded, the credit on the customer's account is checked automatically. If there are no problems then the process can continue. If there is a credit block, the finance department is notified.

Roles Involved

- Internal sales representative

Improvements

The activities for loading a sales order if the customer does not have an account at Grundfos has been unclear in the past. This was a process related problem identified in the JAD session. The internal sales representatives usually notified the finance department, because they did not know that sales orders could be loaded for one-time customers.

See Appendix B for the *Sales Order Loading* process model.

1.4 Credit Release Process

Objective

The objective of this process is to perform a credit release if there is a credit block on the customer's account.

Overview

The account receivables controller receives the notification from the internal sales representative to release the credit block on the customer's account. After the credit release activity is completed, it is communicated to the internal sales representative and the order-to-delivery cycle can continue.

Roles Involved

- Account receivables controller
- Internal sales representative

See Appendix B for the *Credit Release* process model.

1.5 Supply Type Decision Process

Objective

The objective of this process is to indicate the possible paths in the order-to-delivery cycle after a sales order has been loaded. The process serves as guidance for the internal sales representative to determine the next process in the cycle based on the method of supply.

Overview

This process serves as the divergent point in the order-to-delivery cycle where there are different paths to follow. The supply method of the sales order is used to make the decision. There are three methods of supply, namely supply from stock, supply through assembly (build option) or source from suppliers (buy option). If the customer requested an assembly then the processes to create the assembled finished good are activated. If the customer requested a finished good, it should be available in stock before the internal sales representative releases the sales order. If there is no stock available then the purchase processes are activated. A customer can also request finished goods that are not standard stock at GZA or assembled goods which GZA cannot produce. The *Group Supplier Purchase* process is also activated for these requests. If a purchase order exists, it means that there is an incoming shipment containing the required goods and the next process is the *Inbound Shipment Arrival* process. If a purchase order exists, but the due delivery date has passed, then the *Purchase Order Follow-up* process is activated if the goods have not been delivered. If the goods have been delivered but they have not been checked into the system the *Misplaced Inbound Shipment* process is activated.

Roles Involved

- Internal sales representative

Improvements

This process has never been documented. It serves as guidance to indicate the possible paths in the order-to-delivery cycle after the sales order has been loaded. It shows how the processes interact with one another depending on the product requested by the customer and the supply method used to provide this product to the customer.

See Appendix B for the *Supply Type Decision* process model.

1.6 Release Sales Order Process

Objective

The objective of this process is to release the sales order.

Overview

This process is responsible for releasing the sales order. This process can only occur if there is stock, if the inbound shipment has arrived with the goods or if the assembled product is completed. The result of this process is that a pick slip prints in the warehouse and the *Picking* process is activated.

Roles Involved

- Internal sales representative

Improvements

This process indicates the preceding processes and the communication received by the internal sales representative to indicate when the sales order can be released.

See Appendix B for the *Release Sales Order* process model.

1.7 Outbound Delayed Order Notification Process

Objective

The objective of this process is to communicate to the customer if there is a delay with his order.

Overview

This process is activated when the internal sales representative receives communication that that the order will be delayed. The expected delivery date has to be adjusted and the customer should be notified.

Roles Involved

- Internal sales representative

Improvements

The problem investigation indicated that customers are not notified if their order is delayed. This process enforces the rule that customers should be notified of the status of their order if the internal sales representative receives a notification that the order will be delayed. This will improve customer service.

See Appendix B for the *Outbound Delayed Order Notification* process model.

1.8 Cancelled Order Classification Process

Objective

The objective of this process is to initiate order cancellation when the customer cancels his order.

Overview

The process is activated when the internal sales representative receives a notification from the customer to cancel his order. The supply source for the order has to be determined, because there is a different process for every supply source. The internal sales representative has to notify the outbound supervisor, production planner or supply planner of the cancelled order, depending on the supply type.

Roles Involved

- Internal sales representative

Improvements

Formal processes or procedures to address cancelled orders have not been defined in the past. Cancelled orders were one of the frequent process failures identified during problem investigation. Cancelled orders were not communicated downstream to the warehouse or the local assembly department. The actions to deal with cancelled orders were unclear.

This process will guide the internal sales representative when customers cancel orders. The relevant person to notify is indicated depending on the supply source.

See Appendix B for the *Cancelled Order Classification* process model.

1.9 Cancelled Order Stock Process

Objective

The objective of this process is to cancel an order if the supply source of the order is directly from stock in GZA's warehouse.

Overview

The internal sales representative has to determine the status of the order first. If the sales order has not been released, then the line items on the sales order can be rejected directly. A sales order is considered to be cancelled if the line items on the sales order are rejected. The outbound supervisor has to be notified if the sales order has been released. The outbound supervisor is responsible for cancelling the pick slip, ensuring that the goods are returned to stock and rejecting the line items on the sales order.

Roles Involved

- Internal sales representative
- Outbound supervisor
- Picker

Improvements

When customers cancel orders, the cancellation is not communicated to the outbound supervisor. The process to return the goods to stock is undefined and there is no feedback to communicate completion of cancellation back to the internal sales representative. This process addresses these shortcomings and ensures clear communication between the involved roles.

See Appendix B for the *Cancelled Order Stock* process model.

1.10 Cancelled Order Assembly Process

Objective

The objective of this process is to cancel an order if the supply source of the order is the build option when a customised product is assembled by GZA.

Overview

The production planner receives a notification to cancel the order from the internal sales representative. The status of assembly is determined and a handling fee is charged against the customer. If the status is work-in-progress, then the production order is rejected and the assembly technician is notified to disassemble the product. The *Disassemble* process is activated. The usable components are returned to stock and the unusable components are scrapped. If the status is completed then the assembled finished goods are booked into stock or disassembled and the production order is reversed. If these activities are completed then the internal sales representative can reject the line item on the sales order. This process is also followed if the customer changes his requirements.

Roles Involved

- Internal sales representative
- Production planner
- Inbound supervisor
- Packer

Improvements

The activities to cancel production orders and disassemble or stock the work-in-progress (WIP) or completed assembled goods have not been defined in the past and these activities were not clear. The different options to "cancel" a production order were only known by one production planner. Internal sales representatives did not charge a handling fee for the cancellation, because the business rule has not been enforced in the past. This process ensures that a handling fee is charged and it indicates the responsibility of the production planners to communicate to the inbound team that the goods have to be returned to stock.

See Appendix B for the *Cancelled Order Assembly* process model.

1.11 Cancelled Order Buy-to-Order Process

Objective

The objective of this process is to cancel an order if the supply source is the buy option and if the customer requests a special product stocked or produced by a Group supplier. The rule is to return these goods as soon as they arrive at GZA.

Overview

The supply planner receives a notification from the internal sales representative to cancel the order. The Group supplier is notified to determine the status of the order and reach consensus regarding the cancellation. A handling fee is charged against the customer. If the order has not been shipped and the Group supplier accepts the cancellation, then the Group supplier will first delete the sales order for GZA, then the supply planner can delete the purchase order. The internal sales representative can reject the line item on the sales order after these activities have been completed. If the order has been shipped then the supply planner has to notify the inbound supervisor that the order for the goods has been cancelled. The process indicates the consecutive processes that are required to receive the goods and return them to the supplier. This process is also followed if the customer changes his requirements.

Roles Involved

- Internal sales representative
- Supply planner

Improvements

The business rules for addressing these situations have not been defined clearly and they are not enforced. If the goods for these cancelled orders arrive at GZA, they are not returned immediately because it has never been a priority of supply planners or warehouse personnel to address these occurrences. The result is that these goods stay in the warehouse and they cannot be sold because they were purchased for a customer with specific requirements.

This process will ensure that these goods are returned immediately when they arrive. The goods are staged in a returns area to indicate and remind the warehouse personnel that they have to be returned. The process also indicates the other processes that follow on this process to accept the goods, conduct the administration for their return, and return them. This will lead to improved stock levels and ensure that credit is received for these goods.

See Appendix B for the *Cancelled Order Buy-to-Order* process model.

1.12 Changed Customer Requirements Process

Objective

The objective of this process is to communicate the changes of the customer's requirements downstream and describe the activities that are necessary to implement the changes. The rule is to first cancel the original order and then load a new order.

Overview

The internal sales representative receives a notification from the customer indicating that he is changing his requirements. The supply source will determine the actions taken. If the supply source is stock, then the *Changed Order Administration* process will be activated to cancel the pick slip and manage the warehouse activities. After the cancellation has been completed, the internal sales representative will either add a new line item or edit the quantity. The *Changed Order Administration* process will continue and the normal outbound activities will follow. If the supply source is the build option, then the *Cancelled Order Assembly* process is activated to cancel the production order. Afterwards the internal sales representative has to send a request to the production planner requesting a new part number. The *Part Number Creation* process is activated and the order-to-delivery cycle continues. If the supply source is the buy option the *Cancelled Order Buy-to-Order* process will be activated. The internal sales representative adds a new line item to the sales order and the *Supply Type Decision* process is activated. This is to ensure that all the supply sources are considered for the new request, but the purchase processes will probably be activated. The order-to-delivery cycle continues as normal.

Roles Involved

- Internal sales representative

Improvements

This process addresses one of the frequent process failures. The process to address this issue has not been defined before and each employee handled the situation in a different way. When customers change their requirements, the internal sales representatives adjust the sales order without communicating the change downstream. This results in duplicated pick slips, low and inaccurate stock levels and incorrect assembled goods. This process ensures that the changed requirements are communicated downstream and that the necessary actions are taken before sales orders are changed.

See Appendix B for the *Changed Customer Requirements* process model

4.3.2. Procurement Processes

The *Procurement* processes are responsible for acquiring finished goods or components for assembly from suppliers. There are two types of suppliers, which result that a different process has to be followed for each respectively. All processes that address suppliers or deal with purchase orders are grouped in this level 1 process category.

2.1 Group Supplier Purchase Process

Objective

The objective of this process is to place a purchase order at a Group supplier if finished goods or components for assembly are out of stock. It indicates the communication between GZA and the supplier.

Overview

The supply planner receives a purchase requisition from SAP and he places the order at the Group supplier. If the order has special requests, it needs to be communicated. The supply planner should check for an AB confirmation, which means that the supplier has received the order. Reports are run to indicate which orders have been confirmed and which confirmations are late. The supply planner should check if the order is delayed and this should be communicated to the internal sales representative. The supply planner will receive a LA confirmation if the order has been shipped, followed by the required documentation. The documentation for air and sea freight is different. The documents are sent to the clearing agent and to the inbound supervisor. The next process is the *Inbound Shipment Arrival* process if the goods arrive at GZA.

