Improving Linde’s corporate IT Demand Process through Business Capability Management?

# 1 Introduction

An analysis of the specific BC "Deliver Product" in an international comparison between Germany and Korea will be carried out in the course of the work. This should clarify whether BC management can support Linde and specifically improve Linde's corporate IT demand process which is a mediator process between the business and IT. The aim of this Bachelor Thesis is to answer the listed questions in the further stages of this work. To be able to answer the research questions, a scientifically researched foundation is necessary. Chapter 2 introduces corporate and IT governance as the overarching origin of business and IT alignment. In chapter 3, enterprise architecture is explained, and frameworks are presented. A special focus is placed on TOGAF, from which BC Management is also derived in chapter 4. This included accessing the DHBW Library Print and Digital Collection as well as online databases such as Google Scholar, Business Source Premier, SpringerLink, IEEE Xplore and more. In the second part of the thesis, the topic is applied in the practical part using the example of Linde plc. Chapter 5 begins with the introduction of the current corporate IT demand process in the company. In the analysis, the four TOGAF components of process, roles, information, and resources are examined using the example of "Deliver Product". Based on the analyses, an attempt is made to draw conclusions about BC analysis by formulating hypotheses. The hypotheses are verified and therefore are confirmed or disapproved in an interview with two experts at Linde.

Keywords: ['strategy', 'objective', 'capability', 'department']

Polarity: Neutral (0.13)

Subjectivity: 0.33 / 1.0

# 2 Corporate Governance and IT Governance

Corporate governance is to be understood as self-set, but also externally dictated ethnic values, principles, procedures and measures for responsible corporate management. In Germany, for example, help in implementing corporate governance is provided by the German Corporate Governance Code introduced by the Federal Ministry of Justice in the early two-thousands. In addition to legal regulations directed towards German publicly listed companies, it contains internationally and nationally recognised standards of good and responsible corporate governance. More specifically, the Organisation for Economic Co-Operation and Development (OECD) provides guidance through the publication of non-binding principles of corporate governance. They are intended to facilitate the interaction between management, supervisory board, shareholders and other stakeholders. Thus, a multitude of different influencing factors have an effect on corporate governance, which it translates into rules and guidelines that are applied within the company. Corporate executives are therefore provided with a framework for the introduction and execution of planning, decision-making, evaluation, controlling and monitoring tasks. In addition, these rules and guidelines include technological aspects, especially with regard to IT, which must be taken into account within the framework of IT governance. These two aspects cannot be considered separately from each other, as the strategic orientation of IT and corporate goals are equally relevant for the success of the company . Corresponding IT governance frameworks for IT management are provided by Control Objectives for Information and Related Technology (CObIT) and Information Technology Infrastructure Library (ITIL) . ITIL offers a structured approach to IT governance and management that assists companies in efficiently managing IT services . This means that principles, procedures, and policies are designed to ensure that IT is used to fulfil business objectives, responsibly deploy resources, and appropriately monitor risks . The overarching task is to translate and mediate between corporate management, business areas and IT departments. However, typical tasks of IT governance can be divided into two types: operational and strategic. On the other hand, there are the strategic governance tasks such as IT demand management and IT architecture management. Both ensure that the corporate goals and the strategies of the business areas derived from them are aligned with the IT strategy. Furthermore, IT resources are used responsibly and risks can be identified and anticipated at an early stage. The focus of this thesis is placed on the strategic side of the IT governance.

Keywords: ['principle', 'procedure', 'measure', 'participant']

Polarity: Neutral (0.09)

Subjectivity: 0.22 / 1.0

# 3 Enterprise Architecture Management

A fundamental precondition for successful decision-making through strategic IT governance is comprehensive and holistic view of the organization's IT processes, assets and capabilities.

Keywords: ['process', 'asset', 'capability', 'view']

Polarity: Positive (0.38)

Subjectivity: 0.53 / 1.0

## 3.1 Definition of Enterprise Architecture

The latter, “architecture”, is used analogously to the architecture of the building construction as a term for the model-like representation of a system structure. Although it deals with typical IT domains such as information flows, software applications and infrastructure, it also includes the business in equal shares. When this is happening, it is also described as a business-IT alignment. Without, it is still possible that individual local areas in the company already operate in a fully optimised way. However, it is only effective for the company as a whole if all areas are coordinated with each other. That is why the EA tries to capture the most essential aspects of business and IT. The idea is that the essentials are long-lasting and should therefore be preserved, while remaining flexible in the company's orientation and being adaptable. A good architecture manages to balance these conditions and facilitates the implementation of the corporate strategy in everyday operations. The basic requirement for a high architectural quality is an approach that can be understood by all parties involved in the company. While a common language for the general public already exists in building architecture since thousands of years, it is yet to be developed within daily business vocabulary. An important challenge of EA is to establish a common frame of reference that includes the entire company.

Keywords: ['word', 'part', '1980', 'element']

Polarity: Neutral (0.06)

Subjectivity: 0.44 / 1.0

## 3.2 Enterprise Architecture Viewpoints

In addition, potential deficiencies and risks in the architecture can be identified. In the next phase, a proposed future architecture is worked out. Here, the identified deficiencies are addressed and appropriate solutions to the weaknesses are articulated. The transformation process begins in the Act phase, with the realisation and implementation of the target architecture. The company needs to continuously look at market developments and business objectives to review and update the assess, aim and act phases accordingly. The two perspectives are reflected by four architectural layers that represent different viewpoints on the overall architecture. Figure 4 illustrates the role of enterprise architecture for coordinating business and IT based on the following four architectural layers. Data architecture defines what kind of information and how data is recorded, structured, stored, processed and used. At the application architecture level, it is determined which application systems are deployed to support the processes inside the company. The interactions and relationships between applications are core of this consideration. The underlying technological infrastructure that enables the use of applications and the handling of data is part of the technology architecture. It includes hardware, software, network, security, communications and cloud computing architectures. A more in-depth examination of the architecture layers is provided in chapter 3.3.1 in the description of EA frameworks.

