MASTER

Conceptual design of project business workstream guidelines into an integrated planning concept
a case study at a supplier to the construction industry

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Award date:
2015
Conceptual design of project business workstream guidelines into an integrated planning concept: A case study at a supplier to the construction industry

by

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in partial fulfillment of the requirements for the degree of

Master of Science
in Operations Management and Logistics

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Subject headings: Project Business, Project Sales Funnel, Project Demand, Engineer-to-Order, Project Acquisition, Decision Support, Risk Assessment, Risk Management, Intermittent Demand
ABSTRACT

In this thesis, the main focus is on the two topics of project business and project sales funnel. Hilti has been experiencing problems while operating in project business on top of the standard business, which was the ignition of this Master Thesis Project. Two designs are proposed to solve the problems Hilti is faced with. First of all, a project business workstream design is proposed to structure a general workflow for the stakeholders in project business. The workstream makes it clear when decisions need to be made and integrates project business into the Hilti integrated planning concept. Second of all, by diving more into the aspect of making better decision for activating projects, a design of a decision support tool is proposed. The tool is built of two main parts where one focuses on capturing the inputs, a project database, and the other generates the outputs, a risk assessment model. In the end the final outcome of the tool is a one demand number on an item level with transparency of the risk associated with it.
ACKNOWLEDGEMENTS

This thesis concludes the work of my master degree in Operations Management and Logistics at Eindhoven University of Technology. At last I can look back and say my farewells to life as a student and start life as a fresh engineering graduate.

First and foremost I need to thank Ton de Kok for his supervision over the past year and a half. Although, I was originally supposed to be assigned to another person he decided to allow me to continue under his supervision and for that I will always be grateful. I enjoyed all of our meetings and I will miss hearing stories about your experience in the field.

Second of all, I would like to thank my supervisor and the colleagues at Hilti. Ruediger Kuebler’s support and constructive feedback always kept me on my toes to improve and delivery a good project. I owe a special gratitude to all the stakeholders and contributors to my thesis as I would not have been able to generate the understanding of the problems without any of you. I will happily remember my time in Nendlen and all the people who made my day-to-day life there enjoyable.

Finally, none of this could have been possible without the support of my family and friends. Their support throughout my education journey, both in Iceland and in Eindhoven, has been ever encouraging. Then there is my Anna who has been my rock and adventure seeker, first following me to the Netherlands and then Austria. Even though I have not been there for you the past two years, you kept on supporting me and without you I would not be where I am today. It is finally time to devote my time and attention towards you.

Sindri S. Fridriksson
Feldkirch, August 2015
MANAGEMENT SUMMARY

Problem Description

Hilti has been experiencing problems with satisfying project business customers due to lack of transparency over the whole process, which transfers to issues with item availability. Issues with running two main tools for the process has proven to be problematic as much of the same information is captured in the tools and people are not willing to do double work. Furthermore, communication of projects to the supply chain from the salesforce is not active enough which is affecting the service to customers. Preliminary analysis of projects communicated a single BU at HAG level resulted in the following observation (Table 1):

Table 1: Project hit-rate at headquarter level

<table>
<thead>
<tr>
<th>Project Conversion</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects Lost</td>
<td>30%</td>
<td>52%</td>
<td>42%</td>
<td>41%</td>
</tr>
<tr>
<td>Project Hit-rate</td>
<td>70%</td>
<td>48%</td>
<td>58%</td>
<td>59%</td>
</tr>
<tr>
<td>Total #of Projects</td>
<td>152</td>
<td>190</td>
<td>150</td>
<td>492</td>
</tr>
</tbody>
</table>

On average, more than 50% of the projects which are communicated to the chosen BU are won each year. However, this is only a small part of the total number of projects and a careful discussion with stakeholders suggested that on average the hit-rate in the MOs is substantially lower and the highest hit-rates come from small projects, in terms of value. It was moreover identified that there are problems of the system transparency, usage of the sales probability, and the commitment to making decisions.

The main goal of this research was to provide a conceptual design for the integration of the future project sales funnel into the integrated planning concept at Hilti. From this main goal the following research questions was generated:

**Research Question** – How can the project sales funnel be integrated into the integrated planning concept at Hilti such that the transparency of project business is increased in order to mitigate the risk of low item availability and obsolescence?

The Design Solution

Two designs were developed to provide an answer for the research question; a general project business workstream and a decision support tool. First of all, to structure the workstream design it was divided in four steps and in the end all steps were combined in one general workstream. The first step represents the project entry, where all requirements for a project are to be collected in a common CRM project management system called Hi-site. The salesforce is in close contact to capture all relevant project requirements and they are filled in Hi-site. Next step is the quality and feasibility check made by the MO MM on the project requirements. At this stage, the feasibility is evaluated if Hilti should keep projects in the project sales funnel or if adjustment on the requirements is needed. If projects are determined feasible the third step is entered, which is the last stage before the SFI meetings. Projects need to be aligned with the salesforce in terms of the likelihood and, with regards to lead time, what needs to be activated to keep reliable supply to the customers. The salesforce is required to give a commitment to which projects to recommend for activation and what project should only be kept in the funnel for transparency.

The final stage is entered after an alignment and a risk assessment has been made on the recommended project forecast. This final stage is the future SFI meetings where the decision is made.
to activate and accept the risk of the activated projects or to reject the risk and keep the projects only for transparency. The complete project business workstream can be seen in Figure 1.

Figure 1: The future To-Be general project business workstream

The second design, which is the decision support tool, is aimed at diving deeper into the problem of committing to the decisions and making the process more transparent by highlighting the risks associated with the recommended projects. The proposed design requires a project database to capture all inputs for the risk assessment. With additional development to Hi-site it is suggested to use that as a base to capture all the required information. The output of the model will be a risk assessment both on project and business level to give support or an insight into the final decision.

Figure 2: Conceptual framework of the decision support tool design
Conclusion

The literature research did not result in any solutions suggesting how to solve the problems of project business. Therefore the proposed workstream design cannot be validated. However, based on the situation analysis and the fact there is no general workstream structure in place at Hilti it can be assumed that the design will improve the transparency of project business.

It was identified that operating two tools for project business creates additional work and erroneous project information. In Hi-site there is already a system solution available which, however, will need further development. Therefore, it is suggested to incentivize the stakeholders to capture and maintain quality information in Hi-site so that there may be one tool without overlapping information from other solutions.

Further research is needed to stylize the decision support tool and empirically validate it, although, it serves as a starting point given that there is currently no literature that suggests a solution towards improving project business. Additionally, it is suggested to benchmark how other companies are effectively dealing with the issues following the mixture of dealing in project business on top of the standard business.
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<thead>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Logistics Region Rest of Asia &amp; Oceania</td>
</tr>
<tr>
<td>AM</td>
<td>Account Manager</td>
</tr>
<tr>
<td>ASM</td>
<td>Area Sales Manager</td>
</tr>
<tr>
<td>BOM</td>
<td>Bill of Materials</td>
</tr>
<tr>
<td>BU</td>
<td>Business Unit</td>
</tr>
<tr>
<td>BU MM</td>
<td>BU Materials Manager</td>
</tr>
<tr>
<td>ChangeLog</td>
<td>Project Change History Log</td>
</tr>
<tr>
<td>CRM</td>
<td>Customer Relationship Management</td>
</tr>
<tr>
<td>CW</td>
<td>Central Warehouse</td>
</tr>
<tr>
<td>DC</td>
<td>Distribution Center</td>
</tr>
<tr>
<td>E2</td>
<td>Logistics Region Northern Europe</td>
</tr>
<tr>
<td>E3</td>
<td>Logistics Region Central Europe</td>
</tr>
<tr>
<td>E4</td>
<td>Logistics Region Southern Europe</td>
</tr>
<tr>
<td>EE</td>
<td>Logistics Region Eastern Europe</td>
</tr>
<tr>
<td>ET&amp;A</td>
<td>Electric Tools &amp; Accessories</td>
</tr>
<tr>
<td>ETO</td>
<td>Engineer-to-Order</td>
</tr>
<tr>
<td>F&amp;P</td>
<td>Fastening &amp; Protection</td>
</tr>
<tr>
<td>FE</td>
<td>Field Engineer</td>
</tr>
<tr>
<td>FFM</td>
<td>Fulfillment Manager</td>
</tr>
<tr>
<td>GM</td>
<td>General Manager</td>
</tr>
<tr>
<td>HAG</td>
<td>Hilti Headquarters in Liechtenstein</td>
</tr>
<tr>
<td>HC</td>
<td>Hilti Center</td>
</tr>
<tr>
<td>HIP</td>
<td>Hilti Integrated Planning</td>
</tr>
<tr>
<td>HNA (W1)</td>
<td>Hilti North America</td>
</tr>
<tr>
<td>HRP</td>
<td>Hilti Relevant Potential</td>
</tr>
<tr>
<td>IDEF0</td>
<td>Integrated DEFinition Method Zero</td>
</tr>
<tr>
<td>ISB</td>
<td>Integrated System Business</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>KPM</td>
<td>Key Project Manager</td>
</tr>
<tr>
<td>KSA</td>
<td>Kingdom of Saudi Arabia</td>
</tr>
<tr>
<td>LPS</td>
<td>Local Product Support</td>
</tr>
<tr>
<td>META</td>
<td>Near/Middle East, Turkey, &amp; Africa</td>
</tr>
<tr>
<td>MO</td>
<td>Market Organization</td>
</tr>
<tr>
<td>MO MM</td>
<td>MO Logistics Materials Manager</td>
</tr>
<tr>
<td>MSQ</td>
<td>Minimum Ship Quantity</td>
</tr>
<tr>
<td>NN</td>
<td>Neural Network</td>
</tr>
<tr>
<td>PM</td>
<td>Product Manager</td>
</tr>
<tr>
<td>PMO</td>
<td>Project Management Office</td>
</tr>
<tr>
<td>PO</td>
<td>Purchase Order</td>
</tr>
<tr>
<td>R&amp;R</td>
<td>Roles &amp; Responsibilities</td>
</tr>
<tr>
<td>S&amp;OP</td>
<td>Sales &amp; Operations Planning</td>
</tr>
<tr>
<td>SCV</td>
<td>Squared Coefficient of Variation</td>
</tr>
<tr>
<td>SD</td>
<td>Sales Director</td>
</tr>
<tr>
<td>SM</td>
<td>Supply Manager</td>
</tr>
<tr>
<td>Specials</td>
<td>Special ETO items</td>
</tr>
<tr>
<td>W2</td>
<td>Logistics Region Latin America</td>
</tr>
</tbody>
</table>


1 Thesis Introduction

This thesis presents the final results of the Master Thesis Project on project business, conducted as collaboration between Eindhoven University of Technology and Hilti AG. The aim of the thesis is to perform an analysis on the current situation and propose a design aimed at improving current efforts within project business.

Research within the field of project business has been gaining more importance since the 1970’s (Owusu, 1997); however, it is still considered to be a relatively new research field within the management science (Artto, Martinsuo, & Kujala, Project business, 2011b). At Hilti 95% of orders include only seven order lines or less, generating 95% of the turnover where an average sales order is worth 276 CHF. This implies that the project business is merely a small fraction, 1-2%, of the total Hilti turnover. Nevertheless, the opportunities, if a project is won, can in many cases be of great interest with some big projects stretching supply over many years. These projects do not arrive in any predictable process and when they are identified the volatility of the demand can be such that it counts for more than a yearly quantity for some items. Therefore project demand forecasting is not done based on any statistical forecasting methods but on market intelligence. It is the goal of this thesis to improve the whole process with the aim of contributing towards the objectives of Hilti increasing the global growth of project business. Additionally, a hidden objective of this Master Thesis Project is to contribute towards the academic literature by identifying gaps in the literature.

The thesis starts with this introduction where a brief literature introduction is given on the two main topics under consideration; project business and the project sales funnel. The second and last part of this introduction outlines the structure of the remainder of the thesis.

1.1 Literature introduction

1.1.1 The project business

Project business is a relatively new research field in management science (Artto et al., 2011b), which embraces a business-driven perspective to the management of projects, firm, and networks of project and firms (Artto, Davies, Kujala, & Prencipe, 2011a). It was defined by Artto and Wikström (2005), in the paper ‘What is project business?’ as “the part of business that relates directly or indirectly to projects, with a purpose to achieve objectives of a firm or several firms” (p. 351). To put it in a simpler form, ‘it is the term of professionally managing projects within a company’.

The project business is often associated with three main characteristics identified in project marketing literature (Mandják & Veres, 1998; Cova, Ghauri, & Salle, 2002; Hellström & Wikström, 2005):

- **Discontinuity** – The relationship between the customer and supplier is not likely to be strengthened over time through frequent transaction as it so often does in transactional business (Perret, Jaffeux, Fender, & Wieser, 2012). It is caused by the uniqueness of projects (Cova et al., 2002). The demand is, as well, seen as discontinuous (Artto & Kujala, 2005).
- **Uniqueness** – Every project is unique when considering its elements, type of customer, type of organization required, the amount of resources, and the execution. (Perret et al., 2012).
- **Complexity** – Projects are complex in terms of having to consider multiple stakeholders when making decisions, the deliverables of the project, and the resources and skills needed to execute a project are often difficult to realize (Perret et al., 2012). Two main drivers of project complexity are believed to be uncertainty and risk (Bosch-Rekvedt, Jongkind, Mooi, Bakker, & Verbraeck, 2011).

The demand which is associated with the project business is usually large and ‘lumpy’ as well as normal demand from many small orders which constitute to the transactional business demand, often
referred to as “tender” business (Palmatier, n.d.; van Donselaar, Kopczak, & Wouters, 2001). Planning of this project demand requires a regular and disciplined process of communicating projects and when new information is acquired the project management system must be updated, especially when the likelihood of acquiring a project changes (Palmatier, n.d.).

1.1.2 The project sales funnel

The concept of the project sales funnel is well known in the business world, yet, not much has been written on it in the academic literature (Savolainen & Ahonen, 2015). Nonetheless, a literature search resulted in several papers where the concept is described.

The project sales funnel can be seen as the acquisition process of new projects from customers in a business-to-business environment, and stretches from prospecting to closing a sale. The funnel process consists of several consecutive stages, where the number of the stages, as well as the definition of each stage varies significantly in literature (Sönchen & Albers, 2010). The most common stages identified, starting from the initial stage to the last stage: Qualification, approach, product presentation, design of offer, bidding/negotiation, and closure (Figure 3). For the purpose of this Thesis the funnel will be defined in only three stages: Project lead identification, negotiation (quotation negotiation), and execution (Figure 4). This Thesis will focus on the negotiation stage of the project funnel.

At any given stage the project acquisition process can be discontinued by either the customer or the supplier, therefore, the process is in the shape of a funnel (Savolainen & Ahonen, 2015). Each project that runs through the sales funnel is subject to probability or likelihood of being won and the further down the stream it reaches the greater the probability. This implies that for each stage of the funnel a certain probability or a hit-rate is associated to it. These hit-rates are important to track because of the constant improvement and it show where a company is failing in the acquisition process (Cooper & Budd, 2007). To allow for a good overview and monitoring of the hit-rates and the whole project sales funnel, it has been suggested to make use of Customer Relationship Management (CRM) systems (Crosby & Johnson, 2001).

1.2 Structure of the thesis

The Master Thesis Project follows, partially, the process of the problem solving cycle approach introduced by van Aken, Berends, and van der Bij (2012). The process is only followed partially due to the fact that implementation is not part of the scope. The Master Thesis Project started with a thorough literature review of project business and was flowed by a research proposal. This initial phase of the Master Thesis Project served as a formulation of the problem including an initial problem definition. Next phase, this thesis, conducts an even more detailed problem definition where the problem is analyzed (section 3). Based on the analysis, two designs are proposed in sections 4 and 5.
The thesis is then closed with an evaluation of the research and a final conclusion and recommendation is given. The remainder of this thesis structure can be seen in Figure 5 below.

<table>
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<tbody>
<tr>
<td>This section provides a brief introduction in the company of Hilti and the reason for why this project is being conducted.</td>
<td>The project analysis provides a description of the current situation followed by an analysis of the situation. This section ends with a description of the research objectives.</td>
<td>This section proposes a new workstream process for project business and integrates it to the integrated planning concept.</td>
<td>First a conceptual design is given, which highlights the inputs and outputs needed. Later a detailed design of how to capture the inputs and process them into outputs is given.</td>
<td>The final section provides answers to the research questions, followed by the contribution to academics and recommendations for future work.</td>
</tr>
</tbody>
</table>

*Figure 5: Structure of the thesis*
2 PROJECT CONTEXT

In this section the company where this Master Thesis Project was conducted, Hilti AG is introduced. The reader will be provided with some general information about the company to give some insight into its structure and business. Furthermore, a brief introduction to the function of Global Logistics which initiated this project and is seen as the owner, and the ongoing project of designing a Sales and Operations Planning (S&OP) process. Finally, the reason for why Global Logistics saw need for initiating this project is given.

