



Management of international trade of a company

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Řízení mezinárodního obchodu společnosti

Anotace

Diplomová práce “Řízení mezinárodního obchodu společnosti” se zabývá problematikou řízení zakázek ve firmě působící na zahraničních trzích. Hlavním cílem této práce je identifikovat příčiny nečasného plnění zakázek a návrh řešení nebo doplnění stávajícího řešení. Pro dosažení hlavního cíle je třeba vyhodnotit vazby mezi výrobou podniku, prototypovou výrobou, plánováním výroby a vliv mezinárodního obchodu. Primárním zdrojem dat jsou kvalifikované rozhovory s finanční ředitelkou podniku, produktovými manažery a vývojáři na téma faktorů, které ovlivňují pozitivně i negativně řízení zakázek, to, jaké vazby má řízení mezinárodního obchodu s plánováním výroby, a diskuze k zavádění navrhovaných řešení v praxi.

Klíčová slova

Řízení zakázek, management kvality, mezinárodní obchod, výrobní společnost

Management of international trade of a company

Abstract

This diploma thesis, "Management of international trade of a company", deals with the issue of order management in an internationalised company. This study aims to identify the causes of non-compliance with manufacturing orders' delivery dates and propose either a new solution or an upgrade to the existing one. To achieve the main goal, the researcher evaluates the relationships between the company's production, prototype production, production planning, and international trade impact. The primary data sources are qualified interviews with the company's CFO, product managers and developers. The main questions are what factors positively and negatively affect order management, the links between international trade and production planning, and the discussion of implementing the solutions in practice.

Keywords

Order management, quality management, international trade, manufacturing company

Table of Contents

| | |
|--|-----------|
| List of Figures | 13 |
| List of Graphs | 14 |
| List of Tables..... | 14 |
| List of Abbreviations..... | 15 |
| Introduction | 17 |
| 1 Company Management..... | 20 |
| 1.1 Process Management..... | 21 |
| 1.1.1 Problem-Solving Process..... | 21 |
| 1.2 Project Management..... | 22 |
| 1.2.1 Traditional and Non-traditional Projects | 23 |
| 1.2.2 Project Management Life Cycle..... | 24 |
| 1.3 Quality Management..... | 25 |
| 1.3.1 Total Quality Management..... | 26 |
| 1.3.2 ISO 9001:2015..... | 26 |
| 1.4 Risk Management..... | 27 |
| 1.4.1 Risks in International Trade | 28 |
| 2 Order Management in Manufacturing Companies..... | 29 |
| 2.1 Fundamentals of Supply Chain Management | 29 |
| 2.1.1 Order Management | 32 |
| 2.2 Company Information Systems..... | 33 |
| 2.2.1 Enterprise Resource Planning..... | 34 |
| 2.3 Performance Management..... | 35 |
| 2.3.1 Performance Measures | 35 |
| 2.3.2 Characteristics of Key Performance Indicators | 36 |
| 3 International Trade | 38 |
| 3.1 International Business Principles | 39 |
| 3.1.1 Drivers of International Business | 39 |
| 3.1.2 Foreign Market Entry Modes | 40 |
| 3.2 The Global Supply Chain..... | 42 |
| 3.3 International Trade Practices..... | 43 |
| 3.3.1 Export Operations..... | 45 |
| 3.3.2 Import Operations..... | 46 |
| 3.4 International Trade in Resources and Commodities | 47 |
| 3.4.1 Environmental Impact of International Trade | 47 |

| | | |
|----------|--|-----------|
| 4 | Description of the selected company | 48 |
| 4.1 | Unique product..... | 50 |
| 4.1.1 | Innovation strategy | 52 |
| 4.2 | Company Management..... | 53 |
| 4.2.1 | Organisational Structure | 54 |
| 4.2.2 | Quality Management | 55 |
| 4.2.3 | Risk Management..... | 57 |
| 4.2.4 | Supply Chain Management..... | 58 |
| 4.3 | Company's International Trade..... | 59 |
| 4.3.1 | Company's Sales..... | 60 |
| 4.3.2 | International Trade Specifics..... | 61 |
| 4.4 | Order management | 62 |
| 5 | Analysis of the Current Situation | 64 |
| 5.1 | Methodology | 64 |
| 6 | Evaluating the Analysis Results and Formulating Conclusions | 69 |
| 6.1 | Suggestions for Improving the Prototype Order Management System..... | 71 |
| | Conclusion..... | 75 |
| | Bibliographical References..... | 77 |
| | Internet References | 81 |

List of Figures

| | |
|---|----|
| Figure 1 Project process groups..... | 24 |
| Figure 2 Material, information, and financial flows as core elements of SCM | 30 |
| Figure 3 Crytur; organisational structure | 54 |

List of Graphs

| | |
|--|----|
| Graph 1 Number of Employees in years 2011-2021 | 49 |
| Graph 2 Revenues in millions of CZK in years 2011-2021 | 50 |
| Graph 3 Countries' share of exports in 2021 | 60 |

List of Tables

| | |
|---|----|
| Table 1 Traditional versus non-traditional Projects | 23 |
| Table 2 Twelve characteristics of effective KPIs..... | 37 |
| Table 3 Structure of personal interviews..... | 65 |
| Table 4 Prototype production workshop – SWOT..... | 72 |

List of Abbreviations

| | |
|-------|---|
| BCM | Business Continuity Management |
| BPM | Business Process Management |
| CNC | Computerized Numerical Control |
| CRM | Customer Relationship Management |
| EFQM | European Foundation for Quality Management |
| ERP | Enterprise Resource Planning |
| FDI | Foreign Direct Investment |
| FPI | Foreign Portfolio Investment |
| ICC | International Chamber of Commerce |
| IMS | Integrated Management System |
| IS | Information System |
| ISO | International Organization for Standardisation |
| KPI | Key Performance Indicator |
| KRI | Key Result Indicator |
| MNE | Multinational Enterprise |
| NDA | Non-disclosure Agreement |
| PAIS | Process-Aware Information Systems |
| PI | Performance Indicator |
| PLM | Product Lifecycle Management |
| PMI | Project Management Institute |
| QMS | Quality Management System |
| RI | Result Indicator |
| SCE | Supply Chain Execution |
| SCM | Supply Chain Management |
| SMART | Specific, Measurable, Achievable, Realistic, Time-based |

SME Small or Medium Enterprise

TQM Total Quality Management

Introduction

The topic of managing international trade was chosen based on the researcher's acquired knowledge from his completed studies of international trade and the subsequent studies of the international management program. The knowledge is applied in a company operating in international markets. Since his bachelor's degree, the researcher has established a professional relationship with the economic department in Crytur, Ltd. Strengthening these relationships and deepening knowledge or future career opportunities are the motivation for elaborating this diploma thesis. The logical structure of the thesis reflects the issues of production company management and business activities of an internationalized company.

The subject of the diploma thesis is the company Crytur, Ltd. Crytur's economic situation is favourable; the company has been growing for a long time and has had a high and stable number of orders pushing the production. However, from the perspective of order management, constant delays occur. Repeated non-compliance with delivery dates arises from the overpressure of the number of orders combined with more factors. Crytur has made efforts to expand capacity and demand for domestic and foreign personnel. However, there are still multiple situations where the company produces less and fails to meet delivery dates. In most cases, Crytur accepts these delays and strictly avoids using alternative solutions, so the top quality of the products is not endangered.

The first chapter of the thesis theoretically describes the issues of company management. The transition from an SME to a large company brings challenges in redistributing responsibilities and duties. Therefore, there is a transition to a more significant differentiation of levels of management. Nowadays, in the management of a manufacturing company, there is a strong emphasis on both process management and project management. The problem-solving process and project management life cycle are highlighted in the two topics. Furthermore, the issues of risk management and quality management are an integral part of company management, its production and business activities, and intervene in decision-making processes.

The second chapter focuses on a deeper understanding of selected parts of supply chain management, most notably order management as a subject of the study. The chapter also

deals with software systems and performance management. Large manufacturing companies must plan resources, mainly using ERP systems, and monitor production performance.

The third and most extensive chapter describes international trade. In general, Crytur operates in the field based on business internationalisation. This concept includes internationalising products, human resources, intellectual property, or business expansion. Crytur is also a highly exporting company and participates in imports. Attention is paid to global supply chain management, export and import operations, and international trade in resources and commodities, which are relevant to the study and correspond with the essence of Crytur's production. The fourth chapter analyses Crytur from different perspectives with a strong emphasis on coherence with the research, ensuring the relevance of the solutions and the overall integrity of the thesis. The remaining chapters, five and six, deal with methodology, application of the theoretical findings, the conclusion of the study and discussion, which are described as follows.

The study's primary aim is to identify the factors affecting manufacturing orders' delivery dates and provide a partial or complete solution to the company. To achieve the main goal, the researcher sets the objectives to evaluate the relationships between the company's production, prototype production, production planning, and international trade. The methodology used to achieve the objectives is narrative analysis, which is a type of qualitative analysis. The primary data sources are qualified interviews with the company's CFO, product managers, technologists and other key employees.

The main question is: What factors positively and negatively affect order management?
Secondary questions are:

- What are the links between serial production and prototype production?
- How does prototype production differ from serial production? Is it highlighted in the company's information system?
- What is the relationship between the sales department and production or prototype production?

Moreover, the researcher monitors the impact of international trade on company order management and production planning to gain deep insight into the issues of non-compliance with delivery dates of manufacturing orders.

The result of this study should bring the company a solution or adjustment to the solution to the problematics. The benefit of this study for the company should be to facilitate further decision-making on the topic and point out possible side issues that the company can focus on in the future. The problems found can be a guide and an opportunity for further studies.

1 Company Management

Management is a discipline and a field of study representing all activities that aim to keep an organisation running. These activities contribute to the functioning of an organisation and affect the overall value of a company. The quality and skills of the managers are vital for estimating future company success. Management concerns companies and all organisations in other areas such as healthcare, social administration organisations, education, army and sport. As for the companies, management helps operate in a better-organised manner, determine structures and redistribute duties and responsibilities.

Nowadays, companies face numerous challenges, such as a competitive business environment, and great attention must be paid to organisational efficiency in the companies. It is vital to monitor the impact of human behaviour on the company, and human resources must be managed effectively. Furthermore, the company must coordinate the efforts of its members and follow transparent management activities. Mullins (2016) explains these common activities of management that were introduced by Henri Fayol (1841-1925) at the turn of the 20th century:

- Forecasting and planning – deciding about future achievements, developing plans,
- organising – providing the material and human resources,
- commanding – maintaining activity among personnel, getting the optimum return,
- coordinating – unifying and harmonising all activities and efforts of the organisation,
- controlling – verifying if plans were fulfilled.

These management activities occur in different ways and at different levels of the organization. The literature usually describes three levels of management that divide management in organisations according to the scope of responsibilities, decision-making or the length of the planning horizon: Top-Level Management, Middle-Level Management, and Lower-Level Management. In small companies, managerial activities tend to extend across managerial levels, whereas the greater emphasis is placed on compliance with well-defined responsibilities in larger companies.

1.1 Process Management

Process management is one of an organization's most valuable assets. Processes determine managers' and other employees' activities, responsibilities, and future work. Business processes, in particular, have a direct impact on product and service success and customer satisfaction. The better the processes are designed and performed, the higher the quality is potentially delivered to a customer. Processes that are adequately set up support company revenues. Poorly defined processes or process failures, on the other hand, can lead to stagnation. Well-defined processes help the company adapt to new circumstances and meet a growing number of legislative requirements (Dumas 2018). Process management and project management are two often pronounced terms in the company environment and the literature concerning company management. Process management manages and coordinates activities in an organisation to improve regular or ongoing processes.

Process management is inextricably linked to quality management. Several methods are used to manage and measure processes in both process management and quality management, including statistical measures. The most common methods that pay attention to exact time measures are, for example, The Deming Cycle, Business Continuity Management (BCM), Business Process Management (BPM), or six sigma (Snabe 2008). Some of the quality management methods are discussed in chapter 1.3.

1.1.1 Problem-Solving Process

The problem-solving process is a helpful guide in decision making that can be used for both quantitative and qualitative methodology. Managers can learn a quantitative approach by more profound studying management science methods. A manager competent in quantitative methodologies can evaluate both approaches to make the best decisions. Qualitative approach skills are primarily based on the manager's judgment. If the problem is relatively general or straightforward, emphasis may be placed upon a qualitative analysis (Anderson 2012). Qualitative research focuses on descriptions and ideas, while quantitative research investigates statistics. Subjectivity is an unavoidable part of qualitative research.

Anderson (2012) defines the problem-solving process as identifying a difference between the actual and the desired state, followed by taking action to resolve the difference. Minor

problems do not require an accurate description or a lot of time and effort. On the other hand, significant problems demand careful analysis and follow seven steps of solving process:

1. Identify and define the problem,
2. determine alternative solutions,
3. determine the criteria for evaluating the alternatives,
4. evaluate the alternatives,
5. choose an alternative,
6. implement the selected alternative,
7. evaluate the results and discuss the solution.

Decision making is generally associated with the first five steps of the problem-solving process. Decision-making ends with choosing an alternative, which is the purpose of the decision. The next step of the problem-solving process contains determining the criteria used to evaluate the alternatives. The solution can be found according to one criterion (single-criterion decision problems) or one or more criteria (multi-criteria decision problems). The last step is to evaluate each alternative concerning each criterion (Anderson 2012).

