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## Master's Thesis

# Optimizing incoming Quality control processes through SAP QM Implementation


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# Abstract

The current study focuses on the SAP QM module implementation that was done at a significant Danish company that manufactures multiple converters and electric motors. This document also highlights the company's issues and constraints with regard to quality control and production process traceability.

The purpose of this thesis is to investigate how a manufacturing or distribution company can optimize its incoming quality control processes by applying SAP Quality Management (QM). Effective quality control measures are required due to the increased emphasis on efficiency and quality assurance. Conventional techniques can be laborious and prone to mistakes. This thesis will mostly concentrate on how the company's quality structure is put together as well as how quality inspections are conducted during the production process. The various components of quality management will be described, along with how they are converted and entered into SAP. The individual QM processes will be parameterized and then integrated with all of the ERP modules to create the company's final SAP system.

The goal of this thesis is to better understand how to apply SAP QM to improve incoming quality control procedures. It will assess SAP QM functions such material inspection planning, goods reception inspection, and fault recording that are pertinent to incoming inspections. The thesis will examine how putting SAP QM into practice might lead to better data accuracy, more efficient processes, more traceability, and shorter inspection times.

The final part of the present work will discuss how the company's laboratory and production areas' incoming quality management procedures have improved since the QM module was implemented in SAP.



**Keywords** Incoming quality control, Quality process optimization, non-conforming materials, traceability, Continuous improvement, SAP QM, ERP system, Defect management, Supplier quality management, Quality assurance, Data accuracy

# Abstrakt

Die vorliegende Studie befasst sich mit der Implementierung des SAP-QM-Moduls bei einem bedeutenden dänischen Unternehmen, das Mehrfachumrichter und Elektromotoren herstellt. In diesem Dokument werden auch die Probleme und Zwänge des Unternehmens in Bezug auf die Qualitätskontrolle und die Rückverfolgbarkeit der Produktionsprozesse aufgezeigt.

Ziel dieser Arbeit ist es, zu untersuchen, wie ein Produktions- oder Vertriebsunternehmen seine eingehenden Qualitätskontrollprozesse durch den Einsatz von SAP Quality Management (QM) optimieren kann. Aufgrund der zunehmenden Bedeutung von Effizienz und Qualitätssicherung sind wirksame Maßnahmen zur Qualitätskontrolle erforderlich. Herkömmliche Verfahren sind oft mühsam und fehleranfällig. In dieser Arbeit wird vor allem darauf eingegangen, wie die Qualitätsstruktur des Unternehmens aufgebaut ist und wie die Qualitätsprüfungen im Produktionsprozess durchgeführt werden. Es werden die verschiedenen Komponenten des Qualitätsmanagements beschrieben und wie sie in SAP umgesetzt und eingegeben werden. Die einzelnen QM-Prozesse werden parametrisiert und anschließend mit allen ERP-Modulen zum fertigen SAP-System des Unternehmens integriert.

Ziel dieser Arbeit ist es, ein besseres Verständnis dafür zu entwickeln, wie SAP QM zur Verbesserung der Qualitätskontrollverfahren im Wareneingang eingesetzt werden kann. Dabei werden die für die Wareneingangsprüfung relevanten SAP-QM-Funktionen wie Materialprüfplanung, Wareneingangsprüfung und Fehlererfassung bewertet. Es wird untersucht, wie die Umsetzung von SAP QM in der Praxis zu einer besseren Datengenauigkeit, effizienteren Prozessen, mehr Rückverfolgbarkeit und kürzeren Prüfzeiten führen kann.

Im letzten Teil der Arbeit wird aufgezeigt, wie sich die Abläufe des Qualitätsmanagements im Wareneingang des Unternehmens im Labor und in den Produktionsbereichen seit der Einführung des QM-Moduls in SAP verbessert haben.



**Stichworte:** Qualitätseingangskontrolle, Qualitätsprozessoptimierung, fehlerhafte Materialien, Rückverfolgbarkeit, kontinuierliche Verbesserung, SAP QM, ERP-System, Fehlermanagement, Lieferantenqualitätsmanagement, Qualitätssicherung, Datengenauigkeit

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# Preface and acknowledgements

As I write this thesis, I am grateful to the people who have played pivotal roles in shaping this endeavour. This work would not have been possible without the unwavering support and guidance of Nikolay Petrovichev who welcomed me into the project's operations and gave me the chance to assist with Danfoss Editron's operations.

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I am so thankful to God for letting me to walk this path. I am also thankful to my parents for their unwavering belief in my aspirations, encouragement, and support.

Finally, I would want to express my gratitude to EIT Manufacturing Master School for enabling me to pursue my goals of obtaining a master's degree at prestigious European universities. I appreciate you choosing me to be a change agent and sponsoring my scholarship. This amazing experience will always hold a place in my heart.

Espoo, 23 January 2025

Ashutosh Pratap Singh

## Acronyms and Abbreviations

SAP: Systems, applications and products in data processing

QM: Quality Management

ERP: Enterprise Resource Planning

PP: Production Planning

MM: Materials Management

.

WM: Warehouse Management

ISO: International Organization for Standardization

PLM: Product Lifecycle Management

LSMW: Legacy System Migration Workbench

QP01: Create inspection plan: initial screen

QP02: Change inspection plan: initial screen

QP03: Display inspection plan: initial screen

ME03: Display source list: initial screen

MM03: Display material (Initial screen)

LS24: Stock per material

MB52: Display warehouse stock for material

QA32: Inspection lot selection

# 1 Introduction

The fast development of new information technology and globalization have created a highly competitive market for businesses today. The business system and all of its subsystems must therefore be updated to utilize state of the art technologies.

This is necessary to meet market expectations, where managers must act quickly to make choices and give correct information to clients and other stakeholders in the company. Because of this, businesses need to be able to handle information as efficiently as possible and in real time across the whole value chain.

A key concern in the highly competitive production environment of today is guaranteeing product quality. Strong quality management systems are useful in this situation. Incoming quality control (IQC) procedures that are still done by hand can be laborious, error-prone, and time-consuming. Fortunately, creative ways to optimize and streamline IQC are available because to developments in enterprise resource planning (ERP) systems.

The application of the SAP Quality Management (QM) module as a tool for streamlining incoming quality control procedures is examined in this thesis. A thorough framework for controlling every facet of quality, including defect tracking, supplier evaluation, and remedial action, is provided by SAP QM. Manufacturers can obtain notable improvements in by using SAP QM i.e. Efficiency, Accuracy, Transparency and Traceability.

This thesis will examine the particular features of SAP QM that can be used to improve Danfoss editron's incoming quality procedures. Additionally, it will examine the implementation process, highlighting important factors and potential difficulties. This thesis will offer insightful information for manufacturers that looking to improve their incoming quality procedures with SAP QM,

## 1.1 Context of business

Over the course of six months, from February 2024 to July 2024, this thesis was completed for Danfoss Editron. During this time, the author of this thesis was assigned to the Danfoss Editron Operations team in Lappeenranta, Finland, as a Quality trainee.

### 1.1.1 Case Company

Danfoss is a Danish multinational company, based in Denmark, with more than 41,928 employees globally. On September 1st, 1933, Mads Clausen established Danfoss in his parents' farmhouse in Nordborg, Denmark, marking the beginning of the company's quest to create a brighter future. Since then, the company has expanded from a small firm to become one of the top providers of cutting-edge, energy-efficient solutions that boost machine productivity, cut emissions, save energy, and make electrification possible. [11]

### 1.1.2 Danfoss's Business

**Power Solutions**: A wide variety of engineered parts and systems are designed and produced by Danfoss Power Solutions. Our solutions are designed with an unwavering focus on quality, dependability, and safety, including everything from hydraulics and electrification to fluid conveyance, electronic controls, and software.

**Climate Solutions for cooling**: We develop technology to assist you in developing both present-day and future technologies. We offer goods and services for the retail food industry, air conditioning, and commercial and industrial refrigeration. Compressors, pumps, heat exchangers, sensors, controllers, electronics, and valves are all part of our extensive product line.

**Climate Solutions for heating:** We offers solutions that let the future world accomplish more with less. By improving their energy efficiency and resilience, we decarbonize district energy networks. At the same time, we make buildings more pleasant and lower $CO_2$ emissions. Additionally, we guarantee that renters and homeowners will take use of the newest smart heating technology to affordably heat their homes.

**Drives:** Danfoss's ambition is to support your electrification objectives. Because we can build a sustainable, electricity-powered future together. We aim to make that transition smooth and cost-effective by enabling you to fully embrace electrification and hybridization without sacrificing either. This will enable you to operate completely optimized applications in Power-to-X, maritime electrification, and quick charging that you can depend on at all times. We must include clean energy and renewables into tomorrow's smart energy systems in order to power distributed grids, green hydrogen, and hybrid and electric marine vehicles.

**Other businesses:** Emission Monitoring, Fire Safety, High Pressure Pumps, Sensing Solutions, Silicon Power. [11]

### 1.1.3 Danfoss editron

Danfoss Editron is transforming the way the world travels by implementing electric and hybrid powertrain systems for commercial and heavy-duty machinery and vehicles on land and at sea. [11]


Fig.1 The Editron system [11]

### 1.1.4 Danfoss Editron's products

Danfoss offers fully-electric and hybrid EDITRON systems:

**High voltage multipurpose motor**

Danfoss Editron electric machines are founded on permanent magnet synchronous machine (PMSM) or synchronous reluctance assisted permanent magnet (SRPM) technology. They are made to function in the demanding working conditions found in drivetrain applications and are liquid-cooled. For example, propulsion motors in naval applications or traction motors in heavy machinery. They can function as a motor or as a generator. [11]

Fig. 2 Electric Motor [11]

**High voltage electric inverter**

Danfoss Editron electric drivetrains are specifically made to regulate the flow of electric and hybrid power in machinery, vehicles, and marine applications. Converters are made especially for electric or hybrid drive trains found in buses, harbor cranes, mobile industrial machines, and marine boats. [11]

Fig. 3 Electric convertor [11]

# 2 Project details

The purpose of this chapter is to outline the current state of affairs, or the issue that the company is currently facing. Then, the suggested solution to address the problem is presented, followed by a brief explanation of the project's general and specific goals.