2.1 Company description

Hilti AG was founded in 1941 by the brothers Martin and Eugene Hilti. The company started as a small scale construction tool manufacturer operated from a garage in Schaan, Liechtenstein and since then has gradually grown with its presence in over 120 countries, with more than 22,000 employees. Hilti AG, as it is known today (throughout the paper only Hilti will be used), provides full system solutions for the professional construction industry where it is most famous for the Direct Fastening and Demolition tools. Hilti’s product assortment is as listed: Measuring Systems, Drilling and Demolition, Diamond Coring and Cutting, Cutting and Sanding, Screw Fastening Systems, Cordless Technology, Direct Fastening, Anchoring Systems, Firestop Systems, Installation Systems, and Software. Hilti does not only offer products it also offers services including Engineering, Fleet Management (a fixed monthly charge covers all tool, service and repair costs), Training and Consulting, Lifetime Service, Repair Service, and Delivery Service.

Hilti is structured such that the customer is seen as the most important unit of the company. Furthermore, Hilti is divided into four functional units which are all located at the headquarters in Liechtenstein (HAG); Corporate Research & Technology, Business Units (BUs), Supply Chain, and Corporate functions. The fifth functional unit is known as Market Regions/Market Organizations (MOs) which are separate legal entities with marketing and sales functions (Figure 6). There are two main business areas in the structure of Hilti; Electric Tools and Accessories (ET&A), and Fastening and Protection (F&P). These two areas can be further separated in BU Anchors, BU Direct Fastening, BU Installation, and BU Chemicals under F&P while for ET&A there are three BUs; BU Power Tools & Accessories, BU Diamond Systems, and BU Measuring Systems.

Hilti does not sell its products to the typical retail stores or through distributors; Hilti instead has the unique characteristic of operating with a direct sales model. This is represented by the fact that two-thirds of the employees work directly for the customer in sales organizations and in engineering, which means a total of more than 200,000 customer contacts every day. This direct sales model has risen from generating 6.7 million CHF in 1950 up to roughly 4.5 billion CHF. Hilti’s direct sales concept involves five different ways to connect with the customer; Customer advisor (Van or an on-site sales representative), Hilti Center (Shop with only Hilti products and run by Hilti), Hilti Online (Online shop), Customer Service (Telephone consulting), and Technical Service (Technical support from engineers and technicians).

The main strength of Hilti is considered to be its innovation, where it introduces on average 30 new products each year. To support this new product introduction the investment in R&D from sales is relatively large and in 2014 Hilti invested 5% of the total sales back in R&D.
The headquarters of Hilti have been located in Schaan from the days of foundation. However, the company operates HUB functions in each of its market regions (see organizational set-up in Appendix A):

- Hilti North America (HNA, W1) – Tulsa, USA
- Latin America (W2) – Panama
- Near/Middle East, Turkey, & Africa (META) – Dubai, United Arab Emirates
- Rest of Asia & Oceania (A1) – Hong Kong
- Eastern Europe (EE) – Moscow, Russia
- Northern Europe (E1) – Manchester, United Kingdom
- Western Europe (E2) – Magny-les-Hameaux, France
- Central Europe (E3) – Kaufering, Germany
- Southern Europe (E4) – Milano, Italy

Hilti currently operates eight plants in three different continents; a Consumables plant in Mexico, a Diamond Tools and Consumables plant in HAG, two plants in Germany for Consumables and Tool Components, a Tool Assembly plant in Austria, a Consumables plant in Hungary, and finally one Consumables plant and another for Tool Assembly including R&D in China (for a graphical representation of the global manufacturing network see Figure 35 in Appendix A). Additionally, Hilti has several allied suppliers to supply the wide product portfolio, such as for Installation Systems.

2.1.1 Hilti’s supply chain

A simplified overview of Hilti’s supply chain is given in Figure 7. Majority of the whole value chain is under corporate control by Hilti, meaning that Hilti controls the product flow from manufacturing sites until sales channels to a large extent. The suppliers, plants, Central Warehouses (CWs), Distribution Centers (DCs), and Hilti Centers (HCs) are spread all over the world. Due to this global footprint the lead times between locations vary greatly.

Material flows from factories (or allied suppliers) until the end-customer as part of the distribution network. The routing of material flow depends on the magnitude of each shipment between a plant or an allied supplier to the MO CW/DC. In case of large shipments the material flows directly to the MO CW/DC. However, small streams of goods or shipments to a location with long a lead time are consolidated in a HAG WH before being sent.

Customer orders enter the supply chain at HCs, Hilti Online, Customer Service, or through sales representatives. The typical lead time for standard orders is delivery no later than next day or 48 hours based on geography. Specially engineered items or large orders are subject to longer lead times.
2.1.2 Hilti Global Logistics

This Master Thesis Project, as has already been mentioned, was conducted at Hilti AG for Global Logistics in Nendeln, Liechtenstein. Global Logistics manages three main areas: Warehouse Management, Transport Management, and Materials Management. There is one additional branch with a dotted line in the organizational structure and that is Global Logistics Lean. The organizational structure of Global Logistics has been included in Appendix A for further information. The core functional goal of Global logistics is to passionately fulfill the customer’s needs with highest efficiency.

Early in the year of 2013 Global Logistics launched a project called ‘Hilti Integrated Planning’ (HIP) where the aim was to create an integrated planning concept for Hilti’s end-to-end internal supply chain. The project was split into four different workstream projects each with its own goal:

1. **Workflow**: Integrate and synchronize all activities of the demand, production, and distribution planning in the end-to-end supply chain.
2. **Sales Planning**: Implement an integrated planning process such that the entire value chain of Hilti (synchronized calendars and workflow) is covered and driven by “one number”.
3. **Production and Distribution Planning**: Implementation of a process that centralizes production planning activities on the operational as well as the tactical level of the hierarchical planning.
4. **Organization Preparation**: Establish a central function which is responsible for coordinating all levels of planning (from S&OP to Operational) and striving to end-to-end optimization.

2.2 Reason for action

As was mentioned earlier, the increased focus on global growth and at the same time growth in project business has put logistics under some pressure of reacting to the sudden and uncertain demand peaks that follows the possible project demand. As logistics is currently working on the HIP project it was seen as an ideal solution to initiate an additional project that would focus on this project business.

Customers have raised dissatisfaction about product availability on several occasions when Hilti has been chosen as the project supplier. To manage the project business from a logistics point of view, especially when considering product availability, requires a different approach than for the standard product business currently in place at Hilti. Within Global Logistics it was identified that the availability of information of potential sales quantities, by item and month, was a great opportunity for logistics.

Currently, the only planning for project business is captured within Excel and there is no historical data available in a system nor is there any linkage to SAP APO which is the planning tool used by Hilti. Additionally there was introduced a new CRM module where all project details should be captured for potential sales. However, no integration to the planning frame was done.

The above mentioned issues observed by Global Logistics are what drove them to initiate a research project in cooperation with Eindhoven University of Technology. Global Logistics saw an opportunity to initiate a project where it could be analyzed where and when to integrate the project sales funnel into the integrated planning concept. In a later section there will be an analysis whether the perceived issues are in fact the root causes to the problems Hilti is facing. The second part of this Master Thesis Project, the Research Proposal, further confirmed the need to perform an extensive project redesigning of the current approach to project business.

Even though HIP will be mentioned quite often throughout this thesis and an insight into its meaning is given, this project is not seen as part of any of the sub-projects nor the core project. This project is rather seen as an independent project where, however, the conclusion and recommendations will be aligned to what has and will be decided in the HIP project.
3  PROJECT ANALYSIS

In the previous section, the ‘Reason for Action’, there was a description where it was revealed that the current efforts to operate in project business are not efficiently structured by Hilti. Project business brings a great deal of uncertainty on top of the normal uncertainty of dealing with the transactional business (Bosch-Rekveldt et al., 2011). In this section a description of the current process for project business at Hilti and the resources used, as well as the problem analysis and research objectives will be provided.

In order to gain insight into how Hilti is performing in the project business and the process that projects go through, multiple stakeholder interviews were conducted over the whole research period. The interviews were aimed at capturing the current situation, problems and issues of project business in a semi-structured manner (see Appendix B for more information about the structure). These interviews helped give grounds to the problems perceived by Global Logistics and cast light on several of the causes of these problems. Based on the interviews it can be determined that the projects classified as project business can be divided into three different types; Integrated System Business (ISB) projects, large scale projects not classified as ISB projects and are big in terms of hierarchical support, and small projects that can be supplied within the market with standard demand or supply. A further outcome of the interviews was a cause and effect diagram described the linkage from the root causes to the main problem.

This section starts with a brief description of the resources in place for the project business, followed by a description of the current situation. Problem analysis and diagnosis will be described in section 3.3 and at the end of this third section the research objectives are stated.

3.1  The project business tools

Hilti has introduced several tools for project business to capture all project related information and to allow for a more transparent process. Among these tools, Hilti has an Excel template which is used to capture the projected demand for a particular project as well as required delivery dates. Another tool is a new CRM module, called CRM 7.0 or Hi-site. Within this Hi-site functionality, Hilti captures potential sales opportunities in a system solution which allows for better tracking. Within MO Kingdom of Saudi Arabia (MO KSA) an addition of functionality to the Excel template has been made where the person who fills in the template has an overview of the items required for a particular application and it is listed whether the items are kept on stock in the MO or at HAG level. This guides the person to select a more standard solution where Hilti is fast and reliable in delivery. Additionally within MO KSA there is in place an Excel tool, ‘Forecast Tracker’, where the MO materials manager tries to track what projects are currently in the funnel and the demand related to a particular project. This allows for better tracking and more transparent decision making when it comes to ordering material in advance.

There are two other tools used by BU Installation where one is used to aggregate worldwide monthly demand, number of MOs selling that particular item, and to identify country specific items. The other is used to calculate transport volume and weight.

Only recently two new tools have been developed and are being used in the project business, one in E3 and the other in HNA. The tool that is being used in E3 was introduced to give a better overview of the current project demand from the different MOs. Each MO has its own Excel file all the demand from the projects currently active in the negotiation phase is consolidated and aggregated to a total demand within the MO which is then sent to the HUB in Kaufering. There these Excel files are combined into one common Excel file with an overview of the total project demand within the whole region, divided into months, as well as which items are being requested by which MO. This allows for
a better decision making process when deciding on if there is need to increase forecast from the region on specific items to account for the possible project demand.

The tool in HNA was only developed at the time of this project and not much information has been gathered about how it has changed the current situation. However, based on a brief introduction on the tool it shows to be a great asset. By collecting data about all ongoing projects and aggregating the demand, project demand at each stage of the sales process and every estimated delivery month can be analyzed. The Excel tool allows a comparison of what happens to the stock levels if all the project demand is realized in addition to the standard materials forecast. This new tool in HNA shows promise of becoming a real asset as it captures not only all projects in the pipeline and the relative demand but it also aggregates all the demand down to the different stages. Additionally it allows for comparison of the project demand with the transactional forecast, current stock level, and the inventory on order.

The next two subsections are dedicated to a brief description of the Excel template and Hi-site, followed by a discussion on the problems experienced with the two.

### 3.1.1 The Excel forecast template

This Excel template is separated in two parts: The project overview and the project details on item level. The project overview (Figure 8) captures the most important information about the Hilti contact persons for the project, the project name, jobsite start and end date, the target application, the customer, and probability of success and project net sales.

The Excel template is operated as a five stage sales process where each stage is subject to probabilities. To every stage a specific process is outlined and this serves as the only process guidelines where roles and responsibilities for the project business are reported.

The latter part of the Excel template (Figure 9) is used to capture the project Bill of Materials (BOM), the required delivery dates, and if needed partial deliveries. In MO KSA some additions have been made to the tool such as adding fields informing the user about the Minimum Ship Quantity (MSQ), if an item is in a phase out period or not, and whether an item is a standard item (kept on stock in the MO) or an on demand item (not kept on stock in MO, longer lead times). In addition to this MO KSA has also added another page where the user can have an overview of all items that can be used for a

![Excel forecast template – Project information overview](image_url)
specific application and whether the item in question is a standard or on-demand item. This allows for a more standard solution if used and fitting for the customer.

Within this Excel tool the planning activities for the project business are captured as well as the guidelines for communication and information flow.

3.1.2 CRM 7.0 – Hi-site

In 2013, Hilti’s Market Reach department developed a new module in the CRM system called CRM 7.0 or Hi-site (the term Hi-site shall be used throughout the Thesis). The idea of this module was that the sales engineer or the project manager could capture all the required project details and sales potentials of this unique sales opportunity (Figure 10). Relevant project data introduced in Hi-site is among others: Project ID, customer, the Hilti employee responsible for the potential sales opportunity, the status of the project, a qualitative probability of success, and investment. The relative demand can be captured down to item numbers, quantities, and expected delivery dates. Additionally, the system is capable of automatically calculating the Hilti relevant potential (HRP) and the sales target. The HRP identifies what amount of the project is relevant for Hilti as some products are not supplied by Hilti. This means that the HRP can be split into different applications – for example, interior finishing or mechanical and electrical – and gain a much more accurate forecast. Consider if the interior finishing part is received, it is most likely to get most of that area but it does not necessarily mean the mechanical or electrical part will also be received – these areas are furthermore completed at different times and require the products at different phases of the jobsite. There are specifically dedicated account managers in Hilti based on these trades. Therefore, this HRP can add to a more detailed “project forecast” combined with sales target as this can be seen as a S&OP approach of agreeing to a ‘one number’ together with sales with a probability assigned to each product by trade.

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1 On-demand items are not kept on stock within the MO and therefore have to be ordered from HAG upstream.
When identifying a potential for a large construction project, for example, an airport it is entered into Hi-site. This large potential is more likely than not built in several phases where each phase can be captured in Hi-site (the trades above). These phases are seen as applications of the large potential and each application can be captured on an item level in its own account (Figure 11). This allows for better transparency as to what applications were quoted for a single project.

The full Hi-site functionality is stored on a local “cloud” server in Schaan and currently 36 of Hilti’s MOs, which represent roughly 80-90% of the whole business of Hilti, have this shared access which allows for better system transparency. This means that these MOs can access information about projects from each other over the shared cloud server. Other “smaller” MOs still have access to the same functionality of Hi-site; yet, only local information within to current MO can be accessed through SAP ByD (SAP by design).

3.1.3 The project business tools – Problems

There are a several issues that Hilti is facing with using these tools.

**The Excel Forecast Template is completely outside the SAP system**

One major issue with using the Excel template to capture the project information and demand requirements is that it is completely outside the SAP system. For each project there is one Excel file and on some occasions when updates on the project requirements occur, new Excel templates are created with new project identities and confusion arises regarding which one is the most recent version.

**Lack of historical data collection**

Historical data about where in the sales process a project was discontinued or successfully converted to an order has not been collected for all projects and thus the available information is rather unreliable.

**Information quality in Hi-site is a big constrain**

Hi-site has shown to be a great asset for project management, project data collection, and can possibly replace the current Excel template process. However, data quality is the biggest constraint, as very few projects are reported and even fewer have the detailed information about the required BOM. The Excel template and Hi-site are rarely aligned.
Roles & responsibilities of the actors are not clear in Hi-site

When using the Excel template it is easy to send that back and forth with the most recent information and the person that received the file is aware that he/she is responsible for the file at that time. However, this is not possible within Hi-site and the people working on a particular project do not receive any notification that information has been updated on a project without having to go into the system themselves or if the person who updated last makes them aware of it.

The full potential of Hi-site is not being exploited

Today Hi-site is mostly used as a communication tool within the markets and its full potential is not being exploited. Recently within the market region of META, there have been some additions to the performance measures for the sales force regarding data quality in Hi-site. However, there are still problems with aligning the Excel template and Hi-site so that the information is in sync.

No linkage to the SAP APO planning system

One of the main problems with these tools is that there is no linkage to the planning system SAP APO. This means that whenever a decision is made to prepare for a project by forwarding inventory into a MO, the demand must be manually fed into the system. Afterwards, there must be performed a history cleanse such that the project demand history is not taken into account when running statistical forecasting methods on the sales history. All history about actual project demand is kept in the Business Intelligence system; however, there is no link between that and the many Excel files or Hi-site. Furthermore, this problem of lack of linkage is seen in the fact that there is no overview of what part of the demand in the planning system is seen as project demand and to which projects it belongs.