Roles Involved

- Supply planner

Improvements

There are view errors and problems that occur during this process. The Group suppliers are on time and effective. Improvements for this process include follow-up activities to ensure that orders were received, shipped, and that the supply planner received the necessary shipping documents on time. The process model also indicates the triggers that activate this process.

See Appendix C for the *Group Supplier Purchase* process model.

2.2 Non-Group Supplier Purchase Process

Objective

The objective of this process is to place a purchase order at non-Group suppliers for finished goods or components for assembly.

Overview

This process indicates the activities to place a purchase order at a non-Group supplier. The supply planner receives a purchase requisition, but it has to be converted to a purchase order. The purchase order is sent to the supplier via email. The supply planner has to confirm that the supplier received the purchase order and if the required delivery date can be met. The purchase order should be confirmed on SAP and sent to the inbound supervisor to notify him of the incoming shipment.

Roles Involved

- Supply planner

Improvements

Problems and issues for purchasing usually occur with purchase orders for non-Group suppliers. This happens because non-Group suppliers do not have SAP and it has to be manually confirmed whether the purchase order was received. Supply planners do not follow-up on purchase orders and deliveries are delayed because the purchase order was not received by the supplier. Improvements for this process include a follow-up activity to ensure that the purchase order was received and a communication activity to notify the inbound supervisor of the inbound shipment.

See Appendix C for the *Non-Group Supplier Purchase* process model.

2.3 Purchase Order Follow-up Process

Objective

The objective of this process is to follow-up on purchase orders that have not been delivered yet and are past their expected delivery date.

Overview

This process is activated when the supply planner receives a notification that the order has not been delivered yet. The supplier is contacted to determine if he received the purchase order. If the purchase order was received it will be rescheduled. If the purchase order was not received then it will be sent again to the supplier and the supply planner will capture the order confirmation. The expected delivery date is communicated to the internal sales representative and the production planner.

Roles Involved

- Supply planner

Improvements

This process addresses the frequent process failure of delayed purchase order deliveries due to no follow-up on orders placed. This process states the activities to follow-up on the purchase orders and to determine a new delivery date.

See Appendix C for the *Purchase Order Follow-up* process model.

2.4 Incorrect Inbound Shipment Administration

Objective

The objective of this process is to respond to incorrect shipments and communicate the issues to suppliers through customer complaints. The process defines the correct actions to take when incorrect shipments arrive. Shipments are considered to be incorrect if the shipment contains unwanted, excess, damaged or low quality goods and also if the quantity is less than required.

Overview

This process is activated after the inbound shipment has been checked and incorrect goods were identified in the shipment. The inbound supervisor accepts the goods but the goods are staged in the returns area. The supply planner is notified and he should load a customer complaint at the supplier. The supplier responds to the customer complaint and consensus is reached regarding the goods. If the decision is made to keep the excess or unwanted goods then the *Incorrect Shipment Acceptance* process is activated. If the supply planner decides to return the goods then the *Supplier Return Preparation* process is activated. If the shipment did not contain the required quantity of goods then a new purchase order has to be placed to purchase the quantity short.

Roles Involved

- Inbound supervisor
- Supply planner

Improvements

The actions for addressing incorrect shipments and the responsibilities for certain key activities were unclear previously. The inbound team did not communicate incorrect shipments to the supply planners and this also resulted in ineffective supplier management. Improvements include a clear indication of which actions to take for a given type of incorrect shipment, and the process model defines clear communication activities between the inbound supervisor and the supply planner.

See Appendix C for the *Incorrect Inbound Shipment Administration* process model.

4.3.3. Inbound Logistics Processes

The processes categorised under *Inbound Logistics* handle the arrival and incoming of goods or components. This includes checking the goods into the system and handling returns from customers.

3.1 Inbound Shipment Arrival Process

Objective

The objective of this process is to receive and unload inbound shipments and stage the goods in the inbound for shipment verification.

Overview

The process starts when the inbound supervisor receives the relevant documents from the supply planner or a notification providing information regarding an expected inbound shipment. Upon arrival of the shipment, receivers are assigned to unload the shipment and stage the goods for verification. The *Inbound Shipment Check* process is activated.

Roles Involved

- Inbound supervisor
- Receiver

Improvements

The process model indicates the different triggers or notifications that activate this process and the processes that precede this process. This will guide the inbound supervisor and indicate the documents required before the arrival of the inbound shipment. The notifications will allow the inbound supervisor to plan and schedule the arrivals.

See Appendix D for the *Inbound Shipment Arrival* process model.

3.2 Inbound Shipment Check Process

Objective

The objective of this process is to check and verify the contents of an inbound shipment and determine which goods are incorrect. The process indicates the possible paths after the inbound shipment has been checked and the actions to be taken depending on the contents of the shipment.

Overview

The inbound supervisor checks the contents of the inbound shipment by comparing the actual goods delivered to the relevant documents. The quality controller is responsible for checking the quality of the goods. The *Supplier Return Preparation* process is activated if the shipment contains goods requested from a cancelled order. The *Inbound Shipment Pack Away* process is activated for the correct goods that will be accepted into stock. If the packaging of the goods is damaged then the goods are sent to be repackaged and the *Inbound Shipment Repackaging* process is activated. If damaged, unwanted or low quality goods arrived or the quantity goods were incorrect, then the *Incorrect Inbound Shipment Administration* process is activated to address the issue.

Roles Involved

- Inbound supervisor
- Quality controller

Improvements

There were no procedures defined for checking and verifying inbound shipments. The actions to be taken if shipments are incorrect were not specified. Incorrect goods or goods with a low quality will be accepted and the error will be realised in later processes. This process will guide the inbound supervisor during the checking of inbound shipments, and the process indicates the actions to be taken for each situation. The process model also includes activities for upstream communication to notify the internal sales representative or production planner if there are errors with the inbound shipment.

See Appendix D for the *Inbound Shipment Arrival* process model.

3.3 Inbound Shipment Pack Away Process

Objective

The objective of this process is to pack away or stage the goods from the inbound shipment that are correct and have been accepted.

Overview

The process is activated when the inbound goods and invoice have been accepted. Finished goods or components that are not required for a sales or production order will be assigned to a bin location and packed away. If components are required for a due production order they are staged in the inbound assembly area to ensure that they are located quickly when they have to be picked. If finished goods are required for a sales order they are staged in the cross dock area. The arrival of goods and components required for orders should be communicated upstream to the internal sales representative or production planner.

Roles Involved

- Inbound supervisor
- Packer

Improvements

A process related problem was addressed with the new design for this process. Previously, there was no action plan for inbound goods that are directly required for outbound. The goods will be packed away and this increases the lead time for picking the goods when the sales order has been released. The process model describes action plans for goods or components that are required for sales or production orders and goods or components that are not required for an order. Goods that are not required for an order will be packed away directly, but goods that are required for an order will be staged in the newly defined cross dock area. Components that are required for a production order will be staged in the assembly inbound area. This will ensure that the goods or components can be located easily when they have to be picked.

See Appendix D for the *Inbound Shipment Pack Away* process model.

3.4 Goods Receipt Process

Objective

The objective of this process is to check the goods into the system and make them available for sales or production orders.

Overview

The admin controller receives the relevant documents from the inbound supervisor. The goods receipt activity is completed and the goods are checked into the system. A goods receipt report is generated daily and sent to all the employees in GZA. The internal sales representative and production planner look at the report to determine if the goods have been received. The sales and production orders can only be released if the goods are in stock. The *Release Sales Order* or *Release Production Order* processes are activated of goods or components where required for an order. If the goods are not required for a sales or production order, then the process ends.

Roles Involved

- Admin controller

See Appendix D for the *Goods Receipt* process model.

3.5 Customer Returns Process

Objective

The objective of this process is to handle and facilitate returns from customers.

Overview

The internal sales representative receives a request from the customer to return his goods. The request has to be approved before the goods can be returned. The inbound supervisor should be notified of return if the request has been approved. The internal supervisor receives the goods form the customer when he arrives and a goods returned document should be completed. The goods are checked to determine if they have been used or if they are damaged. Goods that have not been used are directly staged in the returns area. If the returned goods are damaged, then they are repaired by the service department and staged in the returns area. A goods returned purchase order is loaded onto the system. If new packaging is required, the goods are sent for packaging or they are packed away directly. The finance department receives a notification and the customer is credited.

Roles Involved

- Internal sales representative
- Inbound supervisor
- Service department
- Finance department

Improvements

This process addresses one of the frequent process failures identified during the problem investigation. The activities and responsibilities were unclear throughout the process and there were communication gaps between the departments. The process model indicates the activities required to receive the goods and check them back into stock. Handover points between departments, responsibilities and communication activities are also defined.

See Appendix D for the *Customer Returns* process model.

3.6 Misplaced Inbound Shipment Process

Objective

The objective of this process is to locate inbound shipments that have arrived but have not been checked into stock.

Overview

The process is activated when the inbound supervisor receives a notification of a missing inbound shipment. The stock controller is responsible for locating the missing stock and following-up to freight documentation to determine if the goods have been received. If the missing inbound shipment has been located, the documents are taken to the admin controller to complete the goods receipt activity. The order-to-delivery cycle continues as normal. The production or sales order can be released. If the shipment is not located then the supply planner is notified to place new purchase orders.

Roles Involved

- Inbound supervisor
- Admin controller
- Stock controller

Improvements

This process addresses a frequent process failure that occurs due to inefficiency and lack of management. This process describes the activities for locating the goods in the warehouse and checking them into the system.

See Appendix D for the Missing *Inbound Shipment* process model.

3.7 Incorrect Shipment Acceptance Process

Objective

The objective of this process is to accept the incorrect goods from the inbound shipment.

Overview

This process is activated when the supply planner decides to keep the incorrect goods. Unwanted and excess goods can be stocked and sold at a later stage. Damaged and low quality goods can be used for assemblies. The supply planner has to place a purchase order for the unwanted or excess goods. An invoice is received and the documents are taken to the admin controller for the goods receipt process. The goods are assigned to a bin location and packed away. Low quality or damaged goods have already been paid for. These goods have to be checked into the system and packed away.

Roles Involved

- Supply planner
- Inbound supervisor
- Packer

Improvements

This process has not been defined in the past. There were communication gaps between the inbound manager and the supply planner if incorrect goods are accepted. This process model describes the activities that have to be performed when the goods are accepted.

See Appendix D for the *Incorrect Shipment Acceptance* process model.

3.8 Inbound Shipment Repackaging Process

Objective

The objective of this process is to repackage inbound goods with damaged packaging or goods that have been returned from customers.