1.2 Project Management

Project management is applicable when something new is being set, for example, relocating a factory, building extensions, or producing new products. It is closely connected to new machinery and skills, and it often requires staff training. Therefore, there is a difference between functional or line management and project management. Functional managers or process managers are more reactive to changes, while project managers are more proactive to changes. Project management is the application of knowledge, skills, or tools that are necessary to achieve a project's requirements (Lester 2017). Companies seek long-term growth and success. The basis is to implement projects effectively and repeatedly so managers can achieve their business results consistently. Managers must be provided with the correct information and tools to use the right project strategy while following a company's business strategy (Martinelli 2016).

1.2.1 Traditional and Non-traditional Projects

A project consists of coordinated and controlled activities or processes to achieve an objective conforming to specific requirements, including time, cost, and resource constraints. The project's resources include both human and non-human resources. Another aspect of a project is that the result provides business value to the company. Companies must emphasise choosing an appropriate project mix (Kerzner 2017a).

Kerzner (2017b) identifies two types of complex projects. Traditional projects are based on linear thinking and well-structured life cycle phases (see chapter 1.2.2), whereas the main aspect of non-traditional projects is their variability. Traditional project management works as long as the scope is reasonably well defined (Kerzner 2017b). The differences between traditional projects and non-traditional projects are described in Table 1.

Table 1 Traditional versus non-traditional Projects

| Traditional Projects | Non-traditional Projects |
|--|--|
| The time duration is 6–18 months. | The time duration can be several years. |
| Assumptions are not expected to change over the project's duration. | Assumptions change over the project's duration. |
| Technology is known and will not change over the project's duration. | Technology will most certainly change. |
| People who started on the project will remain through to completion. | People who approve the project may not be present at the project's conclusion. |
| The statement of work is reasonably well defined. | Statement of work is ill-defined and subject to numerous scope changes. |
| Target is stationary. | Target may be moving. |
| There are few stakeholders. | There are multiple stakeholders. |
| There are few metrics and KPIs. | There can be numerous metrics and KPIs. |

Source: Kerzner 2017b, p. 6, edited

Only a small percentage of all of the projects in a company belongs to traditional projects. Most non-traditional or complex projects are primarily based on business scenarios where the outcome or expectations can change rapidly (Kerzner 2017b).

1.2.2 Project Management Life Cycle

Within each phase of project development, many processes must be completed before a project can move into the next phase. Project Management Institute (2017) identifies five phases of the project management life cycle:

1. Project initiation,
2. project planning,
3. project execution,
4. project monitoring and control,
5. project closure.

Every phase comprehends a list of processes that should consider various factors such as time, size, access to resources, risks, experience, and industry and application area. Figure 1 provides an overview of a project management life cycle.

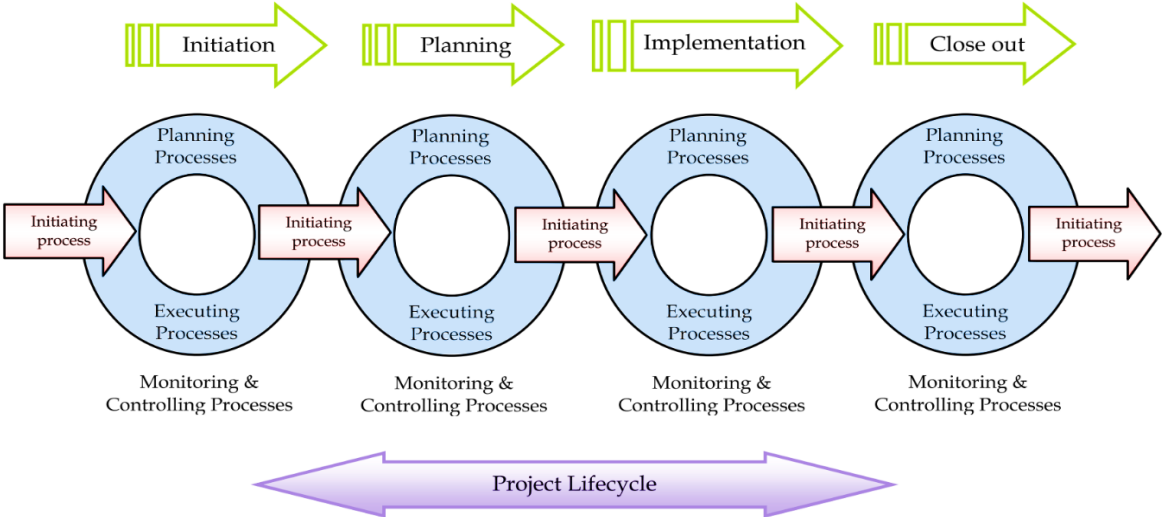


Figure 1 Project process groups
 Source: Aized 2012, p. 42, edited

During the initiation phase, limits for the resources are set. The project is discussed, and the benefits of the project are recognised. Necessary documents for the project are prepared, and the project is assigned to the project manager. The second phase is planning the project more precisely. The work requirements are defined along with the quality and quantity of work.

The planning phase includes risk evaluation and scheduling of the activities. The project is executed in the third phase (Kerzner 2017a). Possible adjustments are negotiated with team members. The project is exposed to critical measurements in the monitoring and control

phase possible impacts are analysed. Desirable adjustments are being implemented. The project ends with the closure phase. The project's current state is compared with the past, and all the work is verified (Kerzner 2017a). The project management life cycle helps project managers organise and control their projects.

1.3 Quality Management

Quality management is closely related to project management. Continuous improvement of a project's performance depends on ensuring proper quality management. The quality of a project refers to time, budget, specification, and quality requirements (Aized 2012). Quality can be defined as a state associated with products, services, people, processes, and environments that meet expectations and helps to produce superior value. A quality manager's job is to ensure that a product achieves all desired business objectives. It is crucial to understand how customers perceive the quality (Goetsch 2013). Quality managers collect and track data to achieve the predefined quality goals. However, gathering the data can be challenging; it can be stored on different servers using various tools or written forms. A quality management plan allows collecting and converting data into useful information.

Over the last hundred years, many Quality Management Systems (QMS) or programs have been developed. Industries worldwide can adopt Total Quality Management (TQM) (see chapter 1.3.1), ISO 9000 norms (see chapter 1.3.2), Six-Sigma, Reengineering, Toyota production system, or lean production, which aims primarily at reducing waste¹ (Aized 2012). Companies with magnificent quality management systems that focus on improving business performance can be awarded Malcolm Baldrige National Quality Award (Institute for Performance Excellence 2020) or EFQM Excellence Award (EFQM 2022). These companies strictly follow TQM concepts and achieve excellent and sustainable results.

¹ Reducing waste by increasing productivity and profits, reduce costs, eliminate redundant activities, avoid wasting skills.

1.3.1 Total Quality Management

Total quality management (TQM) is a comprehensive approach to doing business that maximises an organisation's competitiveness through the continual improvement of quality. TQM comprises several related concepts in business approaches, such as training and education of entire teams, Top management's commitment to quality, customer focus, or team structure with company-wide participation (Goetsch 2013). It is perceived that "*In a TQM effort, all members of an organization commit to and participate in, improving processes, products and services, and the culture in which they work*" (Clough et al. 2015, p. 316).

TQM introduced a new way of understanding quality. Historically, quality has measured the number of defects per hundred produced parts. The exact measurements are made per million parts produced in the TQM approach. The traditional view of quality expected few improvements per year; in contrast, TQM expects ten or more improvements per employee (Goetsch 2013). TQM also sets out tens of basic or advanced quality management tools and methods. The seven essential tools of quality control are described in the following chapter.

1.3.2 ISO 9001:2015

ISO 9000 is a family of quality management systems published by the International Organization for Standardization (ISO). ISO 9001 is one of the most globally accepted quality standards for organisations, and ISO 9001:2015² represents the newest version. The ISO 9001 covers the requirements and processes in 10 clauses: Scope, Normative References, Terms and Definitions, Context of the organisation, Leadership, Planning, Support, Operation, Performance Evaluation, and Improvement. ISO 9001 suggests quality management tools and methods based on which companies can establish or improve their Quality Management Systems (QMS) (Abuhav 2017). ISO 9001 Standard in a company may act regulatory. Nevertheless, companies implement ISO 9001.

ISO 9001 standard helps companies effectively design QMS and also raises the company's reputation if certified by a certificate authority. The main benefit is managing the company's

² Corresponding to Czech valid version ČSN EN ISO 9001:2016.

processes more effectively, describing and eliminating risks, or potentially increasing productivity and reducing costs. A company with a well-established QMS can quickly meet customers' expectations. Additionally, ISO 9001 certificate serves as proof to stakeholders that the company meets quality expectations and works in accordance with the requirements of laws and regulations.

1.4 Risk Management

Risk is perceived as the probability that the outcome of a particular event will differ from the expected outcome. Risk can mean a loss for a company or a benefit by its very nature. Companies are exposed to numerous risks that are controllable or uncontrollable. Hopkin (2018) divides risks into four categories based on the impact on a company: hazard risks, opportunity risks, control risks, and compliance risks. A typical example of hazard risk is theft. Companies manage hazard risks to the level they tolerate. Control risks, in general, make uncertain outcomes of situations (Hopkin 2018). Control risks can be applied to order management (described in chapter 2.1.1), where unknown or unexpected events may cause uncertainties in delivery dates or payment dates.

Opportunity risks can have both positive and negative impacts on a company and can be used to speculate on positive returns. Opportunity risk is embraced in the case of investments. Companies should not underestimate the compliance risk that lies in requirements and regulations (Hopkin 2018). Companies are differently tolerant of selected risks. The fundamental role of risk management is based on three key activities. Firstly, the risk is identified and described in detail. This is followed by a risk analysis, probability assessment and interpretation of the consequences. Finally, risk measurement, risk assessment, and risk management decisions occur. *"All forms of business contain elements of risk, but when it comes to international trade, the risk profile often enters a new dimension"* (Grath 2016, p. 10). The internationalization of business brings additional risks that the company needs to consider. The following chapter determines the risks in the international trade environment.

1.4.1 Risks in International Trade

Machková (2014) divides risks in international trade into the market, commercial, transport, territorial, responsibility and currency risks. Market risks represent the probability of loss due to a change in market conditions. The relationship between supply and demand for specific goods can shift, or the structure of suppliers and customers can change. There may be seasonal fluctuations, changes in customer preferences or changes in preferred production technology in a given market. Commercial risks are the possibility of losses for business partners that result from non-compliance with the obligations of the business partner. Machková (2014) also identifies the most common forms of commercial risks in international trade as follows:

- Withdrawal of the business partner from the trade,
- non-fulfilment or defective performance of the contract by the supplier,
- unreasonable non-acceptance of goods, and
- the debtor's unwillingness to pay or the debtor's insolvency.

These risks can be partially eliminated by preventive verification of the business partner or contract rejection based on previous experience. Transport risks arise when transporting goods are partially or entirely devalued. The transfer of risk is set by trade terms, which must be precisely described. Commonly used trade terms are, for example, INCOTERMS (International Commercial Terms). Territorial risks represent the country's macroeconomic development. These include political risks, economic decisions or administrative measures that affect the company's business. Currency risks represent the risk of loss caused by changes in the prices of exchange rate-sensitive instruments. Literature on international trade (e.g., Machková 2014) perceives currency risks in a broader sense and includes inflation, interest rate developments and restrictions on currency convertibility.

Product liability risk is a protection of the consumer. Strong consumer protection generally applies in developed countries such as the US or the EU. In cases of damage to the health or property of the consumer, the manufacturer bears the responsibility. Companies must pay attention to product safety, and the product must comply with given standards and regulations (Machková 2014).

2 Order Management in Manufacturing Companies

This chapter follows the issue of company management in the narrower context of order management in a manufacturing company. The basic concepts of material and information flow management are reviewed. First, the concept of supply chain management (SCM) and its key areas are explained, focusing on order management for the study. Attention is then paid to information systems (IS), which are an integral part of order management. The chapter on performance management supports the coherence of the topics and builds on the previous chapter on project management.

2.1 Fundamentals of Supply Chain Management

This chapter describes the major tasks that arise during order management in the most important functional areas. The supply chain covers areas such as material sourcing, production scheduling, and the physical distribution system, backed up by the necessary information flows. Procurement, manufacturing, inventory management, warehousing, transportation, and countless others are typically considered part of the supply chain (Knolmayer 2010).

In conjunction with the extensive reorganisation of business structures and processes, the concept of SCM gained importance. Many companies have historically changed their structures and reduced the degree of vertical integration, intending to obtain more products and services from external suppliers. With concepts such as virtual companies, extended enterprises or strategic alliances, companies' legal and business limits became non-transparent. Consequently, the need for coordinating business processes beyond the elementary organisation units was raised (Knolmayer 2010). Publications on SCM emphasise marketing, logistics, and organisational issues. Nevertheless, SCM is possible only with the advances in IT and information systems (further explained in chapter 2.2). Integrating SCM software with Enterprise Resource Planning (ERP) systems is mandatory.