No formal risk assessment

Even though effort has been put into developing all these tools, there is no formal risk assessment being executed at project and business level where the tools are used as resources. The quality of the available information within the tools is insufficient to make an effective risk assessment. The information which is available is not being effectively used and there is no formal historical data collection on project forecast. The tools have not been developed to the extent of allowing for effective communication of project information between the stakeholders. It was stated that the Hi-site is being used as a communication tool in the market but the communication link to logistics and HAG in Hi-site is missing.

3.2 Current situation of project business at Hilti

In 2013, Hilti introduced the concept of ISB which was a paradigm shift with regards to the project business. ISB targets the highly profitable project business outside of Europe with three Project Management Offices (PMOs) in the three locations: HNA, Dubai for the Gulf countries, and in Brazil. These PMOs act as support functions that support project specific needs only for these ISB projects. ISB projects are a very small portion of the project business and a project must fulfill several criteria to be considered an ISB project. First, it needs to involve a large business opportunity of at least 250,000 CHF, or less only for strategic development accounts. Second, ISB is aimed at the target segments of power, natural resources, and complex industrial and commercial buildings (e.g. hospitals and data centers). The ISB projects can be seen as large scale, highly customized projects with large volatile demand and long lead times from identification of potential to order. An ISB project is further not classified as an ISB project until it has been entered into Hi-site. This is done so that the actors use the same project identity when talking about a particular project throughout the whole lifecycle.

The smaller projects are those projects where no support is needed from HAG and the demand is supplied from within the market region or the MO itself. The demand is either determined by the sales team to be not so significant or that after contacting the MO materials manager it is realized that it can be supplied from the MO CW.
The large scale projects that are not identified as ISB are seen as all the projects where any kind of support from logistics and HAG is needed. These projects can be just as large and complex as the ISB project, yet the focus is not on a specific industry segment and product portfolio.

3.2.1 The actors in the project business

There are several players or actors that are actively involved in the project business process. The roles can divide into two different categories; the key actors and the lesser involved actors.

3.2.1.1 Key actors in the project business

The key actors are those people who are involved in the actual process of either acquiring the project information or consolidating item availability. The roles will be listed from the order of closest to customer to furthest.

**Business Developers**

This role aims to identify potential big projects and build relationships with the decision makers so that Hilti products will be considered when deciding to go for a supplier.

**Account Manager (AM)**

The role of the AM is to be in regular contact with the customer to collect important project information. He/she is as well the one who presents the customer with a quotation from Hilti to acquire a Purchase Order (PO).

**Field Engineer (FE)**

In case of engineering or design products the support from a FE is needed. Filling in project information to Hi-site is also required of the FE.

**Key Project Manager (KPM)**

The KPM is the one who initiates the project and acts as the owner of that particular project. Collecting project information, as well as, creating Hi-site opportunity is under the role of a KPM.

**MO Logistics Materials Manager (MO MM)**

The MO MM is a representative of the Logistics branch within a particular MO. He/she consolidates item availability, capacity, and lead times within the region and if needed request support from HAG. This is a role which serves as the “mediator” between the sales force and BUs in HAG.

**Business Unit Regional Materials Manager (BU Region MM)**

BU Region MM is the single point of contact in region support and is responsible for distributing demand to the relevant BUs and BU MMs from the project forecast received from the region.

**Business Unit Materials Manager (BU MM)**

Each BU MM acts as the only Hilti contact for several suppliers as well as represent its own region as a BU Region MM. The BU MM coordinates item availability from HAG and supplier as well as lead times and capacity checks.

**Supply Manager Specials (SM Specials)**

In case a specially engineered or designed item(s) is required by the customer, the SM Specials is contacted regarding lead time and availability.

3.2.1.2 The “less involved” Actors in the Project Business

These less involved actors are merely involved as a support function to those key actors and are listed based on the lowest hierarchical level first.
**Area Sales Manager (ASM)**
The ASM is involved as a support to the AM regarding the business itself or for quotations. He/she is also part of an approval matrix which decides whether inventory is forwarded in advance to the MO. The ASM further reviews the forecast received from the sales team before it is sent to logistics.

**Sales Director (SD) & General Manager (GM)**
Both the role of the SD and the GM is to be part of the approval matrix which decides on forwarding inventory in advance to the MO. Depending on the magnitude of the project either the SD or the GM is needed.

### 3.2.2 The current process of project business

#### 3.2.2.1 IDEF0 functional model

The project business process (Figure 13, Figure 14, and Figure 15) was captured with an IDEF0 (NIST, 1993) function modeling method and a model was integrated in a swim lane diagram, where each swim lane represents a functional role. The IDEF0 model (Figure 12) is built of two main elements: Process (box), data and objects (arrows). A process transforms inputs into outputs using the mechanisms while constrained by the controls. Each side of the box represents its own flow:

- **Inputs**: Data flows into the process from the left as an input.
- **Controls**: Conditions which control the output of the process in the form of budgets, requirements, constraints are fed in from top to bottom.
- **Mechanisms**: Support functions such as manual resources and system solution flowing from bottom up.
- **Outputs**: The only flow out, to the right, data or objects which are results of the process

#### 3.2.2.2 The customer quotation process

**Project lead identification**

Before discussing the possibility of having a project opportunity, first a lead has to be identified. The lead identification process is in the hands of several business developers who are operated from the Energy & Industry department at Hilti around the globe. The goal of the business developers is to influence and build up relationships with the decision makers of the designs. The part of the sales funnel where the business developers work, the design or project formulation, is not considered part of this project and therefore there is no need to go into a more detailed description of this process. The actual salesforce, the AM and KPM, and the FE are likewise involved in identifying leads, yet, with less constraints than the business developers as that role is focused on the energy and industry segments with ISB projects in the forefront.

**Information gathering on project requirements**

When a project lead has been identified the KPM is the one to initiate the project. Depending on the magnitude of the project, either the KPM is involved in gathering the required project information or the AM. The information gathered is, for example, customer name, estimated start and end dates, estimated BOM, and etc. Information about the BOM is the most difficult to gather from the customer as often the customer is not willing to commit to a certain design too early. If there is need for any kind of engineering, support is needed from the FE who will work with the consultants and/or architects to see if a solution can be determined that would fit Hilti’s portfolio.
Hi-site opportunity creation and project determination

After a customer has been approached a Hi-site opportunity is opened where all project related information gathered from the customer is filled in (see section 3.1.2 for further information). At this point no contact has been made with Logistics and depending on how the sales force determines the magnitude of the project no contact will be made for the small scale projects. In case it is determined that a project is small and thus no support needed from logistics the customer is advised to place a PO. This has caused some issues in the past as many people in the salesforce assume that there is always ample inventory and that the customer will receive the order according standard lead times while that is not the case except on rare occasions. When the salesforce determines a project is of the scale it needs support from Logistics the Excel template needs to be used and project information must be filled in (see section 3.1.1). Before it can be sent to the MO MM it is sent to the ASM who reviews it with regards to data quality. At this point there can already be a lack of alignment between Hi-site and the Excel Forecast Template due to updates of the project BOM. If the ASM approves the template it is sent to the MO MM who will review it as well and send back if needed. No clear timelines are available about how long this process takes as it ranges from over a year before order execution to less than a month.

A Key Performance Indicator (KPI) has been introduced (in MO KSA) for the accuracy of this template for the ASM. See Figure 13 for an overview of this stage in the process.

### 3.2.2.3 Hilti quotation process

The MO MM reviews the estimated project requirements with regards lead time requirements and availability in the MO and region. If the estimated demand can be supplied from the MO CW a quotation is made which will then be proposed to the customer. If there is further support needed from HAG the MO MM will communicate the project to the BU with the leading share of items in the BOM. This is likewise the case for an on-demand item that is part of the BOM, which will be communicated to HAG as the item is not kept on stock in the MO. The BU MMs will contact the suppliers to check on item availability, lead time, and raw material status. This information is then reported back to the MO MM who updates the KPM on the project lead time and the customer is presented with a Hilti quotation. Several actions can be taken: the customer places a PO, the customer has changed requirements and needs an update on lead times, the customer rejects and goes for another supplier, or there is no feedback received from the customer. In some cases the KPM and even the MO MM will request better lead times which means that the goods need to be shipped via airfreight and/or in case raw material is scarce that needs to be bought on the spot market. No real timelines are available for this process as it is different from project to project how often the
requirements are changed by the customer and furthermore how long it takes to get a response from the customer (if a response is received at all). See Figure 14 for an overview of this stage in the process.

Hilti has defined a sales process with five different stages which represent where in the process a particular project is located. Each stage is then given its own number which represents the probability of getting the project (Figure 8). At the stage of 80% probability a decision is made to prepare for the project and forward inventory into the MO. Taking the decision to forward the inventory is a managerial decision shared by the SD or the GM. However, it is an ongoing battle who should be the one to take on the risk, if it is the MO, Region, Logistics, or the BU. One thing must be noted and that is these defined probabilities of acquiring a project are based on tacit knowledge of the sales team and are not based on historical hit-rates.

### 3.2.2.4 The case of ETO items or Specials

In some projects it is highly likely to have the specially designed Engineer-to-Order (ETO) items which Hilti does not have, either in the product portfolio or as modified standard items. The MO uses an intranet solution called Local Product Support (LPS) guidance tool to cite the project which this ETO item is part of, product type, the expected modification of the item, and the quantity to name a few. This tool is then used to communicate to HAG the requirements for ETO items. The MO Product Manager (PM) is responsible for filling in these details on the MO side and to do that he uses the support of the AM, FE, KPM, and in some cases the MO MM. After acquiring all the information about the item the MO PM includes a drawing and specifies when the customer wants to receive the item. At HAG the SM Specials checks for feasibility of the requirements, what the price would be and delivery time from Hilti. The SM Specials contacts the supplier and requests a quote and lead time information. This information is then filled in the LPS tool which generates a unique “dummy” item number, only visible in the LPS tool, and the MO is notified so that the customer can be presented with the quotation.

For all requests HAG can decide not to start the process of modifying or producing an ETO item based on the feasibility. If the customer accepts the quotation from Hilti and agrees on ordering the item the MO PM contacts HAG and requests an item number so the order can be placed. Then the SM Specials has to set-up a new item number and waits until the MO has placed an order for the item. See Appendix C for more information and an overview of this process.
Figure 15: The current and complete project business flow at Hilti, IDEF0 model
3.3 Problem analysis

Multiple stakeholder interviews were conducted to capture the current issues Hilti has been experiencing while dealing in the project business. The main problems of value for this Master Thesis Project below are discussed below.

3.3.1 Item availability & obsolescence

The biggest problem when dealing in the project business is the demand uncertainty (Bosch-Rekvedt et al., 2011) and at Hilti that is no exception. Project opportunities arrive randomly and the probability of winning a project is more or less unknown at the early stages in the acquisition process. The demand which follows a single project can range from several items up to a few hundred and the requested quantity is highly uncertain. Hilti has experienced some issues with item availability because of reacting too late with regards to forwarding inventory and preparing for projects. This has led to unsatisfied customers.

Forecasting efforts for the project business at Hilti are not done by statistical efforts but based on market intelligence. Therefore, a great deal of trust must be established between the sales force and logistics when deciding to prepare inventory for projects. This is however a constant conflict as the customer often changes the project requirements several times during the bidding phase. Reasons for that are assumed to be several, such as, the project has not been awarded to this contractor and the requirements have not been fully finalized, or the customer is in negotiation with several suppliers and giving away too much information might affect the best possible offer the customer can receive. Often times it is not only the customer who is withholding information but the AM is guilty of such behavior. The salesforce has the objective of selling products and when an opportunity for a big potential sale, it is fixed in the mind of the salesforce that there is ample inventory both in the MO and especially at HAG. When the salesforce has convinced the customer of ordering and the products do not arrive the day after the customer is not satisfied, in fact the customer should have been told that this would not take the standard lead time of one day but perhaps few weeks due to the volume.

A major weakness in the project business planning is the reliability of promised delivery date. This is a crucial element when negotiating a deal with the customer. This is caused by the fact that no real effort has been spent on preparing, as part of the monthly plan, quantities for potential project orders. However, planning project activities at an early stage is not recommended unless with great care due to the great deal of uncertainty regarding project requirements (Perminova, Gustafsson, & Wikström, 2008).

It is safe to say that problems like these arise because of lack of effective communication. Currently there is no regular and disciplined project communications process to keep the whole project business process transparent for the stakeholders and allow for continuous information flow. An anecdote of a problem which often occurs is that the sales representatives often do not communicate that there is a potential project until a verbal commitment is received from the customer. This issue arises because the sales people do not want to receive the pressure of closing the deal when there is not enough confidence in the sales probability that the project will be awarded to Hilti.

3.3.2 Lack of system & process transparency

In section 3.1.3 it was discussed about the issue of not having any view of which part of the total item demand belongs to the project demand and to which individual project if ordered for that matter. The reason for this is that SAP APO is only fed demand information on an item by item basis and with no linkage to the project order ID. This can cause a great deal of problems since for some applications of projects all items need to be delivered at the same time in order to start construction. This is one of the reasons that the Excel template is still being used. Nevertheless, there is no connection from this file to the planning system and thus the tracking must be done manually. Furthermore, the Specials are
treated outside of this process and in a separate system. Specials are not included as part of the BOM in Hi-site which implies that the communication between the SM Specials and the rest of the stakeholders must be very transparent and active, which is not the case today.

This issue of transparency can further be found in the case of project status. After potential demand has been communicated with request for item availability and lead time the transparency is lost after the information has been given. There is no possibility to see where a project is located and who is currently in “charge” of the current process it is in which makes any kind of preparation regarding item reservation at the plants or suppliers problematic. This issue is due to the fact there is no general workstream which explicitly states when, where, and what to communicate with the stakeholders regarding projects. Although people have a specific role within Hilti it is not clear to all where the roles fit in the project business workstream and who is responsible for which decision. Decision making when it comes to communicate demand further upstream or requesting for Hilti quotation is therefore a sub-optimally structured process.

Last but not least is the lack of transparency when it comes to analyzing the history of projects. When building a knowledge database for projects it is important not only to track the project requirements, it is just as important to track whether demand for a particular project was included in the demand plan and the latest possible time point when a reaction is required of Hilti (Crum & Palmatier, 2003). This information availability also affects the possibilities to do formal risk assessments as that is highly dependent on the available information (Alliance, 2005).

3.3.3 Probability of success

The probability measures in place at Hilti are based on a gut feeling and tacit knowledge of the sales force. This tacit knowledge is important to maintain and improve to get better estimates of the probabilities. However, that may prove difficult considering that, for example, in META there were 14 new KPMs acquired in the year of 2014 alone.

The probabilities currently assigned to the sales process (as seen in the matrix in Figure 8) are pre-defined numbers associated to a single stage in the funnel while the probability field in Hi-site is a field where the probability can be freely chosen. The probability of winning projects varies widely (Crum & Palmatier, 2003) and putting all projects under the “same hat” must be done with great care. There can be a project where a verbal commitment has been reached from the customer; yet, history suggests the customer has never placed an order for Hilti while on the other hand there is a customer who has only just been contacted for a potential project and the probability of acquiring an order from him is even at this early stage 80%.

If these probabilities of the sales process are linked to the sales funnel concept as introduced in section 1.1.2 it can be concluded that there is a clear contradiction compared to what is suggested by literature. In the sales funnel concept each stage is subject to a probability based on the likelihood of a project entering the next stage (Cooper & Budd, 2007).

3.3.4 Decision making

Like mentioned in the previous subsection there are no clear Roles and Responsibilities (R&R) defined for the decision making process. Likewise, there is no process implemented when and what project demand to include in the monthly demand plan. With the implementation of the Sales Planning part of the HIP project logistics have structured an approach to come to a conclusion of the ‘one number’ with project demand as part of that. However, no process has been structured of how to get to the ‘one number’ from a project demand perspective. Therefore, there is need to structure a workstream which allows for a transparent process and a clear decision point of when to make decision on projects.
Currently when decisions need to be made regarding preparing for a possible project demand the stakeholders struggle with deciding who should take on the risk. The MO has not been willing to take on the risk of deciding on higher inventory with the possibility of obsolescence and there are calls for wanting HAG to raise the stock levels centrally. In the same way HAG is not willing to raise its stock levels of finished goods or raw material and want the MOs to take on the risk as that is where the forecast for the possible project demand is made. When decisions have to be made there is a lack of commitment to make them and often the MO requests for different scenarios on uncommitted projects.

It needs to be recognized that making a decision to include project demand in the monthly demand plan needs to be done with caution. The total average hit-rate of projects communicated to one of the BUs at Hilti is roughly 59% (Table 2) over the past three years. To get to these numbers certain assumptions had to be made; pending projects from 2012 and 2013 were considered as lost and pending projects from 2014 were not included in these numbers. However, it must be considered that not all projects are communicated to the BUs and therefore this hit-rate does not represent the total hit-rate. This means that even though the hit-rate for project communicated to this BU is relatively high the total hit-rate can be substantially lower. Unfortunately there was no data available to make such analysis.

