POLITECNICO DI TORINO

Master of Science in Engineering and Management

Implementation of SAP (An enterprise resource planning software) in an international small company

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Acronyms and Abbreviations

ERP   Enterprise resource planning

SAP   System Applications and Products

LIFO   Last in first off

FIFO   First in first out

MRP   Material requirements planning

ATP   Available-to-promise

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1. Introduction

The developed world is living in the 4th industrial revolution which is called industry 4.0 or the digital revolution. And in this new world, the competition between companies becomes more and more fierce. For this reason, how companies can improve their competitiveness and the responding speed to market changes is a very serious issue that enterprises are facing nowadays. Most companies realize that improving their soft power by enterprise informatization is essential.

Through the enterprise's informatization, the capital flow, Logistics, and the information flow are integrated so that a highly shared information management platform can be built. This platform can provide accurate data for top-management to make decisions and can provide good technical methods of business analysis. For this reason, Inkmaker Srl where I performed the internship started to imply SAP S/4HANA® at the beginning of the year 2019. Inkmaker Srl is the group from Turin which actives in the automation field and dispensing system for ink and paints. It is present worldwide, with branches in Europe, the Americas, Asia, and Australia. Over 30 years of activity, the Group has strengthened its presence in international markets. Due to the company's management success in the company's business strategy, in just a few years, the business scope of the group company has continued to expand. And product types and customer numbers have grown rapidly.

However, several problems arose during the implementation of the SAP S/4HANA® in Inkmaker Srl. SAP S/4HANA® is a large-scale project management suit. During the implementation process, the scope of the project was continuously expanding. These expansions caused deviations in project goals and led to the waste of resources. Also, some adjustments and optimizations to business process design were inevitable. The issues that should be noticed during the system implementation are the data standardization, the business process design and the docking design of the SAP S/4HANA® suit to the existing ERP system of the company.

During my internship, I participated in the whole SAP S/4HANA® implementation process and worked with people from different departments of the company who are

responsible for different modules of SAP S/4HANA® suit. I analyzed the current situation of the company and researched the implementation of the SAP S/4HANA® suit. This thesis is going to focus on finding the problems that need to be solved urgently and using the existing SAP management theory in combination with the actual situation of the company to ensure the successful implementation of SAP. Another goal of this thesis is to provide a certain reference for the company that is about to implement the SAP and the consultants who are specialized in implementing SAP.

The thesis is organized into 5 chapters. The first and second chapters discuss the purpose of this thesis and the company's profile. The third chapter addresses the description of the company's current ERP system and the presentation of the SAP S/4HANA® suit. The fourth chapter deals with the main criticalities in the Implementation. And the fifth chapter is about the improvement activities and results.

2. INKMAKER

2.1 Company overview

INKMAKER is a small international company that is performing in the automatic ink dispensing systems sector. It produces integrated dispensing systems that improve efficiency by automating the process of inks and paints. The brain of each dispensing system in the MAESTRO® software, fully developed by INKMAKER's software team. As seen in Figure 1, the INKMAKER trademark.

FIGURE 1. INKMAKER'S TRADEMARK

The company was founded in 1987 by Giuliano Cigna, Carlo Musso, and Luciano Longobardi. With a long history of product innovation, it focuses on the process and organizational innovation. In the past INKMAKER has produced an Innovative system for the industrial tinting machine characterized by radically new technology. The innovative system for dosing inks and paints has become a family of products over the years. These products were incrementally improved. [1]

To support product innovation, INKMAKER currently has a research and development capacity of 8 resources which are divided between the 2 offices in Italy and Kuala Lumpur (Malaysia). Over 30 years of development, the company has strengthened its presence on international markets and created the branches in Europe, North and South America, Asia and Australia. The headquarter is located in San Gillio, Turin district.

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[1] INKMAKER, 2018, Company introduction, www.INKMAKER.com

The present and future of INKMAKER are played not only on product innovation but on the innovation of work processes and the organizational architecture of the company: the complexity reached by the equipment, especially the larger equipment, requires an increasingly complex arrangement of electronics, industrial automation and IT, engineering and mechanics. The complex arrangements led to the development of a new organizational model. The new model indicated the capabilities that needed to be developed within the company and the services that we need to buy from outside. As shown in Figure 2, the internal workforce. Today the company has stable partnerships with a subcontractor who offering the assembly service in the company plant. The workforce from the subcontractor has reached 50% of the workforce present in the plant. As shown in Figure 3, the worker from the partner.

FIGURE 2: INTERNAL WORKFORCE

FIGURE 3: THE WORKFORCE FROM THE SUBCONTRACTOR

In the process of managing orders from design to shipment to the customer, it involves an increasing number of steps, subjects involved, components and technologies. INKMAKER has set itself the goal of improving workflows through the use of production control and planning methodologies which allow the online availability of integrated job order data.

The company's innovation system works thanks to a selective network of actors: mainly customers whose requests are the main stimulus to innovation and, the network of suppliers that are a part of the production processes. The returns on innovation are evident above all about the new organizational model, which has already led to greater flexibility and production capacity, cost control, higher efficiency, and increased revenues.

2.2 Management team

In the headquarters of INKMAKER, there are six departments which are the Sales Department, Technical Department, R&D department, Purchase&logistic department, Production department, Customer service department, Administration department. The company is in a functional structure 2 (A functional structure is based on job functions often labeled as departments – finance, purchasing) as shown in Figure 4
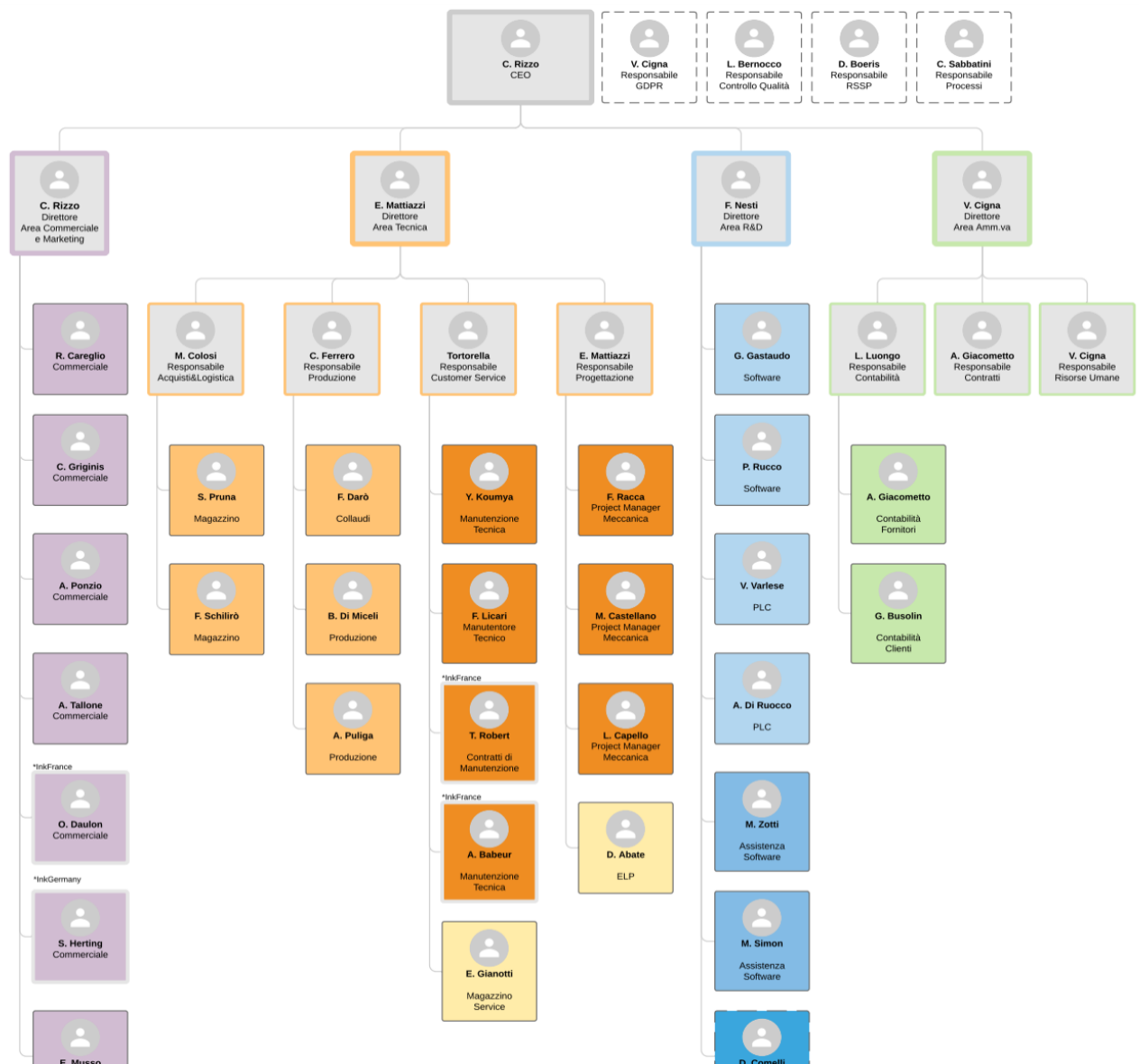
FIGURE 4. INKMAKER ORGANIZATION CHART

2   Valentina.C, 2019, INKMAKER organization chart.

On July 12, 2018, the company is totally controlled by the Top Managers of INKMAKER Group Christophe Rizzo, (Associate Director Italy), Valentina Cigna (President Italy), Roberto Guerra (Managing director Asia) and Kar Seng (General manager Great China). They have successfully concluded the Management Buyout of 100% of the shares of INKMAKER Srl. The Annual turnover achieved is around 17 million EUR with 70 employees worldwide. The total number of installed systems are over 2000 until now.

Company Vision: The vision of a company is what a company want to realize in the future operation. The period could be ten years, or even longer. The company's vision is setting the standards for automated dispensing systems, enhancing as the leader in the ink market and becoming the dominant player as the most competitive and productive engineering solutions provider in the paint market.

Company mission: The mission of a company describes the kind of business and what it aims to do. The company's mission is to provide innovative solutions in the ink and paint market by listening to clients' demands and leveraging on the company's vast professional experience, research capabilities, and globally unmatched in-house designed software.

2.3 Worldwide locations and functions

The headquarter is located in Via Druento 46, San Gillio. The site in Italy is one of the manufacturing centers, another manufacturing center is in Shanghai.