## 2.1 Present Context

To assure the quality of the products that will be utilized in the manufacturing processes, a quality inspection of the raw materials is conducted at the time of goods receipt. In order to ensure that quality standards are fulfilled, quality checks are conducted at various points during the production process. At the moment, the organization uses physical sheets, spreadsheets, or Excel templates (see Fig.4) to manually record the results of the first inspection plans for raw materials entering the warehouse. However, these are rarely carried out because the company has a base of certified, qualified, and validated suppliers. Second, the tests conducted at various points in the manufacturing process, and lastly, the outcomes of the tests conducted on the finished product in the lab by the quality inspectors in accordance with the particular industry standard norms to which the production batch is directed. These inspections also differ depending on the production plant where the work is being done, and even on the production line because different work centres may have different models of machinery and equipment.

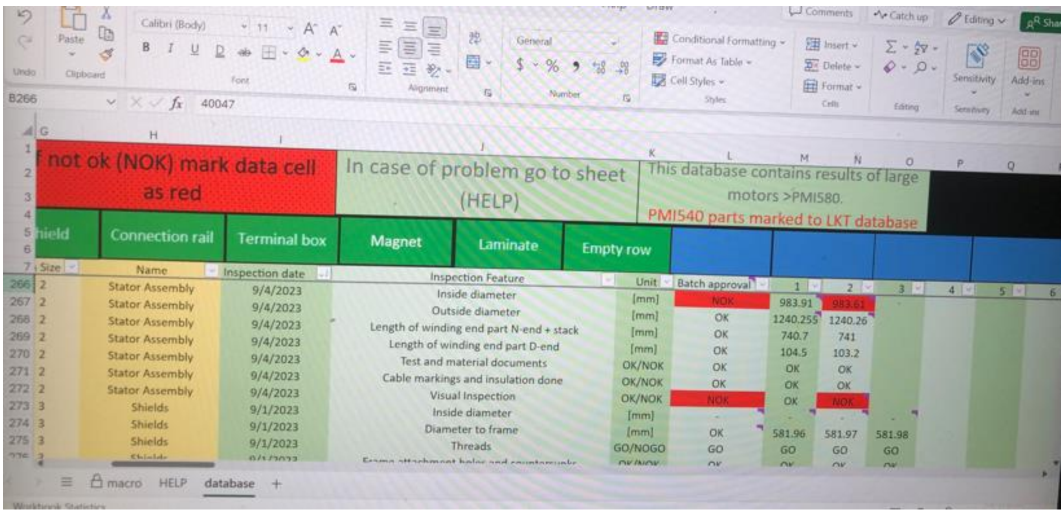


Fig.4 Example of sheet template used in a quality test

In order to compare the sampling results with target values and customer specifications, the data are then entered into a statistical program to visualize them as graphs. After graphically analysing the data and obtaining some indicators, the quality manager decides whether to send the batch to the finished product warehouse. If the graphs do not reveal any irregularities, permission is granted to end the inspection of the batch that was being processed and to proceed with the quality inspection of a new batch. However, this methodology's drawback is that data entry can be a laborious and time-consuming procedure, which results in a high detection time for abnormalities and a low level of responsiveness.

The way in which quality is managed in the company shows significant issues with data analysis because there is no complete historical record of all samples and tests conducted due to the production's large scale, which makes it challenging to process and retain all the data. The majority of the records are kept on Excel sheets and actual paper sheets. Because of the complexity of handling the large number of data kept, it is therefore only possible to obtain a complete statistics report for the present time and not for earlier periods. Furthermore, just a little amount of data is stored on a server.

On the one hand, when raw materials undergo quality checks at the supply level, a record of the findings and the Caliber of the supplied goods is maintained. However, it can occasionally be challenging to identify the raw material suppliers that correspond with production issues or customer complaints because of the volume of data and the database's lack of robustness. However, in the event that a product malfunctions at the production level, the customer notifies the company's quality and production management of the product's failure and the circumstances under which it was disclosed.

However, many times, the organization lacks sufficient traceability information to determine which procedures this product passed, which equipment and work tools were utilized, what kinds of inspections were conducted and the outcomes, what raw materials were used, and many other details. As a result, in some cases, it is challenging to determine which factor caused the failure that is, whether the machine malfunctioned, whether a defective material was employed, or whether the quality equipment or controllers made a mistake.

Therefore, it becomes nearly hard to tell which lots are affected by this failure and whether additional lots have already been produced. Enhancing traceability is therefore essential to safeguarding the company's reputation because it enables prompt action to be taken and these defective lots do not impact customer service or subsequent production processes, which results in fewer defective units and customer returns, higher profits, and a more positive perception of the business.

Since it is impossible to create precise and comprehensive reports of every stage of production and quality for later analysis without a strong and well-organized database, the company's lack of accuracy and detail in the management of the recording of production and quality data results in slow and poor progress in improvements. Instead, SAP would make it possible to produce accurate and thorough reports that would allow for the identification of patterns and trends as well as the assessment of the effectiveness of various processes, determining which ones are more prone to malfunction and need greater attention.

Finally, this new information it would be possible to propose and execute improvements at both structural and process level. Thus, the probability that any failure will take place would be reduced.

## 2.2 Suggested Solution

The organization's quality management needs to advance and adjust to the latest trends in order to boost performance and meet the new environmental concerns. Although the organization now has a SAP license, the Quality Control module has not yet been installed. SAP is used in a number of sectors, including production, accounting, and finance.

Given that the business already has a license for the program and is familiar with it, it won't be as costly, challenging, or time-consuming for the organization to implement and begin using the quality control module and add it to those that are already in use. Thus, by creating and implementing the company's quality control module, the suggested answer is to analyse, identify, define, model, and transfer the quality tests carried out during the production process to the ERP system that is utilized by the business.

It's crucial to provide a quick overview of the features that an ERP system like SAP offers before delving further. A program called an ERP (Enterprise Resource Planning) is in charge of integrating all of the current and essential business operations processes, including purchasing, quality control, accounting, production planning and maintenance, finance, and others. This indicates that SAP is made up of a number of blocks or vertical modules, each of which represents a process and its associated functions inside a department of the company. Several departments are combined into a single system, as seen in the figure. An ERP greatly enhances the flow of accurate and useful information, assisting the organization's management in making more informed decisions and boosting output.

Once the database is fed, the data is accessible from all of the company's operating modules and is available in the system. Any department can access real-time information about the processes taking place in each of them at any moment. Every person in charge of their own region will oversee the daily operations of their module and report back to management. Therefore, it would be simple to manage the traceability of the goods and raw materials by incorporating the quality management module. Additionally, when the production module is functioning in tandem with quality control inside the organization, response in the event of failures increases.

## 2.3 Project objective

To apply the SAP Quality Management (QM) module in order to improve and optimize the incoming quality control procedures within Danfoss Editron. Better product quality, fewer defects, more efficient operations, and streamlined processes are the outcomes of this.

### 2.3.1 Specific Objectives

**Standardize Quality Processes:** Implement standardized quality procedures and requirements in SAP QM to ensure consistency and compliance.

**Reduce Inspection Time:** Use SAP QM's effective procedures and real-time data access to cut down on inspection time.

**Improve Data Accuracy**: Ensure that data is entered and retrieved accurately and promptly using SAP QM's unified database.

**Enhance Decision-Making:** Offer high-quality data and analytics in real-time to facilitate proactive problem-solving and well-informed decision-making.

**Increase Traceability:** To monitor product quality from incoming materials to final delivery, set up an extensive traceability system.

**Reduce Costs:** Reduce expenses related to product recalls, rework, and quality problems by implementing efficient quality control and preventative measures.

# 3 Literature review

The relevant literature and the main ideas of this investigation are covered in this section. This chapter's goal is to provide a summary of the key ideas of the issue under study. The primary ideas and philosophy of ERP system, ERP implementations, integration, challenges and expected benefits are discussed in this chapter.

## 3.1 ERP System

Enterprise resource planning (ERP) is the integrated management of main business processes, often in real time and mediated by software and technology. ERP is commonly defined as a type of business management software, usually consisting of a collection of linked applications, that can be used by an organization to gather, store, handle, and analyse data from a variety of company operations. Both local and cloud-based ERP systems are possible. Because information is now easily accessible from any location with Internet access, cloud-based apps have become more popular in recent years.

ERP uses common databases that are kept up to date by a database management system to provide an integrated and constantly updated picture of the key business activities. ERP systems monitor company assets, including cash, raw materials, and manufacturing capacity, as well as the state of business obligations, including purchase orders, payroll, and orders. The system's applications share data with the departments that supply it, including manufacturing, purchasing, sales, accounting, and others. ERP controls relationships with external stakeholders and streamlines information flow across all corporate operations. [1]

ERP systems were initially designed for large businesses, but they are now being used by smaller businesses more and more.

The ERP system increases an organization's productivity by integrating various organizational systems and facilitating error-free transactions and production. But creating an ERP system is not the same as creating a traditional system. ERP systems, which usually use a database as an information repository, operate on a range of computer hardware and network setups.

The ERP serves as a framework for managing and integrating the essential elements of their business operations. Because they streamline resource planning by consolidating all operational processes into a single system, a variety of enterprise resource planning (ERP) software applications are crucial to enterprises. [1]

In addition, Finance, sales, marketing, planning, purchasing inventory, human resources, and more can all be integrated using an ERP software system.

## 3.2 Concept of ERP Systems

There are multiple ways to define the term "ERP system." A system that consolidates numerous business functions within an organization into a single, integrated database is known as an ERP system. Through a common database that facilitates the seamless integration of critical business operations, real-time information flow throughout the organization, and improved operational management, stakeholders in the business benefit from this information system integration. Ullah et al. (2018) define ERP systems as software applications designed to increase organizational efficiency by generating accurate and up-to-date data that can be utilized by the entire company, including its supply chain.

However, Kurbel (2013) states that an ERP system can be summed up as an integrated system that facilitates all of the business operations that are necessary to the firm and provides employees with the ability to supervise and coordinate the different business processes that are carried out in organizations.

According to Davenport (1998), the main objective of enterprise resource planning (ERP) systems is to promote full integration of various business operations and eradicate information fragmentation within organizations. Thanks to integrated ERP solutions, companies can create a scenario where information is kept in a single, integrated database rather than scattered over several systems and databases.

In recent decades, as information technology (IT) has grown, businesses worldwide have made large investments in ERP systems in an effort to achieve organizational benefits like improved decision-making, better business process integration, and higher profitability.