<table>
<thead>
<tr>
<th>Project Conversion</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects Lost</td>
<td>30%</td>
<td>52%</td>
<td>42%</td>
<td>41%</td>
</tr>
<tr>
<td>Project Hit-rate</td>
<td>70%</td>
<td>48%</td>
<td>58%</td>
<td>59%</td>
</tr>
<tr>
<td>Total #of Projects</td>
<td>152</td>
<td>190</td>
<td>150</td>
<td>492</td>
</tr>
</tbody>
</table>

Dividing these numbers down to the 10 MOs who are most active in the project business and in turn contribute to 80% of the total number of projects over this three year period it reveals some interesting figures. In both Figure 16 and Figure 17 the x-axis are given in descending order with regards to the total number of projects over the period. The MOs with the highest hit-rates communicate projects with the lowest estimated values. In turn the MO which estimates the largest average value over all projects has only a hit-rate of 10%.

This shows the importance of assigning R&R to the main processes in the project business workstream such that decisions can be made when needed and the whole supply chain is more transparent.

Figure 18 represents the cause and effect diagram of the main root causes leading to the problem which improved project planning is intended to solve.
3.4 Research objective

It was identified by Global Logistics while working on the HIP project that there was need to include a research on the project business at Hilti. With the ‘one number’ in the SFI meetings it was important to gain understanding how much of this should be from project demand and when to activate that demand to allow for preparation of the supply chain. This initiative lead to the main research objective of this Master Thesis Project:

**RESEARCH OBJECTIVE** – Provide a conceptual design for the integration of the future project sales funnel into the Hilti integrated planning concept.

The To-Be conceptual design aims to provide a general workstream with R&R where timelines and decision points are clearly stated. In addition, a model which is intended to support decisions regarding which projects to include in the demand plan and how much of the quantity to include will be provided. Hence, proposal of two-sub-objectives:

**SUB-OBJECTIVE I** – Developing a general workstream for the project business with R&R where clear timelines and decision points are clearly structured

**SUB-OBJECTIVE II** – Developing a design of a decision support model for the project demand planning

3.4.1 Research questions

Following the main goal of the research the research question below was formulated:

**RESEARCH QUESTION** – How can the project sales funnel be integrated into the integrated planning concept at Hilti such that the transparency of project business is increased in order to mitigate the risk of low item availability and obsolescence?

In order to answer the research question the following sub-questions are proposed which in turn further compliment the two sub-objectives:

**SUB-QUESTION I** – How should the workstream model be designed in a workflow such that the organizational R&R of the project business actors are clear and understandable?

**SUB-QUESTION II** – In what way can the workflow be designed to allow for more transparent processes for decision making?

**SUB-QUESTION III** – How is Hilti able to reflect the decision points in the To-Be future HIP workflow?

**SUB-QUESTION IV** – How can the probabilities of acquiring a project be better exploited to allow for more efficient risk taking when it comes to making decisions on project opportunities?

**SUB-QUESTION V** – How can the project business forecast be improved?
3.4.2 Research scope

It was discussed earlier in this thesis the three different types of projects identified at Hilti: ISB projects, large scale projects, and small scale projects. For the purpose of the To-Be design of the thesis there will not be any distinction between the different projects as at the end the three scenarios will all come down to the same concept of being regarded as projects.

For feasibility reasons the thesis will merely provide implementation recommendations for the To-Be design and not include the actual implementation. There will not be further consideration for the execution phases of the project business; such as the production, warehousing, and distribution. Planning and forecasting will be kept in the forefront of this research.
4 TO-BE DESIGN OF PROJECT BUSINESS WORKSTREAM

It was stated in the previous section that the main objective of this Master Thesis Project was to provide a conceptual design for integration of the future project sales funnel into the Hilti integrated planning concept. The main objective of this section is to design a future project business workstream which is linked to the To-Be S&OP workstream at Hilti.

This chapter starts with a brief literature direction for the workstream design in section 4.1 where the main criteria for the whole design are discussed. The proposed To-Be design was developed together with few key stakeholders of this Master Thesis Project in a workshop. Section 4.2 outlines the design in four steps where the final workstream is proposed in the final subsection (section 4.2.6). In section 4.3 several exceptions to the To-Be design are mentioned and a description on how to deal with them is given. This chapter is concluded in section 4.4 where a general conclusion and recommendation on the design is given.

4.1 Direction for the To-Be design

In chapter three the available resources, the current process and problems of project business at Hilti have been described. In this section the aim is to give a direction to the workstream design based on both scientific, as well as, business knowledge. A literature review resulted in limited number of academic sources which support how to approach the problems occurring in project business, which is why inputs from practice and business knowledge will be used for direction.

4.1.1 Project demand forecasting & planning

It was mentioned before that project business demand is not accounted for in the transactional forecast. This is in line with what is being done in practice as the transactional demand can be forecasted by using statistical algorithms, while the project business demand is exceptionally ‘lumpy’ and unpredictable, and if included would make the total forecast unpredictable (Solutions, 2015). In his paper for the Oliver Wight Paper Series, Palmatier (n.d.) suggests that the demand planning process for projects requires the regular, routine, and disciplined process of communicating projects and updating the likelihood of winning them.

Within the Sales Planning initiative of the HIP project logistics are introducing the ‘one number’ concept where each MO agrees on a total demand number each month where it is partially built of project demand. Therefore, from a quantity of product perspective, a decision has to be made how much of the project forecast to include in this ‘one number’. Project delivery requirements for each project must be translated into product demand over time to get the total project demand on an aggregated level (Palmatier, n.d.). One important notion is that if a large part of the total product demand comes from the project demand, the product becomes uncontrollable due to the probability of zero demand when a project is not acquired. A clear decision point is needed for when to include project demand in the monthly forecast. Furthermore, if a decision is made to include the demand from a particular project in the monthly S&OP process, it should be visible to the whole chain to keep high transparency and awareness (Crum & Palmatier, 2003).

4.1.2 Communication

In project business it is essential to have good communication in order to achieve value creation (Johannessen & Olsen, 2011) and to keep the project demand planning process transparent (Palmatier, n.d.). A known challenge in all communication is how much information to communicate, to whom, and when to communicate. Companies often struggle to communicate the proper detail of information to facilitate action and decision making. There is tendency to communicate either not enough or too much information (Crum & Palmatier, 2003). Effective communication between sales and the supply
organization is a key driver towards success. The salesforce’s primary responsibility in the project business process is to communicate project opportunities and to keep status of the current projects. This communication is usually accomplished by ensuring that all project information is kept in a central project demand management system. As soon as the information of a project requirement changes, for example the sales probability or delivery date, the salesforce is responsible for updating this information (Palmatier & Crum, n.d.). The better the salesforce is in communicating accurate information in time for the supply chain to react the more reliable supply will be towards the customer which leads the salesforce to be more successful.

Van Donselaar et al. (2001) concluded that project supplier companies should make a selection regarding communicating demand figures from the projects in the project sales funnel and only include the projects which are estimated to have high probability of being acquired. However, this clearly ignores the issue of lead times. The lead times for items of a project are in most cases never identical. If some items have longer lead times compared to other items, the whole project must be communicated even before the probability is “high” in order to allow ample time for reaction.

4.1.3 The probability of success

Probabilities are often used to help enable the yes/no decision regarding which items and how much of each item should be included from the project forecast in the demand plan (Palmatier, n.d.). These probabilities are based on the belief of the salesforce that a deal can be struck with the customer (DeCarlo, Teas, & McElroy, 1997). This is in line with how Hilti is operating, yet, as was identified in the problem analysis with ineffective efforts of exploiting the usage of this sales probability.

Ideally, the sales probability ought to increase as the time draws closer to when the customer is expected to place the order, most certainly when it draws nearer to the required delivery date. If the probability of acquiring the order does not increase over time, it should be an indicator for the sales people to determine if additional actions need to be taken to increase the probability of acquiring the project or if no more effort should be put into it (Crum & Palmatier, 2003). However, this need not be the case because if, for example, other suppliers enter the bidding the salesperson might get more pessimistic and thus the sales probability can drop.

4.1.4 Decision making

Because the probability of winning a project varies greatly, it is important to decide at which stage a clear decision has to be made for which projects should be included in the ‘one number’ in the demand plan (Crum & Palmatier, 2003). For example, consider having five projects all with 50% probability of being successfully acquired. Should all the projects be included in the demand plan? That is a decision where no rules or guidelines found in literature suggest what to do but a simple calculation reveals that if, for example, one item has a demand of 100 in each project the total expected demand would be 250 (5x100x50%). Should a decision be made not to include this in the demand plan yet the project is won, companies run the risk of not having the material available in time and thus can lose the business from that customer.

Companies that focus mainly on projects as their business will sometimes use the sales probability to calculate the quantity to decide on including in the demand plan. However, it needs to be a managed process and the decisions should be made by senior management in the S&OP process (Palmatier, n.d.).

In order to yield better decisions, supporting the company’s goals and objectives, there needs to be effective communication and different scenarios need to be developed to understand the effect a decision has on the financial and resource plans (Palmatier & Crum, n.d.). Decision support is aimed at providing assistance in developing and choosing a course of action, given the uncertainty surrounding the choice (Walker et al., 2003). There is a common understanding that the utilization of
risk assessment and uncertainty analysis provide a useful decision support in the sense that the outcomes inform the decision makers that the risk of a project is relevant for the decision (Aven & Zio, 2011). It has also proved to be a powerful tool for front end decision making where the aim of risk assessment process is to assess several opportunities and to be able to compare, rank, and manage the options (Koller, 2005).

4.2 The To-Be design

The core of the workstream design is set up in four separate steps: Project entry, quality and feasibility check, project collection from the project sales funnel, monthly alignment with sales, and SFI meetings.

4.2.1 Terminology definitions

There are several terminologies that need to be defined so that it is clear what is tended to be captured by using the phrases in the actual design.

4.2.1.1 Market intelligence

When talking about Market Intelligence it must be separated into two different parts: Standard Market Intelligence and then Project Market Intelligence.

- **Standard Market Intelligence**: The standard market intelligence is seen as product promotions, seasonal events, sales trends, new product introduction, and phase-in/phase-out. These are events which are not captured in the statistical forecast but are kept as part of the sales history and are included in the material forecast.

- **Project Market Intelligence**: The project market intelligence considers the project business sales funnel. This is not captured by the statistical forecast and in addition no data on the project is accounted for in the sales history so that it is not used for future forecast calculations.

4.2.1.2 Project forecast

The terminology project forecast is used in three different circumstances; project forecast, recommended (or non-recommended) project forecast, and activated (or non-activated) project forecast.

- **Project forecast** is the demand requirements from the customer projects. The term project forecast is used since before it becomes an order it is treated in the same way as a forecast.

- **Recommended project forecast** is the demand requirements captured in customer projects which is recommended to be included as part of the demand plan or the ‘one number’ used in sales planning in the SFI meetings. **Non-recommended** project forecast is then what is not recommended to be included as part of sales planning in the SFI meetings but is kept in the project sales funnel for transparency.

- **Activated project forecast** refers to the demand requirements from customer projects that are activated in terms of going for order execution. **Non-activated** is the actual project forecast which is part of the project sales funnel and not activated for order execution.

4.2.2 Project entry

The project entry step is the constantly recurrent task of Sales keeping in contact with the customer over new projects or updated project requirements on existing leads and prospects and even running projects. Information about the requirements from these new projects and updated requirements on other projects is to be captured in Hi-site. No matter of what magnitude a project is or if it is an ISB
project, all project information must be captured in Hi-site to keep full transparency of the project sales funnel.

Sales must guide the customer towards a standard product to the maximum since that is where Hilti is extremely reliable and product flows are fast, stock would be immediately available which would allow planning for lead time of additional requirements above normal demand. To help Sales reach this goal a close contact must be kept with the FE who will help guide them towards the optimal standard solution. Furthermore, the ASM, Head of KPM, or the PMO Head will support Sales if management support is needed.

**ETO items – Specials**

The current process for Specials and the usage of the LPS tool was described in section 3.2.2.4 (also see Appendix C). These items must be treated differently than the normal items in the Hilti product portfolio. In the design process no item number is available and thus a unique “dummy” item number is used from the LPS tool. An item number is not created until the customer has expressed his willingness or given a commitment to place an order for the item. It was mentioned that the Specials items are not included in Hi-site. Therefore, a great opportunity to achieve increased transparency for projects with Specials is to include the LPS “dummy” item number in Hi-site. By including this item number, description of the item, and the customer requirements, the whole BOM is visible and everyone will be aware that a Special is part of the project and that it will bring more risk regarding obsolescence if ordered before receiving the customer order.

**How does this process contribute to the workstream?**

Below in Figure 19 the initial process in the workstream can be seen in an IDEF0 diagram. The outcome of this process is a Hi-site quote that will be used in the next process which will be described in the next section.

![Figure 19: Project entry process, IDEF0 model](image)

**4.2.3 Quality & feasibility check**

Project information and project requirements are not always of the required quality which allows the MO MM to start checking for the availability. The same goes for the feasibility in terms of, for example, requested quantity being yearly demand and requested lead time of one month which is infeasible in most cases. Careful discussion is needed in regards to feasibility of the project lead time. Some items will require longer lead times than others and must therefore be analyzed in more detail considering that the criticality of the item in terms of the whole assembly of an application might be crucial to start the project. For that reason, it is important that the MO MM checks for the quality and feasibility of the project requirements. The BU MM can give the MO MM support regarding lead time and quantity feasibility if needed. If the project requirements fail this check Sales are notified and the customer must be visited again and an agreement reached on a different solution. Furthermore, the ASM/Head of KPM/PMO Head is responsible for validating the sales probability determined by Sales.
If the project requirements pass the check the project is collected in SAP IBP which is the S&OP planning tool used in the whole process. The MO MM will upload all feasible projects into SAP IBP to keep transparency of the whole demand coming from projects that will be considered in the SFI meetings.

With regards to Specials, there is no change compared to the current process of feasibility check. Section 3.2.2.4 and Appendix C are referred to for more information.

**How does this process contribute to the workstream?**

The next step in the workstream is represented in Figure 20. As can be seen the quality and feasibility are constrained by standard lead times and the supply capability at plants and allied suppliers. The output is either an infeasible Hi-site quote which then becomes an input for the project entry and the process is repeated until feasible or discontinued by Hilti. The other option is that the output is a feasible Hi-site quote which is fed both into the next step in the workstream and into SAP IBP.

![Diagram of the process](image)

**Figure 20: Quality & feasibility process, IDEF0 model**

### 4.2.4 Monthly alignment with Sales

Demand from projects is an integral part of the ‘one number’ demand plan in the future SFI meetings. However, the projects are subject to different probabilities and positioned in different stages of the project sales funnel. Therefore, it is important that before logistics agree on the ‘one number’, an alignment with Sales is performed. The SFI meetings take place between the seventh and eleventh working day of the month, which means the alignment must be done latest fifth or sixth working day.

The MO MM will gather all the projects and create a project portfolio which will be screened and aligned with Sales what projects are feasible to assume will be awarded to Hilti. Furthermore, the lead time of some projects must be considered as a trigger for a decision if it is to be supplied on time to the customer. Sales must make a commitment to these projects because if that is not done there is no guarantee that any of the quantity can be received before the requested lead time for that particular. When an agreement has been reached between the MO MM and Sales the ASM, Head of KPM, or the PMO Head must agree to the total recommended project forecast proposal. After this alignment the MO MM will be able to do a risk assessment on the projects recommended for activation. The risk assessment will be done with regards to expected inventory risk, obsolescence risk, and expected level of service risk. A more thorough description of the risk assessment is given in the Decision Support Tool design of section 5. The BU MM is required to give input for the risk assessment with regards to information from HAG and supplier. The recommended projects are then fed to the final process. It must be made clear that based on standard lead times some project must be recommended for activation if the requested customer lead times are supposed to be fulfilled.
How does this process contribute to the workstream?

This part of the workstream adds two additional processes, the alignment and risk assessment (Figure 21). Active and feasible projects are used as input for the alignment with Sales where the outcome from that process is used in the risk assessment.

![Figure 21: Monthly alignment process step, IDEF0 model](image)

4.2.5 SFI meetings

The final process step is the SFI meetings where the decision on activating projects and including them in the consensus forecast or the ‘one number’ is made. As mentioned before, the total project demand is visible in SAP IBP where it can be compared to the standard materials forecast and market intelligence. The information is separated into recommended project demand and non-recommended project demand. In most cases it is enough to only have the GM make the final decision to activate order execution or to decide to only keep projects for transparency in the systems. However, if the value of a project exceeds certain cost thresholds, approval is needed from the Region Head or an Executive Management Team Member, and in the most extreme cases an approval is needed from at least two Executive Board Members (further description about this approval process is out of scope for this thesis).