The Scope of Supply Chain Management

SCM represents managing and coordinating flows of products, services, finances, and information and includes all the processes needed for transforming raw materials into final products. The scope of SCM is to improve the flows among companies collaborating under long-term agreements and consequently improve the competitiveness of the entire supply chain. This scope is achieved by sharing information, coordinating planning, scheduling and execution, and collaborating on monitoring and control (Knolmayer 2009). This inter-company cooperation also takes place in quality control. Whereas lean management in quality management tries to counter various forms of waste within a company, SCM aims to avoid waste all along the supply chain.

Supply chains can be made up of independent companies, but they can also be made up of organisational entities that are legally part of the same group. While the literature focuses on inter-company collaboration, the majority of SCM projects in practice are concerned with intra-group systems and collaboration within a group (Knolmayer 2009). Figure 2 shows the typical directions of flows.

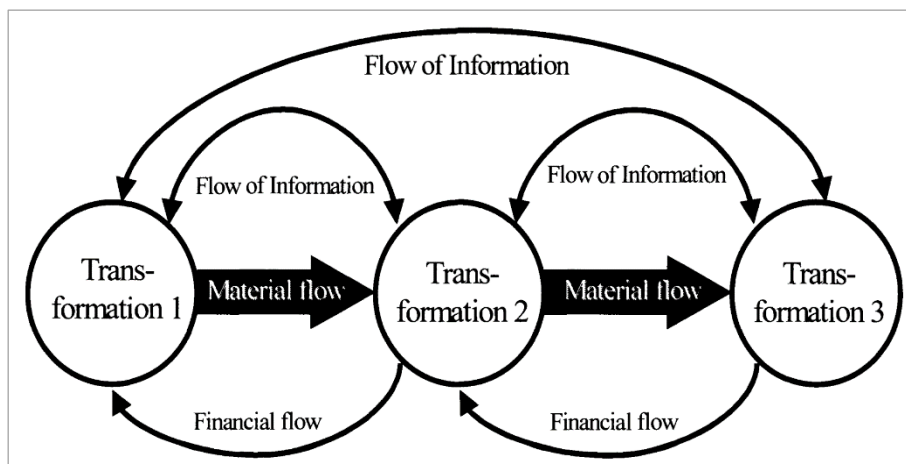


Figure 2 Material, information, and financial flows as core elements of SCM
Source: Knolmayer 2009, p. 4, edited

Material flow begins with the manufacturer sourcing the materials. Material flow goes through operations and is transported to the end customer. Material flow only returns backwards in case of repairs or exchanges. Financial flow is transferred from the customer to the manufacturer. Information flow is the most intensive and complex network. Information flows in both directions, unites operations and connects customers with the manufacturer. All three flow types must be managed effectively to achieve effective SCM.

Logistic Frameworks

Hompel (2007) considers logistics a subset of SCM. It is a systematic approach usually defined as planning and controlling material and information flows. Logistics emphasizes the so-called 6Rs of logistics. The 6Rs describe the logistic targets as delivering: the right goods at at the right location the right time in the right quantity and the right quality at the right costs (Hompel 2007).

An optimal delivery service can be achieved when coordinated information and material flow. Material flows in the supply chain include many factors that can have a massive impact on logistics. Variations at the end of the supply chain (customer behaviour) can cause radical fluctuations at the beginning of the supply chain (system stocks) (Hompel 2007). These correlations are handled with the help of software systems. Software systems are devoted to chapter 2.2. Inventories are used to hedge against shortages in materials and components and allow smooth production flow. Additionally, inventories encourage the timely delivery of products to the end customer. Inventories can be divided into four types: raw materials immediately transformed after the first production activity, components as a functional subpart of a product, so-called work-in-process, and finished goods (Sieke 2019).

Another logistic principle is outsourcing. Outsourcing logistics allows companies in an international environment to concentrate more on the development and production, transfer stocks to the external warehouses or improve delivery services. E-logistics can be defined simply as a connecting element of industrial activities through the Internet. The key to project success is efficient logistics and a quick material flow system (Hompel 2007). This topic is accompanied by E-commerce, which concerns entrepreneurs present on the Internet. E-commerce covers, for example, e-shops and payment services.

Packaging plays an essential role in logistics, as it protects the goods from damage during transport, transshipment and storage processes and protects the goods' environment. Besides, standardizing packaging allows more accessible storage or transportation. Packaging can perform many other functions, usually based on the customer's wishes. Packaging can work as a marketing instrument (Hompel 2007). Packaging also works informatively, and a well-chosen package can reduce waste. Order management is an SCM instrument that a company uses to manage flows in the company, which is described in the following chapter.

2.1.1 Order Management

Order management is a process of fulfilling customers' orders, from placing an order to delivering the product or service to the customer. The companies use inter-company management systems to concentrate on planning, scheduling, controlling, and monitoring the processes (Knolmayer 2010). Managing an order consists of several activities that are entered into a company's information system. Delivery date and payment date are the two fundamental indicators that are monitored.

The first activity is order entry. The goal of order entry is an economical collection of data such as describing the exact product, price and delivery date. After entering data into the software system, an order must be verified together with the ability to produce the product. The technical validation of the product covers parameters of the product, performance or tolerances. The manufacturer must agree with the customer whether the product can be produced with the given parameters and properties. The times between the invoicing date and the actual payment date for each payment are calculated during the manufacturing processes. The expected values are determined and paired with the customer in the software system. Measuring payment dates and limits are a subject of credit management. The customers are assigned to risk classes according to the danger of loss. A company can handle the credit worthiness of the customers individually. Based on past negative experiences with a specific customer, a company can inform the personnel before confirming the order. Creditworthiness can be used to forecast the dates of payment arrivals (Knolmayer 2010).

The manufacturing time can be forecasted during order entry to compare with customers' favoured delivery date. Stocks components are tracked from the final product back in the manufacturing process to the raw materials. Firstly, products that meet customers' needs are searched in the inventory, and then the search continues from components to raw materials. If some components are supplied, the time of procuring must be considered. Based on the times of supplying and manufacturing of missing components, the production is planned, and the delivery date may be forecasted. SCM software supports decisions about delivery dates and considers all stock mentioned above, deliveries, capacities and other required resources (Knolmayer 2009).

2.2 Company Information Systems

This chapter deals with information systems that support company processes. These so-called Process-Aware Information Systems (PAIS) aim to achieve process automation (Dumas 2018). Companies should interact with customers through Customer Relationship Management (CRM) systems. Logistics operations are supported by Supply Chain Management (SCM) systems, and Enterprise Resource Planning (ERP) systems are used to plan the company resources. Product Life Cycle Management (PLM) systems give an overview of products' technical and marketing data.

CRM systems support marketing and sales processes that directly interact with customers on an individual or aggregated level. CRM systems help document the interaction with individual customers through phone calls, emails, Internet portals, and personal meetings. On the general level, CRM systems support sales and marketing activities related to products, pricing, distribution, and campaigning. CRM systems create an extensive database that provides information on prospective customers. Many CRM systems integrate business intelligence techniques (for example, data mining) to help with customer segmentation (Dumas 2018).

SCM systems perform transactions in the supply chain and support logistics operations. These systems coordinate work in the chain, help manage the relationships between customers or suppliers and control the business processes. Practice shows that SCM helps companies optimize planning tasks, allocate stocks and reduce storage costs. Additionally, reading barcodes can be considered a software feature under SCM (Mauergauz 2016).

PLM systems help collect and evaluate information about various product lifecycle processes. These include the product's specification, design, and validation during the product design phase. The manufacturing system is planned during the realisation phase, and actual products are built, assembled, and tested. Products are sold, delivered, used, and eventually disposed of in the service phase. PLM systems support process workflows, planning, and quality management (Dumas 2018). Enterprises can benefit from PLM systems to innovate their products and improve manufacturing processes or order processes.

2.2.1 Enterprise Resource Planning

Enterprise Resource Planning (ERP) systems provide essential business functionality in various industries. ERP systems support business processes in accounting and controlling, HR, quality management, project management and production management (Dumas 2018). Many companies introduced ERP systems in order to reduce the non-integration of systems and enhance interactions and communications with their customers and suppliers.

ERP integrates the departments' functionalities into one unified system. Hardware and software components in this system manage business processes defined in models. All models are integrated with the system to provide the organization with unified views (Ganesh 2014). Despite many advantages of ERP systems, Azevedo (2013) pointed out that was a difference between implementing ERP systems in large firms and SMEs, where successful implementation can be complicated. Nowadays, ERP systems vendors such as Microsoft, Oracle, or SAP SE, offer customizable ERP solutions for SMEs (SAP 2022a).

SAP ERP is mentioned as a practical example because SAP SE is the world's largest provider of enterprise application software. The name SAP is an abbreviation of the company's original German name Systemanalyse Programmentwicklung, which refers to System Analysis Program Development (SAP 2022b). Millions of companies in 190 countries are SAP users. The SAP SE company has around 110000 employees in more than 155 nationalities worldwide (SAP 2022c). SAP Software Solutions cover all previously mentioned software systems, including SAP CRM, SAP SCM or SAP PLM.

Companies firstly instal SAP user interface into their operating system, which is generally Windows or macOS³. The PC setup requires a stable network connection to communicate with the SAP server. Afterwards, SAP ERP is used in companies daily in accompanying business processes using functional components, modules, or functionalities in a window-based user interface (Chudy 2010).

³ Operating system released by Apple Inc.

2.3 Performance Management

Performance management is a concept that manufacturing companies use to achieve the highest possible results. It accompanies the activities of line and middle-level managers and the performance of the team's employees. Performance management is linked to project management and risk management and expands chapter 1.2.1 on traditional and non-traditional projects, as it is used to monitor the achievement of project goals. Tracking and responding to a set of performance indicators can improve companies' order management.

Performance management is a systematic process for improving company performance by developing the performance of individuals or teams. It is a continuous and flexible process that involves managers and employees acting as partners and sets out their highest potential cooperation to achieve the required results. Performance management usually focuses on future performance improvements rather than retrospective performance ratings. It is mainly concerned with individual performance and driven mainly by lower-level management. It is based on the agreement on role requirements, objectives, performance improvement, and personal development plans (Armstrong 2006). Performance management depends on intensive communication and enough feedback from the team members.

The other elements are measurement and positive reinforcement. Performance management measures output in the shape of delivered performance compared with expected performance. The inputs values are knowledge, skills and behaviours. The main focus is on development, although performance management is an integral part of the reward system through providing feedback and identifying opportunities for growth (Amrstrong 2006).

2.3.1 Performance Measures

Parmenter (2015) identifies four types of performance measures. These four measures are result indicators or performance indicators. Many measures can summarize more than one team's input, making them the result indicators. These indicators can be a good visualization of teamwork but do not help management fix a problem or identify who is responsible for the non-performance (Parmenter 2015).

Performance indicators are linked to one or more teams working together for a common purpose. The performance or non-performance can be assigned to one team according to better-defined responsibilities. These future-oriented performance measures give more clarity to the company. Both result indicators and performance indicators can encompass significant measures. These measures contain the extra word "key" to highlight the importance. Parmenter (2015) describes the four indicators as follows:

- Result Indicator (RI) – explanation of team's cooperation,
- Key Result Indicator (KRI) – summary of the company's performance,
- Performance Indicator (PI) – tells management what teams are delivering,
- Key Performance Indicator (KPI) – critical factors of a company's performance.

Companies tend to focus only on the key indicators. Parmenter (2015) states that companies often use KRIs and misinterpret them as KPIs. KRIs are reviewed monthly or quarterly. These reports are delivered too late to improve the ongoing processes. KRIs include net profit on the key product line, customer satisfaction, or employee satisfaction. On the other hand, KPIs express the most critical aspects of organisational performance that can be improved for the company's future success (Parmenter 2015).

2.3.2 Characteristics of Key Performance Indicators

Project managers have to understand critical metrics that need to be managed for a project's success. Measuring processes' performance is necessary for further improvements. However, identifying and measuring KPIs can be challenging. Franceschini (2019, p. 7) states that *"constructing and implementing a measurement system is easier said than done. The crucial point is to identify the "right" indicators to properly represent the process."*

The literature defines the characteristics of KPIs differently. KPIs can be simply characterized by the SMART (Specific, Measurable, Achievable, Realistic, Time-based) rule. Parmenter (2020) defines the seven characteristics of KPIs: non-financial, Timely, CEO focus, Simple, Time based, Significant impact, and Limited dark side. However, Kerzner (2017b) uses a more sophisticated set of characteristics for KPIs.

Table 2 defines the twelve characteristics of Kerzner's (2017b) KPIs. It consists of the characteristics and their explanations.

Table 2 Twelve characteristics of effective KPIs

| Characteristics | Description |
|------------------------|--|
| Strategic | Focus on the desired outcome |
| Simple | Easy to understand |
| Owned | Attached to an individual or group |
| Actionable | Populated with timely, actionable data |
| Timely | Updated frequently |
| Referenceable | Relatable back to the origins of the use |
| Accurate | Accurately measurable and reportable |
| Correlated | Usable to drive the desired business outcome |
| Game-proof | Realistic data, frequent testing and analysis |
| Aligned | Aligned with corporate strategy and objectives |
| Standardized | Standard definitions, rules, and calculations |
| Relevant | Periodically reviewed and refreshed |

Source: Kerzner 2017b, p. 130, edited

It is essential that all staff members fully understand KPIs. Finding the right KPIs is similar to peeling the layers of an onion to get to the core. Despite the fact it is relatively simple to produce a good list of performance indicators, it is challenging to identify the key performance indicators, particularly when it is remembered that there will be fewer than 10 in the entire organization. The company needs to ensure that the KPIs have the characteristics mentioned above (Parmenter 2015).