The Enterprise Resource Planning (ERP) system was utilized by 57% of businesses in the spring of 2023, according to Statistics Finland. The percentage of businesses that use the Enterprise Resource Planning system has increased by 20 percentage points in the last 10 years and by 46 percentage points in the last fifteen. 91% of businesses with 100 or more employees utilize the ERP, compared to 43% of businesses with 10 to 19 employees.

The use of ERP systems in Finnish businesses varied according to the size of the organization; 38% of smaller businesses and 86% of large businesses used ERP systems. ERP system utilization was highest in the manufacturing industry (72% usage) among business sectors. [1]

Use enterprise resource planning (ERP), % of enterprises 2008-2023.

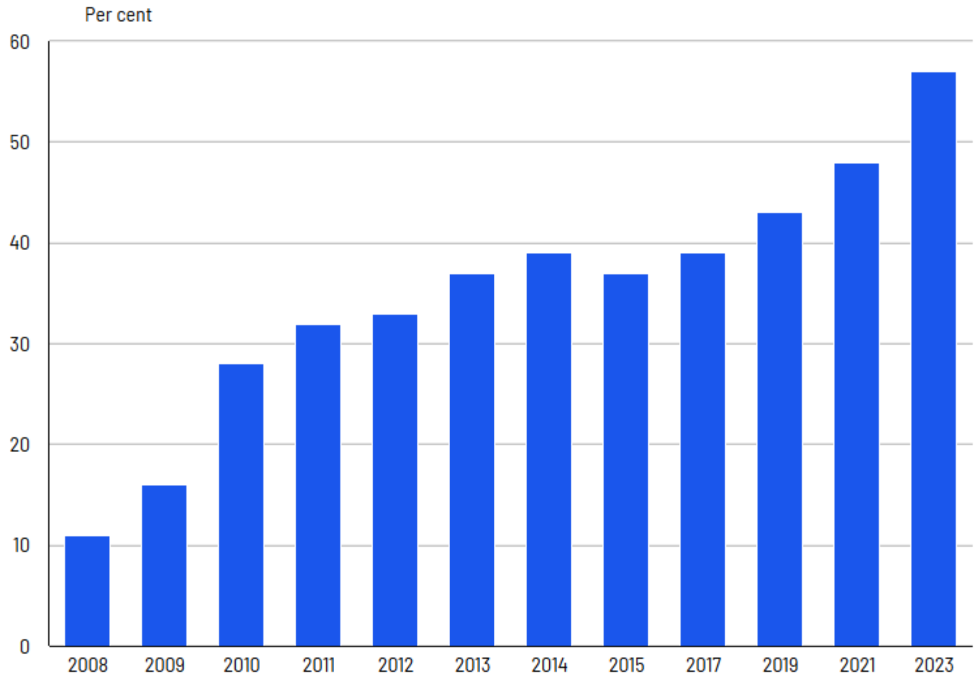


Fig. 5 Statistcs Finland, use of ERP in Enterprises [12]

### 3.2.1 SAP SE

This section of the study reviews and examines SAP as a system. SAP was chosen as the ERP provider for the integrated ERP implementation project at the case firm Danfoss Editron, which is what first caused the current state of affairs at the case company.

SAP SE is a German multinational software company based in Walldorf, Baden-Württemberg, Germany. It creates corporate software for managing customer connections and business operations. The business is the biggest supplier of enterprise resource planning (ERP) software worldwide. was established as System analyse und Programmentwicklung (System Analysis Program Development), a private partnership, in 1972. Following a five-year transition period starting in 1976, SAP GbR became completely System, Anwendungen und Produkte in der Datenverarbeitung (Systems, Applications and Products in Data Processing) in 1981. It further reorganized itself as SAP

AG in 2005. Since July 7, 2014, it has become a subsidiary of SAP Deutschland SE & Co. KG, a pan-European society known as Societas Europaea (SE). It employs over 111,961 people and maintains regional offices in 180 countries.

SAP is a part of the Euro Stoxx 50 and DAX stock market indices. By revenue, the firm is the biggest software company outside of the United States and the third-largest publicly traded software company globally. SAP is the biggest German corporation in terms of market value as of December 2023. The SAP architecture is made up of a number of functional modules that work together to support and carry out important operations. SAP's integrated modules are designed to facilitate the efficient operation of business processes and events, promote business automation and real-time information flow, and increase the security of end-to-end business operations. Key SAP ERP modules are shown in the figure below. [13]


Fig. 6 SAP ERP: Streamlining Business Operations and Driving Efficiency [13]

Visualized in above figure, the SAP system consists of nine core modules: Product Planning, Material Management, Plant Maintenance, Quality Management, Sales & Distribution, Project System, Human Resources, Finance and Controlling. One example of a core module integration is the SAP SD and

FI integration, which occurs when a billing transaction in the Sales & Distribution module is subsequently posted in the Finance module.

Although SAP is frequently linked to the manufacturing sector as an ERP system, it provides solutions for a number of industry sectors. According to Bardhan et al. (2021: 305), the various SAP solutions can be categorized by the following industries: consumer, financial, discrete, energy and natural resources, and public services. [10]

### 3.2.2 SAP Quality Management (QM)

Quality Management (QM) is a SAP S/4HANA component that helps companies set up and manage quality control procedures. It is intended to prevent errors, facilitate ongoing process enhancement, and create long-lasting quality control initiatives. Compliance with manufacturing quality standards, reduced operational expenses, and increased customer satisfaction are some possible advantages for the company.

The functions of this component can be used to implement the key components of a quality management system (QM system), which will help you comply with ISO 9000 and other standards. [3] [4]

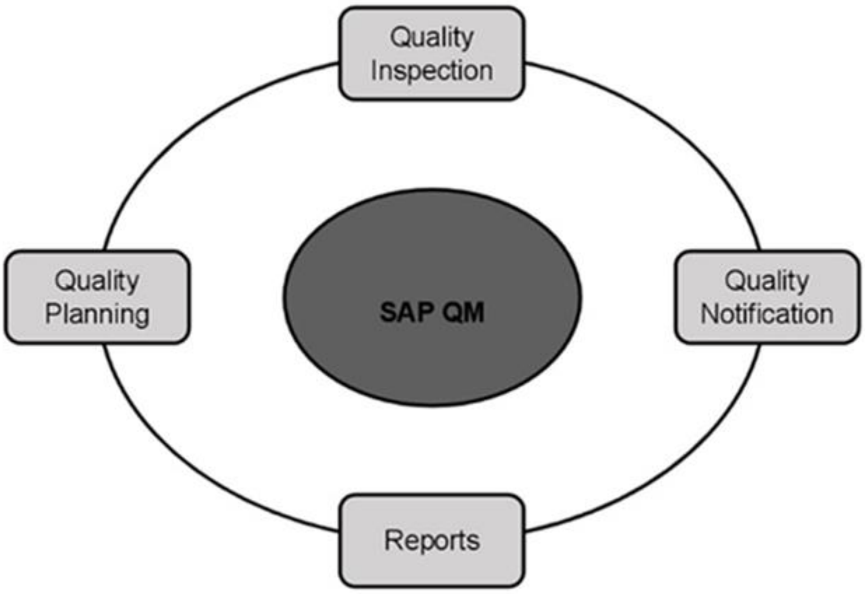


Fig.7 SAP QM module [3]

### 3.2.3 SAP QM-Integration

SAP QM is used to carry out the quality planning, inspection, and control pro-cess by integrating with other SAP modules. These modules can be integrated with SAP Material Management, SAP Production Planning, SAP Sales and distribution and SAP Controlling. [17]

#### 3.2.3.1 Integration with SAP Material management

**Proactive Quality Assurance**: Overseeing supplier, vendor, and material quality aspects, including monitoring release statuses, quality agreements, and RFP specifics.

**Supplier Quality Control:** Inspecting supplier premises and deliveries prior to material movement, ensuring adherence to quality standards and specifications.

**Vendor Performance Management**: Assessing vendor performance based on quality scores, material supplied, and quality notifications, enabling informed decision-making.

**Controlled Material Release:** Using SAP QM to control vendor delivery release status and payment processes, ensuring quality standards are met before re-leasing materials for further use.

**Batch Number Management:** Integrating SAP QM with material management to define batch numbers based on quality inspection results, facilitating traceability and quality control.

**Inventory Accuracy:** Tracking the inventory of goods during inspection and entering cleared items into the inventory system, maintaining accurate inventory records. [17]

#### 3.2.3.2 Integration with Production Planning

**Work Scheduling and Inspection Planning:** Leveraging SAP to coordinate work schedules and plan quality inspections, ensuring timely and effective quality checks.

**Characteristic Management:** Defining and managing inspection and operation characteristics within the SAP QM process, facilitating accurate quality assessments.

**Manufacturing Order Quality Control:** Overseeing quality inspections for manufacturing orders, ensuring products meet quality standards.

**Final Inspection and Goods Reception:** Using SAP QM to set up and conduct final inspections upon completion of the production process, ensuring product quality before release.

**Quality Management for Partial Quantities:** Managing partial quantities of materials with varying quality levels throughout the production process, optimizing resource utilization and minimizing waste.

**Quality Verification for Manufacturing Orders:** Verifying quality information against manufacturing order specifications, ensuring adherence to quality standards.

**Quality Monitoring and Control:** Utilizing SAP QM to generate control charts and reports, providing real-time insights into production quality and enabling proactive corrective actions.

#### 3.2.3.3 Integration with SAP Sales and Distribution

**Customer Data Quality:** Ensuring high-quality customer data is maintained within the sales and distribution process, improving order accuracy and delivery efficiency.

**Delivery Inspection:** Initiating inspections for deliveries associated with sales orders within the SAP QM system, verifying product quality before shipment.

**Customer Complaint Management:** Handling customer complaints effectively, conducting root cause analyses, and implementing corrective actions to improve product quality and customer satisfaction.