If the decision is made to activate projects, the MO MM will activate the demand in APO and the demand is communicated to the whole supply chain. For projects that are not activated, yet would require activation due to lead time feasibility, Hilti will have to accept the risk of either upsetting the customer if the order is placed or lose the business.

ETO items – Specials

Transferring the “dummy” item number from the LPS tool over to APO will not be possible as the system will not recognize the structure of the number and there is no materials master or price behind it in the system. Besides, these items are most often specifically customized to the customer’s needs and it is highly unlikely that other customers will buy the items. Therefore, decisions on activating the demand from Specials requires commitment from the customer to order and then first an item number can be created in APO which is then to be fed to APO (see Appendix C for the process of Specials).

How does this process contribute to the workstream?

This is the final process in the proposed design and can be divided in the separate actions; the actual decision and then the activation (Figure 22). The decision is made by the GM to activate projects or reject the risk and only keep them for transparency. The MO MM activates the demand in APO and the outcome is activated project forecast as order execution.
4.2.6 The final layout of the To-Be workstream

The whole process is combined in one main workstream diagram in Figure 23. Collection of project demand in SAP IBP is not shown in the whole workstream picture as it is rather seen as a resource than a process. Therefore, SAP IBP is added as a resource in the decision process.

4.2.7 Roles & responsibilities for the design

An essential part of an integrated supply chain is to have clear roles and responsibilities of the stakeholders (Stewart, 1995). To ensure that the To-Be design would be structured in a clear and understandable manner a detailed description of the R&R for each stakeholder was made (see Appendix D) and graphically summarized in a RAPID matrix in Figure 24.

RAPID matrix for the R&Rs

To create a structured graphical representation for the R&R a RAPID matrix is used, as introduced by Bain and Company (Blenko, Mankins, & Rogers, 2010). The acronym RAPID is formed by the words: Recommend, Agree, Perform, Input, and Decide. These words reflect primary roles in any decision and a short explanation of each word is given below, as described by Blenko et al. (2010).

- **Recommend**: The stakeholder with the recommendation role is responsible for obtaining and evaluating the inputs and propose a recommended action. It is important that there is only one R.
- **Agree**: Stakeholders who must agree to a recommendation before it can be moved forward to a decision are given this role. Ideally not too many A’s should be used to avoid complexity.
- **Perform**: This role is assigned to the stakeholders who performs or executes the decision. The stakeholder with this role is responsible for implementing the decision.

- **Input**: The stakeholders with input responsibilities are the ones who provide the data which is used to reach a decision. Having too many I’s can create confusion and additional struggles as people will try to get their own ideas into the decision, therefore, the number of I’s should be limited.

- **Decide**: There is always a person who is responsible for making the final decision and only one D is used.

<table>
<thead>
<tr>
<th>R Recommend</th>
<th>A Agree</th>
<th>P Perform</th>
<th>I Input</th>
<th>D Decide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer</td>
<td>Sales</td>
<td>FE</td>
<td>MO MM / PMO / FFM</td>
<td>ASU / Head of KPM / PMO</td>
</tr>
</tbody>
</table>

- Maintain updated H-OE information: I P
- Provide recommendations for use of standard items to maximum: I P
- Maintain feasible project requirements in H-OE: I P
- Communicate HILTI quotations to customer: P I
- Validate Sales Probability: I P I
- Align recommended Project Forecast volume: A P
- Add Project Forecast to Project Sales Pattern: I P
- Provide Risk Transparency on Inventory, Obsolescence, & LOS: P I
- Prepare recommended Project Forecast for SFI: R R P D
- Make decision on recommendations for SFI: R D
- Amend/Activate recommended Project Forecast: I P D I
- Check required documents for activated Projects: P

*Figure 24: RAPID model for the R&Rs of the stakeholders in the workstream*

### 4.3 Exceptions to the To-Be design

There are several exceptions to the workstream which occur frequently that must be considered and dealt with. These exceptions are clustered in two separate cases; ‘Activation of project demand outside SFI meetings’ and ‘Changes in activated project demand’.

#### 4.3.1 Activation of project demand outside SFI meetings

After a decision has been made to activate project demand in the SFI meetings the MOs need to commit to that number. This committed number is communicated to the supply chain and the overview of the total demand of a particular project is only managed within the MO. There are two scenarios where special attention is needed; commitment for an order on a project which was not activated in the SFI meetings, and an order is placed without the project having been communicated to logistics. Both scenarios are managed through the same process.

In case of either event occurring, no promises can be made whether or not the project can be supplied according to the requested lead time. That is because the whole supply chain has been activated for this previously committed number and by activating more demand on top of that number can exceed the available capacity.

#### 4.3.2 Changes in activated project demand

Four different scenarios can occur with regards to changes of activated project demand; Item change, quantity change, timeline change, and cancellation. Changes to the BOM often occur during the negotiation phase with the customer. Even when a commitment has been received from the customer can the requirements change. Therefore, no matter what the change is, if a project has been activated...
the change must be communicated to the supply chain to allow it take the necessary actions if needed. For example, if there is a change in items of the BOM or cancellation of items production might have to change the production quantity if the demand change is high. The same goes for changes in quantity, timeline change, and most importantly project discontinuity.

4.4 Conclusion & recommendation

In this section a new workstream design for project business at Hilti has been proposed. With this design it is suggested to stop using the Excel forecast template and only use Hi-site to capture project information and requirements. Keeping both tools active causes Sales to do double work and the quality of the data are, as identified in section 3.1.3, poor. Therefore, it must be communicated and made clear to Sales that if a project is not entered in Hi-site it will not be considered in the SFI meetings. This means that there is no guarantee that the customer requirements with regards to lead time will be met. Adding a KPI on the quality of information in Hi-site would add an incentive for Sales to feed all available information and work harder on capturing project information from the customer. The more information that is captured and communicated to logistics the likelier it is to have more reliable supply to the customer.

It was identified by the stakeholders to have an additional process added at the end of the workstream. This addition would be a process where the BU’s have the opportunity, during the S&OP discussion, to look at the global project demand for items and take additional actions to increase production capacity to mitigate the risk. This additional capacity would then be stored centrally, or at supplier if possible, and not be allocated to the markets. However, managing the projects is done in the MOs and when demand reaches a BU it is on an item level and not project level. Therefore, this would require an alignment between all BUs which have items that are part of a project one BU wants to activate. Due to the uncertainty of how this process should be managed and structured it was decided not to include it as part of the design in this thesis. Furthermore, time constraints played a role in this decision as a consensus of how to approach this problem was not reached before the end of the Master Thesis Project.

Developments on Hi-site are needed in order to implement the proposed workstream. For example it is important during the quality and feasibility check (section 4.2.3) to consider the item lead times in a project as that may force Hilti to make decisions to activate projects sooner. How to deal with this and further developments of Hi-site will be elaborated on in the following section.
The To-Be design, proposed in section 4, was aimed at supporting the main objective of this Master Thesis Project. However, this section will take a closer look at the whole process of making the decision to take risk on activating project demand or rejecting the risk and only keeping the project demand in the project sales funnel for transparency. The main content of this section is a design of a decision support tool aimed at supporting the decision making process to activate projects. This design is directly linked to the workstream design as it is intended to be used throughout the whole workstream, most importantly, in the phase of the ‘Monthly Alignment’ (section 4.2.4) where the risk assessment is conducted.

In section 5.1 a design direction which explains the general concept of the design in the form of a conceptual design. This is followed by a detailed design in section 5.2 where the main elements of the conceptual design are described in further details and brief model verification is demonstrated. This chapter is concluded in section 5.3 with a conclusion and recommendations for the design.

5.1 Design direction – A conceptual design

Projects arrive in a random process, only captured by market intelligence. For each project there are requirements (inputs), for example, a customer specific combination of products, customer specific ETO items, and other requirements that can be shared by multiple projects. Based on these requirements decisions have to be made to either include projects in the demand plan, thus prepare products for the possible order (Palmatier, n.d.), or if the project requirements should only be kept transparent in the system without going into execution. Furthermore, lead times will additionally trigger the decision making process as for some items of a project a decision needs to be made well before other items due to longer lead times. During this decision process the decision makers must consider multiple alternative courses of action based on a quantified project risk assessment. Risk assessment can on the one hand build support for projects with low risk and on the other hand cause less focus or even discontinuity on higher-risk projects. Projects can be compared and prioritized based on the risk and a greater awareness on the overall risk can be achieved (Kendrick, 2009).

In this section a conceptual framework will be provided for the To-Be design of the decision support tool. The tool will be aimed at providing clarity on the risks and opportunities associated with the projects of the project sales funnel. The To-Be design for the decision support tool is divided into three main parts; input, intermediate outputs, and outputs, each addressing an important part needed to give effective recommendations towards the final decision of including project forecast in the demand plan. This tool is proposed for being used before the SFI meetings, where the final decision is made to incorporate project demand in the demand plan.

5.1.1 Conceptual design – Inputs

The most important part needed for assessing the uncertainty of projects and to quantify the risk of the project sales funnel is the model inputs (Bowers, 1994). Inputs will be used to generate knowledge which allows for analyzing the uncertainty and risk on both project level, as well as business level. These inputs will be gathered from estimated – and the eventual fixed – requirements of past projects, both won and lost, in addition to requirements from ongoing projects in the project sales funnel. There will be further additions to the inputs in the form of more details on each project and actions taken during the project lifecycle.

How can historical project data be of use when there are no two projects identical in terms of requirements (Perret et al., 2012)? Collecting quantitative data that describe past projects allows for making statistical analysis which can provide a valuable basis for project risk analyses. Records of the project estimations and the eventual outcomes from multiple projects are required for the risk
analysis. These statistics can be used to derive a summary on the variation between the estimations and the actual outcome of a project (Bowers, 1994). Therefore, it is determined to be of great importance to monitor the changes in project requirements over the project lifecycle. These project changes will be used as part of the inputs and can serve as a base for gathering knowledge base for better estimates on new and future projects.

Capturing the inputs requires that all inputs are stored in a common system solution or a database. Many companies involved in project business utilize a project or opportunity database to help with the efforts of monitoring project performances (Crum & Palmatier, 2003; Lawrence et al., 2010). These project databases contain specific details about all the projects in one place, which makes it easy to manage the information in a variety of ways for both sales management and project demand planning (Crum & Palmatier, 2003). Therefore, it can be assumed that a project database will serve as an ideal solution to store the inputs needed for the proposed design.

The inputs which are seen as important to feed in the project database and use in generating the eventual outputs for the decision support tool, and evaluate the projects can be seen in the following table (Table 3):

### Table 3: Project database inputs

<table>
<thead>
<tr>
<th>Project Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Project name and project number</td>
</tr>
<tr>
<td>- Customer name and location (country/MO)</td>
</tr>
<tr>
<td>- Date of initial project request</td>
</tr>
<tr>
<td>- Probability of customer placing an order at Hilti (Sales probability)</td>
</tr>
<tr>
<td>- Value of project</td>
</tr>
<tr>
<td>- Items requested (BOM) and the quantity for each item</td>
</tr>
<tr>
<td>- Requested delivery dates</td>
</tr>
<tr>
<td>- Was the project included in the demand plan? (Yes/No)</td>
</tr>
<tr>
<td>- Was the final order placed for Hilti? (Yes[PO]/No)</td>
</tr>
<tr>
<td>- Hindsight demand (if ordered the actual BOM for the order, else no final BOM)</td>
</tr>
</tbody>
</table>

A further solution is required which allows tracking the changes of the projects over time. The changes will be made in the main project database; however, when each change is made the previous information needs to be stored as well. Therefore it is proposed to track these changes with an extension to the project database which will be called ‘Project ChangeLog’ (for the rest of this thesis this will be referred to as ChangeLog). At any moment in the project lifecycle, if a change is made to the project in the project database the ChangeLog will be updated with a time stamp indicating the time when a requirement was valid and the time when it was not required in a project. The inputs for the ChangeLog can be seen in the following table (Table 4):

### Table 4: Project ChangeLog inputs

<table>
<thead>
<tr>
<th>Project ChangeLog</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Project number</td>
</tr>
<tr>
<td>- The change in project requirements</td>
</tr>
<tr>
<td>- Change in sales probability</td>
</tr>
<tr>
<td>- Item change (change from one item to the other, new addition of item, or cancellation of an item)</td>
</tr>
<tr>
<td>- Change in item quantity</td>
</tr>
<tr>
<td>- Change in requested delivery dates</td>
</tr>
<tr>
<td>- Date of change</td>
</tr>
<tr>
<td>- Item part of order? (Yes/No)</td>
</tr>
</tbody>
</table>

This ChangeLog will be linked to the main project database by the unique project number. Each change will be represented by its own input in the ChangeLog with a date indicating when a change
was done. The ‘item part of order?’ input is an automatic entry which is linked to the final input to the project database if an order is generated for the project. Figure 25 represents the general process of how the data is captured both in the project database and the ChangeLog.

![Figure 25: Project information logging process](image)

### 5.1.2 Conceptual design – Intermediate outputs

The next step of the decision support tool is using the inputs to generate intermediate outputs which will be in the form of uncertainty analysis. First historical project assessment is made which will be used to determine the project hit-rate and the uncertainty estimates on an aggregated level. Secondly, this historical project assessment is used as a knowledge base for further estimations on project and business level.

With the historical assessment, certain knowledge can be gathered about the changes in project requirements. An interesting observation is the change in expectation of getting the project as that may give better estimates on future sales probabilities. The concept of expectancy theory was first introduced by Vroom in 1964 and later modifications have been made where it has been linked to the salesforce motivation (Teas & McElroy, 1986). Salesforce motivation expectancy is the belief concerning the likelihood that spending a certain amount of effort on a particular task will lead to an enhanced level of performance on a specific performance dimension (Walker Jr., Churchill Jr., & Ford, 1977). Johnston and Kim (1994) concluded in their study that when information on both current and past performance is provided, the salesforce is expected to change its expectancy on hitting a project. Perceived performance is believed to be directly linked to the expectancy estimates of the salesforce and there are indications that upsurges in selling efforts will lead to an increase in future performance when experiencing successful results (DeCarlo et al., 1997). Therefore, included in the To-Be design is a historical assessment both on sales probability, as well as project requirements.

The next step in this second phase of the decision support tool is to generate intermediate outputs that will serve as input for the final outcome which is a risk assessment on project level and business level. This will be in the form of a project screening and selection phase, that is, all projects of the project sales funnel will be presented in a risk diagram (Hallikas, Karvonen, Pulkkinen, Virolainen, & Touminen, 2004). Risk diagrams (or risk matrices) are known to be very useful for presenting the assessment of identified risks. The risk diagram gives a general perspective upon all risks and makes
the most critical risks requiring the most attention noticeable (Hallikas et al., 2004). On the left side of
the diagram there is sales probability and on the bottom the impact or consequence of each project is
given. The impact is a subjective estimate of the consequence a project demand has on the total yearly
materials forecast for all requested items combined (average over the whole item portfolio of a
project). Table 5 presents the impact scale description and Figure 26 presents the risk diagram, where
the green area represents an assumed acceptable range of risk.

Table 5: Project demand risk impact assessment scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Subjective estimate</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minor impact</td>
<td>0-24% of the total yearly material forecast</td>
</tr>
<tr>
<td>2</td>
<td>Moderate impact</td>
<td>25-49% of the total yearly material forecast</td>
</tr>
<tr>
<td>3</td>
<td>Above average impact</td>
<td>50-74% of the total yearly material forecast</td>
</tr>
<tr>
<td>4</td>
<td>High impact</td>
<td>75-99% of the total yearly material forecast</td>
</tr>
<tr>
<td>5</td>
<td>Serious impact</td>
<td>100% or more of the total yearly material forecast</td>
</tr>
</tbody>
</table>

Figure 26: Risk diagram

The decision maker will be able to use the risk diagram to select the most “attractive” projects based
on the sales probability and impact. From that moment the decision maker has a portfolio of projects
that can be taken through the risk assessment.

5.1.3 Conceptual design – Outputs

After generating the intermediate outputs the tool has the input for producing the final outputs. The
outputs will be in the form of a formal risk assessment on two separate levels: project level and
business level. Assessing risk on project and business level helps creating understanding of the risks
to make better decisions (Oracle, 2009).

A number of useful tools are suggested by literature to be used in assessing project risk, such as
statistics, metrics, and modeling and simulation tools (Kendrick, 2009). In the proposed To-Be design
a combination of statistics and metrics will be used, in addition to highlighting the effects on business
objectives by activating certain projects.