In practice, KPIs provide information for decision making and reducing uncertainty by managing risks. The KPIs can be displayed in dashboards, scorecards, and reports. Publishing the performance awakens the employees' competitiveness. However, it is essential to train employees to interpret the KPIs correctly and respond appropriately to exploit KPIs' potential (Kerzner 2017b).

3 International Trade

This chapter deals with international trade as a generally perceived term by world literature. The foundation of this concept is determined by business internationalization. International business encompasses merchandise export and imports, service exports and imports, investments, or types of international organizations (Daniels 2018). International trade is the exchange of goods and services between countries worldwide. Researchers' domestic literature uses only one phrase for the two terms international trade and international business. Therefore, basic terms are briefly defined to specify the role of international trade and better understand the international trade environment. The chapters cover the fundamental ways companies can participate in international markets. Chapter 3.2 on the global supply chain reflects supply chain management issues in the international trade environment. Subsequently, chapters on export and import surround the core operations in international trade. Chapter 3.5 on trade in resources and commodities is devoted to the company and is an additional component to the theoretical background of this study.

Globalization is the expansion of global connectivity, integration, and interdependence in the economic, social, technological, cultural, political, and environmental spheres (Grozdanovska 2017). The negative view of globalization is the rising power of Multinational Enterprises (MNE) or pressure on the companies to follow global trends, such as the increased use of digital technologies in supply chains (Peng 2019).

Internationalization is a wide collection of processes with which globalization can be achieved and is often attributed to companies. International business is realized within globalization and is defined as all commercial transactions. These transactions happen between companies, markets, investments, and transportation between countries (Daniels 2018). International trade is the exchange of goods, services and capital across international borders or territories (Grozdanovska 2017). Globalisation can eliminate obstacles reducing artificial barriers to international trade.

3.1 International Business Principles

International business occurs in many different forms: export, import, contractual agreements, services, licensing, franchising, manufacturing, R&D, and distribution facilities in foreign markets. It links all countries, organizations and individuals. Enterprises should identify goals and objectives to be placed on the international market. It means determining the possibilities of selling products and services in the countries and how much profit can be made by selling its products and services in specific countries (Grozdanovska 2017). Managers in a company striving to increase the company's value choose from two strategies, higher profitability or profit growth. Higher profitability can be ensured by internationalization with a focus on reducing costs or selling a higher product price in foreign markets. On the other hand, profit growth can be ensured by an increase in sales in the domestic market or through internationalization and sales in new markets (Hill 2021). The following chapters describe the motivation for companies to enter foreign markets and the types of internationalization.

Business markets are the basis for customer-supplier relationships. The volumes and value of products and services traded between the organizations are much larger than the final sold to customers. These relationships in business markets are economically significant because they represent an essential portion of the sales and purchases of the business. Secondly, good customer-supplier relationships contribute to developing new solutions and innovations in technology and business areas in the organisations involved (La Rocca 2020).

3.1.1 Drivers of International Business

Every country has limited resources; therefore, companies cannot produce all the goods and services required. If the amount is insufficient, it needs to be provided from other countries. On the other hand, companies can sell their products to other customers when goods are produced in more significant quantities than the country's demand (Grozdanovska 2017).

Companies can take advantage of international business expansion to learn, build sales volume for a standardized product and realize the effects of economies of scale. For most MNEs, the primary goal is to maximize shareholder value. In order to maximize shareholder value, businesses must focus on increasing profitability and profit growth rate over time.

International expansion may allow a company to earn higher returns by transferring product offerings derived from core competencies to markets where competitors do not possess the desired products or competencies. A company can benefit from activities creating value at that location where conditions are most conducive to performing these activities. This problem refers to so-called location economies (Hill 2021).

MNEs can create additional value by gaining and implementing valuable skills within their foreign subsidiaries in their global supply chain (further in chapter 3.2). Choosing the best strategy for companies often depends on cost reductions and local responsiveness. Companies following a localization strategy customize their products, marketing, and business strategy in countries where they may identify favourable conditions for their core competencies. Companies following a global standardization strategy focus on lowering costs arising from location economies (Hill 2021). Another driver for companies to internationalize their business is the rising competitive environment and pressure from foreign expanding companies. This effect forces companies to adapt to the process.

3.1.2 Foreign Market Entry Modes

Choosing to enter foreign markets depends on many factors, primarily on the nature of the company's existing products and the conditions for entering the foreign target market. Exporting or importing is a standard form of realization of international business (devoted to chapters 3.3 and 3.4). Other forms of establishing an international business encompass licencing, franchising, joint venture, and international investments (Grozdanovska 2017). This chapter gives examples of these forms of international business.

The license is permission given to someone that can use the intellectual property rights. Intellectual property rights can be patent, a trademark of a product, manufacturing technology of a product, and the method of selling a product. With the license, the intellectual property right usually remains with the owner, called licensors, and the licensee has the right to use the intellectual property. A patent licence differs from other types because the licensor controls a product or service quality (Grozdanovska 2017).

Franchising is a network of independent business relationships that identifies a product brand, a method for a successful operation and a marketing system. Franchising is a marketing system established between two countries or companies based on an agreement. This agreement aims at a common goal: market domination (Grozdanovska 2017). The franchisor allows the franchisee to operate the business under the company's name and provides him with benefits, such as marketing strategies and the use of the franchisor's supply chain.

Joint ventures represent a form of organization of the companies in which two or more companies come together to accomplish specific activities and create profit. The main reasons for organizing joint ventures are access to new technology, gaining competitive advantage, and getting intellectual knowledge or necessary HR in the specific region. The difficulties in integrating the cultures of the organizations can be overcome in this manner. Companies that undertake joint ventures agree to create a new corporation to increase capital, share profits and costs, and control the operations (Grozdanovska 2017).

There are two primary kinds of international investments: Foreign Direct Investment (FDI) and Foreign Portfolio Investment (FPI). FPI refers to an investment in a portfolio of foreign financial assets⁴. FPIs do not require intensive managerial participation. Word 'direct' means that it requires substantial resource commitments, including managerial time to oversee the foreign operations (Peng 2019).

FDIs play a critical role in developing global business. It may allow the company to provide new markets and marketing channels, cheaper production, and access to modern technologies, products, knowledge and financial resources. FDIs involve physical investment, such as building factories and facilities, providing equipment, direct purchases from foreign companies, investing in mutual activities, and encouraging the creation of strategic alliances intended to bring technology license or intellectual knowledge. FDIs create new operational or production capabilities, establish new companies, or team up with existing companies (Grozdanovska 2017).

⁴ Investment accounts, funds, stocks and bonds.

3.2 The Global Supply Chain

This chapter discusses the issue of global production and supply chain management. Global supply chain develops supply chain management principles described in chapter 2.1 and explains the leading indicators, integration and coordination. The second part of this chapter points out essential benefits such as cost reduction or opportunities to relocate manufacturing locations. The core of global SCM is logistics, purchasing, production management, or marketing channels (Hill 2021). Logistics (as discussed within chapter 2.1) is the part of the global supply chain that plans, implements, and controls adequate information and material flows and manages the inventory of raw materials, components, and products in manufacturing in an international environment.

Integration and coordination are critical in the global supply chain. The global supply chain coordination is accomplished through shared decision-making opportunities and operational collaboration of key global supply chain activities. Shared decision-making aids in the resolution of potential conflicts among global supply chain participants. Operational collaboration is achieved through eliminating disruptions, integrating inventory systems and integrating control systems (Hill 2021).

Global purchasing is a component of the supply chain that involves the purchase of raw materials, components, and products used to manufacture the company's products and services all over the world. The core purchasing activities include developing an appropriate global purchasing strategy and selecting the best purchasing strategy suited to the company (Hill 2021).

An essential issue in many international businesses is determining which components should be manufactured in-house and which should be outsourced to independent suppliers. Making and buying component parts are primarily based on cost considerations and production capacity constraints, but each make-or-buy decision is also influenced by several factors (Hill 2021). One factor that strongly interferes in this decision-making is the production location and centralized or decentralized production.

Scope of Global Supply Chain Management

The objective of global supply chain management is to reduce total costs of creating value and perform value creation activities so that customer service is enhanced and value-added is maximized. Performing global supply chain management brings more decision-making about locating production and buying or manufacturing components (Hill 2021). Nevertheless, global supply chain management both increases opportunities and brings risks to international trade (discussed in chapter 1.4.1).

The potential for cost savings through more efficient supply chain management is enormous. Material costs account for between 50 and 70% of revenues in the typical manufacturing enterprise. Even a slight reduction in these costs can significantly impact profitability. As a result, managing global supply chains is one of the most strategic areas for an internationalized company (Hill 2021). Correctly set global supply chain management can improve the competitive position of an international business.

The optimal production location must consider country, technological, and production factors. Choosing an optimal production location always depends on these factors. However, all production locations are balanced by compromises. Foreign factories' capabilities can improve over time, greatly benefiting the company. Managers must view foreign factories as potential centres of excellence and encourage and support local managers' efforts to upgrade factory capabilities (Hill 2021).

3.3 International Trade Practices

This chapter describes negotiation as a fundamental practice that is inevitable and accompanies most business activities of an internationalizing company. Export and import operations are the core operations of most companies entering foreign markets and draw attention to the importance of knowledge, information sources, and supervision.

The basis of every business is the interaction of two entities and the negotiation of a contract, which takes into account the economic benefits and distribution of risks. Successful trade requires knowledge of generally accepted trade practices. The partners must start with a proper risk assessment before entering the transaction. The main negotiated terms are terms of payment and terms of delivery. The seller tries to maximize the outcome and minimize

the risk. He must also be willing to accommodate reasonable buyer demands to compete with other companies and reach an acceptable deal for both partners (Grath 2016). A good deal is win-win satiation. The best ones are repeatable, laying the groundwork for a long-term business relationship. Even though the negotiation process should aim for the best possible outcome, a great deal of experience and negotiating skills are required to avoid making mistakes. The buyer benefits from paying as late as possible, whereas the seller prefers to be paid as soon as possible.

Business practices have evolved, and many institutions offer supervision in making contracts. Local banks, trade councils, and chambers of commerce⁵ in both the seller's and buyer's countries can draw on their experience to provide advice. Companies require unbiased business advice on both the method of payment and the more specific terms of payment while also taking into account the size, commodity, and other aspects of the potential transaction. These considerations can then be used to negotiate (Grath 2016).

Many companies combine some or all of the functions of the export and import departments. One or two people may be in charge of both export and import procedures and documentation in SMEs. As companies grow or export and import volumes increase, these functions tend to be divided into export departments. The number of personnel dedicated to compliance responsibilities may be significantly higher. Companies must have an efficient and compliance-oriented program. Organizing personnel within a company and redistributing responsibilities vary. When beginning to export or import, most businesses use various external services, such as freight forwarders, consultants, packing companies, and others. It is also beneficial for the companies to have a manual of procedures and documentation for their export and import departments, especially as personnel changes occur. These manuals are used as a reference tool for smooth operation and training for new employees (Bade 2015).

⁵ The primary sources for international trade in practice are publications issued by the International Chamber of Commerce (ICC) (Grath 2016).

3.3.1 Export Operations

The export department has roots in the sales or marketing department for many companies. Potential customers may place orders through the company's website. When such orders arrive, salespeople must determine what steps must be taken that differ from domestic sales to fill those export orders. For example, how will they arrange for the shipment, how will they ensure payment or who will be responsible for insurance (Bade 2015).

When starting exporting, businesses must have a long-term vision and the commitment of top management. Companies must assess their resources in order to conduct international trade. Exporting enables companies to diversify their portfolios and prevent radical domestic and world economic changes. It should be commonly known that not only large companies but also SMEs export. For example, nearly 60% of American exporters sell to a foreign market. Many of these exporters can potentially expand their business to more countries. The importance of documentation, packing, marking, and labelling should not be overlooked due to rushing a shipment out the inventory doorway. Failure in any of these requirements may result in customs delays, monetary penalties, and dissatisfied customers. There is also the added burden of export compliance. Managing an export compliance program necessitates diligence, ongoing training, and the support of senior management (Cook 2012).

Export can be performed in two ways: applying direct or indirect exports. Indirect export means exporting goods through a mediator. Mediators can be agents or companies performing the export. Agents act as brokers and maintain relationships between exporters and foreign buyers. The agents do not sell on the foreign market but instead facilitate and assist in the realization. They assist primarily in logistics, particularly packaging, shipping, and product documentation preparation (Grozdanovska 2017).

Companies applying direct export to foreign markets have the responsibility and control over the movement of the goods trading foreign markets. Direct marketing can reduce the cost of the mediators. The direct sale of products to consumers is an option for the direct export of goods abroad. This type of export is practised depending on the type of manufacturer (Grozdanovska 2017).

3.3.2 Import Operations

A manufacturer's import department usually develops from the purchasing department. Personnel for managing imports is extracted from purchasing department, which is continuously expected to acquire raw materials or components for the manufacturing, or from the supply chain department, which is in charge of logistics and, most importantly, international transportation. The personnel in charge of import compliance must receive proper training (Bade 2015).