#### 3.2.3.4 Integration with Controlling

SAP QM can be integrated with controlling processes to control non-confirmative and defect control costs in the production process. [17]

## 3.3 SAP Logon 770

The purpose of this subsection is to review modern ERP systems and to discuss whether the upcoming SAP Logon 770 implementation could bring a difference in operations perspective at the company case. SAP Logon 770 refers to a specific version of the SAP GUI for Windows, a graphical user interface used to access SAP software applications, designed to enhance the user experience and productivity in SAP environments**.**

It offers a centralized interface for system settings, user accounts, and connection management. In January 2021, it became available. [9]

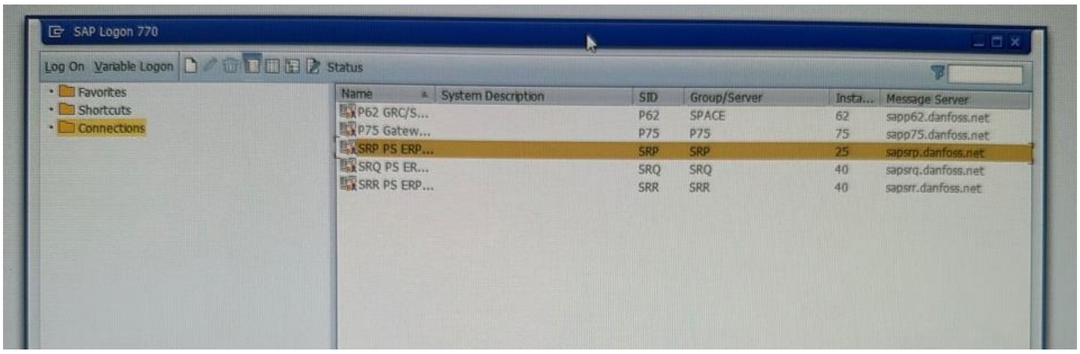


Fig. 8 SAP Logon 770 (Pic. From company’s PC screen)

## 3.4 ERP Implementations

ERP systems are complex and highly integrated software packages. Many businesses all over the globe have made large investments over the past several decades to get better control over their business operations and real-time visibility, which has allowed them to outperform their rivals. However, because of the intricacy of the systems and the significant investment costs of the new systems, businesses have encountered expensive and sometimes catastrophic challenges with ERP implementation projects (Gargeya & Brady 2005). According to Ali & Miller (2017), the nature of ERP systems frequently causes implementation issues because they are frequently built using best practice models, which frequently force businesses to restructure their operations to accommodate those standards.

This subsection discusses the key idea behind ERP installations, the anticipated advantages of putting the ERP system into place, and how to assess the system's success when it is put into use at the post-implementation phase of the process. [1]

### 3.4.1 Concept of ERP Implementation

The term "implementation" describes the process of installing and deploying software or hardware in businesses. The process of organizing and implementing a new ERP system into an organization, from project planning and preparation to system training and follow-up after the new ERP system is deployed, is known as ERP implementation from the perspective of ERP systems.

According to Ali & Miller (2017), ERP implementations can be separated into three crucial phases: pre-implementation, implementation, and post-implementation. In contrast, ERP implementation processes can be separated into planning, implementation, stabilization, and improvement phases.

**Pre-implementation phase:** The tactics used directly affect the implementation project as a whole, and activities including vendor roles, technology introduction, pre-training, and project planning are all impacted. Pre-implementation can be thought of as a beginning point that will influence the implementation project's future.

**Implementation phase:** This stage is quite lengthy and, depending on the size of the business, could run anywhere from 12 to 30 months. Training users for the new system, testing the ERP system modules and functions to meet company requirements, customizing the new system for company-specific needs, and deploying the new ERP system in the project company's target environment are some of the important tasks that occur during the implementation phase.

**Post-implementation phase:** During this stage, activities such as testing system effectiveness, checking data integrity and system utilization and evaluating the benefits of an implemented ERP system. It may take one to three years to fully experience the advantages of a fully operating ERP system. Ineffective integration between ERP modules and other IT systems, user resistance, the loss of qualified IT experts and vendor support following implementation, and the loss of ERP-related know-how are long-term risk factors that affect the success of the implemented ERP system.

Studies of implementation performance in the post-implementation period can assist firms in tracking the impact of ERP installation and identifying areas for ERP infrastructure enhancement, according to Mandal & Gunasekaran (2003). [1]

### 3.4.2 Challenges in SAP QM implementation

Despite its numerous benefits, SAP QM implementation can present several challenges:

**Complexity:** The module's complexity and the need for extensive configuration can make implementation time-consuming and resource-intensive.

**Resistance to Change:** Change management is crucial, as employees may resist adopting new processes and systems.

**Data Migration:** Migrating existing quality data into SAP QM can be a complex task, requiring careful planning and execution.

### 3.4.3 Expected Benefits of ERP implementation

The benefits of ERP implementations are also considered to be multifaceted, ranging from operational improvements to better decision making for accomplishing strategic goals at the organizational level. This is because ERP systems are IT systems that integrate business processes from supply chain management to human resource management (Mishra 2008). The most important advantages of ERP implementation, according to Maas et al. (2018), are better business process integration, improved decision-making, increased business profitability, and smooth information integration across the company organization.

According to Gargeya and Brady (2005), further advantages of an ERP installation that is successful include increased information visibility, customer response, IT system uniformity, increased operational flexibility, and the capacity to replace outdated and ineffective systems.

However, Gargeya & Brady (2005) also propose that the advantages of ERP implementation can be separated into tangible and intangible benefits, depending on whether the latter can be quantified in monetary terms or not, despite having a major influence on business performance. [5]

| System benefits | Business benefits |
|---|---|
| Data integration | Increasing flexibility to adapt to changes in the business |
| Improved system maintenance and support | Information exchange between business units |
| User interface harmonization | Improved customer service quality |
| Increased data security | Enhanced business process efficiency |

Table 1 Benefits of ERP implementation [14]

According to Motiwalla & Thompson (2012: 15–16), who summarized the preceding table, the system benefits of installing an ERP system include the integration of data and applications throughout the organization, which improves data accuracy and overall quality. One anticipated advantage is better system maintenance and support, which may be attained with the ERP system deployment as support companies are centralized and trained to assist end users with system-specific issues.

One of the main system benefits of ERP deployment is the harmonization of the user interface across the new ERP system, which enhances productivity and reduces the need for staff training. The last system benefit discussed was the consolidation and harmonization of the hardware and software infrastructure around the new integrated ERP system, which may ultimately result in increased data and application security inside the company.

Implementing a new ERP system in businesses is expected to yield several business benefits, the first of which is increased agility to adapt to changes in the business environment and industry growth.

Secondly, the implementation of a new ERP system is expected to improve data availability and information sharing within the organization. This is mostly related to current ERP system integration. Since information is anticipated to move more effectively up and down the company across all business units with the adoption of an ERP system, customer service quality should increase. Lastly, business process reengineering of organization functions, which frequently takes place when the new ERP system is supplied and integrated at businesses, is expected to improve the efficiency of business processes. [14]

### 3.4.4 Expected benefits of SAP QM Implementation

**Improved Quality Control:** SAP QM will provide a centralized platform for managing quality processes, enabling organizations to standardize procedures, track quality metrics, and proactively identify and address quality issues.

**Enhanced Efficiency:** Automation of quality tasks, such as inspection planning, execution, and result recording, reduces manual effort and streamlines workflows, leading to increased efficiency.

**Increased Traceability:** The module will offer robust traceability features, allowing organizations to track the entire product lifecycle, from raw material procurement to final delivery.

**Data-Driven Decision Making:** SAP QM will provide real-time insights into quality performance metrics, enabling data-driven decision-making and continuous improvement initiatives.

# 4 Scope and Methodology

The purpose of this chapter is to outline the scope, methodology, and my role in implementing the SAP QM module in company.

The scope of the project spans the analysis, modelling, implementing, and integrating the QM module with other SAP modules that are currently in place inside the organization. Since the SAP Quality Management module is completely connected with numerous important supply chain operations, certain QM related modules most notably the Materials Management (MM) and Production Planning (PP) modules need to be maintained and modified.

SAP QM incorporates two more types of quality inspections: in-process and finished product, as a result of its integration with the SAP Production Planning (PP) module. An in-process inspection verifies the quality of the products being produced during the production process. When it comes to the (MM) module integration, SAP QM enables the addition of quality inspections for raw materials at the time of delivery. Therefore, in conjunction with other modules, the QM module supervises the execution of all duties pertaining to quality planning, control, inspections, and monitoring. Additionally, it is necessary to mention and briefly describe the modules that are closely related to the QM module.

**PP module:** Production planning includes instruments for the various stages, jobs, and techniques that are employed in its operation. For example, product types and quantities, or availability of materials. as well as the actual production procedure. The sales and distribution (SD) and materials management (MM) modules, among others, are integrated with the PP module.

**MM module:** Materials management is the process of handling materials; it includes planning purchases and consumption, controlling invoices, managing stocks, controlling quality, and managing warehouses.

The ASAP technique, which is a standard approach suggested by SAP for the installation of this software and its modules, will be used to deploy and implement the QM module throughout the organization. The acronym for accelerated SAP is ASAP. Helping to plan SAP deployment in the most effective way feasible is its goal. Its objective is to efficiently maximize time, people, quality, and other resources using a tried-and-true implementation technique, since ASAP has an implementation guide that is supported by years of experience with these projects. For implementations, such as project management, technical and business process configuration, testing, and training, the roadmap creates a repeatable standard method. [8]

## 4.1 My role and responsibilities

My primary responsibilities in each project are to collect and analyse the company's business processes and transfer them through the ERP system's configuration or parameterization, as well as any potential extensions and modifications. I am also involved in the management of the Quality, Material Management, and Production Planning modules. A consultant's role then includes assisting businesses with the transfer, configuration, and even improvement of their business operations within the ERP system. It is a function that extends beyond the ERP system to include all required business process documentation.

During my time at the electric motor manufacturing company, I was responsible for several quality assurance tasks. I began by creating a detailed inspection plan for incoming components and meticulously recorded quality data within the SAP QM system. Subsequently, I meticulously identified and defined the essential tests required for our products. To streamline our quality processes, I modelled and parameterized current quality tests directly into the SAP system. Throughout the testing phase, I diligently tracked progress and meticulously recorded results. Finally, I played a crucial role in validating and verifying the overall quality of both the system and its applications.

## 4.2 Project preparation

Project preparation is predicated on the Kick-off, which is the initial meeting between the implementation's client and the partner company. Participants in this meeting include managers, area managers, project directors, consultants for the various modules to be implemented, advanced users, and other responsible individuals participating in the implementation. The project's goals must be precisely stated by those individuals throughout this phase. The project team and working environment are established, along with the initial broad planning of the project.