Overview

The process is activated when the inbound supervisor sends goods with damaged or no packaging to be repackaged. The goods are staged in the inbound packaging area where they are collected by the packaging personnel. The goods are repackaged and staged in the outbound packaging area. If the goods have been returned by a customer, they are relabelled, assigned to a bin location and packed away. The inbound goods that had damaged packaging have to be checked into the system. If the goods are required for a sales order they have to be staged in the cross dock area, otherwise they have to be assigned to a bin location and packed away.

Roles Involved

- Inbound supervisor
- Packer
- Packaging personnel

See Appendix D for the *Inbound Shipment Repackaging* process model.

4.3.4. Operations Processes

The processes classified under Operations, are all the processes that are necessary to create an assembly. This includes the process to create the part number through to the physical assembly and testing processes.

4.1 Part Number Creation Process

Objective

The objective of this process is to create a part number for the assembly. The assembly is considered a new product, which is the reason for creating a new part number.

Overview

The internal sales representative needs a part number to load the sales order, this is the reason for creating the new part number before the sales order is loaded. The production planner receives a notification to create a new part number. He checks if a variant of the part number exists, this means that a similar part number has been created before, but the customer requires a small difference. If a variant does not exist, then a part number has to be created from scratch. Afterwards the part number is extended by using the required procurement key. The new part number is communicated to the internal sales representative and the sales order can be loaded.

Roles Involved

- Production planner
- Internal sales representative

See Appendix E for the *Part Number Creation* process model.

4.2 Production Order Creation Process

Objective

The objective of this process is to create a production order for the assembly. The process also indicates the possible paths after the production order has been created.

Overview

The production order is created by converting the planned order to a production order after the sales order has been loaded. The production planner has to check the production order for errors and determine if all the components specified in the BOM are correct. SAP checks if all the components required for the assembly are available. If all the components are in stock, then the production order can be released. If any component is out of stock, then the production planner will receive a notification of the missing part numbers. The components have to be purchased from Group or non-Group suppliers and the production planner has to reschedule the completion date of the assembly. This process also serves as the divergent point in the order-to-delivery cycle after a production order has been created.

Roles Involved

- Production planner

Improvements

The activities if components are unavailable were not clearly defined previously. The process model indicates which actions have to be taken if components are unavailable. Another improvement includes the activity to check the production order. In the past the assembly team leader will check the production order before production starts. It makes more sense to check the production order directly after it has been created, to ensure that errors are addressed quickly.

See Appendix E for the *Production Order Creation* process model.

4.3 Release Production Order Process

Objective

The objective of this process is to release and allocate the production order.

Overview

The production order is released if all the components are available. The production order prints and the hardcopy is handed to the assembly technician. The process model indicates that there is a parallel gateway. This means that the production order is handed to the assembly technician while the preparation is made for picking the required components. These two activities do not occur in sequence, but they both have to occur.

Roles Involved

- Production planner

See Appendix E for the *Release Production Order* process model.

4.4 Picking for Assembly Process

Objective

The objective of this process is to acquire the components required for the assembly from the warehouse.

Overview

The production planner completes a stock transfer request form with all the required part numbers (components) required and sends it to the outbound supervisor. The outbound supervisor hands the form to a picker. The picker picks the required part numbers, and the quality manager checks if all the part numbers are correct. The picker stages the components in the inbound assembly area, and the outbound supervisor signs to confirm that the components have been picked.

Roles Involved

- Production planner
- Outbound supervisor
- Picker
- Quality manager

Improvements

This process addresses a process related problem defined during the problem investigation. This process was not clear in the past and assembly technicians used to pick the components without following the correct procedures. There was no formal handover between the departments and there was no check process to verify that the correct goods were picked. Improvement activities include the activities that are responsible for the stock transfer request and the activities to ensure that the correct components are picked from the beginning.

See Appendix E for the *Picking for Assembly* process model.

4.5 Physical Assembly Process

Objective

The objective of this process is to complete the assembly on the production order.

Overview

The assembly technician receives a hardcopy of the production order and collects the components from the inbound assembly area. The physical assembly of the product starts. If subcontracting is required for some of the components, the *Subcontracting* process is activated. When the subcontracted components are completed and received, assembly can continue. The name plates for the assembled finished goods are attached and the team leader is notified.

Roles Involved

- Assembly team leader
- Assembly technician

Improvements

The assembly team leader used to be the communication between the assembly technician, production planner and the outbound supervisor. Improvements include that the production planner communicates with the assembly technician directly and the production order is handed to him (was previously the assembly team leader). The assembly team leader used to communicate to the warehouse personnel that components have to be picked, and he would collect the components and hand them over to the assembly technician. Now the production planner sends the stock transfer request to the outbound supervisor, and the assembly technician can collect the components in the staging area.

See Appendix E for the *Physical Assembly* process model.

4.6 Subcontracting Process

Objective

The objective of this process is to send a base plate for painting at a subcontractor.

Overview

The components that require subcontracting are staged in the outbound assembly area. The assembly team leader returns the production order to the production planner, and the production planner hands the production order over to the supply planner. The supply planner creates a purchase order and a pick slip is generated. The outbound supervisor generates a delivery note and hands the components over to the driver. The subcontracting components are delivered to the subcontractor. Time passes and the supply planner contacts the subcontractor to determine if the components are completed. The components are collected, formally checked into the system, and staged in the inbound area. The assembly team leader collects the components, returns them to the assembly technician and assembly continues.

Roles Involved

- Supply planner
- Assembly team leader
- Outbound supervisor
- Driver

Improvements

This process was previously not well defined and informal. The production planner used to generate the purchase order, the assembly team organised for delivery and followed-up to determine when the goods are completed. Responsibilities were unclear and the goods were not traced. Improvements include that the supply planner takes responsibility to generate the purchase order and follow-up from subcontractors. The outbound supervisor has to pick the goods and organise for delivery to the subcontractor. The goods are checked out of the system with a goods issue. When the goods are ready for collection the outbound supervisor organises for the collection. The goods are checked back into the system with a goods receipt. The goods are staged and the assembly team leader can collect them for the assembly technician.

See Appendix E for the *Subcontracting* process model.

4.7 Test and Quality Check Process

Objective

The objective of this process is to test the assembly to determine if it is operating correctly. If the assembly passes the test, then it will undergo a visual quality check and the assembled product will be packaged.

Overview

The assembly is tested to determine if it functions and performs properly. If it fails the test then it has to be reworked to determine and fix the error. After it passes the test, the quality manager is notified to do a visual quality check. If everything is correct the assembly is packaged and staged, ready to be picked. The assembly team leader returns the production order to the production planner.

Roles Involved

- Assembly team leader
- Assembly technician
- Quality controller
- Packaging personnel

Improvements

Improvements for this process include clear activities for staging the completed assembled product. This will reduce confusion between the warehouse personnel and the assembly team leader.

See Appendix E for the *Test and Quality Check* process model.

4.8 Check and Confirm Production Order Process

Objective

The objective of this process is to confirm the completion of the production order for the sales order to be released.

Overview

The production planner receives the production order. The completed assembly is confirmed and the internal sales representative and outbound supervisor are notified that the assembly is completed.

Roles Involved

- Production planner

Improvements

The wrong components used to be specified in the production order or the incorrect components were picked. This resulted that different components were used during assembly and the production planner had to check and adjust the stock levels if other components were used. Checking the production order for errors when it is created and ensuring that the correct components are picked, results that different components are not used during assembly and it is not required that the production order should be checked.

See Appendix E for the *Check and Confirm Production Order* process model.

4.9 Disassemble Process

Objective

The objective of the process is to disassemble work-in-progress or completed assemblies when a customer cancels his order or changes his requirements.

Overview

The process is activated when the assembly technician receives the notification to disassemble the product in response to a cancelled order. The assembly technician disassembles the product and identifies the usable and unusable components. The usable components are staged in the assembly outbound area and the unusable components are staged in the scrap area. The usable components are returned to stock. The unusable components have to be scrapped from the system and disposed of. The production planner is responsible for communicating to the inbound supervisor and stock controller regarding the disassembled components.

Roles Involved

- Assembly technician
- Production planner
- Stock controller
- Inbound supervisor
- Packer

Improvements

This process has not been defined before. The process ensures that the correct activities occur to return the usable components to stock and scrap the unusable components.

See Appendix E for the *Disassemble* process model.

4.3.5. Outbound Logistics Processes

The processes grouped under *Outbound Logistics* are concerned with outgoing goods. This includes the warehouse activities to prepare the goods for shipment and dispatching the goods. The process to return goods to the supplier is also in this level 1 process category.

5.1 Picking Process

Objective

The objective of this process is to pick the goods and ensure that the correct goods were picked.

Overview

The pick slip prints in the warehouse after the sales order has been released. The outbound supervisor assigns the pick slip to a picker. The picker either collects the assembled finished goods from the staging area for completed assemblies, or picks the finished goods from the warehouse shelves. If the picker cannot locate the goods, a second picker has to try to locate the goods. If the goods are still not found then the *Zero Pick* process is activated. After the goods have been picked, they staged in the packing area and are checked to verify that the correct goods were picked. The outbound controller returns the pick slip to the outbound administrator.

Roles Involved

- Outbound supervisor
- Picker
- Outbound controller

See Appendix F for the *Picking* process model.

5.2 Packing Process

Objective

The objective of this process is to generate the shipping documents and labels. The finished goods are packed and staged in the dispatch area.

Overview

The outbound administrator receives the pick slip and generates the delivery note, packing list and labels. The outbound supervisor is also responsible for confirming the transport mode for the order with the internal sales representative. The outbound controller packs the goods to form a single handling unit, and attaches the labels and a copy of the delivery note. The handling unit is staged in the dispatch area.

Roles Involved

- Outbound supervisor
- Outbound administrator
- Outbound controller

See Appendix F for the *Packing* process model.

5.3 Outbound Decision Process

Objective

The objective of this process is to provide guidance for selecting the next process based on the transportation mode.

Overview

There are three different possibilities for the outbound of goods. GZA's courier can collect the goods and deliver them to the customer, GZA's own driver can deliver the goods, or the customer (or the customer's courier) can collect the goods at the warehouse. The process is activated when the outbound supervisor receive a notification that the goods are ready for dispatch. The outbound administrator is notified and the relevant outbound process is activated.

Roles Involved

- Outbound supervisor

Improvement

This process guides the outbound supervisor to indicate the process required for each transportation mode.

See Appendix F for the *Outbound Decision* process model.

5.4 Outbound Grundfos Delivery Process

Objective

The objective of this process is to schedule the delivery and deliver the goods to the customer.