Keywords: ['requirement', 'activity', 'category', 'deficiency']

Polarity: Neutral (0.1)

Subjectivity: 0.37 / 1.0

## 3.3 Enterprise Architecture Frameworks

This enables a unified and consistent representation of architectural solutions that facilitates effective communication between different stakeholders in the organisation. At the same time, they can ensure that their work conforms to company-wide standards and best practices. Overall, there are several EA frameworks that are widely used and provide guidance in aligning basic business goals and strategies with technical requirements .

Keywords: ['framework', 'architect', 'view', 'model']

Polarity: Neutral (0.12)

Subjectivity: 0.26 / 1.0

## 3.3.1 The Open Group Architecture Framework

Each phase is a detailed step-by-step process for identifying the key activities required to acquire the knowledge needed to develop an EA. In the preliminary phase, the architectural capabilities required by the organisation are determined. As this phase lays the necessary groundwork for further work, it is crucial for the ongoing success of the enterprise architecture. In the first phase of the ADM circle, the architecture vision is developed. The enterprise architects team works closely with relevant stakeholders in the organisation to identify business drivers, objectives and also constraints that have impact on the EA. Phase B - Business Architecture: The focus of phase B is on developing a target business architecture. This defines the business side of the EA, such as BC, organisational structure and processes to achieve the previously elaborated architectural vision. Phase C - Information Systems Architecture (Data Architecture and Application Architecture): In phase C, the target information system architectures are created, in a form in which the business architecture can ideally be put into practice. In order to do justice to the information systems to be deployed, TOGAF has split the phase into two sub-phases, data architecture and application architecture. Similar to phase B, a gap analysis is used to identify gaps between the as-is and to-be architecture. Based on its findings, a plan is developed to address the gaps and integrate the information architecture with the other architecture domains. This includes, for example, new requests for applications, data, and interfaces. Because of their scope, data and application are separated in TOGAF, however, they must be viewed jointly . Phase E - Opportunities and Solutions: As the name implies, phase E attempts to deliver a specific solution for implementing the target architecture. The input used here from phases B, C and D such as requirements and architecture documentation are refined again. By combining the gap analyses and recommendation from the previous phases, a first complete version of the architecture roadmap is generated. Often the change actions are so large that an incremental approach must be executed, consisting of intermediate or transitional architectures. Thereby, individual work packages are arranged in a timeline to reach the target architecture. The early stages of ADM identify the need for architectural changes, after which a roadmap for the target architecture is developed. In stage F, a migration plan is created that describes the steps required to transition from the as-is architecture to the to-be architecture. The main task of the enterprise architects is to oversee the implementations and to constantly check that the ongoing projects are in line with the predefined architecture. Phase H - Architecture Change Management: During the iterations, the need for changes to the requirements and the architecture plan is detected regularly. Phase H describes the change management process that addresses and manages the proposed changes. This demands continuous monitoring of the requirements using the measurements created in phase G, but also of new technologies or changes in the business environment. The phase should support the implemented enterprise architecture as a dynamic environment that can evolve quickly in response to these changes in a flexible way. The aim is to ensure that the enterprise architecture is always up to date. Requirements Management: Requirements are generated, analysed and reviewed continuously in each phase of ADM. The requirements management phase describes the process of managing them. Requirements are not static, they evolve dynamically throughout each phase of the ADM. Architecture deals with uncertainty and change and has to find a balance between stakeholder expectations and opportunities. Therefore, architectural requirements are always subject to change. This phase ensures that any changes to the requirements are reflected in all other phases, which is why it lies at the centre of the EA life cycle. TOGAF emphasises that the requirements management process itself does not actually resolve requirements, as this is done in the corresponding phases. The requirements management phase is simply the process of managing requirements throughout the whole cycle. ADM is repetitive across the entire process within and between phases and is not a linear waterfall process model that can be worked through in stages. Ultimately, the techniques ensure a structured approach to efficient EA development. Specifically, TOGAF identifies three different categories of work products: Deliverables, artefacts and building blocks. A deliverable is a product that is reviewed by stakeholders and usually requires approval or signature and is contractually signed. Artefacts are materials and documentation used to record and communicate information about architecture. A distinction is made between catalogues (lists), matrices (representation of relationships between two or more elements) and diagrams (pictorial illustrations). They are mainly created in phases B, C and D to show different views of the architecture or distinctions between as-is and to-be architectures. Examples can be requirements catalogue, an application interaction matrix and a value chain diagram. A building block is a modular unit of architecture that represents a physical or logical component, a defined capability, or a function. The overall architecture is composed of these building blocks. Often, they are assigned to different levels of abstraction, e.g. as business, data, application or technology building blocks. Part 6 - EA Capability and Governance Appropriate organisational structures, processes, roles and governance need to be established within the organisation for EA to operate successfully. The last part of TOGAF Fundamental Content describes how to establish a successful architecture capability. TOGAF takes up the IT governance described in chapter two, a project-leading architecture board as well as guidelines for adherence to compliance issues. In order to help organizations, coordinate their business and IT strategies, TOGAF offers an extensive framework for creating and managing EA. Thus, they can enhance their decision-making procedures, maximize resource usage, and improve their flexibility by adhering to the TOGAF standard.

