POLITECNICO DI TORINO

Collegio di Ingegneria Gestionale

Corso di Laurea Magistrale in
INGEGNERIA GESTIONALE (ENGINEERING AND MANAGEMENT)

Master Thesis

Key Performance Indicators of Supply Chain Seica S.P.A

Tutor:

prof. Maisano Domenico Augusto Francesco

Company Tutor:

Egidio Forestiere

Candidate:

Amin Ullah

December 2019

ABSTRACT

Emergency of highly competitive markets have led to more deep and thorough evaluation of performances across the supply chain of electrical and electronic company Seica to enhance the quality of products and services as well as selection of critical products. Manufacturing industry across the globe have been using different performance indicators and measuring terminologies for performance evaluation. This diversity deters evaluating and comparing manufacturing industries supply chain performance on a globe scale and thus limiting industry collaboration.

This thesis defines key performance indicators of supply chain of seica as well as evaluation of critical products and services. This thesis also revealed the proposed critical performance indicators of supply chain management of seica i.e. Cost, Quality and Critical level of products. This thesis evaluates performance value of the last two years 2017 and 2018 of supply chain of seica along with Implementation of proposed key performance indicators based on a proposed scale of seica. Keep in view the various key performance indicators of a good supply chain management this research work also proposed some good KPIs for a future audit of seica to show more competition.

Keywords: Key performance indicators, Supply chain management, Critical products and services, Electrical and electronic company seica.

PREFACE

‘In the Name of Allah, The Most Gracious and the Most Merciful’

I will start by thanking to my family for their continuous support and motivation at every step of my studies. I am thankful to my professor Domenico Maisano for giving me an opportunity to work under his supervision. I would specially like to thank my company Tutor Egidio Forastiere for their valuable guidance and giving me an opportunity to work in such a multi-cultural environment.

Thanks to everyone who helped me in achieving this milestone.

Amin Ullah

December 2019

Turin, Italy

CONTENTS

LIST OF FIGURES

LIST OF ACRONYMS

AQL	Acceptance Quality Level
DDT	Documento Di Trasporto
EMS	Electronic manufacturing services
ISO	International organization for standardization
IATF	International Automotive task force
KPIs	Key performance indicators
MOD	Module
MRP	Materials Requirement planning
NA	Acceptance Number
NR	Refusal Number
OEMS	Original Equipment Manufacturer
SEICA	Servizi Electronica informatica collaudi Automatici
SCM	Supply chain management
VAT	Value-added Tax
VIP	Viva integrated Platform

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter highlights the core purpose and objective of this thesis. This thesis is carried out at electrical and electronic manufacturing company named Seica. In addition, it explains the basic need or problem that is to be solved in this thesis. Moreover, this chapter also presents hypothesis of this thesis. Finally, a thesis outline is described in the last section of this chapter.

1.2 Problem definition

Performance measurement and assessment has constantly been a critical factor for the management to assess the performances at various levels and departments of an organization. Previously, almost every industry has individually researched, hired people and used different performance evaluating tools for monitoring the performance according to their own parameters. However, as the competition between industries become more intense and the phenomenon of globalization has evolved, the search for those performance indicators have started that can be critical in the success of an industry in a competitive marketplace (T. Gama and V. Cavenaghi, 2009). The immense interest from organizations in findings the KPIs got the attention of international organization such as International standards Organization (ISO) which shifted their focus towards making a standard performance measurement system. Although there has been different set of standards and performance indicators on different levels of manufacturing system, this research work will emphasis only on KPIs at supply chain management level.

The major concern of this thesis work is to find a strategy for evaluating and assessing the performance of supply chain management on the basis KPIs defined in ISO 9000:2015 standards. This research work provides a standardized solution to a Seica company for evaluating their suppliers based on KPIs.

1.3 Hypothesis

In order to identify and define the right set of KPIs for electrical and electronic manufacturing industry Seica, ISO has developed the standard “ISO 9000:2015, Key performance indicators (KPIs) for supply chain management’’. There are more than 200 KPIs identified by supply chain management along with its description, including formula, audience, scope, range, etc. which are applicable at different operational level management in any organization. The implementation of these KPIs will allow the supervisors to monitor and evaluate the performance of supply chain management in runtime for different set of production orders. This monitoring will lead the management to take critical decisions related to the supply chain of Seica and will help them in selection of good suppliers along with evaluation of critical products and services which are based on KPIs.