Some global distribution of branches as shown in Figure 5 is dedicated to the local market, for instance, the branch in France, which is for France market, the one in Australia which is for the Australian market. The same for the South America market, Germany market, southeast Asia market. This the reason why in these areas the company just has employees for Sales and after-sales services. The majority of final products are assembled in Italy and China, the minorities are assembled in the USA.[3]

FIGURE 5: INKMAKER WORLD NETWORK

Due to the geographic distribution of suppliers and the availability of components suppliers, The manufacturing centers are divided into shanghai, China and Turin, Italy. The integration of these two factories allows the company to have a cost advantage and more accessibility to the local suppliers.

[3] INKMAKER, 2019, INKMAKER presentation

As a supplement sale, the company has a collaboration with many agents from the world, which are MEXICO, RUSSIA, UK, POLAND, CZECH REPUBLIC/ SLOVAKIA, SCANDINAVIA, IBERIA, BENELUX, IBERIA, BENELUX, TURKEY, Middle East. As shown in Figure 6.

The collaboration allows the company to reach additional markets without increasing the cost of operation. The diffusion of products to the world benefits the company's reputation in the industry sector.

INKMAKER AGENT NETWORK

- **MEXICO**
  Control Y Movimento
  - Sales
  - Technical services
  - Local support of Claudio 4 months per year

- **RUSSIA**
  Italtechnology
  - Sales
  - Technical services
  - Local support of Alfredo (Russian speaking) 6 months per year

- **UK**
  Graham Siddle
  - Technical service

- **POLAND**
  Pawel Szczepanek
  - Technical service

- **CZECH REPUBLIC / SLOVAKIA**
  Filmix
  - Sales
  - Technical services

- **SCANDINAVIA**
  Westerlins
  - Sales
  - Technical services

- **IBERIA**
  Netzsch
  - Sales
  - Technical services

- **BENELUX**
  Deltapak
  - Sales
  - Technical services

- **TURKEY**
  KNK Kimya
  - Sales

- **ME Regions**
  Hatem Hamed (Saudi Arabia)
  Amir Massouni (Iran)
  Afsal Kottal (UAE)
  - Sales
  - Local support of Younes (Arabic speaking) 6 months per year

FIGURE 6: INKMAKER AGENT NETWORK

3. The Company's ERP And SAP

3.1 What is ERP?

Enterprise resource planning (ERP) is the integrated management of main business processes, often in real-time and mediated by software and technology. ERP is applied by a series of business management software that can be utilized to manage the business activities data. For example, Distribution, Marketing, Finance, Sales, Human Resource, Engineering, Materials, Manufacturing, Distribution.[4] As shown in Figure 7.
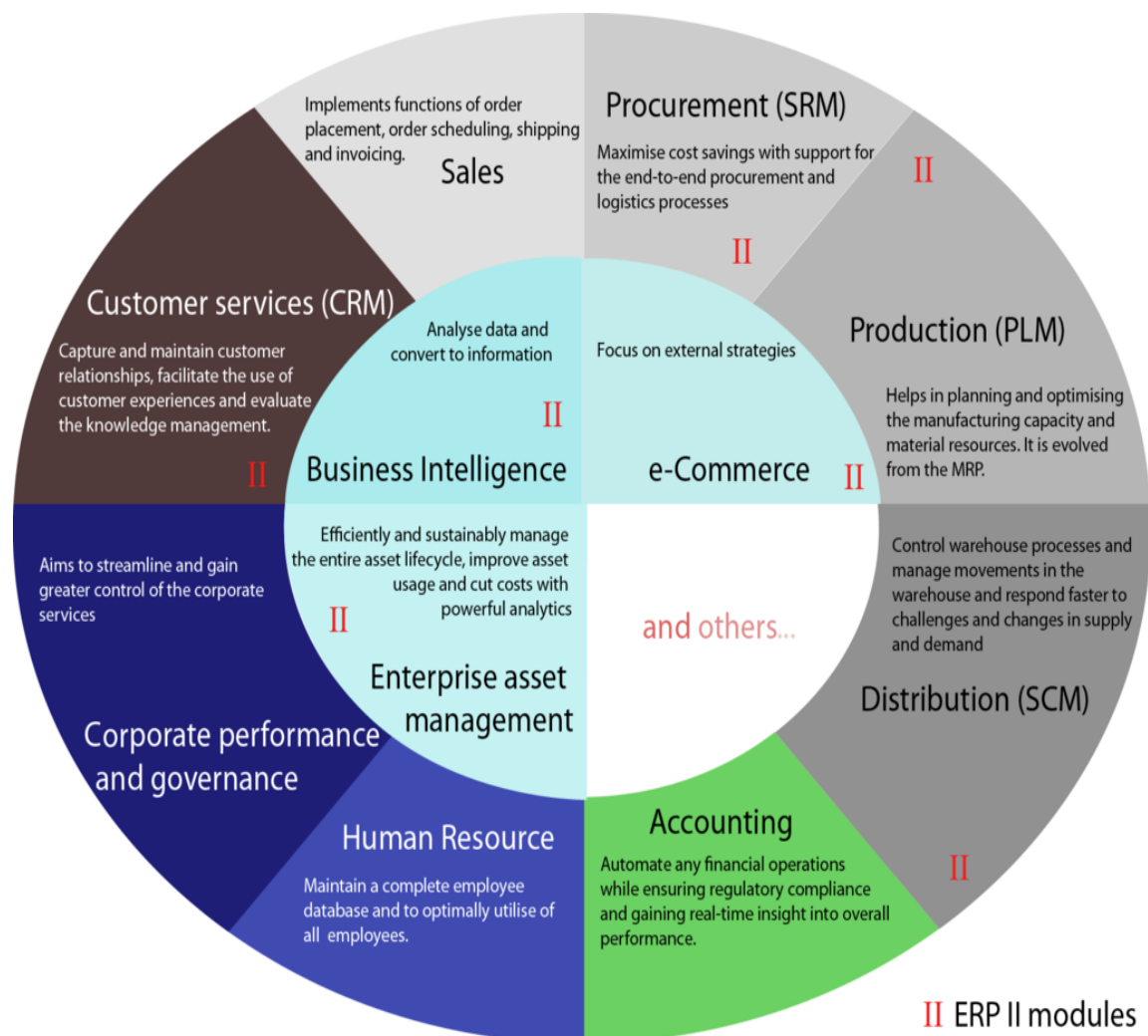
FIGURE 7. DIAGRAM SHOWING SOME TYPICAL ERP MODULES

4   Wikipedia, September 2019, Enterprise resource planning, https://en.wikipedia.org/wiki/Enterprise_resource_planning

The first version of ERP includes limited functions. It was used by Gartner Group in the 1990s which includes material requirements planning (MRP), manufacturing resource planning (MRP II) and computer integrated manufacturing. During the development of ERP, different modules such as finance, accounting, maintenance, and human resource are added by vendors. By the mid-1990s ERP systems addressed all core enterprise functions. Governments and non–profit organizations also began to use ERP systems.

ERP systems are developed from industry best practices. For the different enterprise, ERP vendors offer them a customized service to cooperate with their own rules.
The benefits of customization are about Improving user acceptance, offering the potential to obtain a competitive advantage.

The drawbacks from customization are related to increasing time and resources to implement and maintain, hindering seamless interfacing/integration between suppliers and customers due to the differences between systems, limiting the company's ability to upgrade the ERP software in the future and creating over-reliance on customization, undermining the principles of ERP as a standardizing software platform.

The ERP systems can also be extended with third-party software, such as product data management, product life cycle management, customer relations management, data mining.

3.2 The company's current ERP system: Mago.net

Mago.net is an ERP software designed for small-medium companies. It is composed of Functional Modules that can be purchased separately, based on individual business needs. It has been introduced to the company since 2003. The interface is shown in Figure 8. Mage.net is using in the following departments in INKMAKER: accounting department, production department, purchasing department, warehousing department, technical department.
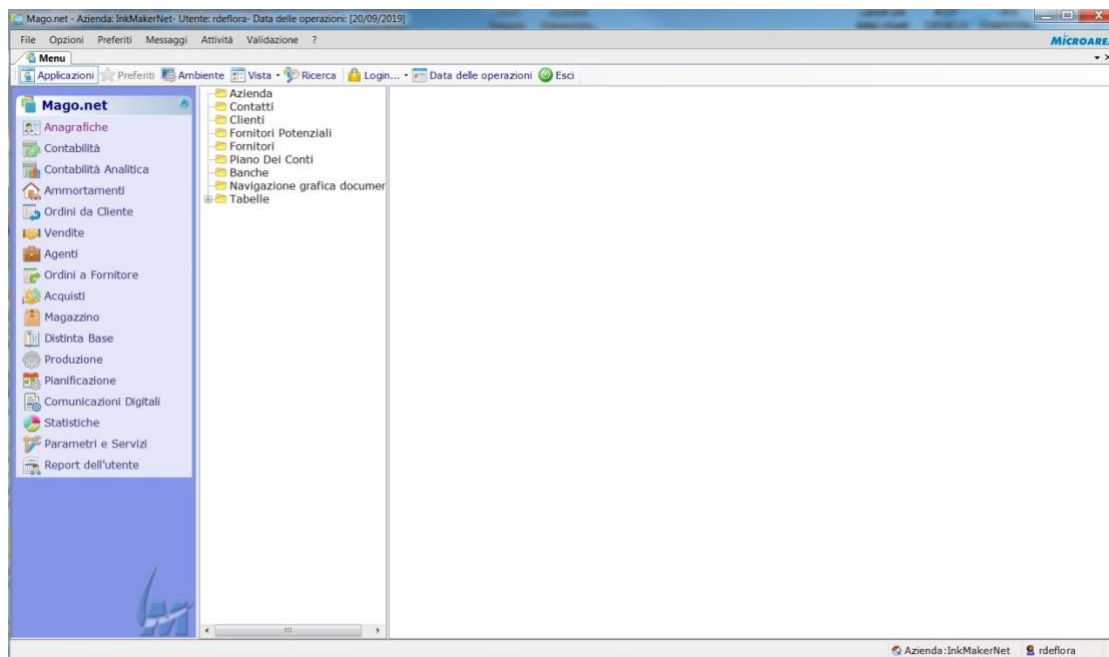
FIGURE 8: MAGO.NET INTERFACE

Mago.net provides strong support for the company's daily operating activities, from receiving an order from the customer to the shipment of final products. Even for after-sales services, for example, exchange a part of the machine according to customer's requirement.