Keywords: ['consultant', 'academic', 'researcher', 'today']

Polarity: Neutral (0.11)

Subjectivity: 0.41 / 1.0

## 3.3.2 Further Frameworks

The y-axis or column consists of the interrogative pronouns “what, how, when, who, where and why”. On the x-axis, the rows of the matrix, there are six different perspectives, namely “executive perspective”, “business management perspective”, “architect perspective”, “engineer perspective” and “enterprise perspective”. The 36 fields of the 6x6 matrix of communication interrogatives and reification transformations are so-called “classifications”. According to Zachman, they result in “a total set of descriptive representations” to describe any possible element of the EA in an organisation. It merely provides support in ensuring that all relevant views are taken into account. In addition to the widely used frameworks TOGAF or Zachman, which are designed not only but primarily for enterprises, there are further frameworks. Since Department of Defense matters are military activities, various stakeholders, such as those of defence agencies or combat commands, have to be taken into account. In addition, priorities and strategic goals differ, making the enterprise architecture different from any other organisation. In DoDAF, there is a high focus on visualisations to understand complex architectures, making it particularly suitable for large systems. The US is not the only country that has developed a framework for military purposes.

Keywords: ['one', 'intersection', 'pronoun', 'row']

Polarity: Neutral (0.07)

Subjectivity: 0.5 / 1.0

## 3.4 IT Demand Management

For this purpose, an IT demand manager records the business’ demand request including requirements. Afterwards, the demands are aligned with the corporate strategy and the enterprise architecture for instance as part of the TOGAF requirement management phase in the ADM cycle. If necessary, the demands are subsequently implemented in the form of specific projects. Without suitable processes and governance, many small projects would run without any beneficial effect for the company as a whole, which is why an IT-DM structure is necessary. The different demands can be divided into three categories altogether: operational, tactical and strategic . Tactical demand is day-to-day and routine demands that often require only minor changes. Through a direct interaction between different business units and IT as a central intersection collecting many different demands, decisions can be made more accurately. This enables IT to allocate resources more efficiently, which can support business goals in a more target-oriented way. Resulting a higher service quality of IT, so that business expectations can be realised easier and lead to an increased user satisfaction. From a financial point of view, avoidable expenditures in the company can be prevented, as investments are only made for IT resources that are actually required.

Keywords: ['symon', 'need', 'resource', 'department']

Polarity: Neutral (0.13)

Subjectivity: 0.5 / 1.0

# 4 Business Capability Management

As stated in “category 1 – assess” in chapter 3.2, insights can be gained on areas for improvement . This facilitates it for organization stakeholders, to make sure that IT activities are in line with corporate objectives. If the capabilities are complemented with further information, they offer an appropriate foundation on which to base strategic IT decisions. In the following, the concept of BC is explained, its benefits for improving EA are presented and ways to analyse a BC are presented.

Keywords: ['insight', 'area', 'architect', 'stakeholder']

Polarity: Neutral (0.01)

Subjectivity: 0.44 / 1.0

## 4.1 Definition of a Business Capability and its elements

However, a variety of other sources suggest the opposite, which consider BC as the actual use of tangible and intangible assets for the execution of performance-improving activities . Here, BC are described as “what a business does without attempting to explain how, why, or where the business uses the capability”. The result such as strategy, product or project is represented as a noun and the respective activity such as delivery, planning or monitoring as a verb. This serves to facilitate the identification of the information objects related to the BC. In addition, it serves as a control not to equate the BC with the name of a department, e.g. transaction recording instead of accounting . One recommendation of the framework is to select names that are appealing to management and stakeholders. This promotes better understanding and clearer communication between different participants. BC are inherently more long-lasting; after all, in most companies a product is always being produced or a strategy planned quite independently of the organisational structure. The naming of the BC is followed by a short description in order to elucidate the scope and objective of the BC and to separate it from other capabilities. Again, special attention should be paid to language that is relevant and appropriate for stakeholders. Both aim to be concise and precise enough in a few sentences to provide enough detail for better understanding without repeating the exact wording of the capability’s name. A possible description for the BC “Product Development” could be: the ability to design and create a product or service that meets customer needs. The components enable four different perspectives, which are roles, processes, information and resources, and will be explained in further detail in chapter XY. Since a BC only represents what the business does, they help to understand how a BC is realised and implemented. Typically, a BC outlasts a longer time frame. Its realisation, on the other hand, is the object of regular changes .

Keywords: ['organization', 'researcher', 'technology', 'resource']

Polarity: Neutral (0.07)