Overview

The outbound supervisor is responsible for scheduling the delivery. The delivery is assigned to a vehicle, the vehicle is assigned to a route and the route is assigned to a driver. The driver is notified about the delivery. The driver collects the goods from the dispatch area and delivers them to the customer. The driver ensures that the customer signs for the goods. The proof of delivery (signed delivery note) is handed over to the outbound supervisor.

Roles Involved

- Outbound supervisor
- Driver

Improvements

This process indicates the control over the goods and the documents. The activities and responsibilities of the driver are clearly defined.

See Appendix F for the *Outbound Grundfos Delivery* process model.

5.5 Outbound Grundfos Courier Process

Objective

The objective of this process is to notify the courier that the goods are ready for collection. This process describes the handover of the goods to the courier.

Overview

The outbound administrator receives the notification that the goods are ready for collection. The courier is notified and a way bill is completed. The courier arrives and the outbound controller checks the goods before the handover. The courier receives the goods and documents and signs the delivery note. The proof of delivery documents are handed over to the outbound administrator. This outbound process is also followed if a courier comes to collect goods that have to be returned to the supplier.

Roles Involved

- Outbound administrator
- Outbound controller
- Courier

Improvements

Improvements of this process include the final check activity to ensure that the correct goods are handed over to the courier. The process clearly indicates the handover points of the goods and documents.

See Appendix F for the *Outbound Grundfos Courier* process model

5.6 Outbound Collection Process

Objective

The objective of this process is to notify the customer that the goods are ready for collection. This process describes the handover of the goods to the customer. The same process is followed if the customer sends his own courier.

Overview

The outbound administrator receives the notification that the goods are ready for collection and the customer is notified. The customer arrives and the outbound controller checks the goods before the handover. The customer receives the goods and documents and signs the delivery note. The proof of delivery documents are handed over to the outbound administrator. This outbound process is also followed if a supplier comes to collect the goods that have been returned.

Roles Involved

- Outbound administrator
- Outbound controller
- Customer, supplier or courier

See Appendix F for the *Outbound Collection* process model.

5.7 Outbound Administration Process

Objective

The objective of this process is to complete a post goods issue after the goods have been dispatched. The goods are checked out of the system.

Overview

The process is activated when the outbound administrator receives the proof of delivery documents. The post goods issue is completed and the proof of deliveries are scanned and attached to the sales order. The documents are then handed over to the finance department for invoicing.

Roles Involved

- Outbound administrator

See Appendix F for the *Outbound Administration* process model.

5.8 Invoice Process

Objective

The objective of this process is to invoice the customer.

Overview

The accounts receivables controller receives the documents from the outbound administrator. The customer is invoiced and the invoice is sent to the customer. The order-to-delivery cycle ends when the customer has been invoiced.

Roles Involved

- Account receivables controller

See Appendix F for the *Invoice* process model.

5.9 Changed Order Administration

Objective

The objective of the process is to coordinate the activities in the warehouse if the customer changes his requirements for his order.

Overview

The outbound supervisor receives a notification that the customer changed his requirements. The pick slip has to be cancelled and the goods returned to stock before the internal sales representative can add or edit lines on the sales order. The problem arises when the customer still requests some of the goods on the sales order. The goods still requested should be temporarily staged, and the goods that change should be returned to stock. The internal sales representative will makes changes to the sales order and a new pick slip will print. The new goods should be picked from the warehouse and consolidated with the goods that have been temporarily staged. If all the goods have been picked then the pick slip is returned to the outbound administrator. The *Packing* process is activated and the outbound process continues as normal.

Roles Involved

- Outbound supervisor
- Picker
- Outbound controller

Improvements

This process addresses the frequent process failure caused when customers change their orders. Internal sales representatives will make the changes to the sales order without communicating the change to the warehouse. This resulted in duplicated picks, because new pick slips printed and they were handled as new orders. This process clearly states the activities in the warehouse if this situation occurs.

See Appendix F for the *Changed Order Administration* process model.

5.10 Zero Pick Administration Process

Objective

The objective of the process is to facilitate the activities if a zero pick occurs. This includes investigation of the missing goods and adjusting the stock if the goods cannot be found.

Overview

This process is activated if two pickers cannot locate the goods. The internal sales representative or production planner is notified of the zero pick. The stock controller receives the pick slip and he conducts an investigation to locate the goods. If the goods are found within 24 hours, the *Zero Pick Goods Found* process is activated. A stock adjustment proposal is completed to acquire authorisation to adjust the stock. The stock is adjusted and the *Zero Pick Response* process is activated.

Roles Involved

- Picker
- Outbound supervisor
- Stock controller

Improvements

This process addresses a frequent process failure identified during the problem investigation. The zero pick process was not defined previously. Investigations were not properly conducted and zero picks were not communicated back to internal sales representatives. The process model ensures that zero picks are communicated upstream and that authorisation is received before stock adjustments are executed.

See Appendix F for the *Zero Pick Administration* process model.

5.11 Zero Pick Goods Found Process

Objective

The objective of this process is to facilitate the activities if the goods have been found.

Overview

This process is activated if the goods were found. If finished goods were found the internal sales representative is notified and the *Picking* process continues. The normal outbound activities follow. If components were found the production planner is notified, the goods are staged in the inbound assembly area and the *Pick for Assembly* process continues.

Roles Involved

- Stock controller

See Appendix F for the *Zero Pick Goods Found* process model.

5.12 Zero Pick Response Process

Objective

The objective of this process is to respond if goods cannot be found. These goods have to be purchased to meet the customer's requirements.

Overview

This process is activated if the goods were not found and after the stock adjustment has been made. The internal sales representative or production planner is notified of the zero pick. The delay should be communicated to the customer and a purchase requisition is sent to the supply planner.

Roles Involved

- Stock controller
- Internal sales representative
- Production planner

Improvements

This process facilitates the communication back to the customer and ensures that the zero pick goods are replaced.

See Appendix F for the *Zero Pick Response* process model.

5.13 Supplier Return Preparation Process

Objective

The objective of this process is to complete the preparation activities for goods that have to be returned to the supplier.

Overview

This process is activated when the decision has been made to return the goods. Goods first have to be checked into the system (goods receipt) before they can be returned. Low quality or damaged goods can be checked in directly. If the goods are unwanted or in excess, the supply planner has to create a purchase order to "buy" the goods first and then they can be checked in. The admin controller receives the documents and completes the goods receipt task.

Roles Involved

- Supply planner
- Inbound supervisor
- Admin controller

Improvements

This process addresses a frequent process failure identified during the problem identification/investigation. The processes to handle supplier returns have not been define in the past. Supplier returns are not prioritised and no one takes responsibility to return the goods. The process model indicates responsibilities and the activities that have to happen before the goods can be returned.

See Appendix F for the *Supplier Return Preparation* process model.

5.14 Supplier Return Execution Process

Objective

The objective of this process is to return incorrect goods to suppliers.

Overview

This process is activated after the goods to be returned have been checked into the system. The outbound supervisor has to create a return purchase order and a credit note is received in response. The packing list, delivery note and shipping labels are created while the picker collects the goods from the returns area. The picker packs the goods and stages them in the dispatch area. The process model indicates the processes that are responsible for the physical outbound of the goods. The *Outbound Grundfos Courier* process is activated if the courier used by Grundfos will deliver the goods to the supplier. The *Outbound Collection* process is activated if the supplier comes to collect the goods. The goods are considered to be returned if the *Outbound Administration* process is completed.

Roles Involved

- Supply planner
- Outbound supervisor
- Picker

Improvements

This process also addresses the frequent process failure of supplier returns. This process will guide employees to handle and address supplier returns. The process includes communication activities and it shows the key processes that will follow on this process.

See Appendix F for the *Supplier Return Execution* process model.

4.4. Process Improvements

The process models designed and discussed will provide the baseline for improvements in the order-to-delivery cycle. The process models were used to document the processes and indicate responsibilities across the order-to-delivery cycle. The integration and handover points between processes and role players are highlighted throughout the process models. The process models provide the steps towards improvement and certain improvements were included in the process models. These improvements are:

- Different staging areas
- Effective communication upstream and downstream in the order-to-delivery cycle
- Addressing the frequent process failures and other process related problems

These improvements will be discussed briefly.

4.4.1. Staging Areas

GZA recently relocated to a new building with a large warehouse. There are clear staging areas in the warehouse, but they are not for specific purposes. The areas are mainly used for inbound and outbound staging of goods. Throughout the process models, the following staging areas were suggested to improve the flow and organisation in the warehouse:

- Packing area: Goods that have been picked are staged in the packing area before the orders are consolidated. The outbound controller checks whether the correct goods have been picked, packs and labels the goods in this area.
- Dispatch area: Goods are staged in the dispatch area if they are ready to be shipped.
- Inbound area: Inbound shipments are unloaded and the goods are placed in the inbound area. The goods are also checked and verified to determine if the correct goods have arrived.
- Cross dock area: Goods that arrived and have been checked are staged in the cross dock area if they are required for a sales order. This will ensure quick lead times to pick these goods when the sales order has been released.
- Returns area: Goods that have to be returned are staged in this area.
- Assembly inbound area: All components that are required for a production order are staged in this area. This is where components are staged after they have been picked for a production order.
- Assembly outbound area: This is where completed assembled goods are staged when they are ready to be shipped.
- Packaging area: This is where goods are staged that need to be packaged or goods that have been packaged.

There are enough staging areas to classify each for a specific purpose. These staging areas will ensure that goods are quickly located and it will improve response times throughout the order-to-delivery cycle. GZA has to acquire the correct signage to improve visibility and navigation in the warehouse.

4.4.2. Effective Communication

Communication between employees and departments was a big problem in the order-to-delivery cycle. If customers change their requirements or cancel their orders, it was not communicated downstream. If orders were delayed, it was not communicated upstream back to the internal sales representative and also the customer. This has a negative effect on customer service.

Throughout the process models, if a delay is realised, it has to be communicated back to the internal sales representative. If problems or errors occur in the order-to-delivery cycle, communication activities were specified to ensure that the right people are notified. If employees communicate with each other clearly, it will also improve response times if these errors occur.

4.4.3. Solutions to the Process Problems

The JAD session conducted in the problem investigation highlighted the problems that occur repeatedly in the order-to-delivery cycle. These problems where coined as frequent process failures and all the counteract processes (red level 2 processes) were defined to address these issues. The process models will guide employees with their decision making and the correct actions to take are highlighted throughout the process models.

The process models alone will not improve the performance of the order-to-delivery cycle. The new processes have to be implemented to ensure that employees follow the processes. The processes have to be managed effectively to identify and address problems quickly. This will be achieved through process measurement. All these aspects will lead to improvement of the order-to-delivery cycle.