1.4 Objectives

This thesis work aims two major objectives, which are to evaluate suppliers list of Seica company and critical products, and services provided by these suppliers based on KPIs proposed by quality manager of Seica. The proposed KPIs for a supply chain of Seica are Cost, Quality and delivery on time. These objectives can be achieved by computing the values of KPIs with the help of formulas in excel file by following operational procedure adopted by Seica. Each performance indicator measurement is evaluated at different levels of organization in different periods of time. Some KPIs are required to be analysed daily, some weekly, some monthly and some annually.

1.5 Thesis Outline

Thesis is structure in the following way. Chapters 2 describes introduction to the company seica. Chapter 3 explain indicators and its importance along with the operational procedure for evaluating critical products and services of Seica. This chapter also describe periodic evaluation of suppliers based on different characteristics of quality as well as conformities and non-conformities in sample plan. Chapter 4 explains in detail the key performance indicators of supply chain management along with proposed KPIs of Seica. This chapter present the results of implemented KPIs on Seica suppliers as well as their products and services. This chapter concludes the work done and present the future prospect for this company.

CHAPTER 2

ELECTRICAL AND ELECTRONIC COMPANY SEICA

2.1 Introduction to the Company

The word Seica stand for servizi elettronica informatica collaudi automatici (see fig.1)**.** Seica S.p.A. is a global supplier of automatic test equipment and selective soldering systems founded in 1986, with an installed base of more than 1800 systems on 4 different continents. Seica offers a complete line of proprietary test solution and has established strong partnerships with leaders of manufacturing and inspection systems to enlarge the portfolio of solutions across the whole production line. In a time of continuous changes, where globalization challenges competitiveness, Seica drives its strategy with local direct presence in Italy, as well as with other countries. Seica use industry 4.0 concept because information and technology needed to collect and analyze data is the key to the successful digitalization of the manufacturing process. Seica has nominated for productronica innovation award 2019.

Figure 1: Seica logo

2.1.1 Mission

The mission of Seica can be summarized in three important aspects:

- *Innovation:* Continuous improvement of the products offered to its customers to maintain a high standard on all 5 product lines, research of new technologies and experimentation of cutting-edge solutions.

- *Integrity*: Almost 30 years' experience, constant passion and continuity in the field of electrical test.
- *Commitment*: A Strong organization, a significant human resource, a strong orientation towards teamwork and information sharing.

2.1.2 Vision

Global Supplier (see Fig. 2): Seica can support customers process with its experience, in even the most complex environments, offering solutions for all types of test requirements, ranging from military to consumer electronics. Seica has a wide vision about electronic tests.

Seica is a complete range of innovative solutions and a series of complementary services for any electronic test requirement, including the development of test programs and fixtures, the design and manufacturing of customized systems and modules for civilian and defense.

Figure 2: Seica vision

2.1.3 History of the company

Seica developed history with a passage of time. Different tests have been performed by Seica and that's why now Seica systems has installed in worldwide. At the beginning in 1995, first flying probe tester installed and after two years, first bare board flying prober installed. In 1998, Seica has done agreement with Genrad for worldwide flying probe distribution; After four years Seica has agreement with Teradyne for worldwide flying distribution. In 2005, first tester sold to main automotive customer by seica and have done agreement with EADS T&S for mil-aero cooperation and after one

year first vertical flying prober and first selective soldering system installed. In 2007, Seica has done first reverse engineering solution for flying probe and after one year first pilot V8 installed. After 2009, more than 1000 testers sold in different market sector as well automation is established. New pilot 4D flying probe test platform developed and at 2018 more than two thousand systems installed worldwide (see fig.3).