Subjectivity: 0.4 / 1.0

## 4.2 Business Capability Mapping

With the help of the BC Map, a summary of all the core functions of the organisation can be presented visually on a single page of paper . Thereby, the 20-30 BC at the highest level are identified, which are later refined downwards in greater detail. The different areas of the company are closely aligned with the BC to some extent and can thus be used as a basis for mapping. It must be noted, that the organisational chart cannot be directly transferred to the BC map. Another source for mapping can be the company's business model. If such a model exists, individual BC can be derived from it since they represent the building blocks of the business model. The third source for mapping is published corporate strategies and operational business plans, which can be used to identify further BC. After determining all relevant BCs of the company, the second step is to arrange them logically. In this process, the BC are classified, grouped and placed in different levels of the map. Each of these three BC offers a different perspective for the different stakeholders of the company, as already indicated in chapter 2. This involves splitting and subdividing top-level or level-1 BC into lower granular levels. According to TOGAF, a map can in practice be divided into up to six levels. However, the BC map of Linde plc is presented in chapter XY. The type and elaboration of a BC map is typically very sector-specific. For example, there is a BC for "Develop Product/Service", "Generate Demand" and "Deliver Product/Service" in every company, regardless of the industry. However, these are the relevant ones for the competitive advantages and success of the company. Once all relevant BCs of the enterprise are illustrated in a map, heat mapping can be used to work towards the target architecture. In heat mapping, BCs that are not performing optimally are coloured differently (e.g. red) than BCs that are performing well (e.g. green). From this, it is possible to derive and illustrate concrete and strategy-relevant decisions . Some selected ones focus on investment decisions, among other things. Deficient core BCs, for example, have a higher priority in this regard. In addition, there are further viewpoints, which, however, would go beyond the scope of this paper . Furthermore, the BC map also supports IT-DM . For instance, a demand for the introduction of a new Customer Relationship Management (CRM) system could be submitted as a request.

Keywords: ['bc', 'capability', 'function', 'area']

Polarity: Neutral (0.09)

Subjectivity: 0.41 / 1.0

## 4.3 TOGAF artefacts to analyse Business Capabilities

To meet these requirements, artefacts in the form of catalogues, diagrams and matrices are used. For example, a catalogue can provide information about applications, data, processes or infrastructure components. Thus, a catalogue helps to obtain a comprehensive overview of all architectural elements. At the same time, this form of artefact often serves as the basis for matrices and diagrams . This method of documentation can be used, for example, to identify dependencies between elements. Diagrams are graphical representations to present architectural content in a simplified way. Although TOGAF supports the presentation of a BC with a variety of suggestions for the use of artefacts, criticism can be stated at this point. While it lists the types of artefacts that can be modelled, in most cases it does not address how and, more importantly, for what purpose they should be documented. It seems that neither TOGAF nor other EA literature illuminates the practical use of the artefacts or what purposes the documentation serves for stakeholders in various use cases . From a practical point of view, this is understandable, because companies often only have the general goal of shaping and controlling the company with the help of EA. The individual requirements, however, usually differ significantly depending on the industry or the size of the business. A company must therefore define for itself when the required depth of EA modelling and BC documentation has been reached. It should be noted that the effort for documentation increases exponentially with the depth of detail. In chapter XY of this thesis, artefacts are used to describe and analyse a BC in practice taken the example of Linde plc.

Keywords: ['bc', 'stakeholder', 'aspect', 'requirement']

Polarity: Neutral (0.16)

Subjectivity: 0.52 / 1.0

# 5 Corporate IT demand management at Linde plc

However, a brief comparison of the financial scope of the different demand processes may explain why Linde is executing its IT demands the way they do. SOURCE The corporate IT demand process, on the other hand, has a different priority in the company. In addition, there is the corporate IT team, which is the equivalent of the global IT team. Therefore, the corporate IT demand process only deals with demands that fall into the strategic category as explained in chapter 3.4. Due to the scope of IT investments, Linde did not fine-tune their corporate IT demand process. Furthermore, although projects are initiated at the global level of corporate IT, they are often implemented by regional IT teams in the countries. Nevertheless, Linde invented and elaborated their own methodology for the corporate IT demand process, the STEPS methodology. STEPS is an acronym for Standards & Tools for Project Success and is based on international project management best practices, in particular on the Project Management Institute (PMI). It is a set of methods, processes, practices and tools that are repeatedly carried out to deliver projects. By providing checklists, examples, best practices, and leveraging learnings from previous projects, STEPS increases the likelihood of project success at Linde plc. If the demand is identified as reasonable, a project is planned and implemented until the change can go live and the project can be declared as finished. Theoretically, an IT project does not require a demand pre-process. After all, any change request can be implemented directly in a project. On the one hand, IT can enable faster processing of the demand, since it can fall back on existing solutions. Furthermore, business requirements are to be met, while at the same time controls and IT architecture are to be considered in accordance with corporate and regional strategies. Only if the demand is considered as a project, a GPS entry is required. When filling out the form, the request owner needs to remember that other people do not know about the described system, change or project. When the demand requestor enters data into GPS, they must ensure that the request is clearly described to prevent additional questions from the review team to prevent any delays. Furthermore, for all new applications or changes to an existing application supporting documentation must be provided clearly showing how all architecture elements fit together. In parallel with the demand request, a risk assessment must also be carried out. With the submission of the request in the GPS through the request owner, the corporate IT demand process is started. Participants include the demand manager and several IT colleagues who provide technical support in evaluating the requests and who have to approve them collectively. This team is called demand committee and includes experts in three different areas: functional, architectural and security. After all contributors have aligned their viewpoints, the demand request is either approved or not. If the decision is positive, the demand is forwarded to the responsible regional IT director. They are then responsible for confirming the recommendation made by the corporate demand committee. In addition, they must prioritize the project for realization and ensure funding and the availability of local resources. However, if the demand committee decision is negative and the application is thus rejected (for the time being), additional processes must be interposed. After the rejection, it is assessed whether the quality of the application is acceptable. If not, and the information provided is not sufficient to understand the basic concept, the request is dismissed entirely. Consequently, the applicant must retry, with greater specifics, more comprehensible explanations and descriptions, and relevant documentation. In the case of a rejected but qualitatively acceptable request, the demand team will review the request again. In this situation, further information is usually obtained from the request owner until the request can pass. Here, too, the request is then forwarded to the regional IT director for further action. Especially from a functional and architectural point of view, there is no stringent procedure, how to decide whether the demand should be approved and executed in a project. This is the point of intervention addressed in the further course of the bachelor thesis.