5. Performance Measurement

Measuring performance is important to manage an organisation effectively (Parsons, 2011). If performance measurement is properly implemented it will provide managers with timely and accurate data. The results of the measures will improve the manager's understanding of a certain situation, which can then lead to improved outcomes due to more informed decision making (Parsons, 2011).

GZA has no performance measures in place. Processes cannot be managed effectively and employees do not have targets to aim for. Defining performance measures for GZA will enable managers to regulate the newly designed processes and determine over a period of time whether gradual improvement is achieved.

Two types of measures were identified for the project, namely metrics and key performance indicators (KPIs). Metrics quantify performance and they usually measure the output of an activity or process (Becher, 2006). KPIs are also metrics, but they help organisations to measure their progress towards achieving an organisational goal. KPIs are outcome-orientated, target-based, quantifiable and easy to understand. For this project, the metrics will measure the key processes

The order-to-delivery cycle consists of many processes that have to be managed and monitored, but it is important to measure the performance of the whole cycle as well. Metrics will measure the key processes and monitor the counteract processes defined in the previous section. The concept of the Balanced Scorecard will be used to develop KPIs for the order-to-delivery cycle, which will measure the performance of the cycle across its different dimensions. Porter's value chain activities used as level 1 process categories in the process design will also be used to define the different dimensions. The performance of the order-to-delivery cycle can be measured across the following four dimensions:

- Sales
- Procurement
- Operations
- Logistics (Inbound and Outbound)

To simplify, the metrics will measure the level 2 processes, whereas the KPIs will measure the level 1 processes. The metrics and KPIs developed for the order-to-delivery cycle will be discussed and explained further.

5.1. Order-to-Delivery Cycle Metrics

Metrics are used to measure the output of a process. It is important for the management of GZA to know the output and performance of the important key processes and to be informed on the occurrences of the frequent process failures. The counteract processes have to be monitored to notify management if action is required to reduce these occurrences.

The metrics and monitors for the order-to-delivery cycle are defined for control and performance purposes. Metrics were not developed for all the processes defined in the design of the order-to-delivery cycle. Some of the processes contribute and influence the performance of a dimension in the order-to-delivery cycle. The metrics for these processes are KPIs and they will be discussed in the next section. The level 2 processes to be measured with metrics were identified with their relevant metrics. Table 17 to Table 21 indicate the metrics for selected level 2 processes for each level 1 process category.

The users of the results of these metrics will generally be the managers in the relevant departments. These metrics will indicate to the manager what the performance and output of the processes are, and the monitors for the counteract processes will indicate if actions are required to reduce these frequent process failures.

The metrics for the *Sales and Marketing* and *Procurement* processes focus on monitoring the counteract processes that address the frequent process failures. It is important to know how many times these issues occur. Measures like sales figures and supplier performance are considered to be KPIs.

Table 17 to Table 21 indicate the metrics for the relevant processes. Each metric is defined by an identification number and a definition. The source of the data to calculate the metric is specified. If the business system is the data source, the data is already available for calculations. If the data is not available on the business system, the data has to be manually collected. The manager of the relevant process should specify the data collection method and analyse the data to derive the metric. Each performance indicator needs a target to provide a context for the performance levels (Marr, 2010). Table 17 to Table 21 also indicate that a target has to be specified for each metric. It is the responsibility of the manager of the relevant process to define a proper target for the metric.

Table 17: Metrics for Sales and Marketing processes

Process		Metric		Definition	Source	Target
Sales and Marketing						
1.4	Credit Release	M 1.1	% Credit releases of total sales orders	The objective is to measure the percentage of sales orders that cannot be released due to blocked accounts. This causes a delay in the order-to-delivery cycle.	Business system	To be determined (TBD)
1.8	Cancelled Order Classification	M 1.2	Number of cancelled orders	The objective is to measure the number of sales orders cancelled by customers. Cancelled orders cause unnecessary reverse logistics and have cost implications.	Business system	TBD
1.13	Changed Customer Requirements	M 1.3	Number of orders with changed requirements	The objective is to measure the number of sales orders where customers changed their requirements.	Business system	TBD

Table 18: Metrics for Procurement processes

Process		Metric		Definition	Source	Target
Procurement						
2.4	Incorrect Inbound Shipment Administration	M 2.1	Number of customer complaints (CCS cases) loaded	The objective is to measure the number of customer complaints lodged against suppliers for incorrect shipments. This gives an indication of supplier performance.	Business system	TBD

The business system of GZA does not support warehouse and production management. Currently, GZA does not have a warehouse management system. The system will only be installed at the end of 2014. The current business system does not store data regarding warehouse and local assembly activities. Measuring the Operations, Inbound and Outbound Logistics processes will be difficult due to the lack of data. The data for the metrics have to be manually gathered and obtained during day-to-day activities. This is not ideal, but without proper data the performance and output of these processes cannot be determined.

Table 19: Metrics for Inbound Logistics processes

Process		Metric		Definition	Source	Target
Inbound Logistics						
3.1	Inbound Shipment Arrival	M 3.1	% Orders received with correct shipping documents	The objective is to measure the percentage of inbound shipments that arrive with the incorrect documents.	Manual data collection	TBD
3.3	Inbound Shipment Pack Away	M 3.2	% Products transferred without errors	The objective is to measure the percentage of inbound goods that are packed away in the correct bin location. This indicates the effectiveness of the packers.	Manual data collection	TBD
3.5	Customer Returns	M 3.3	% Customer credit returns	The objective is to measure the percentage of customer credit returns from total sales. It is important to determine and evaluate the reasons of the return.	Business system	TBD
3.6	Misplaced Inbound Shipment	M 3.4	Number of misplaced shipment occurrences	The objective is to measure the number of times when inbound shipments are not checked into the system or located in the warehouse. This indicates the effectiveness of the inbound team.	Manual data collection	TBD

Table 20: Metrics for Operations processes

Process	Metric	Definition	Source	Target
Operations				
4.2 Production Order Creation	M 4.1 % Production orders delayed due to unavailable goods	The objective is to measure the percentage of production orders that have a delayed start date due to unavailable stock. This will indicate whether inventory levels are correct.	Business system	TBD
4.4 Picking for Assembly	M 4.2 Picking for assembly cycle time	The objective is to measure the cycle time from the point when the production order is released and the stock transfer request sent to the warehouse to the moment when the components are collected from the staging area to start production.	Manual data collection	TBD
4.5 Physical Assembly	M 4.3 Average produce and test cycle time per product type	The objective is to measure the average time from the point when production starts to the moment when the completion of the production order is confirmed on the system.	Manual data collection	TBD
4.7 Test and Quality Check	M 4.4 % First time failures	The objective is to measure the percentage of assembled goods that do not pass the test the first time. This will indicate the accuracy and skill of assembly technicians.	Manual data collection	TBD
4.9 Disassemble	M 4.5 Number of assembled goods disassembled	This objective is to measure the number of times when completed or WIP assembled goods have to be disassembled due to cancelled orders or changed requirements.	Manual data collection	TBD

Table 21: Metrics for Outbound Logistics processes

Process		Metric		Definition	Source	Target
Outbound Logistics						
5.1	Picking	M 5.1	% Incorrect picks	The objective is to measure the percentage of goods incorrectly picked from the warehouse.	Manual data collection	TBD
		M 5.2	Average picking and packing cycle time	The objective is to measure the cycle time from the point when the pick slip has been released to the moment when the delivery note is generated to determine the average cycle time.	Business system	TBD
5.4	Outbound Grundfos Delivery	M 5.3	Delivery performance to customer commit date	The objective is to measure the percentage of orders that are fulfilled on the customer's originally committed date.	Business system	TBD
5.5	Outbound Grundfos Courier	M 5.4	% Orders delivered in full	The objective is to measure the percentage of orders which are considered to be complete. An order is considered to be delivered "in full" if the correct items are delivered in the correct quantities.	Manual data collection	TBD
5.6	Outbound Collection					
5.10	Zero Pick Administration	M 5.5	% Zero picks of total pick slips	The objective is to measure the percentage of pick slips that were considered as zero picks.	Manual data collection	TBD
		M 5.6	% Stock adjusted	The objective is to measure the percentage of the value of the stock adjusted due to zero picks, to the total value of stock.	Business system	TBD
5.13	Supplier Return Preparation	M 5.7	% Returns of purchase orders	The objective is to measure the percentage of returns made to suppliers of the total number of purchase orders.	Manual data collection	TBD
		M 5.8	% Non-Group returns	The objective is to measure the percentage of returns made to non-Group suppliers of the total number of returns.	Manual data collection	TBD
		M 5.9	% Group returns	The objective is to measure the percentage of returns made to Group suppliers of the total number of returns.	Manual data collection	TBD

The metrics defined above will provide a baseline for process performance measurement. It is the responsibility of the managers to review the validity of these metrics on a regular basis and set new targets to encourage process improvement.

5.2. Order-to-Delivery Cycle Key Performance Indicators

Key Performance Indicators (KPIs) focus on the aspects of total business performance that are crucial for current and future success. KPIs link with the organisation's strategy and are used to monitor the progress towards achieving the defined strategic goals (Parmenter, 2010). The KPIs for the order-to-delivery cycle will focus on the performance of the order-to-delivery cycle. The KPIs have to link with a strategy for the order-to-delivery cycle.

GZA's end goal is to improve their customer service, by improving the order-to-delivery cycle. A suggested strategy for the order-to-delivery cycle is "perfect order fulfilment". This will ensure that all employees across the order-to-delivery cycle focus on achieving a perfect order. A perfect order is considered to be delivered on time, consisting of the correct goods, the correct quantity of goods and the goods have to be in perfect condition. All the dimensions in the order-to-delivery cycle (sales, procurement, operations and logistics) contribute towards achieving a perfect order.

The concept of the Balanced Scorecard was used to develop KPIs for the order-to-delivery cycle, which will measure the performance of the cycle across its different dimensions. Goals were defined for each dimension which link with the strategy of the order-to-delivery cycle. The goals guided the development of the KPIs to ensure that the KPIs reflect how well each dimension is achieving and working towards the strategy. Figure 36 displays a Balanced Scorecard outline of the four dimensions to be measured.