As shown in Figure 12, different modules are in the left column:

Accounting module. The Accounting module allows you to fulfill all the tax obligations relating to the maintenance of ordinary accounting. Includes the Customers / Suppliers Accounts. It allows the automatic compilation of records. The module controls the security of the data entered and the automatic generation of year-end entries.

Sales module. It is possible to issue documents such as invoices, credit notes, tax receipts, etc. The management and the schedule are perfectly integrated. The user can price the products and make discounts for different types of sales. With this module, defining the typical customer of the article, the price list, the margin on the cost could be realized. Simple wizards allow the automatic generation of documents. The functions of copying and importing article files are simplified. It speeds up data entry operations. (not used in INKMAKER).

Purchasing module. The module is in charge of managing and checking incoming goods and related documents (loading notes, invoices, etc.). In the loading notes, it is possible to indicate the non-conformity of the goods and automatically generate the documents of returning products from the customer. During document registration, a data consistency check procedure is available to verify any discrepancies. It is possible to connect to the loading movement of the goods to increase their amount in stock. The automatic lead time calculation allows users to correctly plan the purchases, based on the average delivery times of the suppliers.

Warehousing. The module helps the organization of the warehouse to significantly reduce management costs. The incoming and outgoing goods are managed through advanced fully parameterizable methods (article codes up to 21 characters, talking codes, generic and specific units of measurement for each item, able to manage up to 4 dimensions, etc.). An unlimited number of price lists and prices can be entered for ranges of quantities, which can be associated with both customers and suppliers. Each item can be traced by an optical reader or by using search criteria such as product category or manufacturer. The graphical navigation of the articles allows displaying all the information connected to the different articles and to have a total representation of the stock situation in a simple and fast way. Different valuation criteria are available, such as the LIFO / FIFO.

Customer Orders. It manages the offers to potential customers and orders from acquired customers. Objects can be selected through different search criteria, including customer coding. Prices are automatically attributed both in offers and in

orders, based on user-defined pricing policies. The module allows users to quickly know the order portfolio and plan deliveries.

Suppliers Orders. The offers from potential suppliers and orders to suppliers are managed. The module has been designed to make the compilation of orders to suppliers. It is possible to create orders from suppliers by importing orders from customers or generate them automatically through a simple and guided procedure.

In the absence of the Purchasing module, it is possible to fulfill orders to suppliers, generating the registration of warehouse movements through a specific procedure.

Report. All Mago.Net modules are equipped with numerous customizable reports to keep the data of the entire company under control. In the Order Orders module, for example, there are some that allow users to see the supplier order portfolio, the deliveries to be received. In the Customer Orders module, there are reports that allow users to quickly check the order and the quantities to be delivered to customers.

Bill of materials. The module manages the assembly of the products and the costs associated with them. It allows setting quantities, characteristics, units of measurement, etc. The module allows users to check the individual production plans by supplying the number of components to be ordered for production and the related industrial costs.

Planning. It allows the examination of the project of the activities related to the production and replenishment of materials on medium- and long-term scenarios. Planning is carried out by the analysis of the availability of materials and tools for studying the load of productive resources, also by means of Gantt charts (processing steps).

3.3 SAP S/4 HANA

SAP is a company that provides ERP solutions to fulfill customer requirements[5]. With the technical capability's accumulation of the digital transformation and the changing requirements from customers, SAP decided to develop SAP S/4HANA to fulfill current and future customer requirements. The new product fulfills the twenty-first-century requirements and serves as a platform for a company's digital transformation. Let's have look at the evolution of SAP products in Figure 9.
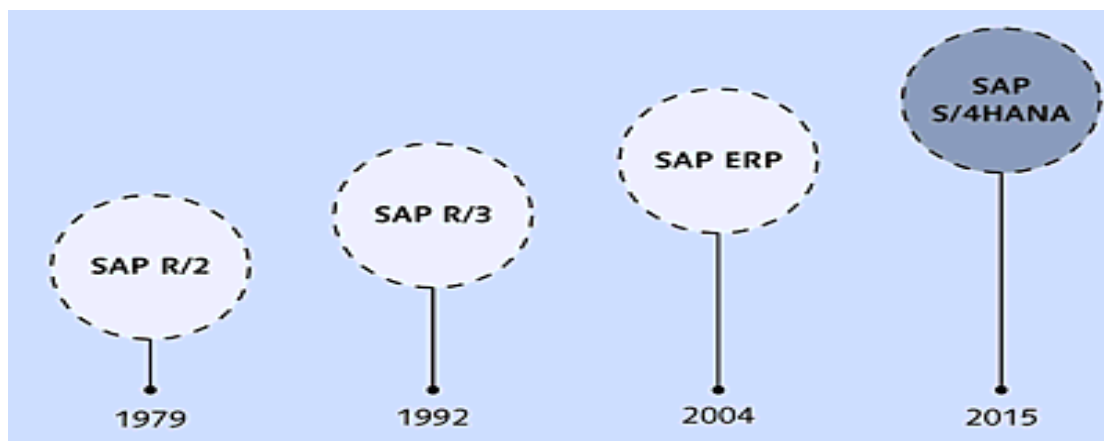
FIGURE 9: THE EVOLUTION OF SAP PRODUCTS FROM SAP R/2 TO SAP S/4HANA

As shown in Figure 10, two different products are developed. Currently, product SAP ERP can be operated on any database, also on SAP HANA. As a second option, you can have classic SAP ERP as an on-premise solution that is enhanced with new financial functionality based on the newly developed SAP S/4HANA core solution. In addition, SAP S/4HANA Enterprise Management (often referred to as the "on-premise edition" for clarity) is a major part of the SAP S/4HANA product line and includes all the new functions. As the last piece of the product line, you can see SAP S/4HANA Cloud, which is 100% based on the new product and code line.

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[5] Devraj Bardhan, Axel Baumgartl, Nga-Sze Choi, Mark Dudgeon, Asidhara Lahiri, Bert Meijerink, Andrew Worsley-Tonks, 2017, SAP S/4HANA, Rheinwerk Publishing
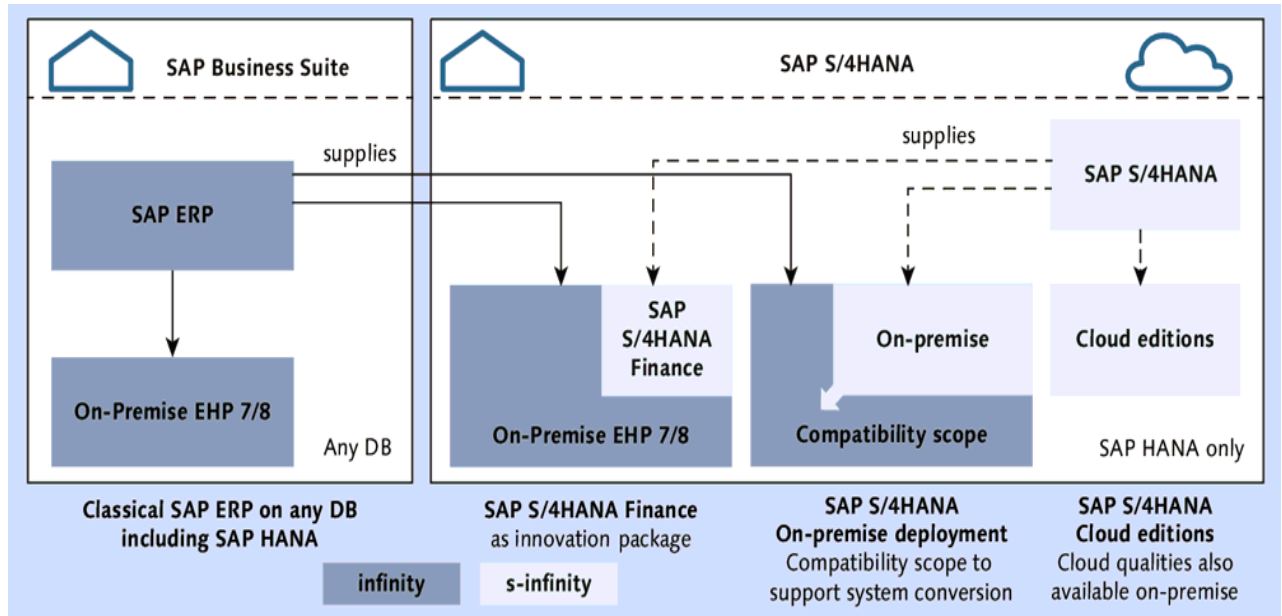
FIGURE 10: OVERVIEW OF SAP PRODUCT LINES AND EDITIONS

SAP currently has a "cloud-first" strategy; because cloud solutions can be innovated and delivered faster, new functionality is usually available first in the cloud and then for the on-premise deployment options. As shown in Figure 11, SAP S/4HANA, on-premise edition, is built and provided on a yearly cycle with new functionality, whereas SAP S/4HANA Cloud is being built on a quarterly cycle with the latest functionality and content.
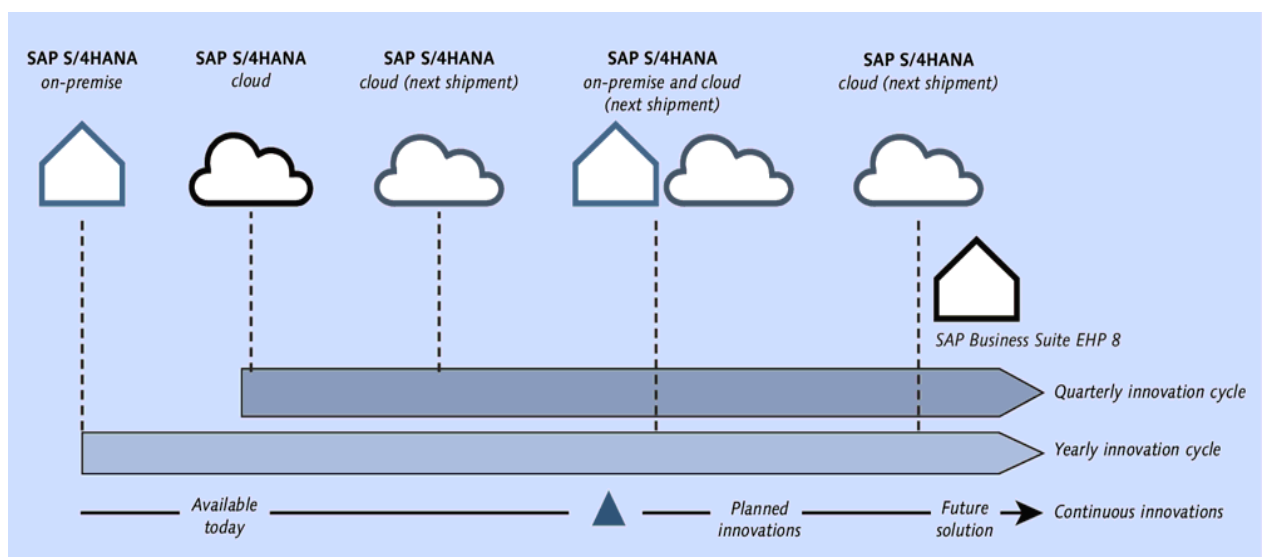
FIGURE 11: RELEASE CYCLE OF THE DIFFERENT EDITIONS

All the key innovations to enable the digital transformation are shown in Figure 12 and described in the following list:

Procure to pay. This process is simplified and standardized to reduce purchase order errors and the related costs via an integrated process flow and simplified user interfaces (UIs). For example, in the sourcing and procurement area, the supplier information and master data with classification and segmentation logically group expenditures to organize spending, responsibilities, and organizations. In addition, the supplier evaluation has been enhanced with SAP Fiori to classify suppliers using attributes and mater data.