Keywords: ['area', 'section', 'digit', 'investment']

Polarity: Neutral (0.1)

Subjectivity: 0.38 / 1.0

# 6 Business Capability Management at Linde plc

This is followed by an analysis of a concrete BC based on the TOGAF methodology in a cross-country comparison. The aim is to find out how a BC analysis needs to be addressed and whether the approach should become part of the IT-DM at Linde in the future.

Keywords: ['bc', 'dm', 'it', 'part']

Polarity: Neutral (0.08)

Subjectivity: 0.25 / 1.0

## 6.1 Business Capability Map

In total, Linde’s map is divided into five key areas or level 1 capabilities, which are subdivided into further level 2 and level 3 capabilities. This area is in charge of creating value propositions, conducting market research and analysing customer feedback to develop and market effective offerings. This segment is responsible for managing customer accounts, resolving customer issues to ensure customer satisfaction. Order-to-Cash is an important business function that covers the entire process from the customer's order to the receipt of payment . Supply Chain Management - Cylinders & Hardgoods focuses on the procurement, production and delivery of physical goods, such as cylinders and other hardgoods. All system applications present in the company are recorded in a central inventory database. Through the introduction of the application inventory, all applications were then captured and described with around 100 attributes. An attempt was made to identify all capabilities in the organisation and assign them a unique number. Unlike the BC Map, the focus was not only on the core capabilities, but on all of them. This resulted in a list of twelve Level 1 capabilities with a total of about 270 individual capabilities. Figure XY lists exemplary the level 1 capability Human Resources with its level 2 sub-capabilities. If someone filters the application inventory by BC reference number 1030, you can see all Recruiting & On-boarding applications existing at Linde worldwide. If a country or a BU is looking for a new solution for their internal processes, they can orient themselves on the solutions already available in the company. This allows the application landscape to be streamlined and costs to be reduced through possible license savings or support services. Since then, this thesis is the first attempt to reintroduce the use of business capabilities at Linde plc.

Keywords: ['bc', 'product', 'need', 'proposition']

Polarity: Neutral (0.09)

Subjectivity: 0.54 / 1.0

## 6.2 Business Capability analysis across international regions

For this purpose, the TOGAF artefacts mentioned in chapter 4.3 are used in practice. In addition, this section also addresses two research questions. How can a BC be analysed across international regions and what are differences and commonalities in the execution of the core capability “Deliver Product” in Korea and Germany?

Keywords: ['artefact', 'question', 'bc', 'region']

Polarity: Neutral (0.12)

Subjectivity: 0.17 / 1.0

### 6.2.1 Business Capability “Deliver Product”

Most of the gases, 85%, are transported directly to the customer via pipelines, also known as tonnage or on-site business.  Frequently, the plants, some of which cost billions, are located directly on or at the customer's site. Trucks loaded with the liquified gas drive to the customer's site and fill the vessels there. In general, however, the cylinders are usually delivered directly to the customer. the business capability model does not expect a representation of the processes in the finest detail. It is important that the reader - regardless of whether from the business side or from IT - understands how the capability is executed. Furthermore, it must be clarified where the BC sequence to be documented and analysed begins and ends. A holistic view of the BC is required in order to be able to deliver added value and support the capability in the best possible way. In order to analyse a BC in concrete terms, the procedure described in graph XY in chapter 4.1 is applied. Once the BC has been named, it must be described and classified precisely and concisely. For the BC “Deliver Product”, the following statement was defined at Linde. “The “Deliver Product”-capability starts with the registration of the customer’s desire and ends when it is fulfilled, and the customer is satisfied.” Consequently, not only the literal interpretation of the delivery to the customer is the focus of the analysis. Instead, all neighbouring and direct upstream capabilities relevant for the delivery of a product must also be included.

Keywords: ['segment', 'plant', 'pipeline', 'billion']

Polarity: Neutral (0.17)