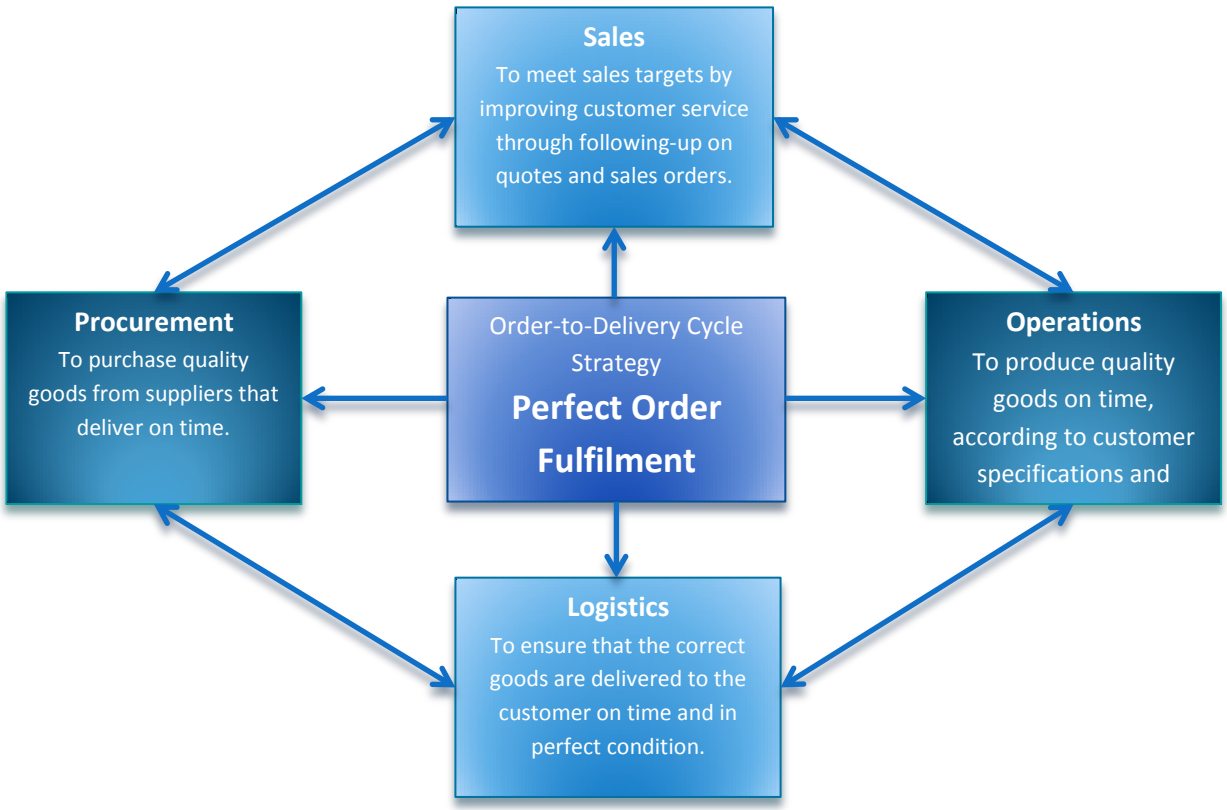


Figure 36: Dimensions of performance for the order-to-delivery cycle

The KPIs for the order-to-delivery cycle are listed in Table 22. The KPIs were developed to measure whether a dimension is performing and contributing towards achieving the strategy for the order-to-delivery cycle. The KPIs for *Sales* determine whether the sales target was achieved over a given period. It is also important to measure the number of quotations against the number of sales orders. This gives an indication of the effectiveness of the sales staff to bring in more sales. The KPIs for *Procurement* focus on supplier performance. Suppliers are measured in terms of on-time deliveries and incorrect shipments. This will provide a baseline for supplier management, to determine which suppliers contribute towards the strategy of the order-to-delivery cycle. The KPIs for *Operations* focus on completing production orders on time and ensuring that the assembled goods pass the test the first time. The percentage of first time failures gives an indication of the effectiveness of assembly technicians. If assembled goods fail the test, they have to be disassembled to fix the errors. This results in delayed completion dates and delayed delivery dates. The KPIs for *Logistics* focus on determining the percentage of orders that are delivered in full and on time. This KPI relates directly to the strategy of the order-to-delivery cycle. It is important to have measures that indicate the effectiveness of the inbound and outbound teams. The KPI that measures the percentage of pick slips that are completed within 12 hours gives an indication of how quickly the outbound team can respond to a pick slip. The KPI that measures the average dock-to-stock cycle time indicates how effective the inbound team is and how quickly inbound shipments are booked into stock.

Each KPI is linked to the goal for the specific dimension (see Table 22). A description is given of each KPI, and the source of data to calculate the KPI is also specified. Table 22 indicates that a target is also required for each KPI. The top management of GZA has to define and agree on realistic targets for each KPI.

The KPIs are developed to measure the performance of the order-to-delivery cycle. This will help the management team of GZA to track the performance of the cycle and make the necessary decisions to improve the cycle further.

5.3. Performance Measurement Conclusion

Process performance measurement is important to determine whether processes are performing, to manage the processes and identify opportunities for improvement. There were no defined performance measurements in the processes of the order-to-delivery cycle before this project was initiated. Metrics were developed to measure the level 2 processes in the order-to-delivery cycle, and KPIs were developed to measure the performance of the whole order-to-delivery cycle.

Performance measurement is important for this project, because the metrics and KPIs will be used to evaluate the new processes after they have been implemented. The KPIs will indicate if the new processes lead to improvement of the order-to-delivery cycle. The processes and the KPIs will be reviewed and improved to ensure continuous improvement.

Table 22: KPIs for the order-to-delivery cycle

Goal	KPI	Description	Source	Target
Sales				
To meet sales targets by improving customer service through follow-ups on quotes and sales orders.	Sales per segment	The objective is to measure the sales per market segment.	Business system	TBD
	Quotations to sales orders ratio	The objective is to measure the amount of quotations to the amount of quotations converted to sales orders.	Business system	TBD
Procurement				
To purchase quality goods from suppliers that deliver on time.	Vendor delivery performance	The objective is to measure the on-time delivery performance of suppliers. It measures the shipments that arrive on time as a percentage of total inbound shipments.	Business system	TBD
	% Incorrect shipments	The objective is to measure whether shipments are incorrect. Incorrect shipments are expressed as a percentage of the total inbound shipments. A shipment is considered to be incorrect if the quantity goods are incorrect, if the goods are damaged, of a low quality or if the goods were not requested.	Manual data collection	TBD
Operations				
To produce quality goods on time according to customer specifications and requirements.	% Production orders completed on time	The objective is to measure the on-time completion of production orders. The on-time completions are expressed as a percentage of the total number of completed assembled goods.	Business system	TBD
	% First time failures	The objective is to determine the accuracy and effectiveness of the assembly process. All assembled goods have to be tested. The first time failures are expressed as a percentage of the total assembled goods tested.	Manual data collection	TBD
Logistics				
To ensure that the correct goods at the requested quantity are delivered to the customer on time and in perfect condition.	% Orders delivered in full and on time	The objective is to determine how many orders are delivered in full. An order is considered to be "in full" if the correct quantity and correct goods were delivered on time and in a perfect condition.	Manual data collection	TBD
	% Pick slips completed within 12 hours of release	The objective is to determine the percentage of pick slips that are completed within 12 hours. This means that the time since the pick slip was released to the time when the goods are ready have to be within 12 hours.	Manual data collection	TBD
	Average dock-to-stock cycle time	The objective is to measure the effectiveness of the inbound team by measuring the cycle time from unloading the shipment to transferring the goods to their bin locations.	Manual data collection	TBD

6. Implementation

Implementation is the actions or execution of a plan to achieve a goal or specific result (Dictionary.com, 2013). The success for any project is greatly determined by the success of the implementation of the suggested solution.

The real improvement in the order-to-delivery cycle of GZA will only be realised and achieved after the use of process documentation has been institusionalised in the culture and day-to-day activities of GZA's employees. GZA's business processes currently have a *initial* (level 1) maturity level. The processes are ad hoc and undefined. The process documentation will serve as a baseline to ensure that processes in the order-to-delivery cycle are defined and improve the maturity level of the processes to *repeatable* (level 2). This can only be achieved if employees follow the activities and processes defined in the process models.

Change management plays a key role in this project. The employees of GZA are used to doing their work and conducting their day-to-day activities without adhering to defined processes. Most employees will be reluctant to change, because they do not understand the importance or benefits of defined processes. It is important to include activities in the implementation strategy that will address change management. The steps of Kotter's change model will be incorporated into the strategy.

The implementation phase of a project has a significant impact on the overall success of a project. The implementation activities have to be carefully planned, and the best implementation approach has to be selected. The implementation approach is a method to change from the existing state to the desired state. The activities for implementation and the selected approach is addressed in the implementation plan.

An implementation plan guides the project team during the actual implementation of the solution. The implementation plan is a formal document used for communication between the project team and the stakeholders (CIU: Australian Government, 2012). It translates the design of the solution to the activities, costs and schedules necessary to achieve the objectives of the project (WebFinance Inc., 2013). An implementation plan has no definite format, but it should include and discuss the following:

- Background and description of the project
- The desired outcomes and vision
- The implementation team and responsibilities
- The actions required for implementation
- A schedule with timelines
- Performance and progress monitoring

It is beyond the scope of this project to define a formal implementation plan for GZA. An informal implementation strategy was developed to discuss the key aspects required for an implementation plan. The implementation strategy also addresses change management on a high level. The strategy will guide GZA through the implementation phase.

6.1. Implementation Approaches

There are different appraoches to implement a new system or solution. The approach used during the implementation phase of a project will depend on the type, size, complexity and nature of the project, system or solution (John, 2012). Table 23 briefly discusses the most common implementation approaches in terms of a system implementation.

Table 23: Implementation approaches

Approach	Description
Direct changeover	With this implementation approach users stop using the old system and start using the new system from a given date (John, 2012).
Parallel run	This implementation approach introduces the new system alongside the existing system. Both systems will be in operation at the same time (John, 2012).
Phased	The implementation will happen in several phases. The new system is closer to being fully implemented after each phase (John, 2012).
Pilot	A pilot implementation is used in large organisations where the system is introduced to a department or location. The problems are identified during the pilot run and solved before the full implementation (John, 2012).

The best implementation approach for this project will be a combination of a pilot implementation and a direct changeover. A pilot implementation will indicate the errors in the processes before full implementation is conducted. After the errors have been addressed, the direct changeover will commence from a certain date. A parallel or phased implementation will cause confusion between employees and departments. A direct change implementation approach is the best for this project, because it will ensure that all employees use the same processes from a given date and it will reduce confusion.

6.2. Implementation Strategy

The implementation strategy briefly discusses the vision of the project, a possible structure of the implementation team, suggested activities and a implementation schedule. This strategy contains suggestions for the implementation phase of the project.