Sourcing and contract management. Operational contract management has been simplified by consolidating all activities and tasks into a single SAP Fiori app and providing additional information to monitor contracts and improve efficiency with insights to action capabilities (e.g., the renewal of a contract).

Operational procurement. Several simplifications have occurred by consolidating information into a single SAP Fiori app for requirement processing and purchase order processing via enhancements for purchase order requisition, simplification, and enhancements for self-service requisitioning, and procurement analytics. While the simplification leads to a reduction in processing and provides further SAP Fiori capabilities (e.g., grouping and filtering), the enhancements in the purchase order collaboration include a standard integration into the SAP Ariba Network (e.g., sending purchase orders, order confirmations, etc.) to reduce invoicing costs and double work efforts within procurement and the supply chain. In the procurements analytics area, efficiency has been highly increased with role-based access to the procurement information to analyze purchasing spend and contracts in real-time via an SAP Fiori app that decreases reporting efforts and provides transparency.

Invoice and payables management. Simplified invoice processing is now available via an SAP Fiori app to accelerate the processing of supplier invoices and integrating into SAP Ariba networks for invoice collaboration.

Inventory management. A new data model and role-based SAP Fiori apps for the inventory manager and warehouse clerk enable real-time processing of inventory

postings and visibility of inventory values. This will reduce the overall inventory costs with a single source of truth, increase inventory turnover, and improve on-time delivery.

Material valuation. Material valuation addresses the challenges around locking bottlenecks, lack of standard price postings, limited insights to the actual cost, and multiple material valuation tables. With the visibility into actual inventory costs due to a simplified table structure (2 document tables and 26 aggregate tables are replaced with a single document table), it becomes easier to control and change inventory settings. Inventory postings are processed in real-time, and there is visibility into inventory values (instead of batch processing). Due to a single material valuation table, you also have better visibility into actual inventory costs, and you can run on-the-fly analytics on the primary data.

Material requirements planning (MRP). MRP is based only on the actual stock requirement list with integrated decision support. It executes the impact analysis of the entire material flow in real-time and identifies disruptions in the material flow to support proactive decision making. The performance is faster and reduces the MRP run time to minutes, which allows swifter assembly/production process adjustments.

Available-to-promise (ATP). With real-time product availability check and use case-driven product allocation check, ATP reduces manual effort and increases the number of orders per employee.

Order management and billing. This process is now being enhanced with the continuously monitoring capability of end-to-end order-to-cash processes and a personalized sales order cockpit to provide transparency on planned and unplanned logistic events.

Universal Journal and Central Finance. The Universal Journal combines FI and Controlling data to provide consistency and on-the-fly aggregation of data and real-time insights into the financial results.
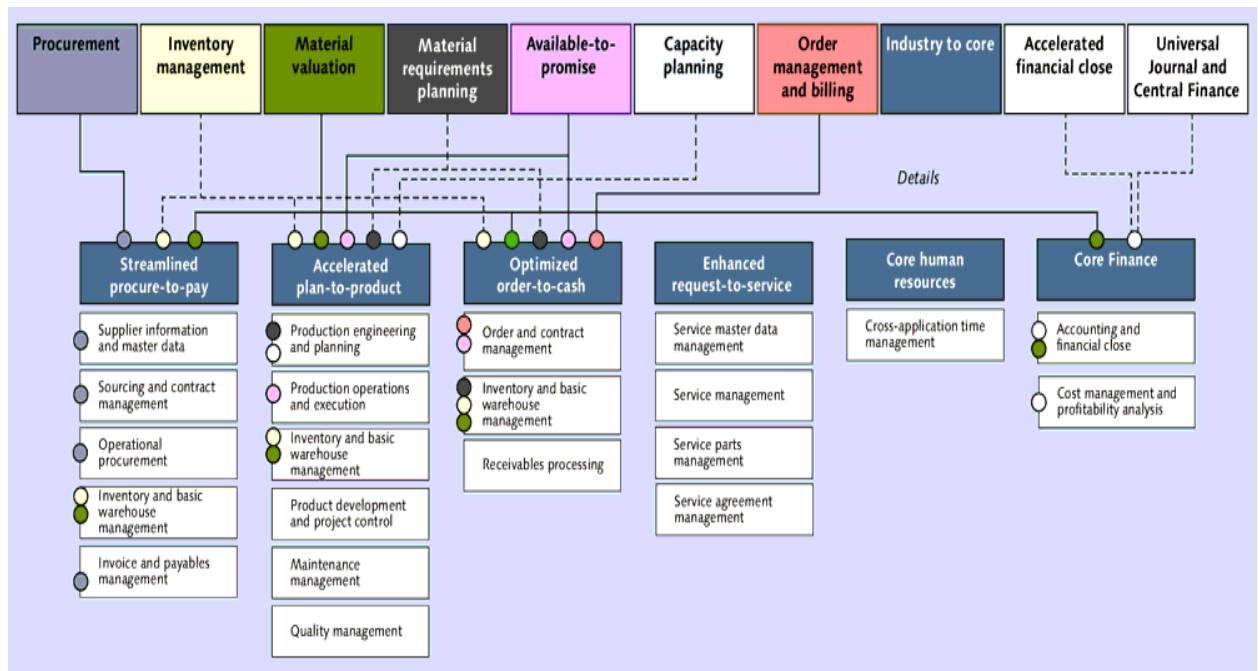
FIGURE 12: KEY INNOVATIONS TO ENABLE DIGITAL
TRANSFORMATION

3.4 Why change to SAP S/4 HANA

After years of development, the company found that the existing ERP system Mago.net could not meet the current operational needs. Although the company is already adopted the idea of ERP since 2003 and introduced Mago.net, many activities cannot be done with Mago.net. Instead, these activities are completed by Excel and Word or e-mail which limits work efficiency and a dramatic rise in the lead time of products.

As shown in the flow chart below, the phases for completing a customer order from the beginning of receiving the offer to the end of delivery of the product. Mago.net has been implemented and used only to integrate the phases from "Bill of material+layout+design" to the end of the process. The employees in the company who are responsible for the other phases have to communicate with e-mail, Word or Excel which reduces the consistency of the work process. Also, the production planning follows up is made manually using excel.

As in the current working process, the long-lead-time-items will be purchased only after the kick-off meeting and it prolongs the total lead-time to the customer. The new SAP s/4 Hana will solve this issue, as SAP is able to integrate all the activity phases. With SAP, the long-lead-time-items will start to be purchased at the moment of receiving the customer offer.

When using Mago.net in the management of the warehouse, the employees have to manually process some data. For example, if in the warehouse one item is used out the employee has to go to the purchasing office to tell about it or by e-mail. There is no immediate information communication with the purchasing office and warehousing. With the integration of activity phases by SAP, each employee in these offices could be able to receive updated information instantaneously.

The company has two branches in China and Malaysia, none of them are operating with the ERP system. Without double, the communication between these two

branches is realized by e-mail and cellphone. Relying on the available functions of SAP, these two branches will also implement the SAP system.