Subjectivity: 0.57 / 1.0

### 6.2.2 Execution of Deliver Product in Korea

For the BU PGP Korea, 70 full-time employees (FTE) are directly engaged in supplying about 300 customers. Almost all gas products can be classified in the specialty gases (SG) sector, where they are produced and filled in two plants in the whole country. To get a good overview of the BC, this figure is placed on the beginning of the analysis of the process component. The purpose of process flow diagrams is to depict the sequential flow of all related activities using the swim-lane technique based on the business process model notation. The Process/Event/Product catalogue in table XY serves as a supplement to process flow diagrams. The Deliver Product process starts with the arrival of the customer order in the customer relationship management (CRM) system. From the CRM, it is automatically forwarded as a sales order to the central SAP system, the enterprise resource planning (ERP) system. A work order is then created to process the sales order. To inform the employees what kind of gas is to be filled or mixed, they receive a production order in the Samsung Quality Management (SQM) application. Therefore, a purity of the gas mixture of (depending on the mixture, almost) 100% is essential. The analysis data are entered in the SQM and, if the quality result is positive, a so-called Certificate of Analysis (CoA) is issued as confirmation for the customer. After the product is completed, inspected, and tested, the dispatch to the customer is scheduled. Once there, the full cylinders are unloaded and any empty cylinders - if available - are loaded back onto the truck for return. Linde always tries to exchange a full cylinder for an empty one when delivering to (existing) customers because of the limited number of cylinders and their high turnover rate. After the return transport is unloaded at the plant, the empty cylinders are cleaned and freed from gas or liquid residues. Depending on the intensity of the cleaning process, the cylinders can also be requalified and used for other kinds of gases. After the cleaning process, the cylinders can be registered as reusable packaging in SQM again. The roles component represents the people, meaning actors, stakeholders, but also departments involved in the execution of the BC . An actor is described by a noun which represents the title of the actor and a role by a verb that describes the performing activity. In practice, it has emerged that a mix of both in the form of an actor/role matrix directly clarifies which actor performs which role . As previously stated in detail in the process dimension, the BC Deliver Product starts with the initial contact and order placement by the customer. All customer related roles in Korea are performed by the actor sales admin. The sales admin is the first point of contact for the customer and manages their concerns and their sales orders, from which the admin creates a work order. This work order informs all actors involved in the process about their duties for this specific order. The roles of production and filling into gas cylinders is the job of the filler. Additionally, the head of operations is accountable for all operational activities such as production, operation, and logistics in general. Afterwards, he consults the filler for the analysis and informs the supervisor filler about the result of the analysis. After the gas analysis has been performed, the cylinder must be inspected visually to check whether there are any external irregularities. This role is also assigned to the filler supervisor. In addition, the scheduler and the plant worker are informed that the cylinder is available for delivery. Another role of this sub capability is the management of the cylinder inventory, which is carried out by the filler supervisor as well. The filler supervisor consults with the sales admin to control sales capacities. For the remaining two roles, the supervisor filler is accountable. This role is performed by the actor plant worker, who after completion of the cleaning process informs the filler that the cylinder is fit for reuse. This role is executed by the plant worker, too. Since the customer delivery is completely outsourced, meaning that drivers and vehicles are provided by an external partner, contracts must be signed and tracked. He is advised by the scheduler who works most closely with the external contractor and who can best assess the reliability of the contractor. The plant worker must also be informed, as he has direct contact with the drivers of the contracting company. Thus, the contractor is the appropriate accountable and at the same time responsible actor for the role maintain fleet. In case of fleet outages, the scheduler and the plant worker must be informed immediately, since it affects their work. The sub capability Scheduling consists of only one role, which is the scheduling of the trip to dispatch the cylinder to the customer. The plant worker and the external contractor who employs the driver must be informed about the upcoming trip. Here, only the driver of the contractor is informed about the completion of the process. The roles executed here are the delivery of the full cylinder and the return of empty ones to and from the customer. After the gas cylinders ordered by the customer are delivered, the sales admin is notified directly. The sales admin must record the successful delivery, book on the corresponding sales order, and initiate following processes to complete the order. When the empty cylinders arrive back at Linde's filling plant, the supervisor filler is informed so that he can inspect the cylinders and record any damage immediately. The plant worker is also informed so that the unloading can begin. The information component, in a broader sense, represents the data, information, knowledge and wisdom used and required by the BC . Figure 15 is a combination of the information map and the data entity/business function matrix. It contains both the information (pink circles) that is assigned to a data entity (yellow square). These are assigned to the business functions (blue rectangles). The direction of the arrow indicates whether the respective business function consumes or provides the data. As in the process diagram, the starting point is the customer. Although the customer is not a logical business function, it can be used synonymously in this context. In order to graphically distinguish it from the actual business functions, it is displayed in a different colour (as should theoretically all external elements). For example, the customer provides information for the sales order entity, which in turn is consumed by the sales business function. The purpose of this view is to demonstrate the relationships between the data entities and the related information within a company on an abstract level. Thus, the exchange of data and information between the business functions becomes more transparent. Furthermore, the basis for the data architecture of the EA is created. As this thesis is written with the support of the corporate IT of Linde plc, a focus is placed on IT resources, the applications. The concept is based on the artefact application/business function matrix. It also supports the practice of a gap analysis and reflects the as-is information system architecture of the enterprise. The Linde-specific and configured template used in Korea is the first in the entire organisation that is based on the new SAP fourth generation system S/4 Hana. The tasks of the SAP system are to provide the deliver processes with the necessary data and to receive it again. This creates an interplay of data exchange, which is shown in diagram XY (information). Most Korean customers, who only purchase gas in small quantities, order through the CRM system of Microsoft Dynamics 365. The CRM system is a special sales module of the Microsoft Dynamics ERP system. It is mainly used for managing customer relationships as well as entering customer orders. The eight largest customers, who account for the vast majority of orders, place their orders via a special set-up electronic data interchange (EDI). A so-called EDI interface enables the exchange of electronic commercial documents. The Linde SAP system and the customer's system are linked via the interface. This allows the customer to place a purchase order based on his own inventory data in real time without manual intervention. Only one system, SQM, is used for the business functions production, operations, and logistics. Apart from that, a lot of information is passed on verbally, as in scheduling, or information is documented using pen and paper or Excel. Other resources as mentioned, such as machines or the vehicle fleet, are also subject to consideration. The artefact technology portfolio catalogue in table 5 can be modified from its original idea. Instead of typical IT hardware architecture elements the catalogue can be used and extended for resources of technical nature in general . For example, it would be possible to document which vehicles are used for delivery. In Korea, trucks from Hyundai, a car manufacturer also headquartered in the Korea , are primarily used. The handhelds are used as personal digital assistants (PDA). In Korea, the handhelds are only needed to scan cylinders in order to register them in SQM and SAP (e.g., full cylinder, empty cylinder, cylinder delivered). It is especially safe and must be utilized in special danger zones, for example, in the production area when handling highly inflammable gases. Furthermore, a special barcode printer, Zebra ZM 400, is used to print labels for cylinders. Not only Linde's own barcodes are generated for the cylinders, but also directly customer-specific ones, so that the customers can also account for the cylinders in their systems. For the quality analysis of the gases, a machine called Gas Quality Analyzer is in operation. Not directly related to any of the four dimensions of process, roles, information, or resources, the TOGAF artefacts can also be applied to related areas. Various contracts and service level agreements are signed to manage the contractor. These can be recorded in a contract measure catalogue in table 6. However, it can be assumed that such or similar contracts exist between PGP Korea and the external contractor. It might be agreed how many vehicles the partner must provide for the deliveries and how often they may be out of service at most. Similarly, there could be a contract that states how many of the assigned trips have to be executed.