The first step for the project managers is to define the implementation project's criteria, boundaries, and overall goals. The project team and the process owners (client) jointly envision the goals to be accomplished and establish each person's responsibilities during this crucial kick-off. A PowerPoint presentation is typically used in this meeting to outline the topics to be discussed, the rationale for the selection of SAP, and, lastly, to introduce the Teamwork members and the client company project managers to one another.

At this point, the implanting company provides a document that explains the implementation's goal. Usually, it comes with succinct presentations outlining the modifications and enhancements that will be implemented. Additionally, a preliminary plan that includes the project's various milestones is given to the business.

## 4.3 Project Analysis

In this stage, the teams of consultants are in charge of obtaining a general overview of the company through meetings with those in charge of the area in the client company. With the client's assistance, the company's present process map is examined to determine its main procedures and potential areas for improvement. It is at this stage that the partner company's pre-launch goal will be announced.

The minutes from these meetings will be used to document the discussions and help with the creation of the Business Blue Prints (BBPs). For the project to be accepted, both parties must ratify these documents, which are created by the implementing business. The operating model will be outlined in this paper for every functional area. Those in charge of the area and project directors will also make sure that the timeframes and other requirements specified in the document are followed. Any change to the project's original scope, whether it be adding new features not originally planned for or implementing modules that weren't agreed upon beforehand, will have an impact on the project.

These consequences are summarized in:

**Cost overruns:** The implementing business will be contacted again to discuss any feature that the company needs that is not covered by the BBP (price not included in the first project). The project might be terminated if a different implementing company is chosen.

**Delays:** As a result of new advancements, the implementing company must put up more work. When capabilities are added outside of the contract, unanticipated GAPs are typically implemented, which slows down the original project.

## 4.4 Project Execution

This explains the components of the SAP QM module, the productive process, the inspection points, and the composition of the company's quality structure. The various components of quality management are gathered, transformed, and then input into SAP. The individual QM tools are then parametrized and connected with all of the modules to form the company's final SAP system.

It will concentrate on parametrization because it is during this phase that all of the QM module's objects are specified and the basic model is made while taking the customer's unique system requirements into consideration. It is possible to truly determine whether the components are functioning correctly and the parametrization is accurate with this model.

## 4.5 People involved

The Quality Management department, which consists of ten individuals responsible for quality control and measuring tool handling, offers a strong framework and reliable procedures to meet customer requirements.

Five of those people work as quality inspector They follow procedures designed and analysed by the quality manager. Besides, there are four Quality engineers of the area of quality, and there is one person responsible for them with the position of Quality Manager. Below the QM staff and their functions are presented.

**Quality manager:**

Quality Manager is responsible for ensuring product excellence throughout the entire manufacturing process. This involves meticulously reviewing customer requirements to guarantee full satisfaction. Additionally, He play a crucial role in upholding international and national standards by overseeing manufacturing and production processes. To maintain and enhance quality standards, they conduct regular reviews of existing quality policies and proactively propose innovative improvements and effective implementation strategies.

**Quality Engineer:**

Quality Engineer is a pivotal role in maintaining product excellence. They are responsible for guaranteeing adherence to stringent process and product quality specifications. In addition, they actively manage daily quality operations and provide essential support to quality inspectors. Furthermore, they collaborate closely with operating staff to define robust quality procedures, ensuring a seamless and efficient manufacturing process.

**Quality Inspector:**

Quality Inspector plays a crucial role in maintaining product quality. They meticulously carry out sampling procedures during the production process to gather essential data. Subsequently, they analyse this data to identify any potential quality deviations. Once the product is complete, they conduct thorough quality control inspections to ensure it meets the highest standards. Finally, they accurately record all inspection results within the designated system.

## 4.6 SAP QM components

To carry out the project, A few components of quality management need to be included in the system. In particular, to develop all inspection characteristics that are utilized to evaluate motors and convertor's part quality. The process for creating inspection lots, entering the results into the system, choosing how to use them, and managing non-conformities must all be specified. Consequently, information gathering and conversion are required to guarantee SAP compliance and optimal operation.


Fig.9 Quality management components

The components of the QM processes could be understood as stages and are explained in the following way:

The inspection plan outlines the location and method of sample collection during the execution of the productive process. The quality department enters the several lots of inspections that are produced during the production operations into the system. In order to obtain and report inspection findings in SAP, product samples are inspected in both the production area and the laboratory while production is underway.

The decision to use the product is made at the end of all quality controls. If the product satisfies the requirements, it is sent to the finished material warehouse. If a defect is found, the system generates a non-conformity notification, which is handled by the production and quality departments. Based on the severity classification of the failure specified in the inspection plan, established procedures are followed, ranging from accepting the lot but noting that it does not meet certain specifications to rejecting the lot.

In any case, the quality process is closed by a non-conformity notification in which it is indicated the results acquired, the quality level reached and when, where and which the problems took place. [18]

### 4.6.1 Inspection Plan

In SAP, the methods for inspecting an object are specified in quality inspection plans. The plan also specifies the location of the inspection; to do this, a sample technique is allocated to a material or work centre. It is also necessary to specify the features of the item that will be examined in each operation as well as all of the resources needed for the inspection, such as personnel, equipment, or tools. [18]

#### 4.6.1.1 Sub-components used in inspection plans

#### 4.6.1.2 Sampling

A sampling technique includes information about the valuation of the inspection feature (attributive, variable, manual, etc.) as well as the rules that indicate how the system determines the sample size. The sampling type contains the guidelines for selecting the sample. For the inspection characteristics, the sample kind and valuation method are merged. The sampling technique is structured around this combination.

**Sampling Type:** The sampling method (fixed sample, 100% inspection, utilize sampling system, percentage sample, or AQL based sample) is determined by the sampling type. The sampling type establishes the parameters for sample determination in conjunction with the valuation mode. The approach suggests a set of guidelines for sample determination based on the sampling type.

**Valuation Mode**: The standards for approving and rejecting a characteristic or sample are specified by the valuation mode (e.g., variable inspection according to Statistical Process Control inspection, attributive inspection based on nonconforming units). A synopsis of the various valuation modes is provided below.

**Attributive inspection nonconformity units:** Sample size and an acceptance number determine valuation for a sampling operation using this valuation mode. The number of nonconforming or defective units and the acceptance number of the inspection results are contrasted. The trait is deemed acceptable if the quantity of flaws or nonconforming units is less than the acceptable quantity. Qualitative traits are evaluated in an attributive inspection.

**Manual valuation used in valuation:** When using this valuation mode for a sampling procedure, valuation is done by hand. In other words, it is manually set to "Accept" or "Reject" during the results recording of an inspection characteristic or a sample. The characteristic must be manually determined to pass or fail.

Inspection by tolerance used in valuation: Inspection against specification limits.

**Sampling schemes:** Activity makes it possible to define parameters for sample plans unique to a corporation. These are a set of sampling guidelines that spec-ify the sample size as well as the acceptance and rejection criteria. It takes into account the AQL, the number of lots to be inspected, and the intensity of the examination. [16]

#### 4.6.1.3 Inspection characteristic

It is created as a record. This feature, which can be either quantitative or qualitative, is meant to be used frequently in inspection plans where it describes the inspection criteria for materials, parts, and products.

**Catalogs**: It relates to data that is kept and categorized in the system to manage, consistently define, and standardize data that comes from the production process (e.g., types, causes, activities, or characteristic qualities of defects) of the client or plant. Problems can be described and qualitative data evaluated with the aid of catelogs.

**Work Centre**: They are the actual locations where all of a production order's processes are completed. These can be machines, tools, or a combination of these. Human resources can also be assigned to a work centre, and they are essential for both production planning and quality control.

**Production resources and tools (PRTs):** These mobile operational resources are essential for carrying out tasks and are utilized often, in contrast to the work centre. PRTs, for instance, consist of engineering drawings, paper-work, and measurement tools. The quantity, timing, and dates of the utilization of production resources and tools are described, and they can be allocated to productive tasks.

**QM material master view:** The QM view of the material master record contains information about QM management. In addition, the inspection setup (located in the QM master view) defines the fundamental parameters for the quality inspection process flow, and there are various indicators to set based on the material being parametrized. [18]

### 4.6.2 Inspection lot generation

The in-process inspection uses a production order as a reference. When a pro-duction order is established, an inspection lot is automatically formed and shaped in accordance with the sampling technique that goes along with it. For the materials to be generated, a specific system configuration is needed to complete this process (see section Material Management Set-Up).

### 4.6.3 Inspection results input

This component records and processes the inspection characteristics' results. The reference point for recording results is the inspection lot. It is possible to make quality inspection evaluations using the documented inspection results, which provide proof of the inspected product's quality.

### 4.6.4 Usage decision

The decision to use the inspection lot is decided after the inspection is over. Although the quality supervisor is the one who verifies whether the examined items are accepted or rejected, the system makes a recommendation based on the results entered.

### 4.6.5 Non-conformity management

This section explains how to handle flaws and nonconformities. In the event of a manufacturing process failure, the quality controller adds all necessary information to a defect report, including photos, a list of outcomes, and signed documentation. In order to further process the defect report, the quality supervisor documents or specifies immediate, remedial, and preventive measures. The quality controller checks to see if the system is functioning correctly after carrying out the specified corrective actions. The quality supervisor closes the defect record following defect resolution. It is necessary to implement notifications of the internal problem type, which will be related to problems with internal operations, equipment, production delays, and other things. A manufacturing order will be linked to the internal problem, which can be fully traced back to its origin and is linked to a defect that was created in the inspection lot. [18]

# 5 Parametrization

In this phase, The QM module's components have been modelled, defined, and produced. Additionally, the company can test the new tools it has at its disposal to enhance its operations with SAP, including control charts and flawless product traceability at every point of the supply chain.

Finally, a foundation of trust about the system's capacity to run the business is given since the model with the parametrizations and quality management tools provided by SAP allows for the examination of the daily behaviour of the business's quality processes through a number of tests.

In this project, it will be used 2 methodologies of data transfer, which are individual configuration and massive migration.

In this project, I worked only on Manual creation. So, we will discuss only in details about manual creation.

**Manual creation**: Projects typically demand precise and comprehensive information in addition to the creation of master data in modest quantities. In this instance, the process of creating this data involves the functional consultants filling in the relevant fields and adding the information as detailed as needed through the creation transactions that correspond to each of the master data in the system. The sampling process and the establishment of the quality management view in the material masters will be carried out using the individual configuration; the processes involved will be described later.