6.2.1. Vision and Project Outcomes

The vision of the project is to create an efficient order-to-delivery cycle to improve customer satisfaction. This includes standardisation and improvement of the order-to-delivery cycle through the implementation of process documentation. The project aims to achieve the following outcomes:

- Reduce errors and daily problems with orders
- Enhance customer service and satisfaction
- Efficient processes
- Improved communication throughout the order-to-delivery cycle

6.2.2. Implementation Team

The implementation team will govern the detail planning and management of the implementation phase. This ensures that the correct management structures, roles and responsibilities are established and sustained during implementation.

The implementation team will consist of a project owner and project manager, who are both responsible for overseeing and managing the implementation process. There will be five project leaders to each represent one of the level 1 processes identified in the design of the order-to-delivery cycle. The project leaders will be responsible for the management and physical implementation of the processes in their area. There will be a process manager to make necessary changes and improvements to the process documents. There will be five additional team members from different departments who will assist the project leader from his department with the physical implementation. Table 24 indicates the role, responsibility and job title associated with each member in the implementation team.

Table 24: Implementation team roles and responsibilities

Project Role	Job Title	Project Responsibility
Project Owner	Operations Director	The owner is responsible for facilitating and overseeing the implementation process.
Project Manager	Logistics Manager	The project manager oversees the implementation and ensures that activities are completed according to the schedule.
Process Manager	Quality Coordinator	The process manager is responsible for adjusting the process models if any errors or improvements are identified.
Leader: Sales and Marketing	Sales Segment Manager	Each leader is responsible for managing the implementation in his department. He ensures that the employees in the department are using and following the process documentation.
Leader: Procurement	Head Supply Planner	
Leader: Inbound Logistics	Inbound Supervisor	
Leader: Operations	Production Manager	
Leader: Outbound Logistics	Outbound Supervisor	
Member: Sales and Marketing	Internal Sales Representative	A member has to assist the leader from their department with the implementation process. He will guide other employees and initiate the change.
Member: Procurement	Supply Planner	
Member: Inbound Logistics	Quality Controller	
Member: Operations	Assembly Team Leader	
Member: Outbound Logistics	Outbound Controller	

6.2.3. Implementation Actions

The implementation actions are the high-level phases for implementation and they consist of the activities required to implement the new processes. The implementation team has to review the activities and provide more detail regarding the specific tasks and responsibilities. These activities are only suggested and explained on a high-level basis. The steps of Kotter's change model are included and merged with the activities to ensure that the change management issues are also addressed. Table 25 discusses and explains the suggested activities to implement the new processes.

Table 25: Implementation activities

Action 1: Implementation Kick-off
Activity 1: Kick-off Meeting
The meeting to be presented by the project management to communicate the project to the relevant stakeholders. The meeting should establish a sense of urgency for the need to change.
Activity 2: Implementation Team Creation
The implementation team will be formally established and communicated to the whole organisation. The team members will be responsible for the actual implementation and they will also drive other employees to change.
Activity 3: Process Model Finalisation
The process models are communicated and explained to the team members. The project team can make final changes to the documentation before the models are approved by management.
Activity 4: Process Model Approval
The process models will be communicated to the top management. The management team should give approval of the new processes to be implemented.
Activity 5: Formal Process Documentation
The process models will form part of the final documents, but each model requires a process narrative to provide more detail regarding the process.
Action 2: Implementation Preparation
Activity 6: Vision Development and Communication
A strong vision should be created to lead the whole organisation in a direction. The vision should be communicated to everyone through various streams of communication. The implementation team should talk about the vision often to receive buy-in from other employees.
Activity 7: Identify and Remove Barriers
The project team should identify the possible barriers that will affect the success of the implementation. There should also be plans for addressing and removing the barriers.
Activity 8: Generate Achievable Short-term Goals
The implementation team should identify as least two short-term goals that are easy to achieve and where employees can see the real results of their efforts. This will motivate employees to change to achieve improvement.
Activity 9: Training Preparation and Planning
The implementation team should identify the best methods for training employees. This can be through demonstrations and shop floor training. A training schedule should be set up to ensure that all employees performing the processes have received training. Training will also include explaining to employees how to use the process documentation.

Action 3: Actual Implementation
Activity 10: Pilot Process
This activity includes running a pilot run of the processes to ensure that they are working correctly and that all activities in the processes make sense. It is suggested that the pilot run should be completed with few employees in each department. Errors and adjustments should be made to the processes.
Activity 11: Training
This activity relates to the physical training of employees. The training plans are executed in this activity. It is suggested that a day per department should be used for training.
Activity 12: Roll-out
All the new processes will be introduced at the same time. There will be a direct changeover from the previous processes to the new processes. A week should be set out to assist and provide guidance to employees during the change.
Activity 13: Review and Build on Change
A review is conducted to ensure that employees are following and using the process documentation. The project leaders should build and drive the change in their department.
Action 4: Implementation Close-out
Activity 14: Anchor the Change in the Corporate Culture
The project manager and leaders should ensure that the use of process documentation and process management become part of the company culture. This activity will occur continuously for a few months after the roll-out phase to ensure organisational wide change.
Activity 15: Measure Processes and Review
The processes are measured with the measures and KPIs defined to review the performance of the order-to-delivery cycle. The measures and KPIs are also reviewed to determine if the correct aspects are measured. This activity will generally occur three to four months after the roll-out phase and will continue to occur to ensure that the processes are monitored and reviewed on a regular basis.
Activity 16: Process Adjustment
Adjustments are made to the process documentation to improve the processes. The changes are communicated to the whole organisation and the changes are implemented. This activity will occur after each process review to ensure that the processes are continuously improved.

These implementation actions and activities will help the team and guide them through the implementation phase. These activities are high-level and it will be the responsibility of the project manager to define more detailed tasks for each activity.

6.2.4. Implementation Schedule

The implementation schedule indicates the sequence of the activities and the estimated duration of the activities. The management team of GZA decided that the implementation phase will kick off in November 2013. The duration of the implementation phase is estimated to be six weeks. The implementation schedule does not include the activities 14 to 16, as these activities are part of continuous improvement and they occur three to four months after the implementation roll-out activity. Activities 1 to 13 are the core activities required to implement the processes. Most of the activities are in series because they are dependent on one another. Figure 37 indicates the sequence and estimated duration of the activities.

ID	Task Name	Start	Finish	Duration
1	Implementation Team Creation	04-Nov-2013	04-Nov-2013	1d
2	Kick-off Meeting	05-Nov-2013	05-Nov-2013	1d
3	Process Model Finalisation	06-Nov-2013	07-Nov-2013	2d
4	Process Model Approval	08-Nov-2013	11-Nov-2013	2d
5	Formal Process Documentation	12-Nov-2013	18-Nov-2013	5d
6	Vision Development and Communication	19-Nov-2013	20-Nov-2013	1d
7	Identify and Remove Barriers	19-Nov-2013	21-Nov-2013	2d
8	Generate Achievable Short-term Goals	20-Nov-2013	21-Nov-2013	1d
9	Training Preparation and Planning	21-Nov-2013	26-Nov-2013	3d
10	Pilot Process	26-Nov-2013	29-Nov-2013	3d
11	Training	29-Nov-2013	06-Dec-2013	5d
12	Roll-out	06-Dec-2013	13-Dec-2013	5d
13	Review and Build on Change	13-Dec-2013	20-Dec-2013	5d

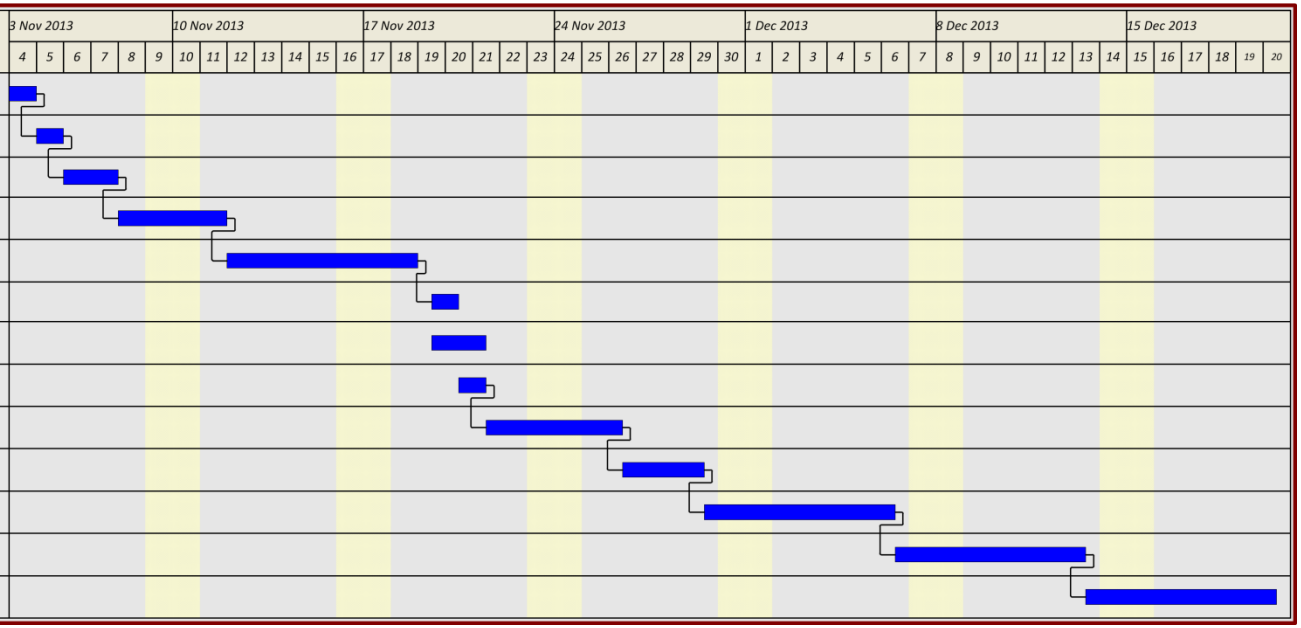


Figure 37: Implementation schedule for new processes

6.3. Implementation Conclusion

The implementation phase of any project determines the success or failure of the project. Careful planning of this phase is required. All activities, costs, schedules and risks are recorded in the implementation plan. It is the responsibility of GZA's implementation team to derive the implementation strategy into a formal implementation plan.

Implementation means that change is required, and most employees are reluctant to change. Employees need motivation to change and negative attitudes can have a great impact on the success of the implementation phase and overall project. Change management should be included during this phase to ensure that employees are willing to change and that they do not relapse to the previous inefficient state.

Improvement in the performance and operation of the order-to-delivery cycle will only be realised after the new processes have been implemented. This requires that employees follow the processes defined in the process models. This involves training and clear management to ensure that the processes are followed.