Keywords: ['bc', 'metric', 'conclusion', 'employee']

Polarity: Neutral (0.11)

Subjectivity: 0.45 / 1.0

### 6.2.3 Execution of Deliver Product in Germany

However, it can be said that at the time of writing, cylinders were placed at 135,000 customers sites. In total, 2.3 million cylinders are owned and the number of cylinders sold is at least 3.9 million per year. This includes industrial gases (IG), technical gases, medical gases and SG, all sold at different price ranges. Every day that the cylinder is at the customer's site, 0.25€ is charged. Thus, PGP Germany earns more on the rental of the cylinder bottles than on the content, the gas. Additionally, there are also high-priced SG in Germany, such as Xenon, for which a price of up to 500,000€ can be charged. The first analysis with figure 17 and table 8 refer to SG, the second analysis with figure 18 and table 9 refer to IG. From there, the sales order is automatically forwarded to the SAP ERP system. This is then used to create a work order, which informs the respective departments about the order. Simultaneously to the gas production, a schedule order is created in the Paragon planning system based on the work order in SAP. For SG in Germany, there are two types of shipping: direct shipping to the customer and internal plant-to-plant shipping. Therefore, most gases are shipped from the SG filling plant to another Linde plant, where they are then safely stored. Their task is to provide and assign an external driver and an external vehicle, which is not owned by Linde, for these trips as well. The initial “tour” planned by an internal Linde employee is now referred to as a “trip” after being processed and planned by the transport contractor. After the trip is planned, the corresponding cylinders are taken from the storage and loaded onto the truck. During this process, the cylinders are scanned with a Zebra handheld. As a result, the system registers that the cylinders are no longer available for further sale. When the driver takes the loaded truck to the customer and unloads the cylinders, they have to be scanned again. Since this event takes place locally at the customer's site and therefore not on Linde's property, a different application called Inlabel must be utilized for scanning the cylinders. The driver loads the empty cylinders and after returning to Linde territory, Lima is used again for scanning during unloading. Based on factors such as driving behaviour and adherence to traffic and safety rules, a driving score is generated for the driver from several key performance indicators (KPI). A driver debriefing takes place at regular intervals and sometimes even after each trip. As the very last step, the cylinders are thoroughly cleaned, repaired if necessary, and made reusable by replacing broken parts. After completing the process analysis of the SG, the process analysis of the IG is now carried out. The Deliver Product process in the production of IG at PGP Germany starts instantly with the production and filling of gas. After filling, the cylinders are visually inspected and are then ready for sale. In parallel, Linde receives the customer's order via the eChannel system. Here, the customer selects his standard IG from the product catalogue. The sales order is then manually entered into SAP, where a work order is directly generated in the route planning system Paragon for scheduling the delivery. Part of the scheduling process is to first compare the customer's purchase order with the gas stock inventory. If the desired product is not available in the filling plant's stock, a so-called plant-to-plant delivery must be triggered. In this case, the desired product is delivered by a filling plant from another region in Germany. If the ordered gas is available, a tour is planned. To execute the tour, the fleet is prepared and checked for roadworthiness, a driver and a vehicle are assigned to the tour, and a precise delivery time is set. After this step, it is no longer called a "tour" but a "trip". When the trip is fully planned, the cylinders are loaded onto the truck. The loaded truck drives to the customer and there, using Lima, the full cylinders are unloaded, and the empty ones are loaded for return. Back at the Linde filling plant, the empty cylinders are unloaded again and scanned with Inlabel. After the trip, a driving score is generated, and the driver is debriefed based on his driving behaviour. Any roles and actors that only occur in one of the two product categories are marked accordingly in the matrix. When executing the capability Deliver Product, the plant manager is accountable for each role and actor that is occupied or executed by an internal employee. New roles are formed when the Deliver Product capability is exercised in Germany. Here, for the first time, a dispatcher acts as the responsible actor. He is dealing with the trip plan communication with the drivers of the external contractor. In addition, he also monitors the driving behaviour and conducts a driver debriefing together with them. After the cylinders have been used, they are dispatched to the partner, who operates his cleaning facilities at its own site. There, the cylinders are cleaned, maintained and, if necessary, repaired or replaced. A special function in Germany and the entire Europe, Middle East and Africa (EMEA) region has the Centre of Competence (CoC). The CoC supervises, improves, and standardizes all sub-capabilities involved in the level-1 supply chain management capability across all countries. For this reason, they provide reciprocal consulting support for all roles of the Deliver Product capability. The changes are limited to a different information of the data entity sales order. A material number is required for IGs, as these are standard gases that only have to be selected from a catalogue. Besides, the information for the gas analysis is omitted for the product data entity. As part of a large SAP project at Linde, the system is to be replaced in the future by SAP S/4 Hana. For entering the customer order, the e-commerce system eChannel is used. It makes no difference whether the customer requests a self-defined gas mixture or simply selects standard IG from Linde's product catalogue. In the operational area, Paragon is used for route and delivery planning. When loading and unloading the truck, the cylinders are scanned to record their movement data and keep the stock inventory data accurate. The Inlabel application is used inside Linde's own facilities and the Lima application is used outside Linde's facilities, for example at the customer's site. The company TomTom specializes in navigation technology and applications and offers a wide range of products and services for fleet management efficiency. The same-named software TomTom used by Linde is implemented as a GPS tracking and locating system for monitoring and supervising drivers. Webfleet, also an application from the TomTom portfolio is a fleet management solution, which helps to manage the fleet effectively. At Linde, the system is used to document and evaluate driver movements and driving behaviour. The vehicles in use at Linde are from the Swedish manufacturer Scania and the Japanese company Mitsubishi Fuso, which, however, is largely owned by the German company Daimler Trucks. It is an Android touch computer which is characterized by its robustness and can therefore be operated in production facilities and similar environments. The contracts listed here are fictional but could exist in this or a similar form. PGP Germany could have contracts for the deployment of external vehicles, the completion of assigned trips, and the maintenance and cleaning of cylinders and other accessories.