Importers include many standard terms and conditions in purchase agreements. The purchase terms on which the seller and buyer must agree must relate to title transfer, risk of loss, price, and payment. On the other hand, a buyer can purchase on different terms of sale from different sellers, depending on the terms expressed in each seller's contract (Bade 2015).

Customs brokers are often a subpart of freight-forwarding organizations or international transportation service providers. They are authorized to shift goods through border fees on behalf of importers. They are required to act as a customs extension, enforce import laws and regulations, and collect duties and taxes. Brokers do necessarily have to participate in clearing goods. Typically, brokers provide more services to the companies as it makes commercial sense. To ensure timely and accurate product release from customs, they should be familiar with the clearance process's laws, common practices, and functionality. Even though brokers are charging for their services, they are a safe and usually cost-effective option for the companies (Cook 2012).

A company has two product selection options for import, reactive approach or proactive approach. When using a reactive approach, products are chosen based on market research, foreign travel and comparison with competition in terms of quality, uniqueness or popularity. Importing reactive products highly depends on market needs. Selecting a proactive approach means Selecting proactive approach requires developing a product according to consumers' needs or wishes. These products aim at solving given problems, and companies need to have experience and education to produce this type of product (Seyoum 2013).

3.4 International Trade in Resources and Commodities

This chapter follows the issue of international trade and connects the theoretical foundation with the chosen company, which is covered in the subsequent chapters. Resources and commodities are relevant to this study because they are involved in managing international trade in the chosen company.

Increased trade is essential for overcoming localized natural resource supply constraints. Most economies' reliance on material imports has grown, as most countries' imports have increased faster than domestic resource extraction. Import dependency has increased most significantly in the case of fossil fuels and metals. In terms of material requirements, the quantities exchanged through international trade are increasing faster than global material extraction. Global interdependence is rising, as is the vulnerability of the global trading system. Furthermore, its balance is based on fewer resource producers. In recent decades, international trade's upstream resource requirements (energy, water, land, and materials) have been increasing disproportionately. Some factors may prevent potentially more environmentally efficient allocation of resources through international trade. Whether international trade improves or degrades global resource efficiency remains unresolved (UNEP 2015).

3.4.1 Environmental Impact of International Trade

The purpose of involving this chapter in the thesis is to emphasize the importance of the environmental impact of company activities, which extends to all areas and is often overlooked. In the context of international trade and sourcing commodities, companies should examine the economic and the biophysical point of the matter. Companies should focus on sourcing commodities from those countries where the production or transportation of the commodities requires fewer resources and generates a smaller amount of waste and emissions. Suppose a company has the opportunity of sourcing commodities of the same quality at the same cost from another country, which would reduce environmental pollution. In that case, the company should undoubtedly involve sourcing from this particular country.

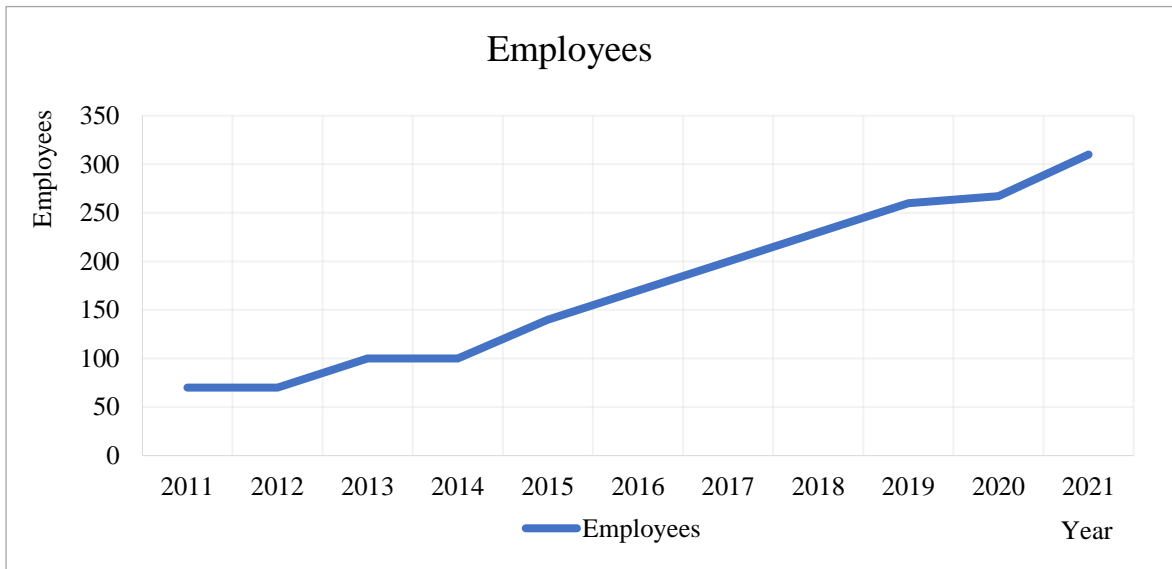
4 Description of the selected company

This chapter describes the selected company Crytur, Ltd. First, the company's origin is briefly described, followed by an analysis of the unique products that the company manufactures. Furthermore, the company is analyzed from the perspective of the company's overall management, the company's organisational structure is described, and the company's activities are discussed according to the company's management topics. The following chapters, 4.3 and 4.4, represent essential parts of the company's management. These chapters define the company's specifics in the given actions and are the theoretical and practical basis for the analysis of the current situation of the company's order management in the international environment. The resources for chapter 4 are extensive and comprehensive, including the researcher's experience in completing an internship in the company in the past, attending personal consultations in the company and presentations beyond the research, and the company's website. The provided sources are internal information and documents, which are abstracted. This phenomenon influenced the choice of methodology. The methodology is analyzed in chapter 5.

CRYTUR, Ltd is a manufacturing company based in the Czech Republic in Turnov. The company's origins date back to 1943 when the company started as a research institute for gems and began to approach synthetic cultivation due to the decline in natural resources. The company has undergone a long development process. It has become one of the world's leading companies in developing, producing and processing synthetic crystals, focusing on technical applications for science and the hi-tech industry. Crytur is the world's leading supplier of scintillation detectors for electron microscopy (Crytur 2022a).

Crytur operates in a specific B2B market. Chapter 4.3.2 explains this and other specifics. Crytur is strongly focused on innovation and has grown for a long time. Long-term relationships with academic and scientific societies and good customer-supplier relationships play a significant role in the company's growth. As explained in Chapter 3.1, customer-supplier relationships contribute to developing new solutions and innovations in technology and business areas in the organizations involved.

Crytur's annual growth has been about 15% for the last 20 years. Two areas were selected for the interpretation of the annual growth of the company; the annual number of employees and, more importantly, the annual revenues. Graph 1 shows the increase in employees in Crytur in the years 2011-2021.



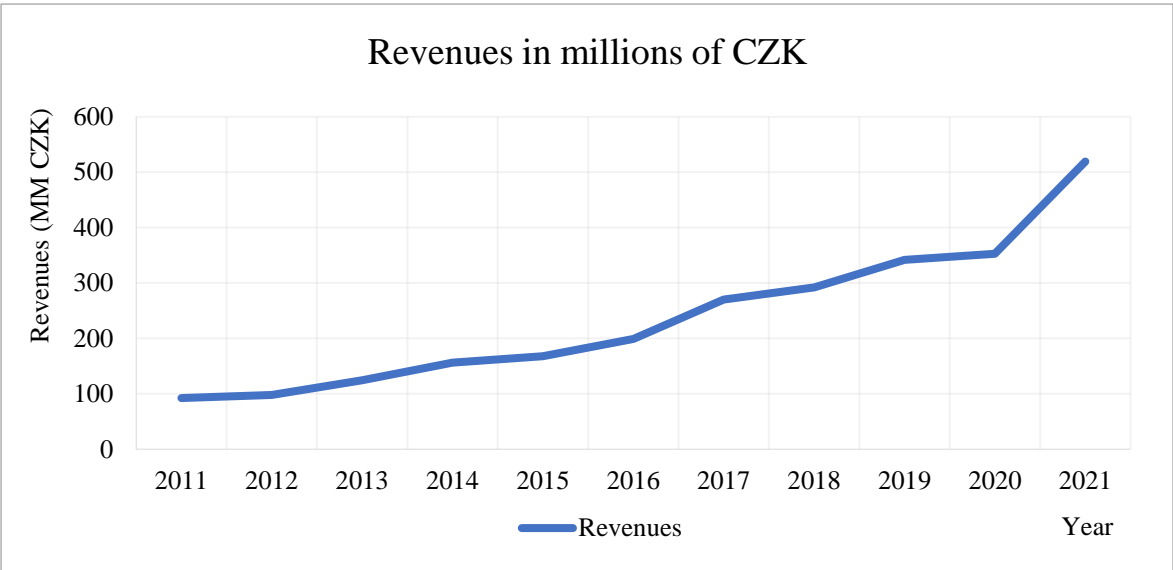
Graph 1 Number of Employees in years 2011-2021

Source: Own creation based on internal data

As of December 2021, Crytur had 310 employees and still plans to hire more employees. The company is aware of the benefits of human potential. Several employees study during their employment, and vice versa, the company, selects future employees from university students. In this regard, the company expects changes in the structure of employees in the coming years with an emphasis on higher expertise and educational attainment. The current organisational structure is described in chapter 4.2.1.

Crytur hires foreign workers in the field of science and technology. The proportion of master's degree or Ph.D. degree graduates fluctuates between one-quarter and one-third of the company's total number of employees. Crytur cooperates with many academic and scientific institutions such as CERN in Switzerland (Crytur 2022b), Jefferson Lab in the US and FAIR in Germany (Novotny 2018). Crytur builds patent portfolios protected in developed industrial countries, especially in Europe and the USA, to maintain its global position.

A more significant area that directly indicates the importance of this 15% growth is the annual increase in revenues. Graph 2 shows the increase in revenues in the years 2011-2021.



Graph 2 Revenues in millions of CZK in years 2011-2021
Source: Own creation based on internal data

The chart shows a particularly short-term decline in growth in 2020. Revenues in 2019 amounted to 341,503,000 CZK and in 2020 352,494,000. Revenues from 2019 to 2020 increased by 3.2% due to the impact of the COVID pandemic. In 2021, the situation stabilized. Crytur realized revenues totalling 519,212,000, thus confirming that the company has maintained a 15% annual growth rate.

4.1 Unique product

Synthetic monocrystals have unique properties that no other materials have. They can be used in many applications since they can convert radiation into visible light. They are used only in areas where a single crystal is worth it due to its high price, such as electron microscopy. Crytur exports the material in the required form and complete systems or devices to world markets. Other exciting areas are high-resolution X-ray machines, exploration of oil fields, meteorology, the defence industry, the nuclear industry, and lighting technology. For example, in lighting applications, Crytur crystal phosphors for LEDs provide effective light conversion in high power applications and offer a solution to overheating.

Technological processes in Crytur are complex, some involving tens to hundreds of operations. A detection unit may consist of at least 20 parts containing a sun tunnel, a scintillator, a metal part manufactured within the company, and others. Dozens of operations take place on all individual parts. The product is assembled in the cleanroom. The complexity of technological processes is complicated by constant changes, even during production.

Crytur's activities focus on seven main areas:

- Electron microscopy, detection units,
- laser components,
- scintillators and detection devices
- monocrystals,
- luminophores, LED systems,
- sapphire profiles,
- precision optics.

Two parts of production processes can be identified within production. One part of the production is piece-shaped due to the nature of the crystals; the other part of the production can be characterised as mass production. Crystals represent a piece production. A crystal is valued at a fixed amount per kilogram, regardless of the accompanying costs. Crystal cultivation earns money by selling crystals at a fixed price. During production, damage occurs to the crystals. The crystal may have a small crack or other optical defects. In this case, the crystal is modified in production, and after its transformation, it can be used for other products. Mass production is based on fixed prices, and inventories are valued over time. Operations have a standardised time for which the department receives payment. The shift of the product in production takes place in the same way as with crystals and is measurable. After the production completion, the production section's profitability (as a subset of the production department) can be calculated.

Due to the nature of crystal cultivation, it is not possible to determine production to a certain number of pieces to order because a relatively high proportion can be devalued during the process. If a contract for ten pieces is agreed upon, it is necessary to put fifteen pieces into production. If the surplus crystals are not degraded, new pieces will be registered for which there is no certain use in the future. A unique inventory called surplus production is used for

this purpose. The price of good pieces is increased by the price of additional pieces (that will not be sold) because the related costs have already been incurred. Surplus pieces are taken to the unfinished inventory with zero value. When a customer orders the same crystals, the company knows that it already has five ready-made pieces in the inventory. On the other hand, damaged crystals are moved to the technological waste inventory. Despite their value, these pieces can still be used for economic activities. Everything is subject to critical inventories and must be intensively consulted and approved by tax advisors and auditors.

The mutual comparison of different products is complicated because some products are registered at fixed prices while others are by weight. As a result, the processes are relatively non-transparent, which makes the activities of the economic department much more complicated. Due to the complexity of the product shifting in production, a new production management and planning department was established. In this department, product managers take care of their product lines. They ensure proper registration and pairing of products with specific inventories and expose documentation to technologists.

4.1.1 Innovation strategy

Crytur is a very specific company (explained in more detail in chapter 4.3.1) and, above all, an innovative manufacturing company looking for niche applications that no one else can. It has long supported R&D, in which it invests foreign and own funds and expands its capacity to support new products. Thanks to Crytur's significant investments into research, which represent 15-20% of turnover in the long term, there is an opportunity to penetrate other fields as well.