The decision making part of the model allows the decision maker to analyze the consequence of
activating a single project and then what consequence it has on the whole portfolio. This final
outcome of the decision support tool is not aimed at taking over the control of the decision maker
when it comes to making the actual decision. The results should not be blindly accepted as they are
based on estimations and the final decision regarding whether a project should be included in a project
in the demand plan or not will always be a case-by-case managerial decision (Crum & Palmatier, 2003).
However, the outcomes can be used to compare different scenarios and thus make a better decision
regarding how much of the risk should be accepted.

5.1.3.1 Risk assessment on project level

Risk assessment on project level is most often focused on the individual risks, should the risk occur,
that will affect the project’s objectives (Bartlett, 2004). The goal is to highlight the estimated impact
of the requirements and translate that into the project level risk assessment. In principle, if the risk
assessment shows that Hilti can afford not to worry about the risk at the individual project level, then
the decision maker can focus on maximizing the potentially expected return (or minimize the
expected cost) which should then drive all choices and manage the uncertainty within each project.
This would be the ideal outcome and has the obvious merit of simplicity. Be that as it may, monetary related risk of a project captures only one objective. Generally, there is an extensive variety of other risks and rewards which require effective management – including managing critical items, expected impact on inventory and obsolescence, ensure customer lead time expectation, and potential waste of human resources (Chapman & Ward, 2011).

It is recognized in literature and practice that risk assessment and prioritization are required to be able to choose suitable management actions for the identified risk factors at both business and project level (Hallikas et al., 2004). This design proposes to use the weighted value of the risk or the expected value (Goodpasture, 2004) in terms of expected demand and expected value of items. These expected values of a project will be used to prioritize the projects based on the impact (as determined in the risk diagram). Furthermore, the standardization of items will be used – standardization means items can be standard, on-demand, or Specials (ETO items). It is assumed that by performing this prioritization the decision maker can filter out the projects which are subject to the greatest risk even further (Goodpasture, 2004).

An important part of the risk is the lead time aspect. This lead time risk appears when considering when is the latest point in time a decision has to be made to activate project demand. Some items require substantially longer lead times than others and, therefore, it must be included in the risk assessment that not activating a project at a specific time may lead too late delivery compared to the requested dates by the customer.

By extending the risk assessment beyond the single project level to a project portfolio it can be identified that some projects include items which are also part of other projects and thus the risk can be balanced and even decreased (Oracle, 2009). This will help identify risk mitigations as Hilti is more likely to be willing to accept the risk if multiple projects ask for a specific item.

5.1.3.2 Risk assessment on business level

By assessing the risks on business level, the risks and opportunities are identified that will affect the business objectives and business goals (Alliance, 2005). Furthermore, the risks involved can be seen as financial where the expected revenues are to be considered (Jordan, 2013), lost opportunity on other projects which were not part of the activated projects, and the expected costs.

The output will give the decision maker the opportunity to analyze the total effect of activating the project demand, while not accepting the risk on other projects and leave them as non-activated in the project sales funnel. The potential risk on inventory and obsolescence risk will be identified, in addition to the expected monetary gains, potential losses, and costs.

The decision maker must consider three things before coming to a conclusion of what projects to recommend for inclusion in the demand plan: The potential gain of activating a project, the consequence of not hitting an activated project, and the potential loss if a project is won without activating it (Table 6). Based on these three criteria the decision maker can evaluate if the gains of hitting a project outweigh the risks of not hitting it, or hitting the non-activated project. The decision maker must carefully assess the projects that are not determined as feasible for activation with regards to the requested lead times and at which point in time is the latest possible decision point.
The project forecast is either activated in full quantity or not at all, there is no option of only activating a partial quantity since the project is either won in full or not. Therefore, it is important to give the potential gains and losses expectancies in terms of the full quantity.

### 5.1.4 The conceptual framework for the To-Be design

A conceptual framework was developed as an overview of the To-Be design. In general, the main goal of the design was to structure a decision support tool which could be used to reach a better decision. This framework can be found in Figure 27 below. As the figure suggests the final outcome of the decision support tool will be the eventual recommendation for the ‘one number’ of project demand. The number will be compared to the total demand from the MO under analysis to give a prediction of the controllability.

#### Table 6: Possible gains & losses of project activation – Opportunity matrix

<table>
<thead>
<tr>
<th></th>
<th>Activate Project Forecast</th>
<th>Do not activate Project Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Win Project</strong></td>
<td>Expected revenues [EQ 9]</td>
<td>Expected lost revenues [EQ 11]</td>
</tr>
<tr>
<td><strong>Lose Project</strong></td>
<td>Expected costs [EQ 10]</td>
<td>-</td>
</tr>
</tbody>
</table>

**Managerial decision to accept or reject the risk of activating project forecast**

- **Accept Risk**
  - Activate project forecast quantity in Demand Plan

- **Reject Risk**
  - Keep the remaining projects in the project sales funnel transparent and under review

**Figure 27: Conceptual framework of the To-Be design**

### 5.2 Detailed design

The conceptual design described the general structure of the decision support tool and the objective of the tool. In this section a detailed description of how the project database and the ChangeLog will be structured is given including a description of the risk assessment model.

#### 5.2.1 Project database

The project database is structured in two main overviews starting with an individual project overview where the user identifies what project he/she wants to see from the whole project portfolio. Under this main project overview the user will furthermore be able to find the ChangeLog for that particular project. The second overview is the aggregated overview of the project portfolio of all projects whether won or lost. The user will furthermore be able to identify a specific time period in case the...
portfolio overview or the historical overview is chosen (Figure 28). Each entry in the project database is collected in separate view which is not visible unless a report is run from the database storing all the inputs.

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Start Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Or</td>
<td></td>
</tr>
<tr>
<td>Project Number</td>
<td>End Date</td>
</tr>
</tbody>
</table>

**Figure 28: Mockup of the project database home screen**

### 5.2.1.1 Individual project overview

Within the individual project overview of the project database only the most recent information on requirements will be available; that is, if a project was won only the hindsight demand with latest requirements is seen and for projects that were lost the last known quote will be shown. All other requirements which are no longer valid are kept in the ChangeLog, although the most recent information can be seen as well. The reason for this is to keep the main overview as simple as possible for the people who will become the users of the project database. The ChangeLog is easily accessible within this overview. See Figure 29 for a mockup of the design.

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Requested Delivery Date (Start)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Number (ID)</td>
<td>Requested Delivery Date (Finish)</td>
</tr>
<tr>
<td>Initial Date of Request</td>
<td>Last Update</td>
</tr>
<tr>
<td>Customer Name</td>
<td>Sales Probability</td>
</tr>
<tr>
<td>Customer Location</td>
<td>Estimated Value</td>
</tr>
<tr>
<td>Included in Demand Plan (Yes/No)?</td>
<td></td>
</tr>
<tr>
<td>Order Placed (Yes/No)?</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 29: Mockup of the individual project overview**

### 5.2.1.2 ChangeLog

When entering the ChangeLog overview the user will have a view of all changes made to a particular project. Each change is identified with a ‘Change ID’ which indicates what type of a change was made; be it changed sales probability, change (addition or omission) of item, item quantity, or requested delivery date. Each ‘Change ID’ triggers the fields relevant to the change and keeps the irrelevant fields empty. This is important as with this approach the sales probability can be separated since that is a change on project level and all other changes are on item level. The first matrix shows the changes in sales probability with a time stamp for when each entry was valid and when it became invalid. In the second matrix the item changes are found with all possible information about possible changes as listed before. A mockup of the project ChangeLog overview can be found in Figure 30.

Each entry into the project database, whether it is a new entry or a change, will get a unique number which will not be visible in any of the overviews. This number is used to create a new entry line in the background which can be used to differ between changes on, for example, the same item multiple times.

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5.2.1.3 Project portfolio overview

The project portfolio overview shows all projects captured in the project database and the overall project level information: Project number, name, sales probability, total value, entry date, start and end date, and information on inclusion in the demand plan or if it was ordered. Active projects that have not entered execution, won or lost, do not have any value in the ‘Order Placed?’ field. Furthermore, there is the possibility to filter out specific projects which are of interest to the user, such as from a specific time period and project value or sales probability interval. With these filters the user can screen through at which stage in the project lifecycle projects were won over a specific period or even if project that were included in the demand plan became orders or not. See Figure 31 for a mockup of the project portfolio overview.

Available Filters:

- Project Entry Date
- Project Value
- Sales Probability

Order Placed?
Yes
No

Included in Demand Plan?
Yes
No

Figure 31: Mockup of the project portfolio overview

5.2.1.4 Project database output

The project database is the collection layer of inputs for the whole risk assessment model. Before being able to start the risk assessment, the relevant project information must be extracted from the main data storage which is the background of the project database. This extracted project information will then be fed in the risk assessment model for the user to run multiple analyses.

5.2.2 The risk assessment model

In this section the risk assessment model is introduced. First some variables and parameters are introduced before a description of the model is started.

Variables & parameters

- $N^m_p(t)$: Number of projects arrived at or before time $t$ (arrival process of projects), in MO $m$.
- $P^m_n$: $n$-th arriving project in MO $m$. 

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\( O_t^m \) \( (t) \) Number of projects executed (won/lost) before time \( t \), in MO \( m \). \( O_t^m \) \( N_p \).

\( G_n^m \) Set of items \( i \) estimated to be required in project \( n \) from MO \( m \).

\( W_t^m \) \( (t) \) Number of projects won before time \( t \) in MO \( m \). \( W_t^m \) \( O_p \).

\( \theta_t^m \) Sales probability of project \( n \) in MO \( m \).

\( ED_{t,n}^m \) \( (t) \) Estimated demand of item \( i \) from project \( n \) for delivery at time \( t \) in MO \( m \).

\( HD_{t,n}^m \) Hindsight demand for item \( i \) from project \( n \) for delivery at time \( t \) in MO \( m \).

\( MF_t^m \) Materials forecast of item \( i \) in MO \( m \) over a year.

\( V_i^m \) Value of item \( i \) in MO \( m \).

\( IC_t^m \) Inventory cost of item \( i \) in MO \( m \).

\( OB_t^m \) Obsolescence cost of item \( i \) in MO \( m \).

### 5.2.2.1 The intermediate risk assessment model

The intermediate outputs are important to generate for calculations in the final outputs. The following description includes the quantified measures for the intermediate outputs.

**Project hit-rate**

The project hit-rate is considered to be one of the most important intermediate outputs. The project hit-rate is based on the ratio between all projects won within a MO and all projects captured (and communicated) within the same MO. \( Equation (1) \) shows how the project hit-rate is calculated.

\[
H_t^m = \frac{W_t^m}{O_t^m}, \forall m
\]  

**Delta project demand**

As part of the historical assessment there will be an uncertainty analysis. This uncertainty analysis will be determined by the Squared Coefficient of Variance (SCV) of the difference (delta) between project forecast demand of item \( i \) of project \( n \) in MO \( m \) and hindsight project demand of item \( i \) of project \( n \) in MO \( m \). As suggested by Hopp and Spearman (2008), having a high SCV value of 1.77 involves a highly uncertain event and should be avoided, therefore if the SCV value is higher than 1.77 the estimation of project demand for item \( i \) yields too much uncertainty to give accurate estimation of the eventual order quantity. See \( equation (2) \) and \( equation (3) \) for the mathematical expression of the delta demand and the SCV, respectively.

\[
\Delta D_{t,n}^m = ED_{t,n}^m - HD_{t,n}^m, \quad \forall i, m \text{ and } n \in O_p
\]  

\[
SCV_i^m = \frac{\sigma_{\Delta D_t^m}}{\mu_{\Delta D_t^m}}, \quad \text{where } \Delta D_t^m = \sum_n \Delta D_{t,n}^m, \text{ and } n \in O_p
\]

**Where:**

\( \sigma_{\Delta D_t^m} \) Represents the standard deviation of the delta demand

\( \mu_{\Delta D_t^m} \) Represents the mean of the delta demand

**The risk impact**

In the conceptual design section (section 5.1.2) it was described how the model will determine, as an intermediate output, a project risk impact assessment. To calculate this risk impact it needs to take into consideration all active project demand for a particular item \( i \) of project \( n \) and divide it by the total materials forecast for this same item \( i \). \( Equation (4) \) gives the mathematical expression of the risk impact.

\[
R_l^m = \frac{ED_{t,n}^m}{MF_t^m}, \quad \forall i, m, \text{ and } n \in N_p \setminus O_p
\]

At this point the user can assess the risk of the active projects in the project sales funnel based on the risk diagram (Figure 26). The next step is to select which projects to include in the risk assessment for
the final project portfolio, that is, a decision making risk assessment highlighting the effects on project
and business level.

5.2.2.2 The final output of the risk assessment model

Below the model representing the final outputs can be found. First a description of the project level
output is given, followed by a description of the business level.

Project level – Expected demand

First there is need to calculate the expected demand for each project. To do that the estimated
requirements from Sales must be multiplied by the sales probability as indicated by equation (5).

\[ EED_{i,n}^m = ED_{i,n}^m \times \theta_{n}^m, \quad \forall \ i, n, m \text{ and } n \in N_p \setminus O_p \] (5)

Project level – Expected project revenue

The next step is to evaluate the expected project revenue. This is then used as one of the main outputs
for the business level output. See equation (6) for the mathematical expression of the expected project
revenue.

\[ PR_{n,m} = \sum_i EED_{i,n}^m \times V_{i}^m, \quad \forall \ m \text{ and } n \in N_p \setminus O_p \] (6)

Project level – Standardization

Items are divided into three different standardization types; standard, on-demand, and Special. The
risk of standard items is typically none except if extreme quantities are asked for. Therefore, standard
items are assumed to be no-risk items. On-demand items are the items which are not kept on stock
within the MO and therefore involve substantial risk of becoming obsolete should a decision be made
to order without a customer order. With that in mind, on-demand items are labelled as risk items.
Finally, there are the Specials which have been described earlier in this Thesis (section 3.2.2). These
items, due to the customization, get the label extreme risk item.

Project level – Project prioritization

Depending on what is valued as a higher priority; the expected demand of a project, the expected
value, or the item standardization, the user can prioritize all projects based on these measures.

Business level – The ‘risk factor’

When a decision has been made to include demand from a project in the demand plan there is one risk
event associated with it, the probability of not winning the project. This will be called the ‘risk factor’
of projects. To calculate this risk factor the project (or quotation) hit-rate must be calculated first and
then subtract that from one. Equation (7) shows the formula for the ‘risk factor’.

\[ RF_{m} = 1 - H_{m}, \quad \forall \ m \] (7)

Business level – Expected activated project demand over lead time

Before calculating the potential gains the total project demand for all items must be calculated over
the period \((s, t)\) where \(s\) stands for the current time and \(t\) for a required delivery time. Because either
the whole project is won or nothing at all, the sales probability is excluded for the assessment on
business level. A decision variable \(X_{n}^m\) is introduced, indicating the decision to include a project in the
assessment \((=1)\) or to exclude it \((=0)\). Equation (8) shows the mathematical expression.

\[ EDL_{i}^{m}(s, t) = \sum_{n=N_p(s)}^{N_p(t)} ED_{i,n}^m \times X_{n}^m, \quad \forall \ i, m \text{ and } N_p \setminus O_p \] (8)

Business level – Expected revenues

For the expected revenues the hit-rate finally comes into the equation. The hit-rate is included since it
can be expected that, independent of the sales probability, a project can be won with X%.
Furthermore, either the whole project is won or it is lost, therefore, only the hit-rate is included and
not the sales probability. Equation (9) represents the formula for the expected revenues of item $i$ in MO $m$ if activated.

$$Z_i^m = EDL_i^m * V_i^m * H^m, \ \forall \ i, m$$  \hspace{1cm} (9)

**Business level – Expected costs**

The expected costs are considered to be the inventory cost of item $i$ and added to that the obsolescence cost. In this calculation the risk factor is considered due to this being a risk situation, that is, the supply chain prepares for the project and the projects are not hit. Equation (10) shows the mathematical expression for the expected cost of item $i$ in MO $m$.

$$EC_i^m = RF_m * EDL_i^m * (IC_i^m + OBI_i^m), \ \forall \ i, m$$  \hspace{1cm} (10)

**Business level – Expected opportunity loss**

In a similar manner the expected opportunity loss is determined. If a decision is made not to prepare for a project there is an expected loss in revenues if the customer ends up awarding Hilti the project. Equation (11) shows how the mathematical expression of the expected opportunity loss for item $i$ in MO $m$ is determined.

$$OL_i^m = \sum_n EDL_{in}^m * (1 - X_{in}^m) * V_i^m * H^m, \ \forall \ i, m$$  \hspace{1cm} (11)

These three expected gains outputs will be represented by the opportunity matrix defined in Table 6.