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        ┌──────────┐
        │  SALES   │
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   ┌──────────┐      ┌──────────┐
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   │management│      │   the    │
   │department│      │production│
   └────┬─────┘      │   plan   │
        ↓            └──────────┘
   ┌──────────┐
   │ Meeting  │      ┌──────────┐
   │Discussion│─────→│Purchasing│
   │and long– │      │ for LLTI │
   │lead-time │      └────┬─────┘
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   │ Bill of  │           │
   │material+ │           │
   │layout+   │           │
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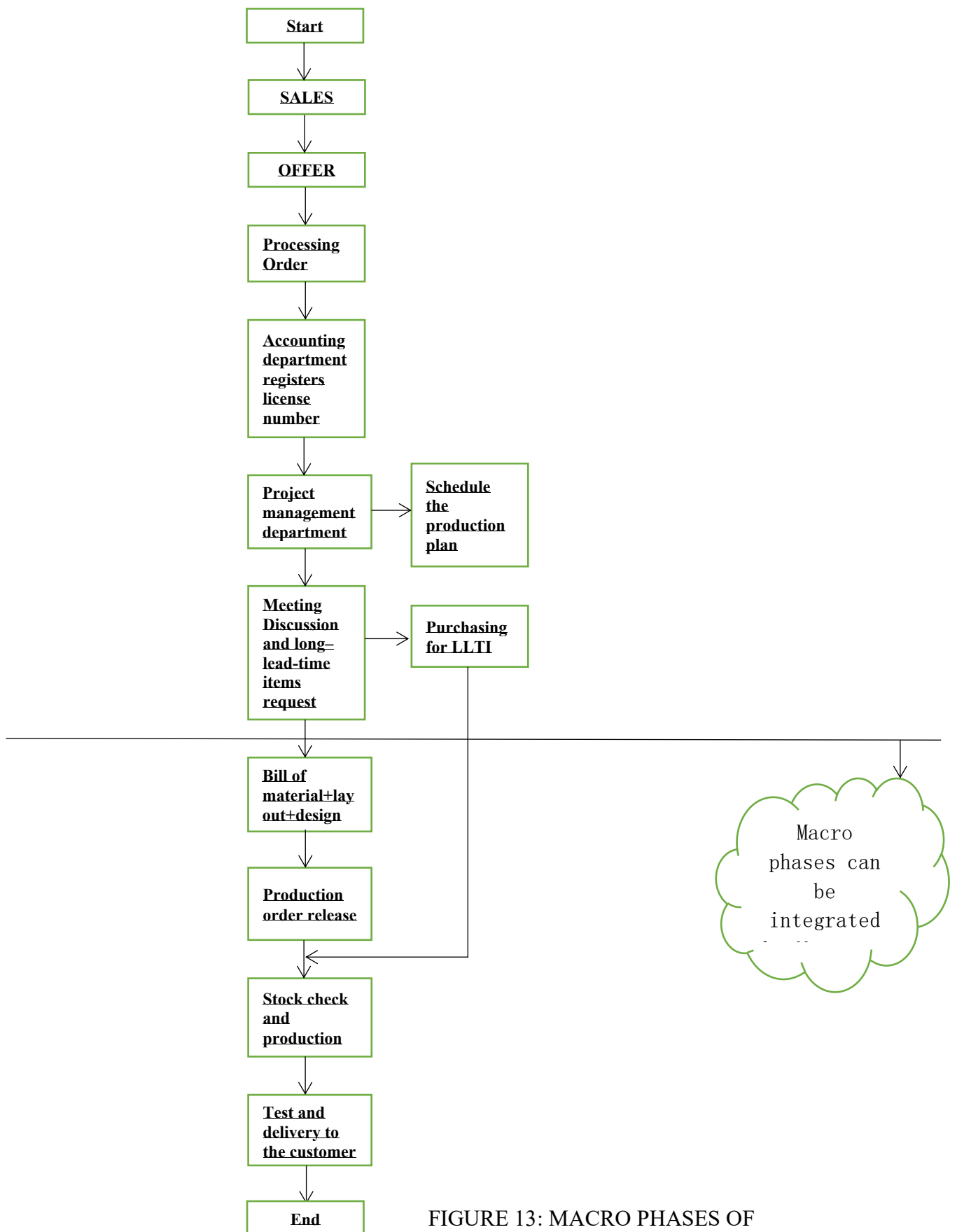
Macro phases can be integrated

FIGURE 13: MACRO PHASES OF OPERATION ACTIVITY

4. Criticalities In The Implementation Of Sap S/4 Hana

4.1 The implementation methodology of SAP S/4 HANA

The implement of SAP is always a complex and long-term project. The duration of the project can take up to several years. Each employee in the company should be involved. The implementation process should be well planned and executed with a solid method.

In the traditional SAP method, AS-IS and TO- BE study is used as the initial phase of implementation. The SAP consultants need to go to the client company to understand the business process embedded in the company and the way they are working. This process is called the AS-IS study. During this process, all the detailed information about a client's process should be collected. After the AS-IS study, the consultant has to propose a new way of working by introducing new processes of functions. These will reduce the client company's operation cost. The new process is named TO-BE and it involves the mapping between the existing process and the standard SAP.

As described above, the AS-IS and TO-BE study require long working hours of consultants as well as the Company's resources. If SAP implemented in this way, the overall project cost Is quite high, especially for SMEs. It is not necessary and affordable for a small company. Finally, the company decided to implement SAP in a way based on ASAP.

The implementation project will be carried out based on the "Fairway" methodology which was developed by the consultant company. The "Fairway" methodology is based on the methodology ASAP of SAP AG adapted to the fact of small and medium-sized Italian companies.

4.1.1 Project phases according to the methodology[6]

The methodology requires the project team to carry out the project activities in the specific phases. Each phase related to precise commitments and deliverables as described in Table 1.

	Phase	content
Project management	Phase 1 - Gap analysis	**Installation** of SAP best Practices. **Definition** of additional features with respect to the provisions in the SAP Best Practices. **Training** of key users. **Execution** of unit tests and integration tests
	Phase 2 - Final preparation	Data recovery and preparation and initialization of the production system **Implementation** of additional features
	Phase 3 – Start-up	Start in production
	Project Management	Project management (the methodologies and tools to be used.

TABLE 1. PROJECT MANAGEMENT

Project activities are guided by predefined "standard" rules and preconfigured "template" models. The project documentation, deliverables and project management tools will be produced in the project language.

[6] INKMAKER, 2019, SAP technical implementation

4.1.2 Phase 1. gap analysis

Prerequisites

Objective	Make the development and test environment operational
Activities	In this phase, the consultants cooperate with process owner and key users for the consolidation of the foreseen processes in scope: • Installation of Best Practices • Identification of possible deltas • Interfaces activation • Provision training on the job of key users • Execution of unit tests and integration tests
Deliverables	The consultants will • Support the activities of defining and sharing data traces. • List the "Change Requests" regarding topics not included in the project scope: • Data recovery not foreseen by the SAP Best Practices solution. •Interfaces •Produce a document approving the completion of the Phases

TABLE 2. TECHNICAL SUPPORT FOR THE MANAGEMENT OF THE SYSTEM ENVIRONMENT

As shown in Table 2, it presents the technical support for the management of the system environment. A "change request" is a request for change with respect to the "baseline" of the project or with respect to previously agreed decisions.

The realization of a "change request" must be previously authorized by the company according to the agreements and specifications shared with consultants. Table 3 represents the responsibility matrix.

Activities	Deliverable	Consultant role	Company role
System Management	Customizing and installing SAP best Practices	R	C/S
Delta analysis	Process analysis document	R	C/A
Activation Add on	SAP solutions	R	C/S/A
Interfaces Activation	Development of Interfaces with	S	R
Key users training	Performing training	R	C/S
Execution integration Test	Execution of test scenarios defined by key users	S	R
Approval phase	Validated approval letter	S	R

TABLE 3. RESPONSIBILITY MATRIX

Legend:

  •(R) Responsible for the activity

  •(C) Collaborate in the execution of the activities both in conceptual terms and in operational terms, preparing possible deliverables and/or semi-finished products.

  •(A) Approves the results of the execution of the activity

  •(S) provides support

Loading data

The activity related to the initial data recovery requires a particular commitment by the company Team.

Regarding the recovery of **automatic** data, the company Team undertakes to:

  • normalize data on the legacy system

  • implement data extraction programs

  • execute loading cycles from legacy system to SAP

- check the transferred data

- certify the data transferred

- upload data to SAP

The consultants will provide the tracks of the SAP Best Practice loading model to the company and will support the company team in the definition of data loading methods.

Automatic data recovery includes:

- Materials Master Data (Including lots, Items and related features)

- Customer Master Data

- Supplier Master Data

- Assets Master Data

- Warehouse stocks

- Customer and Supplier Open Items

The test procedure for start-up in production

The Unit Test and integration test is considered as an activity of strategic importance for the success of the project. This activity makes the company team responsible for identifying and sharing the Solution implemented.

It also represents the completion of key user training on the implemented solution.The company team will take care of the preparation of the test cases (unit and integration tests/scenarios) and of the definition of the test control rules.

Each scenario is composed of a number "n" of macro-activities that must be defined in terms of activity logic and activities required by the SAP system. Each macro-activity must be documented in detail with:

- the individual activities to be performed on the system

- specific data

- the expected results.

The execution of this activity also consolidates the company team's knowledge on the Solution and on the SAP product, thus facilitating production start-up activities in achieving operational autonomy.

The company team undertakes to carry out test cycles on processes that involve multiple company functions, aimed to check the results on the integrated process.

Layout

The forms will be used for the logos. Any further adjustments to the print forms are the responsibility of the company.

4.1.3 Phase 2. final preparation

Prerequisites

The final preparation phase has the same approval prerequisite as phase 1.

Phase 2 includes all the activities of installation and preparation of the production environment. Table 4 shows the technical support for final preparation.

Objective	Preparation of the production system
Activities	Implementation of add on and any delta process Production technological environment preparation Transport Execution Automatic and / or manual data recovery (manual conversions and uploads) Enable user interfaces and profiles
Deliverables	System ready for Go Live Formal acceptance of the system

TABLE 4. TECHNICAL SUPPORT FOR FINAL PREPARATION

Note: The company project manager needs to confirm the approval document at production start-up which prepared by the project manager of consultants.

The company team also need to carry out manual loading if required by the implemented processes of data. Table 5 shows the Responsibility matrix of phase 2.

Activities	Deliverable	Consultants role	The company role
Detail planning	Detail plan	S	R
GAP implementation	Transport execution	R	S
System Test	Scenario and data definition	S	R
Cutover	Transport execution	S	R
	Loading Master Data	S	R
	Performing uploads manuals	S	R
Formal system	Accept documents	S	R

acceptance	for starting		

TABLE 5. RESPONSIBILITY MATRIX

Legend:

•(R) Responsible for the activity

•(C) Collaborate in the execution of the activities both in conceptual terms and in operational terms, preparing possible deliverables and/or semi-finished products.

•(A) Approves the results of the execution of the activity

•(S) provides support

4.1.4 Phase 3. Start-up

Prerequisites

The start-up phase has the same prerequisites as in phase 2. Phase 3 includes all the start-up activities and post-start operations.

The fundamental points that must be concluded at the end of the phase are:

 • Completion and verification of data and parameter transport.

 • Formal approval of production start-up

Table 6 shows the technical support for the start-up phase.

Objects	Use of the features provided in the reference model
Activities	Manage SAP transaction activated
Deliverables	Project closure documents

TABLE 6. THE TECHNICAL SUPPORT FOR START-UP PHASE

Note:

The company project manager needs to confirm the project closure document, drawn up by the consultant project manager. Table 7 shows the Responsibility matrix.

Activities	Deliverable	The consultant role	The company role
Support in-production start-up	List of problems and solutions	S	R
Project closure	Document closing Project	R/A	A

TABLE 7. RESPONSIBILITY MATRIX

Legend:

 •(R) Responsible for the activity

 •(C) Collaborate in the execution of the activities both in conceptual terms and in operational terms, preparing possible deliverables and/or semi-finished products.

• (A) Approves the results of the execution of the activity

• (S) provides support

4.1.5 System activities

All the planning phases are supported by daily and extemporaneous system activities. The company System Management Team will take care of the planning of system activities in accordance with the consultant project manager and the execution of the same activities, in compliance with the times established by the plan of the project. The consultants will provide support for activities on SAP systems. Each project phase is characterized by particular activities.