Not only technologies are being expanded through the acquisition of new machines, but also real estate expansion. In November 2019, Crytur completed the reconstruction of the 16,000 m² complex. Unique applications, which are often targeted, are usually costly. The company also draws subsidies, such as within the “INOVACE” program for production or “POTENCIAL” for R&D. In 2018, the second cleanrooms were put into operation, which tripled the area in this sector, including excellent equipment.

The volume of funds invested in technologies in 2016-2020 within the projects amounted to CZK 200 million, and the reconstruction of the complex amounted to CZK 80 million.

Investment projects and constant innovation are a prerequisite for Crytur to maintain its position in the world. An important activity is, of course, the protection of property. The research and development results are recorded in a register to clear the origin. Patent applications are filed through patent companies with a national and international scope, mostly valid for the world. Concluding a non-disclosure agreement (NDA) with customers or suppliers is often an accompanying phenomenon. NDA is a contract ensuring necessary confidentiality.

4.2 Company Management

The company's management system consists of managerial activities covering all company issues. Specific subsystems are adjusted according to certain standards either on their initiative to streamline management or on the initiative of customers requesting the implementation of selected activities according to a standard specified by them. A typical example is ISO standards (see chapter 1.3.2) in quality management.

Since 2015, the extension to the integrated management system and the specification of other standards began to create more accurate documentation and introduce standards. The company has implemented a comprehensive Integrated Management System (IMS). IMS manual or quality manual is a helpful part of IMS, which contains a rough description of all business processes and implemented standards.

Highly qualified staff is essential for the company. In recent years, Crytur has faced the threat of staff shortages in development and production. Crytur needs technologists and developers, nuclear physicists, chemists, and experienced engineers. The company's rapid growth is followed by increasing demand for training new employees and the growing complexity of management. In 2020, a new organisational structure was created, reflecting the company's rapid development. In addition to the standard division into production and development, a so-called technical department is being set up to develop new production technologies.

4.2.1 Organisational Structure

Crytur's managing director is Mgr. Jindřich Houžvička, Ph.D. The organisational structure determines the company's departments and the links of superiority/subordination between them. The CEO makes organisational or personnel changes based on the recommendations of subordinate employees or his initiative. The structure is based on a logical division of labour, where one worker can work in two areas. Figure 3 describes the organisational structure of Crytur.

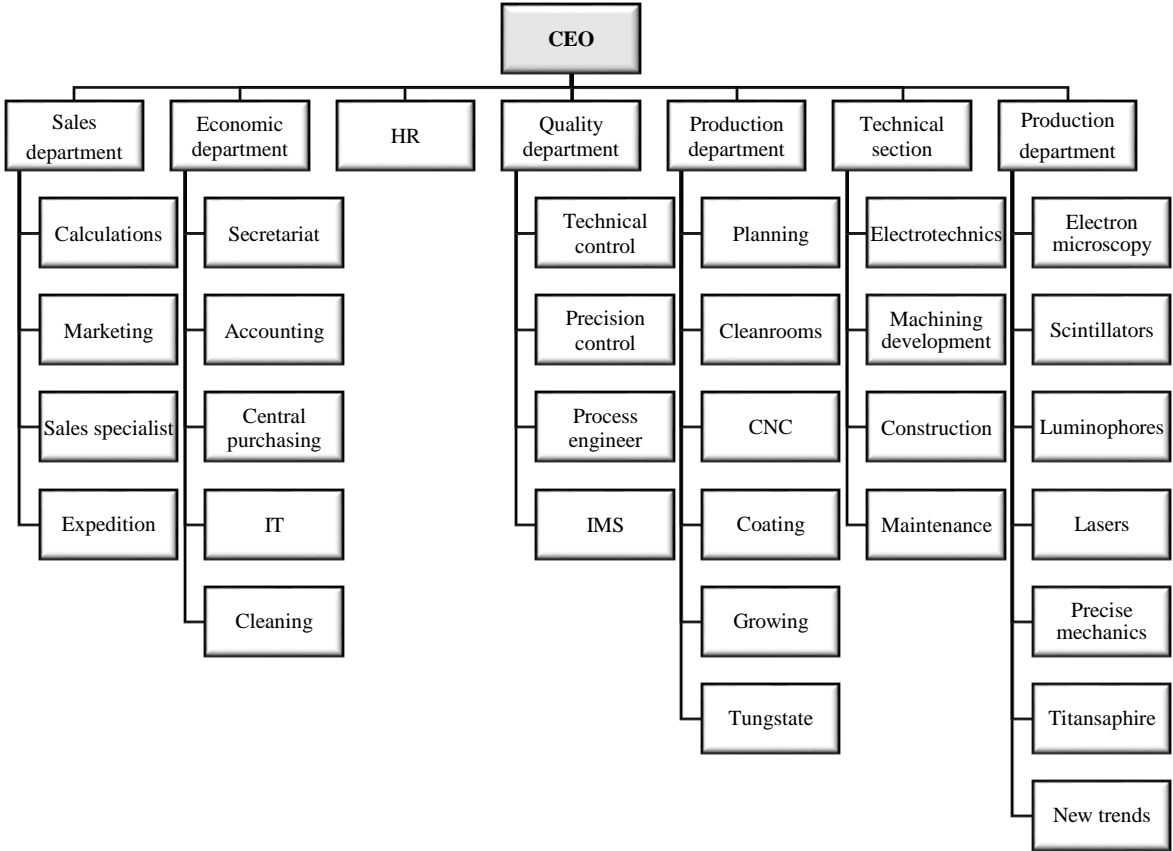


Figure 3 Crytur; organisational structure
 Source: Own creation based on internal data

Crytur is consistently growing in the number of employees, as interpreted in Chapter 4. Together with extensive innovation, it causes frequent changes in its organisational structure. The current scheme of the organisational structure is divisional. In 2019, Crytur surpassed the limit of 250 employees, transitioning from an SME to a large company.

4.2.2 Quality Management

Crytur is following the quality management system ISO 9001: 2015 (in the Czech form ČSN EN ISO 9001: 2016). At the same time, it is the target of a number of customer audits of large multinational companies, which are inherently stricter than the ISO: 9001 quality management system itself; the vast majority require control and traceability. The result is a negligible share of complaints. This chapter describes the material flow controls in the company and related issues during production. It is based on the basic principles of input material control, control during production and output product control.

Firstly, the material is purchased, stored, taken over from the inventory, and must pass the entrance quality inspection. Great emphasis is placed on inter-operational controls, while each product has different quality control processes based on technological procedures. It varies mainly according to the number of operations. Products with a technological process of one hundred steps can have ten or more extensive inter-operational controls.

Minor material input control is performed in two areas. The first area is the purchase of specific materials, where Crytur has few approved suppliers. If a lower quality of supplied materials is found, it is discussed with suppliers whether they have changed, for example, in their supply chain. The suppliers may face a decrease in the quality of processes and a change in the quality of materials supplied⁶. The second area is the purchase of materials for which intensive input control is less critical. These are iron bars for which only dimensions are monitored. Greater attention is paid during production processes. Crytur buys from those suppliers from which it has historically supplied high-quality materials.

The scrap products can be fixed most of the time. Therefore, there are much more reworks than scraps. Reworks are not mapped in detail and measurements. Every product manager manages his product line differently, and technologists have different attitudes. Each product line has its specifics, and there are few universal procedures. A new rework document must be created to make the process visible when rework is being made. That means extra work for the employees and cost capacity.

⁶ Natural materials are mined of various qualities. The supplier may not be informed precisely as well.

The metal or non-metal gets prepared for machining depending on the technological process. The given operation is performed, where the quality of the output is monitored. When performing a given operation, the time requirements for the technological subprocess are also measured. Product scrap can come from new under-trained employees or experts who are forced to try new procedures (and waste is expected). Each machine has its specifics; the products are machined with tolerance measured in microns.

In a simplified technological procedure for single crystal application, the object is a scintillator created by a perpendicular cut to the direction of crystal growth forming in a thin slice. The customer monitors the quality of the scintillator on two indicators – dimensions and optical quality. During the manufacturing process, critical operations may reveal defects⁷ in the crystal or make new defects. The company is looking for defects below one micrometre, which are very difficult to identify. Another step for the company is to improve cleaning procedures, measure optical defects, and check scratches. Polishing can reveal defects that were not revealed during the beginning inspection methods.

Customers may or may not accept certain defects. The defects are very demanding and intensively negotiated because of the expensiveness of crystal growth. The functional application can be negotiated with a customer when a minor defect appears on an outer ring and has no significance to functionality. Customers can accept it, but they generally demand the product without defects, which can be exceedingly expensive. Compromises are being made on this issue. In manufacturing, dimensional measurements are taken. Depending on the product, reworks are common.

Different optical systems detect various optical defects. Therefore, the products in the quality control have predefined systems for checking the optical parameters. In addition to dimensions and optical quality control, packing is also monitored. A product has predefined electrostatic packaging to avoid dust. Some products' cleanliness must be such that a customer can directly apply the coating.

⁷ Crystals might have defects undetectable in optical quality control.

4.2.3 Risk Management

It is impossible to eliminate or substantially reduce all risks, so the risks must be properly divided, assessed, and managed to reduce the most significant risks at the lowest possible costs. The company distinguishes between critical, business, industry, and operational risks. These risks are primarily opportunity and control risks, as described in chapter 1.4.

An existential risk is for Crytur in the area of competition. Crytur is the world leader in crystal manufacturing, for example, in the growth of large-diameter monocrystals. However, many areas are threatened by introducing new applications or transitioning to new technologies. The semiconductor industry can become a competitive sector.

The company is also exposed to the competitive environment in competing companies offering job positions that can be favourable for highly qualified employees. Crytur eliminates competition risks by diversifying the portfolio and a strong focus on innovation. However, in electron microscopy and the growth and processing of monocrystals, the company must rely heavily on the quality of its products and very costly entry into the industry.

The significant risk for the company arises from changing order structures, rapid development, or risks in production. These risks strongly impact order management and are also the subject of a study. Factors affecting order management and departmental relationships are the research subject discussed in chapter 5. Less significant risks are lack of capacity or a lack of qualified staff.

However, another significant risk is the long waiting time for feedback from customers. When something is developed and manufactured, feedback on the functionality of prototypes can take months or years because the products are to serve for a long time. Prototype testing must be long-term as well. Light feedback starts coming in after half a year. The customer communicates changes to the final product and negotiates serial production of the product, for example, from the following year.

4.2.4 Supply Chain Management

As mentioned in chapter 2.1.1, SCM represents managing flows and includes all the processes needed for transforming raw materials into final products. This chapter describes the principle of flows and inventories because they are very demanding for the company due to the high number of inventories. The material flow begins with the purchase.

After the purchase, the material arrives and passes through the economic department, specifically under the inventory management. Therefore, the economic department is also in charge of material supply and purchasing, which is unusual. The assistant first gets an inventory receipt, checks which item belongs, and stores it in the central inventory. The Assistant also informs the person who ordered the goods. Upon collection of the goods by the authorized person, inventory shipment material is recorded and stored in the inventory of the specific centre. The person responsible for the material in production extracts the production order. The production order contains a technological procedure and has defined cards of consumed goods.

The economic department provides receipts for the inventories. The department is therefore in charge of material supply and purchasing as well. Economic department employees are responsible for the package arrival, recalculating, making a receipt, stocking it, and billing all the 60 inventories warehouses once a month. This process is complicated and brings a threat of irregularities. The materials that flow through the supply chain are mainly oxides and other specific materials. These materials must be supplied with the required quality and absolute purity. Unclean material could pollute a furnace, which must be complicatedly and expensively cleaned. Crytur has approved suppliers, but there are so few such specific suppliers in the world that Crytur orders from one or two suppliers.

SW support

Crytur uses common software such as MS Word or MS Excel for minor operations or measurements. Crytur uses the K2 ERP system for order management (see chapter 4.4) and production management. K2 uses standard modules, but specific modules have also been developed specifically for Crytur for more accurate documentation in production, for example, crystal machining, which is too specific for the use of conventional systems.

4.3 Company's International Trade

Crytur is a highly exporting company operating on the world market in the hi-tech industry. It exports to the markets of developed countries in Europe, the United States, Japan, South Korea, China and Israel. The specificity of realizing international trade activities in Crytur is a strong participation of production employees such as technologists and developers. The commodity department can technically perform trades instead of the sales department.