One critical assumption needs to be made in the model; the items of one project cannot be used in another project if it is lost, but in reality that is of course not the case, therefore, the decision maker must be aware that this is a worst case scenario and he/she needs to keep this in mind.

### 5.2.2.3 Final outcome of the decision support tool

The final output of the decision support is as discussed a one project demand number which is recommended for activation. This number is to be compared to the total demand so that the controllability can be determined. To compare the two the project demand number for item $i$ in MO $m$ is divided by the material forecast of item $i$ in MO $m$. This is a similar calculation as was done for the risk impact, see equation (12) below for the mathematical expression.

$$Controllability = EDL_i^m / MF_i^m \ \forall \ i, m$$  \hspace{1cm} (12)

The higher the number to more uncontrollable the project demand becomes and a threshold is determined to be above one.

### 5.2.3 Example using the risk assessment model

To verify if the risk assessment model works and yields usable data, an example run with a mixture of hypothetical numbers and real projects was executed. The historical information was excluded from the example run as it was not determined feasible to generate random numbers for the calculation of those values. For the example, a random MO was chosen as the base for gathering projects and other relevant information. 36 projects were chosen randomly with adjusted sales probability to get reasonably distributed values. To start the verification the risk impact was calculated for each item of the projects and then the average was mapped up in the risk diagram (Figure 32) with the sales probability. The hit-rate and risk factor are both assumed to be 50%.
Based on the risk diagram seven projects were chosen for the main risk assessment: Project 02, 08, 13, 16, 19, 28, and 33 all in the green area. No Specials were used in the assessment and, therefore, the highest ratio of standard items was used as a prioritization in addition to the expected project revenues (see Table 7 for overview of the projects).

**Table 7: Project level outputs**

<table>
<thead>
<tr>
<th>Project</th>
<th>Sales probability</th>
<th>Expected Project Demand</th>
<th>Expected Project Revenue</th>
<th>Standardization ratio</th>
<th>Prioritization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project 02</td>
<td>99%</td>
<td>282'200</td>
<td>523'684</td>
<td>0.83</td>
<td>1</td>
</tr>
<tr>
<td>Project 08</td>
<td>91%</td>
<td>3410</td>
<td>17'429</td>
<td>0.50</td>
<td>6</td>
</tr>
<tr>
<td>Project 13</td>
<td>99%</td>
<td>21'798</td>
<td>134'963</td>
<td>0.87</td>
<td>2</td>
</tr>
<tr>
<td>Project 16</td>
<td>84%</td>
<td>51'000</td>
<td>64'361</td>
<td>0.67</td>
<td>4</td>
</tr>
<tr>
<td>Project 19</td>
<td>88%</td>
<td>18'477</td>
<td>92'385</td>
<td>0.00</td>
<td>7</td>
</tr>
<tr>
<td>Project 28</td>
<td>90%</td>
<td>18'000</td>
<td>31'913</td>
<td>0.60</td>
<td>5</td>
</tr>
<tr>
<td>Project 33</td>
<td>97%</td>
<td>25'051</td>
<td>158'457</td>
<td>0.85</td>
<td>3</td>
</tr>
</tbody>
</table>

Most of the projects have a high ratio of standard items which indicates a low risk value for the projects. It is assumed that all these projects are to be recommended for activation to calculate the business level outputs. In order to calculate to outputs on business level there was need to invent some values for inventory cost and obsolescence cost which were determined to be 20% and 50% of the item value, respectively. In Table 8 the business level outputs can be seen.

**Table 8: Business level output - Opportunity matrix**

<table>
<thead>
<tr>
<th></th>
<th>Activate Project Forecast</th>
<th>Do not activate Project Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Win Project</td>
<td>1,023,192</td>
<td>5,505,298</td>
</tr>
<tr>
<td>Lose Project</td>
<td>716,234</td>
<td>-</td>
</tr>
</tbody>
</table>

Finally there is the recommended demand number from projects. Below in Table 9 the recommended item demand for the selected projects and the controllability of each item compared to the annual materials forecast. As can be seen majority of the items are well below the chose cut-off value of one, however, there are several items with extremely high demand which would need further investigation by the decision makers (highlighted in red).
This verification is only intended to give a brief overview of how some of the main outputs can be used. Not enough time was allowed to properly analyze the model and run a proper simulation to test formulas. However, this should give an indication of what can be done with the model.

5.3 Conclusion & recommendations

Even though the example in section 5.2.3 provides an introduction into the feasibility of the risk assessment model it does not provide empirical validation or comparison to the current situation which limits the feasibility slightly. The whole decision support tool requires further development which can be achieved with initiating additional research projects to stylize the whole model and run detailed simulations to empirically validate it. Nevertheless, the As-Is analysis (section 3.2) and the problem analysis (section 3.3) highlighted the need for improved efforts in risk assessment and data collection on projects. Furthermore, a project database is needed to track all projects and changes in the requirements including the decision support tool to have a transparent overview of the project requirements. Therefore, it is safe to assume that the proposed design will serve as an improvement on current efforts to manage the project business at Hilti.

There are several recommendations for Hilti regarding the design of a decision support tool which will be elaborated on in the following sections.

5.3.1 Project database

Before diving into designing a new solution for a project database, where all the relevant input for the risk assessment is gathered, it must be considered if there already exists a functional solution within

<table>
<thead>
<tr>
<th>Item</th>
<th>Demand</th>
<th>Materials Forecast</th>
<th>Controllability</th>
</tr>
</thead>
<tbody>
<tr>
<td>418751</td>
<td>2'247</td>
<td>96'933</td>
<td>0.023</td>
</tr>
<tr>
<td>2038062</td>
<td>8'000</td>
<td>49'548</td>
<td>0.161</td>
</tr>
<tr>
<td>2038061</td>
<td>1'953</td>
<td>78'759</td>
<td>0.025</td>
</tr>
<tr>
<td>376959</td>
<td>51'000</td>
<td>379'700</td>
<td>0.134</td>
</tr>
<tr>
<td>216415</td>
<td>45'000</td>
<td>6'380</td>
<td>7.053</td>
</tr>
<tr>
<td>216465</td>
<td>90'000</td>
<td>4'100</td>
<td>21.951</td>
</tr>
<tr>
<td>282890</td>
<td>90'000</td>
<td>2'400</td>
<td>37'500</td>
</tr>
<tr>
<td>388614</td>
<td>1000</td>
<td>35'100</td>
<td>0.028</td>
</tr>
<tr>
<td>388615</td>
<td>200</td>
<td>13'400</td>
<td>0.015</td>
</tr>
<tr>
<td>388616</td>
<td>400</td>
<td>10'700</td>
<td>0.037</td>
</tr>
<tr>
<td>388611</td>
<td>320</td>
<td>100</td>
<td>3.200</td>
</tr>
<tr>
<td>388612</td>
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<td>10.667</td>
</tr>
<tr>
<td>388614</td>
<td>90</td>
<td>60</td>
<td>1.500</td>
</tr>
<tr>
<td>375957</td>
<td>912</td>
<td>12'720</td>
<td>0.072</td>
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<td>375958</td>
<td>168</td>
<td>3420</td>
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<td>236647</td>
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<td>11'802</td>
<td>0.161</td>
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<tr>
<td>430801</td>
<td>278</td>
<td>9'264</td>
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<td>1'760</td>
<td>2'380</td>
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</tr>
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<td>369651</td>
<td>1'242</td>
<td>57'24</td>
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<tr>
<td>369649</td>
<td>2'566</td>
<td>40</td>
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</tr>
<tr>
<td>369623</td>
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<td>91'850</td>
<td>0.229</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Demand</th>
<th>Materials Forecast</th>
<th>Controllability</th>
</tr>
</thead>
<tbody>
<tr>
<td>371587</td>
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<td>127'725</td>
<td>0.047</td>
</tr>
<tr>
<td>371593</td>
<td>250</td>
<td>39'456</td>
<td>0.006</td>
</tr>
<tr>
<td>369685</td>
<td>1'250</td>
<td>60'350</td>
<td>0.021</td>
</tr>
<tr>
<td>369686</td>
<td>1'500</td>
<td>47'000</td>
<td>0.340</td>
</tr>
<tr>
<td>369687</td>
<td>1'700</td>
<td>19'500</td>
<td>0.082</td>
</tr>
<tr>
<td>418770</td>
<td>5'000</td>
<td>20</td>
<td>250'000</td>
</tr>
<tr>
<td>376967</td>
<td>15'000</td>
<td>925'850</td>
<td>0.016</td>
</tr>
<tr>
<td>369679</td>
<td>10'000</td>
<td>19'980</td>
<td>0.501</td>
</tr>
<tr>
<td>369680</td>
<td>10'000</td>
<td>5'220</td>
<td>1.916</td>
</tr>
<tr>
<td>304190</td>
<td>300</td>
<td>300</td>
<td>10'000</td>
</tr>
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<td>369626</td>
<td>7'000</td>
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<td>0.579</td>
</tr>
<tr>
<td>431908</td>
<td>2'441</td>
<td>3900</td>
<td>0.626</td>
</tr>
<tr>
<td>431837</td>
<td>430</td>
<td>5'331</td>
<td>0.081</td>
</tr>
<tr>
<td>431850</td>
<td>2040</td>
<td>470</td>
<td>4.340</td>
</tr>
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<td>431860</td>
<td>206</td>
<td>445</td>
<td>0.463</td>
</tr>
<tr>
<td>433478</td>
<td>13'100</td>
<td>3900</td>
<td>3.359</td>
</tr>
<tr>
<td>431910</td>
<td>260</td>
<td>1120</td>
<td>0.232</td>
</tr>
<tr>
<td>369632</td>
<td>6'000</td>
<td>600</td>
<td>10'000</td>
</tr>
<tr>
<td>216468</td>
<td>6'000</td>
<td>950</td>
<td>6.316</td>
</tr>
<tr>
<td>2004163</td>
<td>6'000</td>
<td>49'792</td>
<td>0.121</td>
</tr>
<tr>
<td>369611</td>
<td>20</td>
<td>190</td>
<td>0.105</td>
</tr>
<tr>
<td>369602</td>
<td>174</td>
<td>606</td>
<td>0.287</td>
</tr>
<tr>
<td>369604</td>
<td>228</td>
<td>438</td>
<td>0.521</td>
</tr>
</tbody>
</table>
the organization. Much has been mentioned about Hi-site throughout this thesis and there is a very good reason for that. The opportunities of usability within this system go well beyond the current usage as identified in this thesis and in a previous research executed at Hilti (Franquet-Guell, 2014). Much of the content collected in Hi-site, as well as the proposed additional requirements for the ‘Workstream design’, are identical to the ones that have been proposed as inputs for the decision support tool. With that in mind this design will not focus on developing yet another system solution; however, it is proposed to use Hi-site as the project database with several further developments.

Using Hi-site as the project database is further supported by the fact that the salesforce has access to CRM 7 in an application form, accessible from smartphones. With some further development on that application to include the project overview, the salesforce could have the possibility to capture all the requirements directly into the system without the possibility of risking erroneous information. Furthermore, if it is possible to link the lead times for items into the system the customer can be fed instantly with average lead time information, although subject to some uncertainty.

Combining the project database design into Hi-site is in line with what the stakeholders of this Master Thesis Project intended. Furthermore, this will allow the usage of one tool to manage the transparency of projects and not several tools. However, developments on the current tool are required which will be introduced below.

**Hi-site requirements for the proposed designs**

The need for further development of Hi-site is not only required by the proposed design in section five but moreover by the workstream design and the focus on only using one tool to manage the project business at Hilti. Hi-site is intended to be used as a project management overview tool that provides transparency of all projects and the associated requirements, to ensure reliable supply to customers. In Table 10 the requirements needed in Hi-site are listed, where some are currently available and others are new additions and development is needed. A distinction is made between data input (input from a stakeholder) and functional information (automatic output of Hi-site). Below a short description is given about the requirements that are not available in Hi-site.

**Table 10: Hi-site requirements for the proposed designs**

<table>
<thead>
<tr>
<th>Required Data Input Information</th>
<th>Available</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Name &amp; Number</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Customer Name &amp; Location</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Date of Request</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Sales Probability</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Project Value</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Project BOM</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Detailed Delivery Information</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Item Availability Information</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Information about inclusion in the Demand Plan</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Information about Order Placement</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Functionality Information</th>
<th>Available</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Lead Times</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Standardization of Items</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Standard BOM for Typical Applications</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Automatic Triggers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reporting Functionality</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Change History</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Risk Assessment Tool</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

**Data input – Detailed delivery information**

Many of the projects which Hilti is faced with require that the full quantity is not delivered at the same time but in smaller parts. For example, split the delivery of a particular item to fortnightly shipments. Items within a project can be requested on different dates as not everything is required at the same time to start construction. Therefore, the requested date of a project is not necessarily a single date but several different dates. This is an important part of the project requirements and
incorporating this in Hi-site can allow for transparency on when items of a project are required. This can be done by adding, for each item, the option of stating if a partial delivery is required and how much quantity and when it is needed.

**Data input – Item availability information**
A critical new addition to Hi-site is the option of including information about the item availability in terms of lead time and capacity from plants and suppliers. Based on feasibility, it is proposed to have an open field which allows the MO MM and BU MM to fill in the availability information.

**Data input – Information about inclusion in the demand plan**
This addition would give transparency to the stakeholders as to what has actually been activated and what has not been activated. Furthermore, for the future this information could be used to gather knowledge about project that were activated and won or lost, and vice versa. This information could be used in the Neural Network discussed in section 5.3.2.

**Data input – Information about order placement**
Having information about order placement in Hi-site would increase transparency for the stakeholders as it is important that projects currently in execution, or already executed, are distinguished from projects under negotiation. Including this in Hi-site will serve the purpose of the decision support tool in the calculation of both the hit-rate and for capturing the hindsight demand.

**Functionality – Standard lead times**
If standard lead times would be included in Hi-site it would allow immediate feedback to customer regarding the whole project lead time. Although, it must be considered that the lead times are dependent on the demand quantity, and thus if a project includes substantial demand for items, which is the case with project business (Palmatier, n.d.; Donselaar et al., 2001), then it can only be used as an estimation. This addition is likewise important for the risk assessment in the decision support tool.

**Functionality – Standardization of items**
As was discussed in section 5.2.2.2 the standardization of items is used to distinguish between the risk criterion of items; that is, standard items, on-demand items, and Specials. This would be MO dependent and linked to the master data in SAP. When capturing project requirements the salesforce would get immediate visibility if an item is standard or on-demand and could therefore try to convince the customer to go for a standard solution at the same time, instead possibly having to wait for feedback from the MO PM or MO MM. Furthermore, this would make it more transparent when deciding on what projects to recommend for activation.

**Functionality – Standard BOM for typical applications**
Within the Excel template in MO KSA the option of choosing standard applications where the applications have already a standard BOM was added. This addition to Hi-site would definitely improve the right first time quality of project data. By adding the option of choosing standard combinations for typical applications the system could automatically generate a standard BOM and the sales person would only have to adjust the requirements in terms of quantity and timing.

**Functionality – Automatic change triggers**
One of the main reasons for why Excel is still being used is the flexibility of being able to send back and forth emails with Excel files, ensuring immediate notification of new projects or changed requirements. Therefore, a similar functionality is needed within Hi-site allowing immediate notification of changes, or new additions, in project requirements. This can be done by adding an automatic trigger which is activated when new information or changes to projects are made, for example item change, quantity change, or change in sales probability. This could be in the form of an automatic email to the responsible stakeholder of the next step in the process, quality and feasibility check (MO MM/PMO FFM), or detailed availability information from BU MM. However, not all
changes are critical and therefore trigger criteria must be determined. For example, substantial quantity is requested with short lead time and decision would be needed at the first possible time should trigger the system and report it to the MO MM.

**Functionality – Reporting functionality**

Reporting functionality is extremely important to allow for data extractions to get an aggregated overview of the total project demand requirements on item level, i.e. aggregated quantity based on lead time requirements. Additionally, not every stakeholder will have access to Hi-site and therefore being able to run reports from Hi-site is important.

**Functionality – Risk assessment tool**

Including the risk assessment tool in Hi-site would allow for instant information on the risks associated with the current project sales funnel. Nevertheless, depending on the effort of IT and the limitations of Hi-site this addition may not be feasible.

**Additional requirement regarding Specials**

There is need to link the Special item numbers to Hi-site and later to APO. As discussed before it is only deemed possible to transfer Specials to APO when an item number has been created in SAP APO with master data behind it. However, the important part is to have the Specials visible in Hi-site to have a complete visibility of the project BOM. Discussions revealed that as long as an item number is not part of the ERP system it will not flow over to Hi-site. This means that either the LPS “dummy” item numbers must be inserted in the ERP system. That will most likely not work as these item numbers are in a different format than the typical item numbers. Therefore, it can only be recommended to start the discussion with the main Specials stakeholders how this can be linked together.