The acquisition and installation of the technological infrastructure and the SAP ERP product must be foreseen by Phase 1 of the project. It is necessary to plan to make the environment operational by defining the various environments (principals or other methods) and verifying the operating procedures.

In particular:

For Phase 1:

✓ Create development environments (principals or other modalities)

✓ Definition and creation of User and authorization profiles

✓ Define and verify copy-client procedures

✓ Define and verify transport procedures

✓ Define and verify operational management

✓ Define backup and recovery procedures

✓ Check the development and quality environments

✓ Define system administration procedures

✓ Create an SAP production environment

For Phase 2:

✓ Data transport from the pre-production environment

✓ Interfaces activation

✓ Data recovery activation

✓ Activation of customizations / if provided)

✓ Activation of peripheral units

For Phase 3:

✓ Definition of daily activities - running - (backup, user support, device management, etc.)

The activities supporting the System Management activities described above are included in the project.

The company employees in the company are divided into three groups for the implementation of SAP.

Team 1 is composed of the board of administration. In small and mi-size business companies, the top management team is strongly involved and interacted with all the employees. The actions from the top management team can easily influence the staff because the staff can see and talk with the top management team easily. Therefore, support from the top management team is essential for the implementation of SAP. With the support, the staff's resistance will be diminished which is helpful for SAP implementation success. If executives share their support and continuously encourage their staff to be open to new processes and procedures, employees are less likely to resist.

Team 2 is composed of Process owners.

Team 3 is composed of Key users

4.2 Criticalities during the implementation process

1) The completeness and accuracy of Master Data

The data operated by the SAP system is from the company's daily operation activities. The inaccuracy data will result in unpredictable results and finally the failure of SAP implementation. The Master Data must come from the long-term operation of the company.

2) The training of Key Users

The Training of key users is carried out by the implementation consultants, while end-user training should be done by key users. The benefit of this decision is that both Key users are trained, and the key points of the system are communicated to the end-user as much as possible. Because the Key users are the supporters of the normal operation of the system after the consultant team has been evacuated. Through the training, a strong internal team will be established. End-user training includes all end-users involved in the operation.

3) Changes in the working process and working model

The work content of each employee will change greatly, for instance, the purchasing department employee has to consider the minimum amount of stock for each raw material which was decided by experience in the past. The employee should convert some of their daily work to be measured in numbers and then insert data into the SAP system. More data processing will be completed by the system, and the workload of the basic data will be increased. These will lead to employees' resistance to process reengineering.

4) Changes in Management structure

  As the working process changing, the role of each employee in the working process will be probably changed. To be compatible with the working model and process in the SAP system, the management structure should be redesigned. Therefore, the working relationship cannot be the same as before.

5. Improvement Actions And Results

5.1 Master data[7]

Before the SAP system goes live, it always involves the problem of how to transfer a large amount of master data from the actual ERP system to the SAP system. In general, If there are few data, then it can be manually entered; if the amount of data is slightly larger (several hundred to tens of thousands), it is not realistic to use manual input.

More important is the quality of the master data: SAP needs a lot of parameters for each item and normally this information has never been used in the previous system. This means that between the export of master data from the existing ERP and the upload in SAP there is an important phase of review the master data basically by adding more parameters.

You can consider the platform that SAP has to import data in batches. Regardless of which ERP system, the initial work is basic data preparation, and this process has a precondition which is to standardize data, remove garbage data, whether you are switching from an old version sap system or another ERP system. Preparation is the key to implementing SAP. For an enterprise, there are thousands or tens of thousands of materials, different models, different specifications, and different uses, so it is necessary to establish a standardized code to establish a unified material database.

SAP MM (material management) module, it manages material inflows and flows through and out of the company through material management. Materials include raw materials, semi-finished products, finished products, spare parts, packaging materials, etc.

The SAP needs several mandatory master data for each item. Master data includes

[7] INKMAKER, 2019, Mater data of SAP preparation

basic data and business data for materials. Business data includes sales, purchasing, inventory and village location, warehouse management, MRP, work plan, accounting, cost, etc. plan/inventory. The material master record describes the comprehensive information for each item in the enterprise's use:

1. Basic data: Information describing the material, such as the unit of measure / net weight /gross weight.

2. Sales and distribution master data: information about department sales orders and pricing. For example, sales price, minimum order quantity, etc.

3. Control the main data of procurement and import: the data provided by the procurement system for the materials, such as sales price, minimum order quantity, sales department name, etc.

4. Material planning and control: MRP information and based on consumption plan/ inventory control. For example, safety stock levels, planned delivery times, and material reorder levels.

5. Warehousing master data: Information related to material storage/warehouse, such as storage location, shipping unit, storage conditions, and package size.

6. Master data on costs and accounting: information on costs and valuations.

7. Engineering data: CAD drawings, basic dimensions, etc.

8. Data on forecasting: Information used to predict material requirements. For example, forecast period, consumption situation, etc.

When we create material master data, all information related to the material master data must be entered into the system. This is feasible for creating a small amount of material master data.

Raw materials are grouped into 22 new product groups according to their properties

Product Family (Gruppo merci)	SAP CODE
AISI 304/316 Fittings, pipes and accessories	YBR01
Steel and galvanized steel Fittings, pipes and accessories	YBR02
Brass Fittings and accessories	YBR03
PVC Fittings and accessories	YBR04
Flexible hoses and accessories	YBR05
Manual/actuated ball valves and accessories	YBR06
Structural parts and accessories	YBR07
Cable Ducts and accessories	YBR08
Mixer, Agitators and accessories	YBR09
Electrical motors and gearboxes	YBR10
Pneumatic pumps and accessories	YBR11
Tanks and accessories	YBR12
Fasteners	YBR13
Mechanical parts	YBR14
OR, lipseal and seals	YBR15
Dispensing head and accessories	YBR16
Dispensing valve and accessories	YBR17
Scales and accessories	YBR18
Pails handling	YBR19
Electrical cabinets and accessories	YBR20
Electrical/pneumatics parts and accessories	YBR21
Hardware,PC,Monitor and accessories	YBR22

Raw Material

FIGURE 14: PRODUCT FAMILY OF RAW MATERIALS

For each raw material its part number in sap system, description in Italian, description in English, description in Chinese, technical diagram, Code of last supplier, last supplier name, last receipt date, last issue date, last cost, product family in English, product family in Chinese should be specified. All the raw materials which belong to the same product family are collected in one excel file as shown in Figure 15.

S	new P/N	Old P/N	Descrizione (ITA)	Descrizione in SAP (ITA)	Controllo lunghezza testo (ITA)	Descrizione in SAP (ENG)
1	YBR01.0001	30205.00010	GIUNTO 3 PEZZI AISI 304 DA 1/2 A SALDARE	GIUNTO 3PEZZI 1/2"AISI304	25	UNION 1/2" AISI304
2	YBR01.0002	30205.00010SOX	NIPPLO AISI 304 DN 1/2 (MICROFUSO) BSP FIL MASCHIO CONICO	NIPPLO 1/2" BSPT AISI304	24	NIPPLE 1/2" BSPT AISI304
3	YBR01.0003	30205.00015SOX	NIPPLO AISI 304 DN 3/4 (MICROF.) BSP FIL MASCHIO CONICO	NIPPLO 3/4" BSPT AISI304	24	NIPPLE 3/4" BSPT AISI304
4	YBR01.0004	30205.00020SOX	NIPPLO AISI 304 DN 1 (MICROF.) BSP FIL MASCHIO CONICO	NIPPLO 1" BSPT AISI304	22	NIPPLE 1" BSPT AISI304
5	YBR01.0005	30205.00025SOX	NIPPLO AISI 304 DN 1 1/4 (MICROFUSO) BSP MASCHIO CONICO	NIPPLO 1"1/4 BSPT AISI304	25	NIPPLE 1"1/4 BSPT AISI304
6	YBR01.0006	30205.00030SOX	NIPPLO AISI 304 DN 1 1/2 (MICROFUSO) BSP FIL MASCHIO CONICO	NIPPLO 1"1/2 BSPT AISI304	25	NIPPLE 1"1/2 BSPT AISI304
7	YBR01.0007	30205.00035SOX	NIPPLO AISI 304 DN 2 (MICROFUSO) BSP FIL MASCHIO CONICO	NIPPLO 2" BSPT AISI304	22	NIPPLE 2" BSPT AISI304
8	YBR01.0008	30207.00005SOX	GIUNTO 3 PEZZI AISI 304 DN 3/8 SALDARE	GIUNTO 3PEZZI 3/8" AISI304	26	UNION 3/8" AISI304
9	YBR01.0009	30207.00060	RACCORDO CLAMP / TRICLOVER AISI 304 1"	TRI-CLAMP 1" Øi29-Øe32 AISI304	30	TRI-CLAMP 1" Øi29-Øe32 AISI304
10	YBR01.0010	30207.00061	RACCORDO CLAMP / TRICLOVER AISI 304 3/4"	TRI-CLAMP 3/4" Øi26-Øe27 AISI304	32	TRI-CLAMP 3/4" Øi26-Øe27 AISI304
11	YBR01.0011	30207.00062	RACCORDO CLAMP / TRICLOVER AISI 304 1.1/2" ex diam. 48.3	TRI-CLAMP 1"1/2 Øi45-Øe48 AISI304	33	TRI-CLAMP 1"1/2 Øi45-Øe48 AISI304
12	YBR01.0012	30207.00065	RACCORDO CLAMP / TRICLOVER AISI 304 1/2" Inner D 19 external D 22	TRI-CLAMP 1/2" Øi19-Øe22 AISI304	32	TRI-CLAMP 1/2" Øi19-Øe22 AISI304
13	YBR01.0013	30210.00037	PORTAGOMMA M. INOX 304 E.S. 1/2 x 20 DIS. PV05 GAS CONICO ISO 7/1	PORTAGOMMA 1/2"M-Ø20 BSPT AISI304	33	HOSE FITTING 1/2"M-Ø20 BSPT AISI304
14	YBR01.0014	30210.00039	PORTAGOMMA M. INOX 304 E.S. 3/4 x 25 DIS. PV06 ø25x37 GAS CONICO ISO 7/1	PORTAGOMMA 3/4"M-Ø25 BSPT AISI304	34	HOSE FITTING 3/4"M-Ø25 BSPT AISI304
15	YBR01.0015	30210.00102	PORTAGOMMA AISI 304 - DN25 - 1"M-Ø25 FIL. GAS CONICO ISO 7/1	PORTAGOMMA 1"M-Ø25 BSPT AISI304	31	HOSE FITTING 1"M-Ø25 BSPT AISI304
16	YBR01.0016	30210.00103	PORTAGOMMA AISI 304 - DN32 - 1"1/4M-Ø32 FIL. GAS CONICO ISO 7/1	PORTAGOMMA 1"1/4M-Ø32 BSPT AISI304	34	HOSE FITTING 1"1/4M-Ø32 BSPT AISI304
17	YBR01.0017	30210.00104	PORTAGOMMA AISI 304 - DN40 - 1"1/2M-Ø38 FIL. GAS CONICO ISO 7/1	PORTAGOMMA 1"1/2M-Ø38 BSPT AISI304	34	HOSE FITTING 1"1/2M-Ø38 BSPT AISI304
18	YBR01.0018	30212.00008INO	GOMITO AISI 304 M-F ¾ MICR BSP FIL FEM CILINDRICO/ MASCHIO CONICO	GOMITO 90° 3/4"M BSPT-F BSPP AISI304	36	ELBOW 90° 3/4"M BSPT-F BSPP AISI304