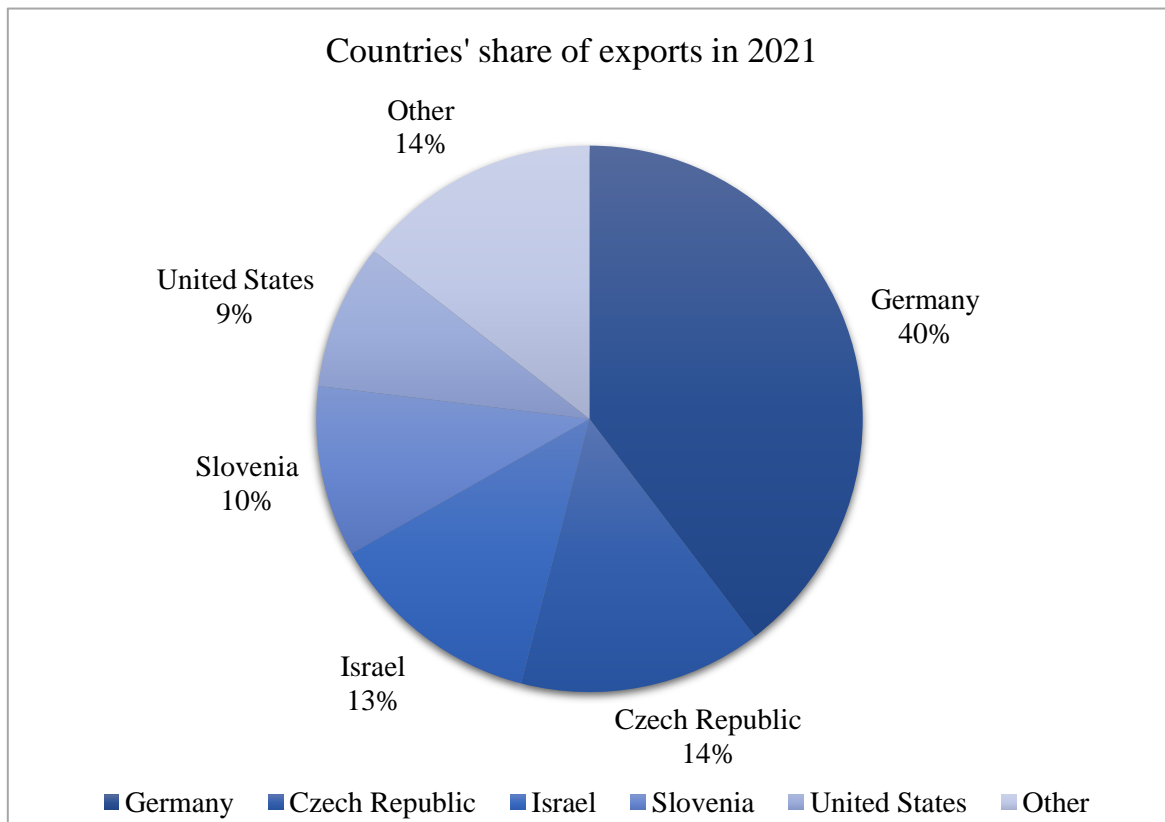
Marketing and initial international trade activities are focused on trade fairs. A technologist who has developed the product can make a presentation at expert conferences. This represents a specific type of offer. Subsequently, the technologist can make the first model of a custom solution with the customer, which can then proceed to business negotiations. Most international trade operations are performed with long-term business partners.

Crytur operates in the B2B market and deals with niche applications. A niche market is a specific market with a specific product or service. Crytur focuses on specialized hi-tech applications that require specialized researchers. The company's business strategy is based on the supply of these unique products, realized mainly in small series. Creativity and flexibility of supply are ensured by a high technical and technological level and a close connection between development, production and trade. The company's advantage is a relatively broad portfolio. The share of any segment does not exceed 30% of total sales. Production is divided into several segments, whose business cycles vary and adapt over time.

In terms of distribution and sales, Crytur is an atypical company; it does not use the usual sales channels. The primary marketing and sales channels are scientific conferences and trade fairs. Crytur participates in scientific conferences in the USA, Australia, Japan, and Europe. New demands are coming from scientists and technicians who contact the company. Together, a solution is being developed and incorporated into the final products, which the customer often produces.

4.3.1 Company's Sales

The company's sales were chosen to interpret the company's business activities. Total sales for 2021 amounted to 520683010 CZK. Of this total number of sales, the company's European Union represents 72.4%. The remaining sales of 27.6% are exports outside the EU. The percentage of customer countries in the total is shown in the graph 3:



Graph 3 Countries' share of exports in 2021
Source: Own creation based on internal data

The highest realized revenues were generated with Germany for CZK 206.5 million. Crytur also sells on the domestic market. Other major customers are Slovenia and the USA. The rest of the countries each represent 3% or less, such as the Netherlands, Italy or France. Countries from the European Union bring the company revenues of 377 million CZK, while other countries over 143 million CZK. The mentioned electron microscopy prevailed in the share of individual components in sales.

4.3.2 International Trade Specifics

This chapter describes the specifics of Crytur in a broader sense, pointing out the curiosities in international trade and marketing strategy. It also draws attention to Crytur's long-term relationships with customers, where most international trade has its roots. New opportunities can arise at a pronounced marketing communication tool in Crytur, science fairs.

Crytur communicates important information with customers, suppliers or employees. Marketing communication describes the main communication paths that can be used to gain new customers and retain existing ones. Crytur uses common marketing communication tools. It uses Internet advertising, such as two websites at www.crytur.com and www.sapphit.com, available in foreign languages concerning the customer portfolio. Banner and click advertising are also used.

Furthermore, Crytur presents itself in industry periodicals in the period before important events. The mentioned trade fairs belong to important marketing and international trade channels. In addition to other common marketing communication tools such as printed matter for the customer or electronic direct mailing, Crytur uses sponsorship. Sponsorship supports regional PR and recruitment. Company cars are marked with the company logo.

Crytur's business relations are based on long-term agreements. Customers have known Crytur for a long time, and trust has been built. Interestingly, the agreements after long-term cooperation with customers are more important for the company's operation than the formalities of purchase contracts. The companies cooperate closely and negotiate the terms of the contracts willingly. This phenomenon is good payment morale and the high creditworthiness of business partners in the industry. A significant aspect of business relations is the visits of business partners. This supports inter-company communication. Customers visit Crytur and attend meetings, as well as Crytur employees, visit foreign partners.

Crytur pays attention to environmental management. The company's production requires extreme cleanliness, even concerning the surrounding pollution. The company's activities do not pollute the environment, and the company meets legal requirements.

4.4 Order management

In order management, several flows can be described: information flow, document flow and material flow. The flow of documents in the purchase of prototype production begins with an order from the supplier. The supplier sends the goods, and the delivery note travels with the goods. The financial value of the goods is described by the invoice that comes to the accounting office. The invoice is posted, and the goods are stored in the inventory with the help of a delivery note. The value of the goods is entered into the system from the invoice. The material drains with the production document for the next production operation.

Material flow begins with material storage. The person in production takes over the material and enters it into the information system, where it is already in stock by the delivery note. An inventory shipment transfers material from one inventory to another. The material is then consumed at any stage of the product.

A product manager manages and coordinates the passage of the order through all production operations to meet the delivery date to the customer. He determines priorities with the sales department and then sets deadlines on the production order. The product manager participates in the purchase, deals with orders and deliveries of input material, and helps coordinate the dates of individual parts. He must monitor the inventory for the production of the product lines in his responsibility. The minimum and maximum stocks in the inventories are entered. Subsequently, the production begins – accompanying documentation is issued, and the fulfilment of the deadlines of production operations is monitored. Solutions to problems arising during the production process must be coordinated and actively communicated with the departments across the company.

The purchase begins by sending a purchase request to the purchase department email. The purchase process is set up and approved to prevent possible abuse. The assistant creates an order in the system, which she then sends to the 3-stage approval: approval by the superior placing the order, approval by the production director, and approval by the business owner.

After approving the purchase order, the assistant sees the order's status as approved and sends it to the supplier. In the case of larger purchases, which are planned mainly because large investment projects are done, a tender must take place according to the law. The tender is processed separately, and the best offer is selected. Then the company has strategic

materials from which single crystals are grown, i.e. oxides, molybdenum elements, tungsten elements, special rods, sheets, and others.

There are prototype orders or standard orders that customers regularly order that have already defined technological procedures and processed times and all steps in procedures. When a development technologist receives a prototype order, he must invent a technological process of production. The developer receives a new drawing for a new part from the customer. It is agreed with colleagues which machines will be used for production, how many operations will be performed, and the defined procedure. Time requirements are made up for each operation. These time allocations are estimates only. At that moment, development technologists enter production with a prototype order, hand over technological procedures and estimated production times.

The production thoroughly tests the manufacturability of the product in the appropriate quality, and at the same time, operations are assigned more precise time requirements. The prototype is delivered to the customer. If the customer is satisfied, the technological process of production is transferred to the planners and prototype production is included in the production system. The planners further assign machine capacities in the continuous planned manufacturing.

5 Analysis of the Current Situation

The aim of the research is to gain insight into the issues of the causes of untimely fulfilment of orders. The objectives are to identify the factors that affect order management, monitor the links between production, development, production planning and international trade, and finally discuss solutions.

5.1 Methodology

Quantitative research collects and evaluates measurable parameters, mostly numeric data, whereas qualitative data focuses on words, ideas, descriptions, or concepts. This study uses a qualitative method called narrative analysis.

The narrative analysis focuses on stories told by participants. Narrative research collects data from observations, letters, interviews or observations. It may provide a context-based evaluation and evolve from personal perspectives (Mohajan 2018). The narrative analysis allows analysing of a large and comprehensive amount of qualitative data. It follows specific patterns in conversations or texts on a common theme from many perspectives. In the case of this study, the factors influencing order management are monitored from various company employees' perspectives. Personal interviews provide a vast amount of data complex data. A question or problem is not precisely defined in advance, and narrative analysis is also a suitable tool because it focuses on what and how it is being said.

One of the common phenomena is that in narrative analysis, secondary problems can arise during the research that the researcher can point out. On the contrary, the disadvantage of narrative analysis is that it cannot be replicated well and cannot be quickly followed up. The limitations of narrative analysis are generally small samples due to the time-consuming process. In the case of this study, these are personal interviews. Another disadvantage of this analysis is the subjectivity of the conclusions. In this case, the conclusion unfolds from the researcher's communication skills and general overview of the company.

Narrative analysis execution

After determining the narrative analysis, the researcher chose the method of interviews. He further established the structure of the interview as a semi-structured interview. The respondents were interviewed with the same questions and collected data. During the interviews, the researcher monitored the regularity of certain opinions, emphasized the context and discussed his premature conclusions with the respondents.

Respondents' selection

The company's CFO offered the researcher a list of respondents. After consulting the interview structure, a selection of respondents was made based on a common judgment. Due to the aim and goals of the research, highly qualified and experienced employees were selected as the target group, who can actively participate in the course of the contract in the company. The survey is carried out across sections of the Crytur company.

Sample characteristics

Based on 11 semi-structured personal interviews with the CFO, product managers, technology, and other company key employees, data was collected from Crytur, Ltd. The number of interviews and employee positions are assigned in Table 3.

Table 3 Structure of personal interviews

| Position | Number of interviews |
|------------------------------------|-----------------------------|
| Chief financial officer | 3 |
| Head of a commodity department | 1 |
| Quality Manager | 1 |
| Product Manager | 2 |
| Production Planner | 1 |
| Technologist | 2 |
| Laboratory assistant in cleanrooms | 1 |

Source: Own creation

A qualitative survey in the form of semi-structured personal interviews with the company's employees listed in the table identifies insight into the issue of order delays.

Data Evaluation

This chapter is a research output that contains a question framework and unified answer evaluation. The evaluation answers the question of what causes the non-compliance with delivery deadlines of orders and prototype orders.

- **What are the factors that negatively affect order management?**

The order process can be affected by many factors, which can be variable in nature. Variability applies to almost all areas that will be listed. The first is the variability of the quality of the input material, which is very difficult to influence and can cause delays due to reworks. Another area is HR involving, for example, employee illness. Another factor is the timeliness of delivery from suppliers. The orders are usually negatively affected by the overall structure of other orders in production. The most common is a conflict of orders and capacities when some machine bottlenecks two or more orders or a qualified person cannot be present.

- **What are the factors that positively affect order management?**

The better scenarios are less common and have a similar structure to the negative factors. Firstly, HR can positively affect orders. In such an innovative environment, employees also have to adapt quickly, and many of them are improving. Communication and staff qualifications are improving. The most complex cases, for example, in prototype production, then do not depend on one person, which potentially speeds up the order. The overall structure of orders can have a positive impact too. This situation may arise where one qualified person is in charge of two manufacturing orders and operates two machines simultaneously if the situation allows. This higher efficiency is coincidental.

The factors that affect the course of the orders are identified, and the aim of the study is achieved. The goal is achieved entirely by answering the objectives in the remaining questions.

- **What are the links between serial production and prototype production?**

Serial production and prototype production compete. Production produces what they are told according to the technical procedures they receive. Production progress is reported

to planners. Planners have their software to plan production not according to the highest possible efficiency but according to optimal efficiency for assigned production priorities.

Technologists develop applications based on prototype orders. They enter production and intervene in scheduled orders to perform tests. The development also has scheduled deadlines for customers. That breaks down the main role of planners. The current situation is such that it is challenging to set aside that time without negative consequences.

Production has inadequate preparation and adjustment times and high machining time. In prototype production, it is the other way around. Technologists spend most of their time preparing, adjusting, and creating a program that changes even during machining.

- **How does prototype production differ from serial production? Is it highlighted in the company's information system?**

The sales department gives production planners priorities for the orders. This question was asked to find out how these prototype production orders differ from series production, whether the production employees are sufficiently familiar with it and whether the employees are given sufficient emphasis to comply with the given priorities.

Prototype production orders have blue markings. The blue colour highlights prototype production so that employees are informed about the uniqueness of product production. This highlighting assigns high priority. However, it is easier for the production to continue series production than interrupt due to prototype production. Therefore, they are asked to follow the priorities.