### 5.3.2 Neural Network – Better estimates of the project requirements

Neural Network (NN) is a method based on the basic anatomy of the human nerve cell or the neuron. The structure of a NN is computed in three layers – the input, the hidden and the output layers. Inputs are fed into the input layer which activates the node and sends a signal over the weighted connection to the hidden layer. The same happens in the hidden layer which sends a signal or information over the weighted connection to the output layer. The NN will eventually learn through repeated exposure to the data pattern and is able to recall it for categorization or pattern matching (Dasgupta, Dispensa, & Ghose, 1994). Figure 33 illustrates the general structure showing the weight matrices to the right (for more information on the structure and general knowledge on NNs see Dasgupta et al. (1994)).

![Figure 33: General structure of a Neural Network and the associated weight matrix](image)

NNs have proven to be good competitors for intermittent demand forecasting problems (Kourentzes, 2013) – where intermittent demand is a sporadic demand pattern, with some time periods where there is no demand at all and when demand occurs it may be highly variable (Teunter, Syntetos, & Babai, 2011). It is safe to assume that – based on the characteristics of intermittent demand and project
business demand – it would be worthwhile to implement a NN to make better predictions on future project requirements. Furthermore, it could be used to build knowledge on past behavior of Hilti when it comes to activating project demand. The project database could be used as an input source as all relevant requirements can be found there.

5.3.3 Sales probability – Expectancy theory

The pre-defined sales probability which Hilti is using for it projects and the decisions to prepare for projects is in fact not a probability (see section 3.3). However, this is merely a step in the project acquisition process independent of probability. Therefore, introducing the actual expectancy of hitting a project from the salespeople will truly capture the expected likelihood of winning a project (Walker et al., 1977). Research has shown that there may be a positive linkage between performance and expectancy of the salespeople. Salespeople are expected to change their efforts and beliefs depending on past performance, for example, losing a project can affect future prediction of sales probability with negative effect and winning a project can increase effort and belief in future predictions (DeCarlo et al., 1997).

The introduction of the ChangeLog is ideal to gather the data on the changes in expectancies from the salespeople to run assessments on the changes after positive or negative experience. As has been discussed, the ChangeLog offers the possibility of tracking changes in sales probability with a time stamp for each change and by adding to the project database the responsible sales person will allow for these assessments. To start the analysis of the sales probability evolution the salespeople should do a weekly project assessment where they reassess their own beliefs on winning a project and update Hi-site accordingly. Another option, although less structured, would be to ask them to update the sales probability as soon as their belief of winning the project changes and after certain time the changes could be analyzed.

More effective usage of the sales probability is needed to allow for better estimates in the project forecasting and projects will not advance in the project sales funnel unless an effective estimate by the salespeople is received. Furthermore, tracking the hit-rate for each of the stages in the project sales funnel would help with the decision of taking risks on future projects.
6 CONCLUSIONS & RECOMMENDATIONS

This section will provide concluding remarks to the Master Thesis. First off, answers to the research questions will be given (section 6.1) followed by a discussion of the scientific contribution of the research and the recommendations for future research (section 6.2). Finally, a brief discussion of recommended future work for Hilti is given (section 6.3).

6.1 Answering the research questions

This Master Thesis presents the design of a new workstream for project business at Hilti and how it is to be integrated with the integrated planning concept currently being designed and implemented. Additionally, a decision support tool is provided where the main focus was to provide a recommendation to capture all projects to run a formal risk assessment which would help making better decision when deciding on accepting the risk of projects. The workstream design is mostly based on creativity of several of the stakeholders and the author. Furthermore, the decision support tool as a whole is purely based on the author’s creativity. However, several academic papers and business examples served as guidance for approaching both designs. In this section answers to the research questions will be provided.

RESEARCH QUESTION – How can the project sales funnel be integrated into the integrated planning concept at Hilti such that the transparency of project business is increased in order to mitigate the risk of low item availability and obsolescence?

To answer this main research question, the sub-questions must first be answered as they all contribute to the final answer. Therefore, answers for the sub-questions are provided first, followed by the final conclusion and answer to this main research question.

SUB-QUESTION I – How should the workstream model be designed in a workflow such that the organizational R&R of the project business actors are clear and understandable?

The chosen method for the design was to integrate an IDEF0 functional model into a swim lane diagram. First and foremost, developing the workstream using a swim lane diagram clearly highlights what role is responsible for which task and it is easy to distinguish between different roles in the process. Furthermore, structuring the workstream with the IDEF0 functional modelling method and integrating it into the swim lane diagram provides clarity to the workflow. The whole workstream becomes more understandable and it is clear what controls each process, including what resources are needed to finished a task.

The following two questions will be answered together.

SUB-QUESTION II – In what way can the workflow be designed to allow for more transparent processes for decision making?

SUB-QUESTION III – How is Hilti able to reflect the decision points in the To-Be future HIP workflow?

In order to provide transparency for decision making there are three clear decision points added to the workflow. The first decision point is during the quality and feasibility check of the project requirements. In case a consensus on the requirements, in regards to feasibility, cannot be reached with the customer a decision is made to discontinue the negotiation. The second decision point is during the alignment with Sales where a commitment is needed for which projects it is feasible to activate demand. This is captured in a separate process where a decision is made to recommend part of the project portfolio for activation in the SFI meetings, while other projects are kept for transparency in the funnel. Aligning what projects to recommend and providing the decision support (acquired from the decision support tool and the risk assessment proposed in section 5). The final
decision point is the actual activation of the project forecast during the SFI meetings where project forecast is used to bridge the gap between the marketing sales plan and standard materials forecast (see Appendix E).

**SUB-QUESTION IV – How can the probabilities of acquiring a project be better exploited to allow for more efficient risk taking when it comes to making decisions on project opportunities?**

As was discussed in section 4.1 using sales probabilities based on the expectancy of the salesforce is often used in the project planning when considering yes/no decisions. Using these actual sales probability gathered from beliefs of the salesforce will give better estimates than having predefined probability steps in the process. For example, at the stage of initial contact one project has a 50% probability and another 10% probability of being hit. Furthermore, applying the NN method recommended in section 5.3.2 can help validating the sales probability estimates of the sales force to make better decisions.

**SUB-QUESTION V – How can the project business forecast be improved?**

Forecasting for project business at Hilti is done by the means of market intelligence. With the proposed design in section 4 a structured process was developed to help make a more transparent process aimed at improving the current efforts of forecasting and planning project business. Moreover, the design in section 5 captures the main requirements from projects, as well as, the change history over the project lifecycle which can help build a knowledgebase of certain situations. As recommended in section 5.3.2 this knowledge can be used to give better estimates for the future project requirements and help prioritize the right projects.

Finally an answer to the main research questions can be given by considering all the answers from the above sub-questions. There is no academic literature nor are there any clear business examples which suggest how to integrate the project business into an integrated planning environment. Although it is a well-known problem how to manage project business within the standard business it is always business specific and a case by case decision if project demand is to be included in the S&OP process or not. At Hilti there is everything in place to improve on the current efforts in project business, with the direct selling model and current tools which, however, require some further developments. By putting more emphasis on establishing a better communication throughout the whole supply chain Hilti is destined to achieve better results from the project business.

It is impossible to escape the risk following project business due to the uncertainty surrounding it. Increasing the transparency of the workstream and implementing clear decision points, as suggested in section 4, will help mitigating the risk of low item availability and obsolescence. In the end if Hilti wants to succeed in project business this uncertainty and risk must be embraced as the reward will eventually outweigh the risk costs.

### 6.2 Scientific contribution & recommendations for future work

The literature research for this Master Thesis Project identified big gaps to the problem of project business. First of all, there is a base literature on the marketing aspect of project business and some of the problems which occur while dealing with projects in parallel with the standard business. However, no papers were found that suggest how to really solve these problems and how they should be integrated into an integrated planning concept. Therefore, it can be assumed that this thesis contributes as an initial starting point of how to solve these problems. It is suggested to look at how other companies deal with the same issues and benchmark the solutions.

Second of all, this thesis identified that lead times rarely pop up when discussing project business in the literature. This is a huge gap as lead times are an important criterion that determines when decisions need to be made latest to communicate project demand to the supply chain. The proposed risk assessment model serves as the first attempt to incorporate the lead times to assess the risk of
project demand. Further and more detailed research is needed to model the risk and make more stylized models that can be applied to other companies operating in project business. A link between the models in an assemble-to-order or a configure-to-order environments could be used to develop a more generalized solution.

6.3 Recommendations for future work at Hilti

It is recommended to initiate future projects that build on this research with two separate directions. The first direction should be towards the actual implementation of project business to the integrated planning concept. This thesis did not go to the extent of implementing the workstream and therefore there is need to initiate a project with focus on implementing the workstream. The other direction should be aimed at the system development. Due to feasibility the effort needed for the system developments was not considered. Initiating a project where IT will look into how much effort is needed and what system requirements are feasible for initial implementation is needed.


Appendix A. ORGANIZATIONAL & MANUFACTURING SET-UP

Figure 34: Organizational set-up Global Logistics

Global Manufacturing and Technology network

Figure 35: Global manufacturing and technology network of Hilti
Appendix B. **STAKEHOLDER INTERVIEWS**

Before the start of this Master Thesis Project the main stakeholders and contributors had already been identified and introduced to the project by Global Logistics. This allowed them to somewhat prepare for the coming stakeholder interviews which were 30 minutes each. The purpose of these interviews was to capture and gain understanding of the current situation of project business at Hilti, and identify the main problems and issues related to it. A semi-structured approach was taken when conducting the interviews. All participants were asked to describe their perception of project business at Hilti, the current process, and problems and issues related to it. All questions asked were open questions which had not been introduced to the stakeholders beforehand. The following were the planned questions which all stakeholders were asked to answer (further unstructured questions were asked and answered based on the input received):

- Can you explain or go through the process of project business as you have experienced it?
- What are the main problems Hilti is faced with by operating in project business?
- How is the sales probability being used in the project business process?
- What is needed to improve the current situation?

The information gathered was first analyzed and reported in an As-Is analysis described both in the previous work of this thesis, the research proposal, and in section 3. Some effort was needed to filter out project relevant information and conduct the problem analysis which resulted in the cause and effect diagram. Below in Table 11 is a list of the people interviewed that were used to gather the input needed for the analysis on the current situation. There were more people interviewed later in the process, yet, they were not part of the semi-structured interviews.

*Table 11: Stakeholder matrix*

<table>
<thead>
<tr>
<th>Individual</th>
<th>Role/Position within HILTI</th>
<th>Type of meeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hermann Holzer</td>
<td>Head of ISB</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Maximilian Baczkiewicz</td>
<td>Head of Supply BU Installation</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Alexander Liewer</td>
<td>Materials Manager ISB</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Ellen Schoenleber</td>
<td>Process Manager BU Installation</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Petar Roncevic</td>
<td>Head of Materials Management BU Anchor</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Roeland Bajiens</td>
<td>Head of Global Logistics</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Gilberto Matias</td>
<td>Head of Logistics Region META</td>
<td>Lync online</td>
</tr>
<tr>
<td>Veronika Schnabel</td>
<td>Customer Service E3</td>
<td>Lync online</td>
</tr>
<tr>
<td>Alessandro Sasso</td>
<td>Head of MM MO/Region+Demand &amp; Supply Planning</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Patrick Beusch</td>
<td>Product Manager Project Tools E&amp;I ISB</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Stephan Gaehler-Brand</td>
<td>Supply Manager E&amp;I ISB</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Michael Krueger</td>
<td>Head of Materials Management E3</td>
<td>Lync online</td>
</tr>
<tr>
<td>Daniel Goering</td>
<td>Head of Materials Management META</td>
<td>Lync online</td>
</tr>
<tr>
<td>Sofien Dhouib</td>
<td>Head of Sub Region Gulf</td>
<td>Lync online</td>
</tr>
<tr>
<td>Peter Rupp</td>
<td>BU Head Installation</td>
<td>Lync online</td>
</tr>
<tr>
<td>Rolf Riedl</td>
<td>General Manager Saudi Arabia</td>
<td>Lync online</td>
</tr>
<tr>
<td>Pietro Bianchi</td>
<td>MO Engineering (CRM/Hi Site)</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Niels Goos</td>
<td>Product Manager E3 Anchors</td>
<td>Lync online</td>
</tr>
<tr>
<td>Mario Retter</td>
<td>Materials Manager BU Installation</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Philip Meledjiev</td>
<td>Dir Supply Chain Bus Process Excellence (HNA)</td>
<td>Lync online</td>
</tr>
<tr>
<td>Sagen Glasscock</td>
<td>Project Manager, Logistics HNA</td>
<td>Lync online</td>
</tr>
<tr>
<td>Mahmoud Abu-Abdoh</td>
<td>Material Manager, Logistics MO Saudi Arabia</td>
<td>Lync online</td>
</tr>
</tbody>
</table>
Appendix C. SPECIALS

Figure 36: General workstream of Specials

Figure 37: RAPID matrix for Specials
Appendix D. WORKSTREAM – ROLES & RESPONSIBILITIES

Local/Regional Salesforce

Local/regional salesforce is referred to as a combined role of the TS, AM, KPM, and the ISB KPM (this role will be shortened to Sales). These roles as part of project business are somewhat identical and there will not be any distinction between them. The main task of Sales is to keep in close contact with the customer and maintain the project information in Hi-site up to date, as well as add new information for new project opportunities. As soon as new information on projects is acquired from the customer Sales is required to update Hi-site. However, there is no need to change the sales probability of getting a project unless there is new information which clearly influences an increase or decrease in the likelihood and then it should be done immediately.

Just as Sales do today, they need to keep in close contact with the FE in case they are not certain what Hilti solution is needed for a particular requirement from the customer. They should try to work on a solution together which directs the customer towards using standard items to the maximum. Furthermore, they are responsible for proposing the Hilti quotation to the customer and re-discuss the lead time information or additional costs if needed, such as airfreight. Finally, Sales are responsible for, in cooperation with the MO MM, to align the project forecast which should be considered in the recommended quantity for the SFI meeting.

ASM, Head of KPM, or the PMO Head

Depending on the organizational set-up in a particular MO/region the ASM, Head of KPM, or the PMO Head have the same role in the project business at Hilti. This role serves as a support function for Sales and validates the sales probability estimation of Sales. The main responsibility towards the project forecast is to make decision on the recommendations for the SFI meetings. Depending on the project forecast quantity proposed by the MO MM and Sales a decision is made if it should be recommended or only included in the project sales funnel.

Local MO MM (PMO FFM)

In some regions where a PMO has been implemented the Fulfillment Manager (FFM) has the same role as a MO MM, for simplicity this will only be referred to as MO MM. The MO MM is responsible for monitoring project requirements from the time they are entered into Hi-site until execution. When Sales has updated Hi-site with new project requirements the MO MM is responsible for verifying the information and check for feasibility of supply. In cooperation with Sales and the ASM, Head of KPM, or the PMO Head, the MO MM works on determine a feasible plan for the customer out of standard supply constraints.

Quality of the project information in the Hi-site is extremely important to allow for a good transparent process flow. Based on this quality and feasibility, the MO MM uploads the Project-Market Intelligence and sales probability to APO Project Sales Funnel as unconfirmed project forecast. This will be done to keep transparency in the system of what is in the pipeline of potential quantities.

The MO MM will align with Sales the project forecast which is to be recommended for the SFI meetings. As mentioned in section 4.2.3 this recommendation needs approval from the ASM/KPM Head/PMO Head before it can be proposed as a recommendation for the SFI meeting. As part of the recommendation process the MO MM will provide transparency on inventory risk, obsolescence risk, and level of service risk.

After the SFI meetings and when a decision has been made to activate the recommended project forecast, the MO MM will activate this quantity in APO and thus move it to execution mode. Furthermore, in case this quantity needs to be changed after a decision has been made in the SFI meetings the MO MM is responsible for amending the project forecast.
**BU MM**

The BU MM is responsible for providing input based on Hi-site requirements towards item availability and capacity from HAG and supplier. It falls under this role to check if any special documents are needed, such as test certificates or country of origin certificate. When the MO MM executes the risk assessment the BU MM gives an input towards the inventory, obsolescence, and level of service risks. Finally when discussion start about the actual activation or changes of activated project forecast the BU MM is required to give input to the process.
Appendix E. CHANGES TO THE TO-BE HIP DESIGN

The original version of this graph did not include any information about project business. This graph is part of the sales planning process where the goal is to highlight how to compare the different forecasts and reach the final consensus forecast. The addition of project business into the graph shows that the project forecast is an addition on top of the standard materials forecast and is used to bridge the gap between marketing sales plan and the standard materials forecast itself.

Figure 38: The direction towards the consensus forecast