FIGURE 15. EXCEL FILE OF EACH PRODUCT FAMILY

The technical data sheet of the raw materials in the same product family and the corresponding excel file are put in the same folder as shown in Figure 15.
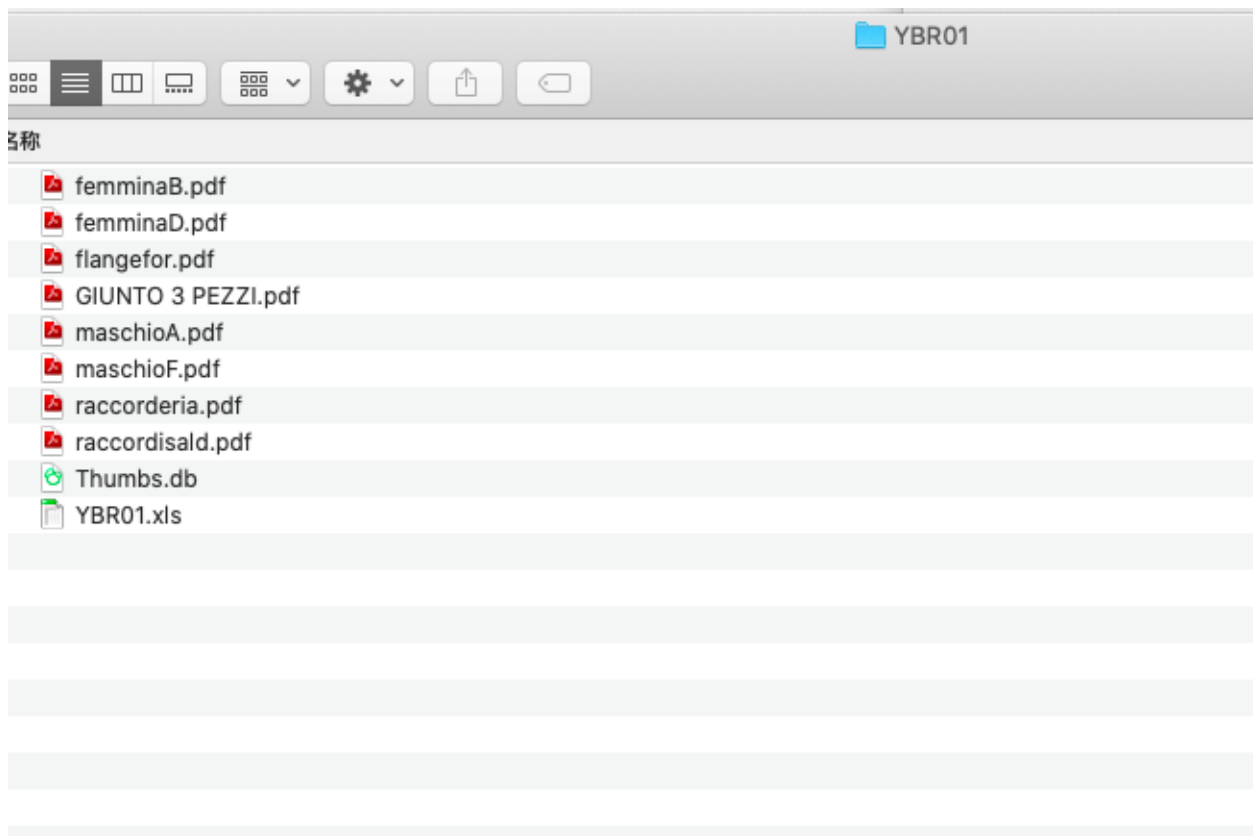

FIGURE 16. PRODUCT FAMILY FOLDER

All the items inserted into the SAP system; the size of the item must be not greater than 40 characters.

The technical data sheet associated with raw material should present the raw material name, technical specification, raw material picture, and supplier code. An example is shown in Figure 17.
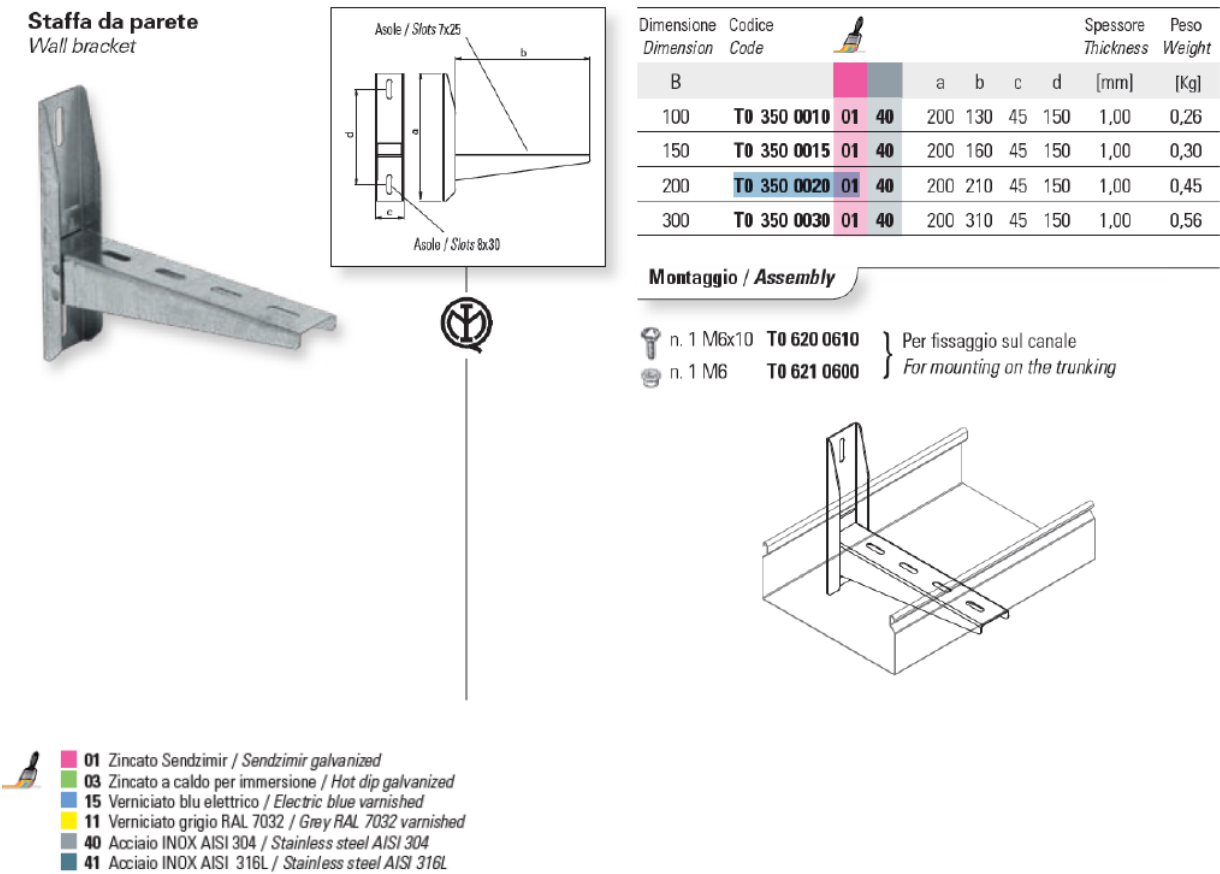

FIGURE 17. AN EXAMPLE OF TECHNICAL DIAGRAM.

5.2 The training of Key Users

The training of Key users is consistent throughout the implementation of the project which is very difficult and important. It is the guarantee for the continuation of the project implementation, just like a link between the implementation of the consultant training key users and the training of the end-users by key users.

The training model for both key users and end users is different. So, first of all, we need to coordinate between training for key users and end-users. It is important to arrange training consultants, training content, training environments, and training programs.

Applying such a training method, Key users can be fully communicated with some key points that are most relevant to the end-user. After the project is successfully launched, the key users act as the core role for supporting the system normally operating. Through training, an internal system support system will be established automatically. During the end-user training process, all end users related to the operation of the system are included and being trained by key users

Internal training is also faced towards company-wide training, as well as training for top-management

During the training of key users, they produced implementation manuals which are a guide to use the Sap system. An old employee of the company or a new employee can operate the system according to the manual.

5.3 Changes in the working process and working model

In the MM (material management) module, BOM (Bill of materials) is a management unit that lists the raw materials and spare parts required for the final product produced. It is the starting point for enterprise material management and planning.

The Bill of material, production plan, and inventory quantity constitute the three main inputs of the SAP system. The three inputs have the sequence relation between each other. It can be said that once the information on the bill of materials is wrong, it will directly affect the materials used in the production process. Improper material consumption can cause waste or resource waves Fees, production chaos and other phenomena will bring considerable losses to the enterprise. Therefore, in order to ensure the accuracy of the information on the bill of materials, the materials on the bill of materials are defined with uniformly code, and each material has a unique code. The bill of materials includes not only the material number but also the code for each material, as well as the number of raw materials and related tools. It can be seen that the bill of materials involves multiple departments and links such as production, procurement, and warehousing.