By asking this question, another secondary issue was identified. CNC production has various software tools for planning, and the connection with the company's information system is not perfect. Schedulers extract the times they take into their own system and then schedule the work queue according to the shifts.

Software management in its current form describes machines well but does not sufficiently describe HR. A specific example: The source for a particular operation is an employee of a laboratory assistant position. However, not every laboratory assistant possesses the required skills.

A work queue is planned in the company. One person falls ill for a week, and the whole plan has to be modified manually, although the software may have suggested enough free human resources.

- **What is the relationship between the sales department and production or prototype production?**

As has already been said, the role of planners is to determine what and in what amounts will ever be produced, in order to use capacity as evenly and efficiently as possible, given the estimated times. Planners set the production schedule and assign orders. The sales department complicates work for planners by prioritizing orders. This disrupts the role of planners and the optimization of production processes.

The sales department gives production planners the priorities of the orders. Thanks to long-term relationships with international customers and repeated activities, the sales department sees prospects. The sales department can make forecasts without orders being confirmed based on international trade experience. Everything is based on long-term relationships and forecasting. There is no guarantee, and the customer is not obliged. Those forecasts do not correspond to what the company is interested in producing. However, Crytur relies on future consumption due to its market position and historical international trade activities. An overview of how much the customer is likely to order is compiled. Forecasts are usually not provided to production. Nevertheless, the production is to be a work-in-progress. Work-in-progress is vital if the customer suddenly requests a significantly larger order than expected.

6 Evaluating the Analysis Results and Formulating Conclusions

Crytur's primary focus areas are development and production. However, it is the sales department that generates profits for the company. The company's current market position is so significant and favourable that there is no need to make high efforts to find business partners or receive many orders. Crytur is a leading manufacturer of monocrystal and a developer of applications in electron microscopy. The current problem is the company's order management system and limitations in production and development. The company has a long-term overpressure of orders. In other words, for each order received, the company manages to produce approximately one third less in a predetermined time.

This situation should be solvable. It is necessary first to identify the factors that may cause non-compliance with manufacturing order delivery dates, which is also the aim of the study. This goal was achieved by a qualitative research analysis using narrative analysis. The factors were identified in the following three areas:

- **Prototype production conflicts with series production.**
- **The sales department sets priorities for production planners. The production is planned according to the priorities instead of the most efficient production.**
- **The structure of orders changes rapidly, and bottlenecks arise, such as an overloaded specific machine or a busy qualified person that needs to participate in the process.**

During the analysis and after the analysis, the researcher compiled possible solutions. The researcher compiled five solutions or adjustments to existing solutions based on completed qualified interviews, the analysis's evaluation, and applying theoretical research knowledge. These five solutions are followingly listed. The first four solutions are rejected based on gained knowledge and discussions with qualified employees. The fifth researcher evaluates it as implementable.

The researcher identifies the first method as another significant capacity expansion. Expansion of production is costly and requires the supply of qualified personnel. HR in this area is limited, and the learning process is demanding and long-term. In recent years, the

company has already implemented capacity expansion or tested introducing a third shift (in the current two-shift operation). Despite introducing the third shift in selected areas, the company still produced about 20-30 % less than optimum because new limitations were raised, such as specific machine bottlenecks or HR limitations. Further significant expansion focusing on production (without eliminating the conflict of orders) would be expensive and have higher risks. In the future, it could expose the company to an even more demanding and costly situation if the number of orders suddenly decreases.

The second way to solve these delays in order management is sourcing materials. External products of such high quality are costly and disadvantageous for the company. As stated in chapter 3.2 on Global SCM, a slight reduction in costs can significantly impact profitability. Therefore, the company should produce these expensive components because reducing costs and eliminating expensive sourcing is an excellent opportunity.

The third way the researcher identifies is an increase in production efficiency. The company has a high scrap rate during production. There is the possibility of more intensive and expensive quality control. Based on the experience of interviewed managers, this suggestion was refuted for two reasons. The first reason is that the causes of defects are challenging to find and change very often. Performing the same processes with the same materials on the same machines by the same employees brings variable results. In addition, it is beneficial for the company to produce more even with a relatively high scrap rate than to incur enormous costs for even higher process management and quality management or control.

The fourth option also concerns the possibility of increasing production efficiency, but with a stronger emphasis on planning instead. Production could be planned according to the optimal efficiency of production processes. According to the researcher, this cannot be implemented because the sales department must be able to set priorities for production.

The fifth solution is the only solution that the research evaluated as applicable and desirable. This solution is to eradicate the conflict between prototype production and serial production and slightly increase production capacity in prototype production. This solution is achieved by establishing a new and separate prototype production department.

6.1 Suggestions for Improving the Prototype Order Management System

It is better to separate the development of prototypes from series production so that it does not conflict. There are 14 machines in CNC production directly operated by 28 employees. Interviewed employees estimated that a fully equipped prototype workshop for testing needs six specific machines and necessary tools. This smaller copy of CNC production represents a total investment of 50 million CZK.

Crytur has already assigned capacities and put two new machines into operation, creating a new space for the prototype workshop. The company has also worked on calculations to assess that the acquisition of new machinery represents a favourable investment for the company. However, this investment is not a solution to the problem of conflicting production orders and prototype orders. It is more appropriate to develop a solution so that the prototype production interferes with ongoing serial production as little as possible, which could be achieved by purchasing the remaining four machines.

The researcher proposes to improve this existing solution. This improvement is establishing a new section and a separate prototype production workshop to avoid production blockages. A prototype developer would move with his team to the new workshop to perform tests independent of serial production. This solution with a greater emphasis on order management issues would bring the following additional benefits:

- **Minimal conflict of prototype orders, production orders, and fewer delays.**
- **Less overload of specific machines that are the bottleneck for multiple orders.**
- **Higher opportunities for planning production processes according to the optimal efficiencies.**

The most significant benefit for the company would be a new system in the management of prototype production orders: International trade would set priorities, which would be strictly followed. A prototype workshop would solve priorities for prototype production, and priorities for serial production would be solved by production. Production planners could also begin to focus more on optimal production efficiency planning in both areas.

The design of a new prototype workshop and introduction of a new prototype production system was intensively discussed with employees, and SWOT analysis of this new system was requested. Table 4 states a SWOT analysis of the prototype production workshop:

Table 4 Prototype production workshop – SWOT

| Strengths | Weaknesses |
|---|--|
| Minor conflicts between development and production orders | Low current communication intensity |
| Compliance with set priorities in production | More demanding product transition from development to production |
| Remarkable ability to plan production according to efficiency, optimal machine load | Higher demands on HR |
| Greater production capacity | Twice higher the investment |
| Clarity, greater measurability | The need to purchase identical machines |
| Opportunities | Threats |
| Investment opportunity | Increase in CNC competition |
| Greater CNC capacity in the future | Risk of unfavourable market development |
| Fewer bottlenecks of particular machines | High market demand for HR – developers, technologists |
| Possibility of production of own products | Government restrictions for specific commodities |

Source: Own creation

Weaknesses in HR especially require attention. Developers may not be able to take over production know-how, which is comprehensive from the point of view of engineering and technology. An example might be when a customer wants to produce a prototype that cannot achieve the required properties, and the technologist would not be able to recognize it because he is not an experienced engineer. Another aspect is that one team would develop a prototype in the workshop, and another team in production would produce it in the future – the team would do something new that it has not tested. There will be a higher level of communication between prototype production and series production due to more demanding preparations during the pre-production for series production.

The compiled SWOT shows that establishing a new department would bring higher investments that would double the production capacity in prototype production and make serial production more operational. Higher investments in the development workshop are favourable from an economic point of view, concerning the company's long-term growth, constant and high number of orders or current and future machining opportunities. A more substantial development base and intensive CNC production can represent a potential for Crytur; it can produce its products without the expensive outsourcing of some components.

First, developers must learn to procure machines delivered to prototype production independently. It is uncertain whether they will learn this in time, followed by the fact that the machines in development must correspond precisely to the machines in production so that it is possible to move the developed prototypes into production while maintaining the technological processes. Imperfectly matching machines can produce a product that does not match the development product even while maintaining the same procedures and using the same program. Another significant risk is that a different team of people would manufacture the product after its development. Therefore, developers need to participate in the initialization of subsequent production.

The condition is that the machines in development are identical to those in production. The establishment of the production department would take place in parallel. The estimated time for establishing the production workshop and the department's independence is at least two years. Premises are already reserved, so the acquisition of machines, transport, adjustment, and HR management is considered.

Creating a new prototype workshop is a new and challenging process from an HR perspective. It requires personnel who has experience introducing new products and adapting machines to new requirements. Experience with specific machines is necessary. It is expected that more commodity departments will want to conduct tests in a prototype workshop in the future. Therefore, the big challenge would be the operational management of prototype production and coordination of orders from individual commodity departments.

Secondary Suggestions

This chapter describes four other minor issues that have arisen while conducting the research. These suggestions can be opportunities for further research or improvements.

The first side problem identified and that the company could improve on is inadequate attention to processes and more specific descriptions of business processes. A well-defined process can bring predefined desired results. As described in chapter 1.1, the better the processes are designed and performed, the higher the quality is potentially delivered to a customer. The company's priority is to develop and produce, not to produce quality and reduce scrap products. Therefore, the company's process and quality management could have even more attention. The quality delivered to the customer is very high, but the quality of the processes to achieve this result is lower. From this point of view, quality management does not have the attention it could have.

Secondly, it is not precisely monitored whether employees adhere to production priorities from planners. Therefore, there is a risk that non-compliance may occur. An authorized person in production can, at his own decision, first complete series production and then reconfigure the machine to a prototype product. The reason is that the employee does not have to suspend ongoing production and can adjust the machine less often. That can directly cause delays in prototype production, which causes conflicts (of machines or between employees) in subsequent scheduled production.

Deficiencies were found in software systems, such as misinterpreted inputs in CNC production. The human resource for a specific operation should not be an employee of the laboratory assistant position but an employee of the laboratory assistant position that meets the requirements for the given operation (know-how) instead. A more intensive description of the outputs could reduce the need for manual production planning.

Reworks in manufacturing (concerning piece production) are not mapped and measured in detail. That might be another opportunity for further improvements, mainly by measuring rework times and the quality of the reworks.

Conclusion

The subject of this study was issues related to the management of the manufacturing company and the management of the company's international trade in the first three chapters. Part of this research covered the issues of process management, project management and quality management, which are an integral part of the management of manufacturing companies. Strong emphasis is placed on managing material and information flows, and greater attention is paid to the management of production company orders.

The study was conducted in the company Crytur, Ltd. The company accepts orders from customers around the world through international trade. The primary insufficiency is that Crytur produces less than required, and constant delays occur. However, failure to meet delivery deadlines for production orders may worsen customer relationships. According to the company, it is difficult to identify factors that influence order management because production bottlenecks occur and change frequently.

The diploma thesis "Management of international trade of a company" aims to identify the factors affecting manufacturing orders' delivery dates and provide a partial solution or upgrade to the existing one. The study's objectives are to evaluate the relationships between the company's production, prototype production, production planning, and the role of international trade.

The aim of the thesis is achieved by using a qualitative analysis called narrative analysis. Eleven semi-structured interviews were conducted. The result of the analysis is an evaluation of the factors. The most critical factor in order management is the conflict between the orders in production and prototype orders. Prototype orders enter into competition in production and disrupt effective planning. Serial production is then delayed due to the need to test prototypes. In addition, production planners cannot plan according to production efficiency. There may be other issues, such as non-compliance with assigned priorities. This system inevitably brings conflict and high employee reluctance in this regard.

Crytur's current solution in prototype production is to increase production volume. The company purchased two machines and expanded the capacity for prototype production. However, this solution still does not cover prototype production orders. Furthermore, it does

not solve the conflicts between prototype production and serial production that might be underestimated. Complementing the current solution was developed based on applying theoretical knowledge from the literature research and intensive consultations on possible solutions in the company environment. At the same time, the identified factors in this study were taken into account.

Complementing the existing solution is establishing a new prototype workshop as a new prototype production section. This system provides the opportunity to follow a more efficient order management system. A self-sufficient prototype workshop needs six machines while maintaining the team's current size of six people. Therefore, four necessary additional machines can be purchased.

The benefit is in better coverage of prototype orders and better overall management of the company's orders. The sales department assigns production and prototype production priorities to planners. According to the priorities, the planners plan production and prototype production separately. The strong role of the sales is maintained. Serial production is not being disturbed by extensive prototype testing; the prototype is first thoroughly tested and measured in a prototype workshop. When the prototype goes into serial production, it is possible to hand over the prototype at a much more advanced stage with a complete technological production process. As a result, prototype production capacities are extended, and the production load is reduced.

This study can help the company decide about making higher investments to expand the prototype workshop further. At the same time, it summarizes the factors which may affect order delays. This study allows the Crytur to focus more on individual aspects, such as meeting set production priorities. Secondly, it was evaluated that the company could improve the description of internal and production processes and better monitor compliance with production priorities and prototype production. Human resources could be better defined in the company's information system, and the reworks could be mapped in more detail.

Space for further research is verifying the proposed order management system across departments in the company. Thus, there is a possibility of expanding the existing projects, calculating higher investments, and possibly applying a dynamic method of determining the return on investment.

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