**Massive Migration:** Legacy System Migration Workbench (LSMW). Large projects might have a team solely focused on master data loading, but in other situations, like this one, the functional team is in charge of loading a lot of da-ta, including objects, configurations for already-existing records, and transfers of fixed assets from multiple databases. LSMW is a typical SAP tool that gradually fills in the structures unique to each master data in order to upload the information from source files into the system.

## 5.1 Manual Configuration

### 5.1.1 Material Management Set-Up

**Individual Creation:** It is used to set up the material masters after creating a single material, such as a new material with unique properties that set it apart from the company's current materials. For the purpose of illustration, the individual creation of a quality management view in a master material is shown below.

### Create a "Quality Management" view in the material master:

The individual creation of this view can be done through transaction code MM01 where the parameters would be set manually in the views corresponding to Quality management as shown in Figure 10.

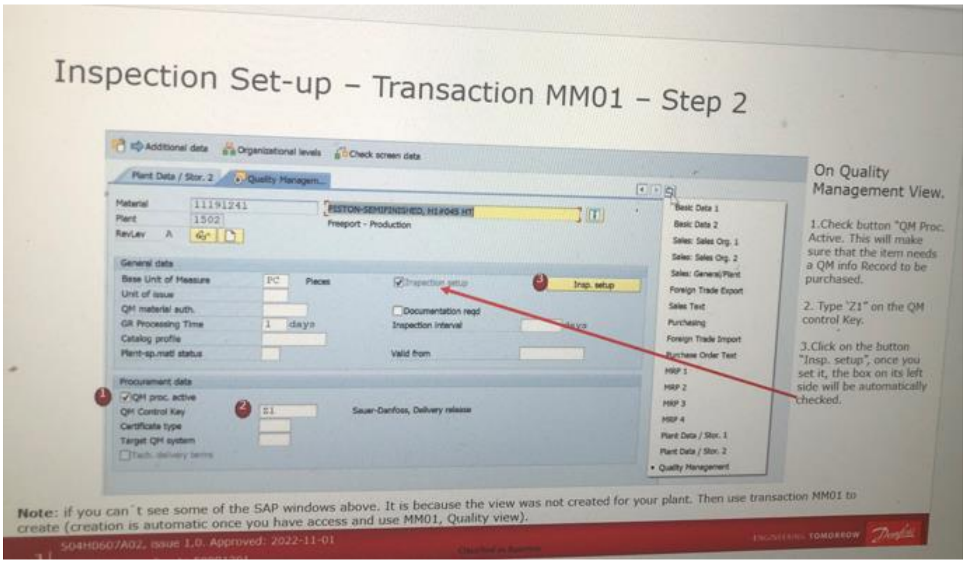


Fig.10 Material Master QM view (Pic taken from Danfoss training ppt)

In order to configure the inspection setup, the material must first be assigned an inspection type from among the possibilities provided by SAP, as illustrated in Figure. In this instance, the inspection type 03 is selected, meaning that the system will generate inspection lots throughout the manufacturing process. The inspection fields with the job list, permitted skips, and check characteristics are then indicated. As shown in the figure, the Q-score process is inserted as 06- from the usage decision.

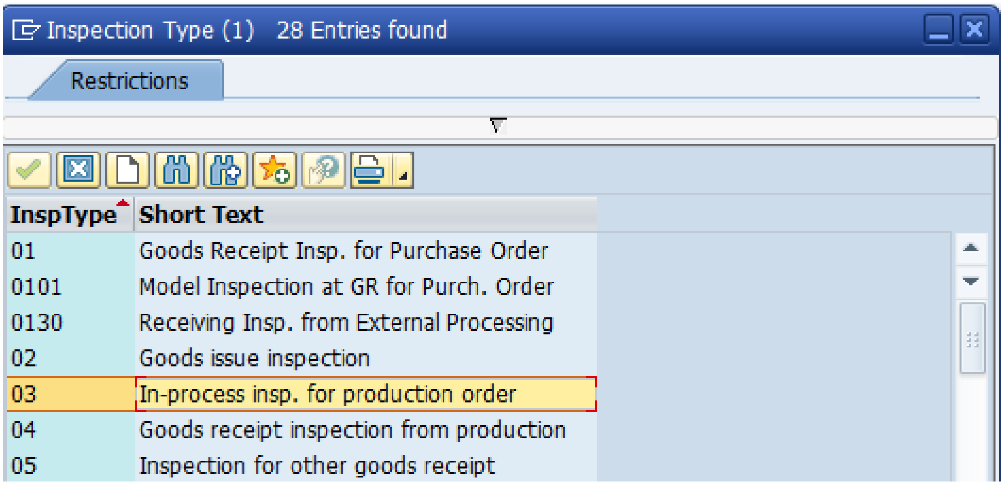


Fig.11 Inspection types available in SAP (taken from SAP)

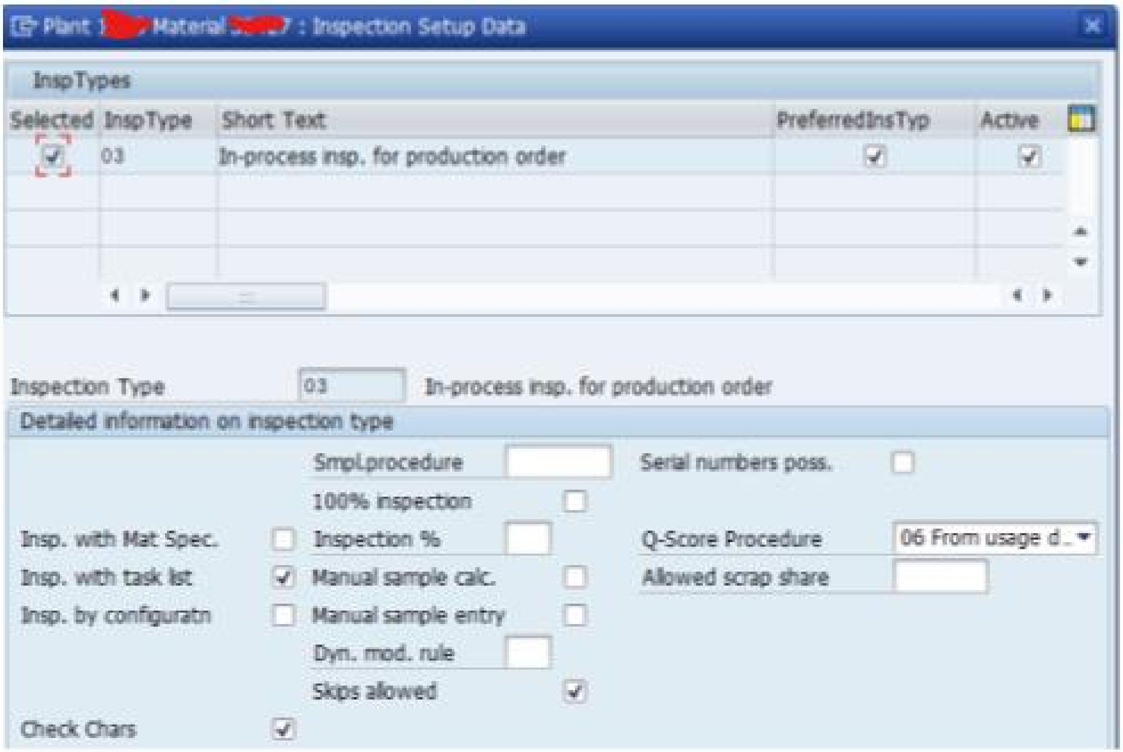


Fig. 12 Inspection setup data for QM view

### 5.1.2 Sampling Procedure

The sampling technique in the SAP QM module is used to determine the sample size. While the valuation mode establishes guidelines for accepting or rejecting a characteristic or sample, the sampling type specified in the sampling procedure specifies how the sample is chosen (see Figure).

The company has six sampling techniques that are parameterized based on the final product's process parameters (qualitative and quantitative). A sampling scheme is primarily used for goods receipt and consists of tables with sampling plans that depend on the lot size and use parameters like AQL (acceptable quality level). Other sampling methods include a fixed sample, a percentage of production, a 100% inspection, or a sampling scheme.

| **Sampling procedure** | **Sampling type** | **Valuation mode** | **Description** |
|---|---|---|---|
| C0 | Fixed Sample | Manual Valuation | Dimensional control |
| C1 | Sampling Scheme | Attributive Inspection non-conforming units | Sample size based on AQL –Goods Receipt |
| C2 | Sampling Scheme | Mean Value within tolerance range | Fixed sample size |
| C3 | Sampling Scheme | Mean Value within tolerance range | Fixed sample size |
| C4 | 100% Inspection | Attributive Inspection non-conforming units | 100% Lot inspection |
| C5 | Percentage Sample | Manual Valuation | Percentage of total production - |

Table 2 Sampling procedures created in the company

The processes involved in creating a sample method in the SAP QM module are shown below. As is the case with the majority of the company's products, the example to be made has a sampling technique with a fixed sample. Materials whose production is controlled in a defined lot size are subject to this sort of operation. As a result, the quantity to sample in a production lot is known for the majority of references.

## 5.2 SAP QM Master Data

In order to carry out the quality process, you must keep track of inspection planning data in the SAP system. Maintaining regular reports on material master, supplier, and customer complaints requires you to keep up with the data for quality planning.

### 5.2.1 Qualitative Inspection Characteristics

The inspection characteristic's pertinent control indicators are specified. Inspection results can be classified as either a quantity of the results determined, an OK/not OK valuation, or an inspection catalog code. It doesn't specify theoretical values or tolerance bounds. Consequently, no measured value can be included, for in-stance, in the confirmation result.

Entering the loading program (LSMW) into transaction QS21 requires filling out the following fields; the first line matches the database table fields that need to be filled out. [18]

**Plant:** It is a type of distinctive identification that corresponds to the plant where the data is being loaded.

**Characteristic ID:** It is the name that is consistently used within a plant for each of the inspection features.

**Start date:** It relates to the date on which the attributes will become active.

**Status:** Refers to a status in this case, Released in the master record.

**Description:** Refers to a short description text for the characteristic, up to 40 characters.

**Search field:** Refers to a brief search text field. Using the search aid, this field ought to increase the search options for master data records.

**Catalog**: Refers to the selected set assigned (Catalogue class) to the inspection characteristic.

**Parameter**: Inspection characteristic, sampling procedures, result entry, notification of results, Fixed sample size etc must be specified for the inspection.