In order to ensure a balanced production for customer orders, it is quite necessary to develop an MPS (Master production schedule). The main production planning function is to determine the number of raw materials and parts required to produce a product in a certain period of time in the future. Generally speaking, the formulation of the main production plan is a forecasting activity. It should not only consider the customer's needs but also consider the production capacity and constraints of the company's WIP inventory. At the same time, it should also pay attention to the specific processing methods, storage conditions of the enterprise, Economic situation, and outsourcing policies to provide the accurate bill of materials for key time nodes in the future and provide a basis for the effective supply chain management.

The company's main production activities are based on the assembly of the final

product which will be directly delivered to the clients or to the factory in Shanghai. For this reason, the management of the warehouse and the purchasing of raw material and sub-assemblies play an important role in assuring the operation of the whole company. The constitution of MM module is in charge of two key users, one is from the warehouse department and another one is from the Purchasing department.

5.4 Changes in Management structure

To be compatible with the sap system, the company organization structure has been redesigned and the employee right has been reassigned.

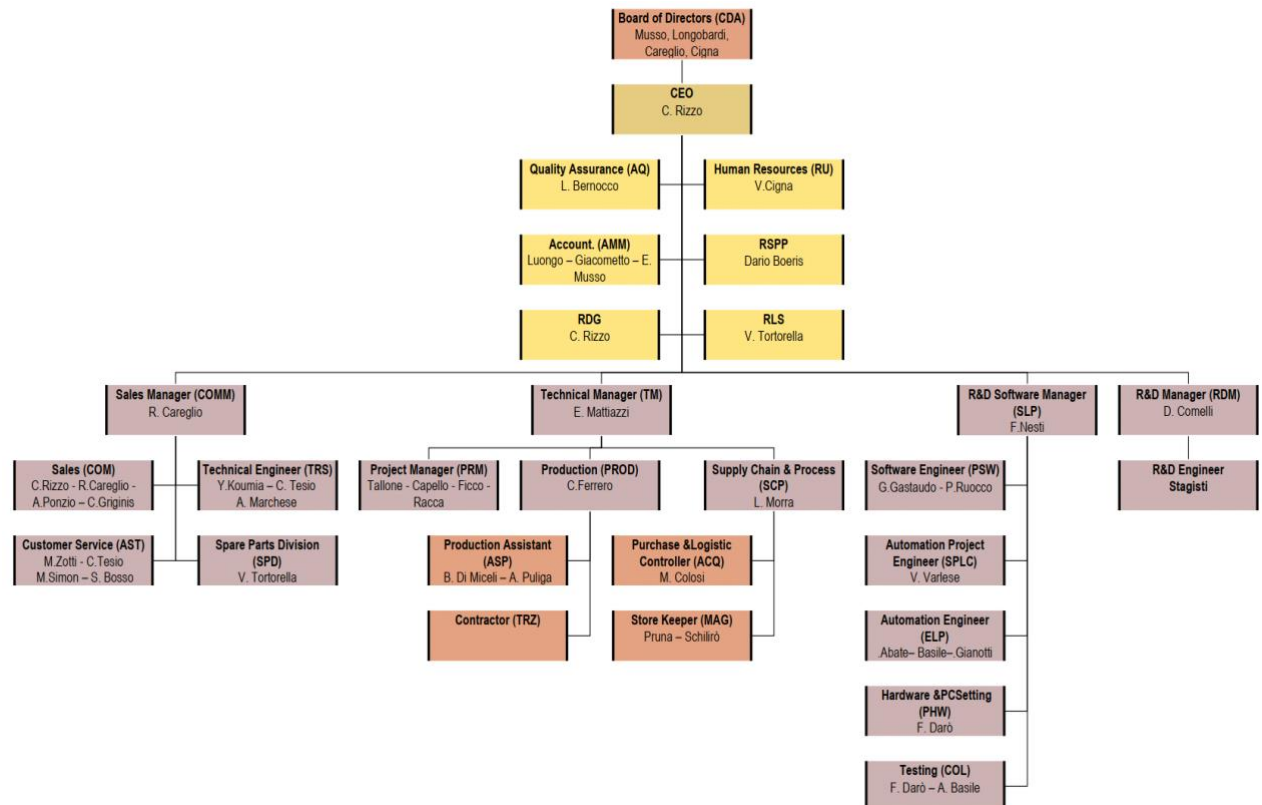As shown in Figure 18, it is the old version of the organization structure[8].

FIGURE 18. THE OLD VERSION OF THE ORGANIZATION STRUCTURE

In the new organization structure as shown in Figure20, all the R&D activities are consolidated into one department named "Area R&D".

The company daily operating activities are divided into four areas which are "Commercial and marketing area", "technical area", "R&D area" and "administration is". Each area is managed by the corresponding director.

It creates a new area named "Area administration" which consists of Accounting

[8] INKMAKER, 2019, INKMAKER old organization chart

activities, contract activities, and human resource activities in the new organization structure.

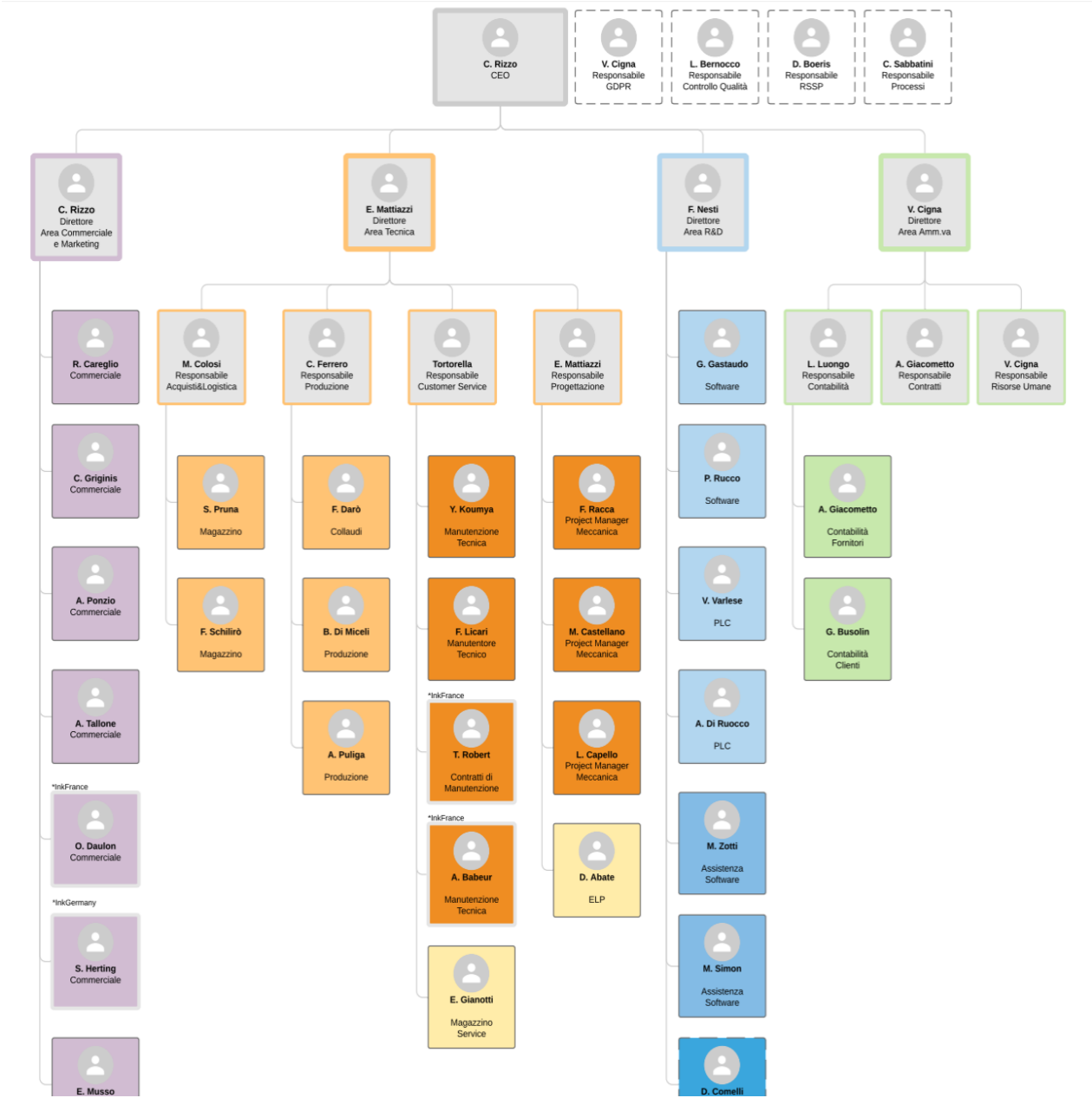Customer service is added to "technical area" and managed by the director of "technical area"

FIGURE 20. THE NEW VERSION OF THE ORGANIZATION STRUCTURE

Conclusion

Based on the analysis of the business requirements and current status of the company for implementing the new SAP system and the analysis of future strategic challenges, this paper analyzed the criticalities in the SAP implementation process and proposed the corresponding improving actions. The proposed actions improved Accuracy and timeliness of basic data, training for key users and end-users and effective communication during the implementation process, which increases the possibility of successful implementation of SAP.

With regard to my personal contribution, I carried out some activities which have a positive impact on the implementation process in these months. At the beginning of the internship, I spent about 2 weeks to be familiar with different products and the components which composed the products. After that, I spent about 1 week in the warehouse and about 1 week in the quality department working with different staff from these two departments. The first 4 weeks' working experience enables me to have a good knowledge of the different working processes, raw materials, and staff, which is beneficial for me to cope with criticalities in the implementation process. After that, I started to work with other staff for Master data preparation and the Chinese translation of all raw material. I also participated in the changes in the working process, for example, the production method converted from make-to-order to maker-to-stock to have more flexibility in production management. According to the implementation method, the consultants train the key users and then key users train end-users. For this reason, the user manuals are necessary. To understand how to write the user manual with key users I attended all the meetings which including consultants and key users. The user manuals that I wrote will help the end-users understand how to use the SAP system in the future and have to be used along with the official documents released by SAP named Building Blocks

SAP is a standardized process software, not a customized software designed for one company. Therefore, in addition to the cost of hiring the implementation consultants and payment of sap licenses, the larger capital investment is brought by the process modification and the later implementation. The company needs to be prepared for

further investment after SAP go-live. The investments are related to 1) the revenue reduction caused by the working process change, 2) the increased human resource cost caused by the Reallocation of rights due to process changes.

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