Keywords: ['euro', 'unit', 'bottle', 'artefact']

Polarity: Neutral (0.07)

Subjectivity: 0.39 / 1.0

### 6.2.4 Comparison of Korea and Germany and its emerging hypotheses

The aim is to find out what conclusions can be drawn about the similarities but also the differences in the execution of the BC. For this purpose, XY hypotheses are presented below based on the developed artefacts in chapter XY. In order to confirm the derived hypotheses, a semi-structured expert interview was conducted with two experienced Linde managers, referred to as P2 and P3 in the attached interview transcript. Furthermore, disparities were identified that occur as a result of the dissimilar scaling of the business, thus entailing different business requirements (Hypothesis 5). Consequently, there are differences in the allocation of roles by actors, which can be attributed to the different scaling of the two businesses as well (Hypothesis 2). Furthermore, it was indicated that country-specific conditions exist, which are demonstrated in the execution of the BC and need to be considered (Hypothesis 6). Despite the anticipated differences, a standardisation of the application landscape seems feasible in the future. This requires that the Korean business scales up to be on a similar footing as the German business. (Hypothesis 9) One object could already be identified for standardisation in the field of common technologies used (Hypothesis 7). When considering standardisation projects, it is important to be aware of local circumstances that could complicate the effort of standardisation and reduce the potential benefits (Hypothesis 8). In summary, it can be concluded that the Deliver Product execution of the two countries analysed is fundamentally the same. However, there are differences that can be explained by country-specific characteristics and in particular the scale of the businesses.

Keywords: ['conclusion', 'similarity', 'difference', 'hypothesis']

Polarity: Neutral (0.1)

Subjectivity: 0.41 / 1.0

# 7 Improving Linde’s corporate IT demand process through Business Capability Management

As presented in chapter 5, the demand team does not follow a stringent approach when deciding on the realisation of demands. In order to assess whether the application of the TOGAF BC method offers added value, it is necessary to take a closer look at the demands that are created. Because Linde does not use a consistent method, the BC components, with a focus on processes, roles, information and resources, have to be examined and analysed each time anew. In the case of wide-reaching demands that affect the EA deeply, the application of the TOGAF BC analysis is value-creating. The implementation in chapter 6.2 indicates that the analysis can be used to develop an understanding of the BC under consideration and subsequently provide a basis for decision-making. In the case of Korea and Germany, the BC analysis of Germany can serve as a target architecture for the baseline architecture presented in Korea. The largest proportion of requests consists of "small" requests, such as a change to an existing system or the introduction of a new Software-as-a-Service (Saas) solution. Here, only selective background information is required, such as the type of change and the value added through the new functionality of the system. This question must be decided depending on the situation and can be answered with "no" in most cases. The situation is different when a demand is created that requires a "major" conversion project. However, it was not based on a methodology like TOGAF, but on the experience of the business consultants and the IT demand team. For their BC analysis, the IT demand team acquires its own understanding of BC and uses, for example, the application inventory mentioned in chapter XY. As long as the initial situation, i.e. the as-is and to-be architecture in the corresponding BC is clear to all participants, this procedure is tolerable. Since this is not necessarily the case in many cases, applying the TOGAF BC analysis using the artefacts can offer an advantage at this point. As an industrial group with annual sales of $33 billion in 2022, earnings of $8.7 billion and an EBIT margin of 27%, Linde is well above industry peers. This is partly due to the fact that Linde has its capex under control. The annual $3.2 billion euros investments are extensively planned in the corresponding demand and planning processes and the expenditures are meticulously calculated to optimize costs. This is necessary because Linde has set itself the goal of increasing profits by up to 12% for the following year .

Keywords: ['artefact', 'expert', 'request', 'enhancement']

Polarity: Neutral (0.06)

Subjectivity: 0.49 / 1.0

# 8 Summary

Due to the company structure mentioned in chapter XY, Linde should be described as international rather than a global company. Each country has its own local supply-chain and thus no reason to document or share its own information in detail.

Keywords: ['IT', 'chapter', 'Linde', 'structure']

Polarity: Neutral (0.06)

Subjectivity: 0.47 / 1.0