### 5.2.2 Quantitative Inspection Characteristics

When you record the findings of an inspection, you can obtain the quantitative specifications results directly. Each parameter's minimum and maximum values can be set at the master level. The inspection method might also be linked to the degree of the inspection standard.

The loading program (LSMW) is entered into transaction QS21, it is required to fill out the following fields:

**Parameter:** Lower tolerance limit, upper limit, sampling procedure, sample size, SPC, result notification, measured value, no. of inspected unit etc must be specified for the inspection characteristic.

**Number of Decimals:** Refers to the number of decimals that are considered in a value.

**Unit:** Refers to the unit of measure of the standard values (target value and tolerance limits) of a quantitative inspection characteristic.

**Target value:** Refers to the target value of a quantitative characteristic which must be within the tolerance limits.

**Lower limit:** Refers to the lower limit, which is the lowest value that an inspection characteristic can take in order not to exceed the working limits (Rejected).

**Upper limit:** Refers to the upper limit, which is the maximum value that an inspection characteristic can have without going beyond the work restrictions (Rejected).

### 5.2.3 Work Centre

A key that identifies a work centre which is an organizational unit, this key defines where and by whom an operation is performed. The loading program enters the transaction CR01, it is required to fill out the following fields:

**Plant:** Refers to the plant where the data are loaded, it is a form of unique identification.

**Class (0007):** Refers to a production line. Crucially, the work centres are differentiated according to their class or application (e.g., manufacturing work centres, maintenance work centres).

**Description:** Refers to the work centre description.

Responsible: Refers to the person responsible for the job.

Usage: Refers to the use of task lists.

**Standard value key:** The standard values in the operation, which may vary from 1 to 6, are assigned according to the standard value key. Operation time, capacity needs, and expenses are calculated by the system using standard values as parameters. These standard values are given a parameter ID using a standard value key.

## 5.3 Creating a Master Inspection Characteristics

To create a Master Inspection Characteristic (MIC) in SAP QM, first access the transaction QS21. In the subsequent window, input the plant code, the desired MIC code, and the effective date. Next, specify whether the MIC is quantitative or qualitative, set its status to "Released," and select the "Complete copy" model to preserve all data. Enter a short text and search field for easy identification. Click the "Control Indicators" button to define lower and upper limits and a sampling procedure, if necessary. In the tolerance window, set the acceptable range for quantitative MICs. Finally, save the MIC to complete the process. [17]

## 5.4 Creating an Inspection plan

### 5.4.1 Preparation

To effectively utilize SAP QM, you'll need access to the SAP QM module and a stable internet connection. A solid understanding of key transaction codes like QP01, QP02, QP03, ME03, MM03, LS24, MD04, MB52, MIGO, and QA32 is crucial. Additionally, knowledge of components, part drawings, inspection methods, and master inspection characteristics (both qualitative and quantitative) is essential. A strong grasp of sampling procedures, inspection plans, plant codes, and warehouse codes is necessary. Before creating inspection plans, ensure that the Quality Management view is activated in the material master data (MM03) for the relevant components.

### 5.4.2 Plan creation

An inspection plan is necessary in order to document the outcomes of quality records. To define inspection methodology in SAP QM, you must specify the materials subject to inspection, the precise inspection procedures, and the relevant work centres, inspection specifications, and quality characteristics to be assessed. This information serves as the foundation for planning and executing quality inspections effectively.

To create an inspection plan in SAP QM, first, use T-code QP01. Enter the material code, plant code, and effective date. Set the usage to "5" for goods receipt and the status to "4" for release. Enter a lot size of 99999999 for maximum flexibility. Next, assign a quality lab work centre and the control key "QM01" for quality checks. In the inspection characteristic screen, input the master inspection characteristic name, inspection method, and sampling procedure. Lower and upper limits will be automatically populated. Save the inspection plan to complete the process. Once the plan is created, you can initiate incoming inspections and use QA32 to check the status and block or release components as needed.

# 6 Results

The successful realization of Chapter 5 has led to significant advancements in quality control, production management, and traceability.

## 6.1 Enhanced Quality Control

**Automated Inspection Lot Activation:** Streamlined quality control processes through the automatic activation of inspection lots upon production order creation.

**Comprehensive Quality Control Plans:** Reduced human error and minimized setup times by utilizing pre-established quality control plans.

**Rigorous Inspection Procedures:** Ensured product quality and compliance by releasing materials only after successful completion of quality inspections at each stage of the production process.

**Proactive Issue Resolution:** Timely identification and resolution of quality issues through real-time monitoring and control, preventing further defects and minimizing production downtime.

**Effective Nonconformity Management:** Improved quality performance by systematically recording, analysing, and resolving nonconformities, facilitating root cause analysis and corrective actions.

## 6.2 Improved Production Control

**Strict Quality Gatekeeping:** Maintained strict control over production processes by halting production in case of anomalies or defects, ensuring product quality and compliance.

**Clear Accountability:** Enhanced accountability and transparency through documented approvals from supervisors or shift leaders for production resumption after quality issues are addressed.

## 6.3 Enhanced Traceability

**Comprehensive Data Capture:** Enhanced traceability through the collection of comprehensive data during the production and quality assurance procedures.

**Real-time Insights:** Facilitated real-time monitoring and analysis of production and quality data, enabling timely decision-making and problem-solving.

**Support for Continuous Improvement:** Leveraged historical data to identify trends, optimize processes, and drive continuous improvement initiatives.

Through the implementation of these enhancements, the company has improved overall product quality, boosted operational efficiency, and attained a greater degree of quality assurance.

Additionally, the research findings have been verified for accuracy in collaboration with the case company's quality manager.

# 7 Conclusions

During the six-month period from February 2024 to July 2024, this thesis was carried out for the case company, Danfoss Editron. This thesis aimed to assess the effects of SAP QM implementation while investigating the benefits and challenges.

One of the primary goals established by the organization when it implemented the SAP QM module was to align with the needs of modern businesses, which require access to accurate, dependable, well-organized, and real-time information about events pertaining to quality control in every department of the business.

The thesis is dedicated to the problem of simplifying of incoming inspection process by reducing communication between the warehouse department and the quality control department, and structuring inspection plans. A feature of the work is the grouping of characteristics of inspected products into plans, taking into account the similar application of the products, their nominal values, and tolerances. The practical part helped streamline records of incoming control, reduce inspection time and costs without losing objectivity in judging product quality, and subsequently reduce the time for making changes to control plans.

This thesis offers a solution that allows the organization to track the performance of the incoming quality process as well as its results at every level. The results of the thesis were successfully implemented at company. Now, Danfoss editron is using the SAP QM system. It serves as an excellent basis for the continuous improvement of the inspection control system.

However, the true advantages of the system, will be realized in the medium and long term because there is a clear relationship between the amount of time an ERP system is employed and the experience that the businesses gain. The reason for this is that the business needs to adjust to the best practices that SAP, a globally certified software, requires.

Furthermore, a future task is to apply Quality Management to equipment calibration. This will allow the QM module to be coupled with the PM (plant maintenance) module and track the accuracy of the calibration devices. Additionally, as new system updates and functionalities are deployed, it is handy for the staff to receive ongoing training.

Finally, I have a very favourable view of this first job experience since it helped me understand various aspects of the business world and apply the production and quality concepts that I had studied in university. This assignment helped me better understand how ERP and quality management systems work and how important they are to businesses.

# 8 References


1. Ali, M., & Miller, L. (2017). ERP system implementation in large enterprises – a systematic literature review. Journal of Enterprise Information Management, 30, 666-692.
2. Akhtar, J. (2016). Production Planning and Control (SAP PP) with SAP ERP (Vol. 2nd Edition). Rheinwerk.
3. SAP. (2011). PLM400 Quality Management Handbook.
4. SAP. (2013). PLM114-Basic Data for Production
5. Gargeya, V., & Brady, C. (2005). Success and Failure Factors of Adopting SAP in ERP System Installation. Business Process Management Journal, 11, 501-516.
6. Wikipedia contributors. (2024, November 9). SAP. Wikipedia. https://en.wikipedia.org/wiki/SAP
7. O'Leary, D. E. (2004). Enterprise Resource Planning (ERP) Systems: An Empirical Analysis of Benefits. Journal of Emerging Technologies in Accounting, 1(1), 63–72. https://doi.org/10.2308/jeta.2004.1.1.63
8. SAP Modules List: Main SAP ERP Modules (Business and Technical) – SAP4TECH. (2015, August 13). SAP4TECH. https://sap4tech.net/sap-modules-list/
9. How To Login Into SAP Logon 770 - All Tech Magazine. (2024, November 11). All Tech Magazine. https://alltechmagazine.com/how-to/login-into-sap-logon-770/#:~:text=Released%20in%20January%202021%2C%20SAP,user%20accounts%2C%20and%20system%20settings
10. Wikipedia contributors. (2024a, November 7). Enterprise resource planning. Wikipedia. https://en.wikipedia.org/wiki/Enterprise_resource_planning
11. Wikipedia contributors. (2024a, April 16). Danfoss. Wikipedia. https://en.wikipedia.org/wiki/Danfoss
12. SAP ERP: Streamlining Business Operations and Driving Efficiency. (n.d.). https://www.softobotics.com/blogs/sap-erp-streamlining-business-operations-and-driving-efficiency/
13. SAP Help Portal. (n.d.-b). https://help.sap.com/docs/SAP_S4HANA_ON-PREMISE/9905622a5c1f49ba84e9076fc83a9c2c/e2f8f94be737403696eeea0e2be80d87.html
14. Motiwalla, L. F., & Thompson, J. (2012). Enterprise systems for management. 2nd ed. Upper Saddle River, NJ: Pearson Education.
15. Enterprise Resource Planning (ERP) was used in 57 per cent of enterprises in 2023 | Statistics Finland. (2023, July 12). https://stat.fi/en/publication/cl8ju4icl85120cvzb2317b7z