7. Process Design Evaluation

Evaluating and determining if the new process design performs better than the previous process, is necessary to measure and evaluate the new process. There are various methods to assess the new process. A general approach would be to first measure the current process with the developed KPIs, then implement the new process. After the new process is fully implemented, the performance should be measured again, and the results compared to determine if there is improvement in the process's performance.

The evaluation of the new design and process models of the order-to-delivery cycle requires a different approach. It is commonly accepted that the current processes followed are not standardised or documented. According to the CMMI process maturity model, depicted in Figure 9, the processes of GZA have a level 1 maturity (*initial*). Their processes are ad hoc and undefined. Grundfos management decided that it will not be effective to measure the AS-IS performance of the processes in quantifiable terms. The decision was made to implement the new processes developed, and first achieve a level 2 maturity (*repeatable*). The performance of the new processes will then be measured at regular intervals. This follows the DMAIC cycle proposed for the project and depicted in Figure 11 to ensure continuous improvement.

Due to the size and complexity of the order-to-delivery cycle, the scope of this project did not include the implementation. The new design and process models can thus not be evaluated by measuring the physical performance of the new processes. With this in mind the following two evaluation phases were followed:

The first phase evaluated the process models according to accuracy, detail, and readability. The method of evaluation was validation. The process models were constructed after interviews with employees, but these initial process models included activities that were incomplete and redundant. Managers checked the processes to ensure that they agree with the processes or to suggest alternative activities and solutions. Modifications were made to the processes according to each manager's specifications. The final process models were validated by the managers and employees to ensure that they are accurate, and that the manager agrees with the final process. Constructing the process models were an iterative process to ensure that the models are correct and that there are no logical gaps in the processes. Figure 38 indicates the validation process followed to ensure that the process models are realistic and correct. All the process models have been approved by the relevant manager and the operations director.

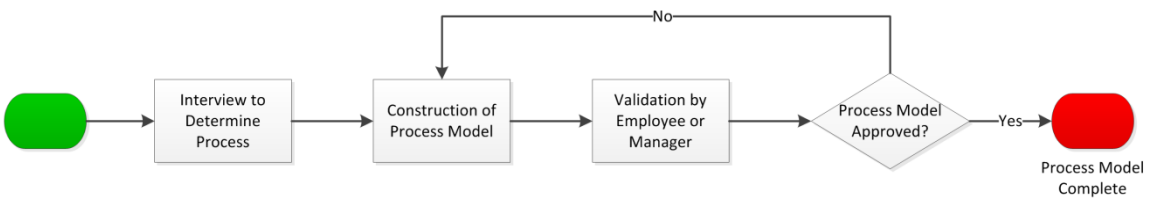


Figure 38: Validation process applied to validate process models

The second phase evaluates the new processes by measuring their performance after they have been implemented. This will indicate if there is an overall improvement in the order-to-delivery cycle. There will be two approaches to the second phase of evaluation. The first will be to evaluate the processes against the CMMI maturity model to ensure that maturity level 2 (*repeatable*) is reached. The second is to use the metrics and KPIs developed for the processes to assist with this activity. The metrics will measure the performance of the second level processes and the KPIs will measure the performance of the order-to-delivery cycle. The processes and metrics have to be reviewed every three to four months to identify opportunities for improvement in the processes. The process models have to be adjusted accordingly. This will ensure continuous improvement of the order-to-delivery cycle and the ability to grow the maturity of these processes.

It was beyond the scope of this project to implement the new processes, thus it was not possible to implement the second phase of evaluation. This activity will occur after the processes have been implemented by GZA.

After the *Problem Statement* in Section 1.2, it became clear that GZA has a need for proper process documentation that meets the following requirements:

- Employees at all organisational levels have to be able to understand the process documentation.
- The process documentation must guide employees through their day-to-day activities, to ensure consistency in the process execution.
- Managers have to be able to use the process documentation to control the processes and monitor their employees.
- The process documentation must address the problems in the order-to-delivery cycle by suggesting improvements for the processes.
- The process documentation should be accompanied with the relevant performance measures to assist GZA's management with managing the processes and identifying opportunities for improvement.

Throughout the first phase of evaluation, managers and employees from the relevant departments were consulted regularly to ensure that the process models meet their specific requirements. All the process models have been validated and approved by the operations director and the relevant managers. The management of GZA verified that the process models addressed the agreed upon process-related problems and frequent process failures. The defined KPIs and metrics were also evaluated and approved by management. It can be concluded that the project satisfied GZA's initial need and that all their requirements have been addressed.

8. Conclusion

GZA experience inefficiencies in the business activities that influence the order-to-delivery cycle. This is because the processes are out-dated, not documented properly and there is no indication of process management. These errors have a significant impact on customer service.

This project aimed to construct process documentation of the order-to-delivery cycle to provide the baseline for GZA to improve the order-to-delivery cycle.

The employees of GZA experience inefficiencies and problems in the processes. These problems are addressed by improving the design of the processes to eliminate these problems or manage them if they occur (the frequent process failures).

Research indicated the importance of first determining the maturity level of an organisation's processes and then deciding on the improvement objectives of the project. GZA's processes are ad hoc and undefined, thus their processes have a level 1 maturity. A realistic objective was to assist GZA to move to a level 2 maturity where their processes are clearly defined and they can produce consistent results. This is achieved by clearly defining and documenting the key processes in the order-to-delivery cycle.

The concepts of business process improvement (BPI) and business process reengineering (BPR) were investigated. These approaches indicate the importance of process mapping, performance measurements and change management to facilitate the implementation of the new process. Each of these aspects was investigated further. There are various process mapping notations, and after careful consideration, it was decided that a notation will be developed for this project. Performance measures play a key role in managing and monitoring the processes. KPIs were developed to assist with future management of the order-to-delivery cycle and guide further improvement. A critical success factor for this improvement initiative is the successful implementation of the new processes. Change management was investigated and a change management model was selected to be the baseline for an implementation strategy.

An extensive problem analysis was conducted to determine the biggest pain points for employees. A JAD session was held to gather the inputs of different role players and gain their support. The session delivered various problems and only the process related problems were selected to address through the project. The biggest contributors to the inefficiencies of the order-to-delivery cycle are the appearance of frequent process failures. These are situations that affect the normal flow of the order-to-delivery cycle dramatically. As there are no instructions for employees to follow if these situations occur, this leads to more problems. The design of the order-to-delivery cycle should address these process failures through clear process documentation of the procedures to follow.

The design of the order-to-delivery cycle is based on the concept of process hierarchy. The top-level processes of the order-to-delivery cycle are derived from the generic value chain activities defined by Porter. The order-to-delivery cycle can also be defined as a value chain.

The top-level processes are categories for the level 2 processes. The level 2 processes describe the activities required during the order-to-delivery cycle. The order-to-delivery cycle consists of key processes that work together to achieve the common goal of providing goods to the customer. The frequent process failures are addressed by defining the processes to follow if these situations occur. The processes are defined as the counteract processes. There is a distinctive interaction between the key processes and the counteract processes. Process models were developed for each level 2 process. The process models indicate the responsibilities across the order-to-delivery cycle, and the integration and handover points between the processes are clear. The process models provide the step towards improvement but certain improvements were included in the process models. These improvements are:

- Different staging areas
- Effective communication upstream and downstream in the order-to-delivery cycle
- Addressing the frequent process failures and other process related problems

The new processes have to be implemented to ensure that employees follow the processes. An implementation strategy was defined to assist GZA with the implementation phase. The processes have to be managed effectively to identify and address problems quickly. This will be achieved through process measurement. Metrics and KPIs were defined to measure the performance of the level 2 processes and the order-to-delivery cycle. The concept of the Balanced Scorecard was used to develop KPIs for the order-to-delivery cycle, which will measure the performance of the cycle across its different dimensions, namely sales, procurement, operations and logistics. A suggested strategy for the order-to-delivery cycle was defined to guide the develoment of KPIs. The strategy is: perfect order fulfilment. The KPIs should reflect how well each dimension is achieving and working towards the strategy.

The process models alone will not improve the performance of the order-to-delivery cycle. The real improvement in the order-to-delivery cycle of GZA will only be realised and achieved after the new processes have been implemented. The implementation phase of any project determines the success or failure of the project. It is important to manage the change during the implementation phase. An informal implementation strategy was developed to discuss the key aspects required for an implementation plan. The implementation strategy addresses change management on a highlevel. The strategy will guide GZA through the implementation phase.

GZA wants to improve their customer service by improving the order-to-delivery cycle. To achieve improvement the processes in the cycle had to be defined and documented. The process models will provide the baseline for improvement. It is important that the processes are implemented and managed to ensure that employees follow the process documentation. This will lead to process standardisation if all employees conduct the processes in the same way. The processes should be measured and reviewed regularly to identify opportunities for improvement. This project will contribute significantly to GZA's understanding of their processes and it will set a foundation for improvement of their other business processes.

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Appendix A: Industry Sponsorship Form

Department of Industrial & Systems Engineering
Final Year Projects
Identification and Responsibility of Project Sponsors

All Final Year Projects are published by the University of Pretoria on *UPSpace* and thus freely available on the Internet. These publications portray the quality of education at the University and have the potential of exposing sensitive company information. It is important that both students and company representatives or sponsors are aware of such implications.

Key responsibilities of Project Sponsors:

A project sponsor is the key contact person within the company. This person should thus be able to provide the best guidance to the student on the project. The sponsor is also very likely to gain from the success of the project. The project sponsor has the following important responsibilities:

1. Confirm his/her role as project sponsor, duly authorised by the company. Multiple sponsors can be appointed, but this is not advised. The duly completed form will considered as acceptance of sponsor role.
2. Review and approve the Project Proposal, ensuring that it clearly defines the problem to be investigated by the student and that the project aim, scope, deliverables and approach is acceptable from the company's perspective.
3. Review the Final Project Report (delivered during the second semester), ensuring that information is accurate and that the solution addresses the problems and/or design requirements of the defined project.
4. Acknowledges the intended publication of the Project Report on UP Space.
5. Ensures that any sensitive, confidential information or intellectual property of the company is not disclosed in the Final Project Report.

Project Sponsor Details:

Company:	Grundfos
Project Description:	Business Process Improvement of the Order-to-Delivery Cycle
Student Name:	Babette Roberts
Student number:	10137425
Student Signature:	**B. Roberts**
Sponsor Name:	Gerhard Steenberg
Designation:	Director of Operations, B. Eng (Honours)
E-mail:	gsteenberg@grundfos.com
Tel No:	011 579 4800
Cell No:	083 629 0783
Fax No:	-
Sponsor Signature:	**G. Steenberg**