16. Hlzer, M., & Schramm, M. (2009). SAP Quality Management. In SAP PRESS eBooks. https://dl.acm.org/citation.cfm?id=1643528
17. SAP QM - Master Data. (n.d.). https://www.tutorialspoint.com/sap_qm/sap_qm_master_data.htm
18. Chen, TJ, & Thornton, AC. "Quantitative Selection of Inspection Plans." Proceedings of the ASME 1999 Design Engineering Technical Conferences. Volume 3: 11th International Conference on Design Theory and Methodology. Las Vegas, Nevada, USA. September 12–16, 1999. pp. 175-185. ASME. https://doi.org/10.1115/DETC99/DTM-8759
19. SAP QM - Overview. (n.d.). https://www.tutorialspoint.com/sap_qm/sap_qm_overview.htm
20. Electric Motors: Types, Applications, Construction, and Benefits. (n.d.). https://www.iqsdirectory.com/articles/electric-motor.html

# 9 Appendices

This part deals with the Electric motor definition and information about parts, types, applications, benefits and drawbacks

## 9.1 Electric motor

An electric motor is a machine that generates mechanical energy from electrical energy. It produces torque on the motor shaft by using electrical current in a wrapped wire to create a magnetic field. Although an electrical generator and electric motor share basic similarities, they operate in opposing directions, transforming mechanical power into electrical power. [20]

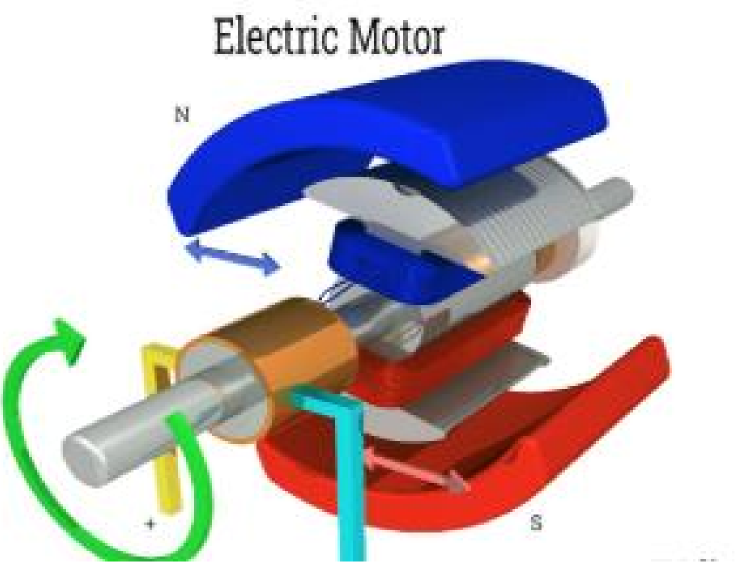


Fig.13 Electric motor [20]

### 9.1.1 Electric motor parts

**Rotor:** The moving part in charge of providing mechanical power is called the rotor. Usually, it has current-carrying conductors that work with the stator's magnetic field to provide rotational force on the shaft. However, in some motors, the conductors are found in the stator, while the rotor may be made up of permanent magnets. [20]

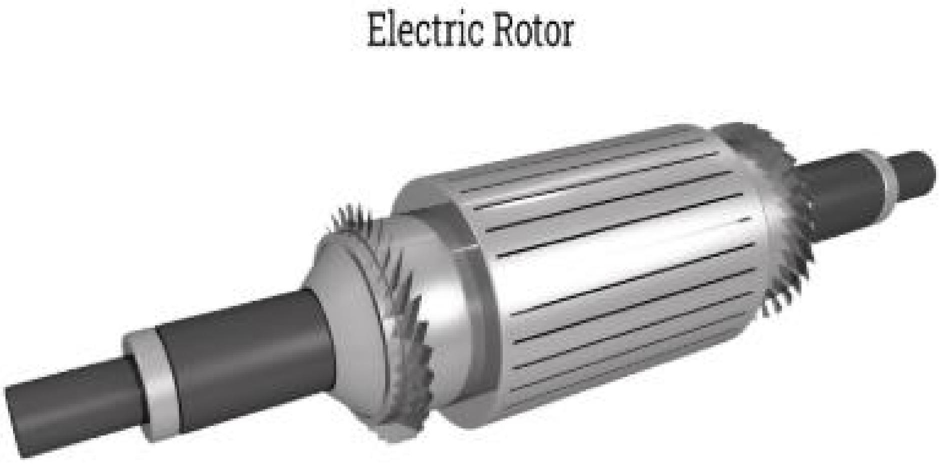


Fig.14 Rotor [20]

**Stator**: The stator, which surrounds the rotor, usually houses the field magnets, which can be permanent magnets or electromagnets with wrapped wire on a ferromagnetic iron core. A magnetic field produced by these magnets interacts with the rotor winding to exert force on it. To minimize energy losses, the stator's iron core is made up of several thin, insulated metallic sheets called laminations. [20]

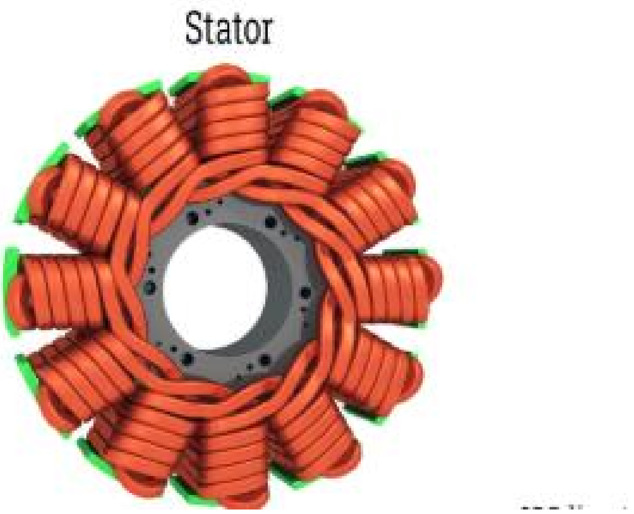


Fig.15 Stator [20]

**Armature:** The armature consists of wire wound around a ferromagnetic core. The rotor rotates and produces mechanical output when current passes through the wire because it creates a magnetic field that applies a Lorentz force to the armature. When electricity is given to the windings, which are coils of wire usually wound around a soft, laminated iron core, magnetic poles are produced. [20]

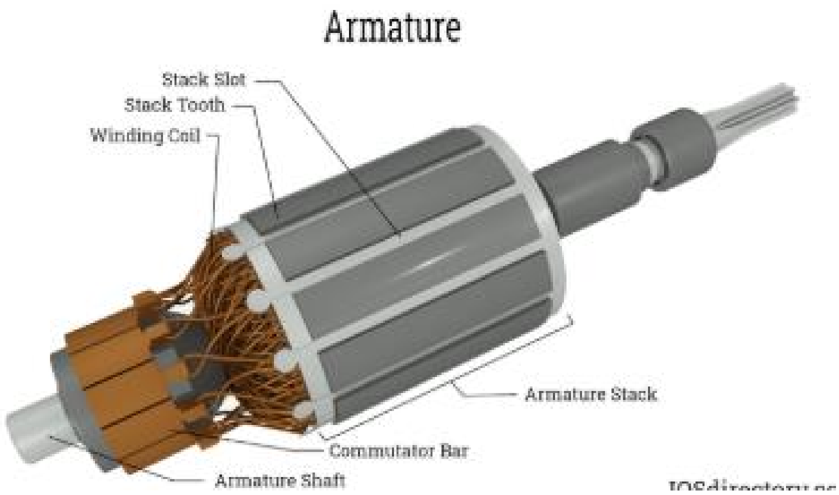


Fig. 16 Armature [20]

**Commutator:** A commutator is a rotating switch that can provide the rotor with either direct or alternating current. As the shaft rotates, it periodically reverses the rotor winding's current flow. A cylinder with many metal pieces on the armature makes up the commutator. The commutator is pressed against by brushes composed of a soft conductive substance, such carbon. These brushes supply current to the rotor by maintaining sliding electrical contact with the revolving commutator segments. [20]

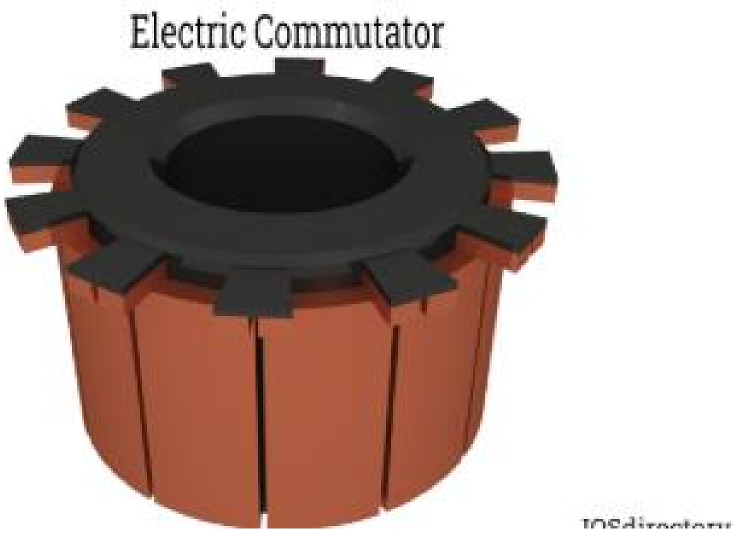


Fig.17 Commutator [17]

**Bearings:** Bearings give the rotor stability and allow it to spin smoothly on its axis. For these bearings, the motor housing provide support. [20]


Fig.18 Bearings [20]

### 9.1.2 Electric motor applications

Numerous machines, including blowers, machine tools, fans, turbines, pumps, power tools, compressors, alternators, rolling mills, movers, ships, and paper mills, use electric motors. They are essential components of electric vehicles, home appliances, cooling and ventilation systems, and high voltage AC heating systems. [20]

### 9.1.3 Electric motor benefits and drawbacks

**Benefits**

Electric motors offer a compelling alternative to fossil fuel engines due to their numerous advantages. Despite similar horsepower ratings, electric motors are generally more cost-effective. Their superior design with fewer moving parts contributes to a significantly longer lifespan, often exceeding 30,000 hours with proper maintenance. Additionally, electric motors boast high efficiency and advanced automatic control systems, enabling automatic start and stop functions. Perhaps most importantly, they are environmentally friendly, producing zero harmful emissions. [20]

**Ddrawbacks**

Large electric motors present unique challenges. Their substantial size makes them difficult to move and transport, necessitating careful planning and specialized equipment. Additionally, they require precise current and voltage supply, often necessitating costly line expansions in areas with limited electrical infrastructure. Furthermore, when operating high-horsepower motors with low load factors, significant energy consumption can lead to substantial operating costs. [20]