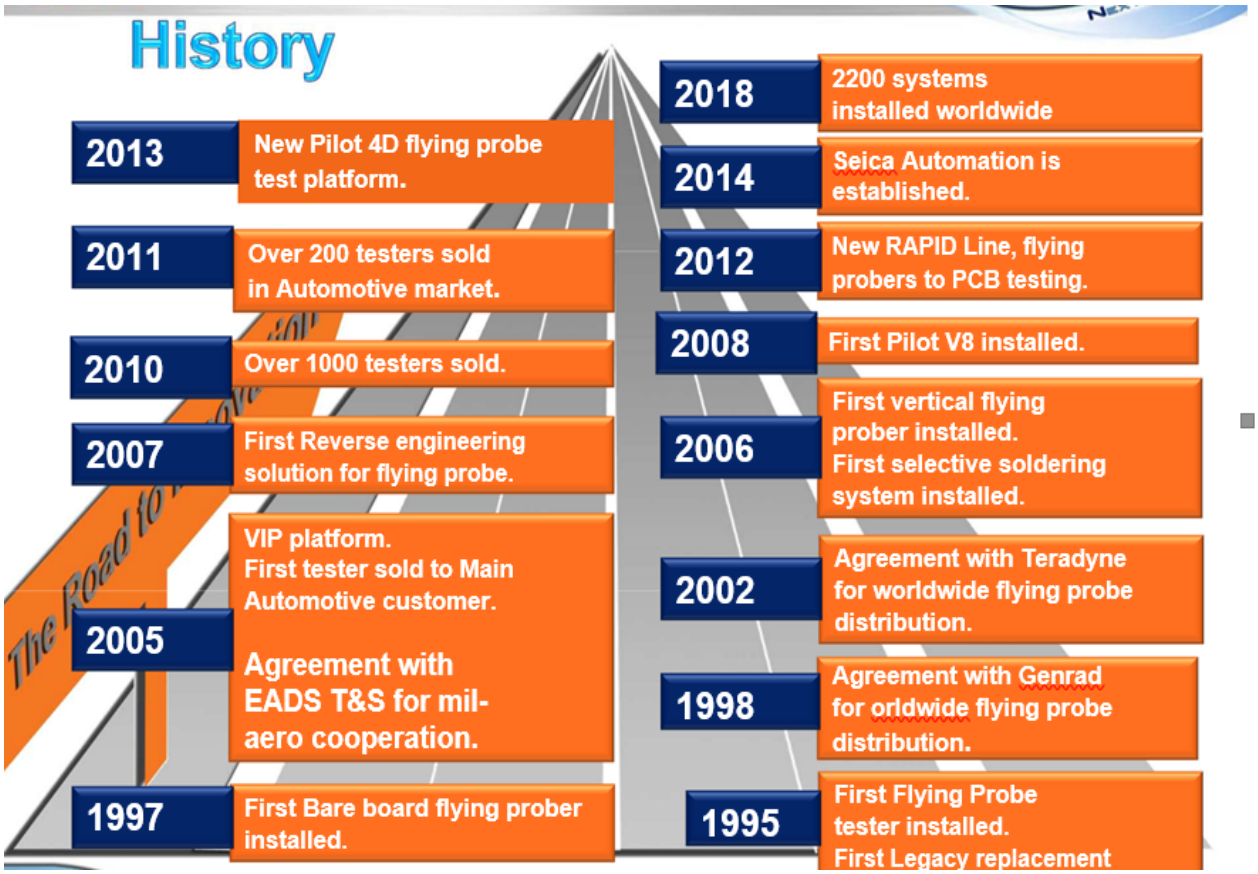

Figure 3: History of Seica with a passage of time.

2.1.4 Seica S.p.A Headquarters

Seica S.p.A. was established in 1986 in Strambino, Italy, but today, it is part of a broader and more coordinated Group. In Italy Seica has established in other cities. i.e. Proxima, Piacenza (italia), sole Seica marketing agent for the national territory. Beside these, Seica France Elancourt, (Paris) France established in 2000 and Seica GmbH, Ettlingen, Germany Open since 2008. Thousands of systems

installed worldwide with the help of strong professional team, which provide best services and support different test quality solutions

2.1.5 Seica Worldwide Network

Seica has a worldwide sale and support network in four different continents i.e. America, Europe, Africa and Asia (see fig.4). It has more than 40 representatives worldwide and has more than Hundred employees working in different departments in Italy and has more than two hundred employees in the world. Seica can also ensure local service support where the customers need it, in addition to 24-hour telephone assistance and it has also installed more than two thousand systems all over the world as after 2018 (fig.5).

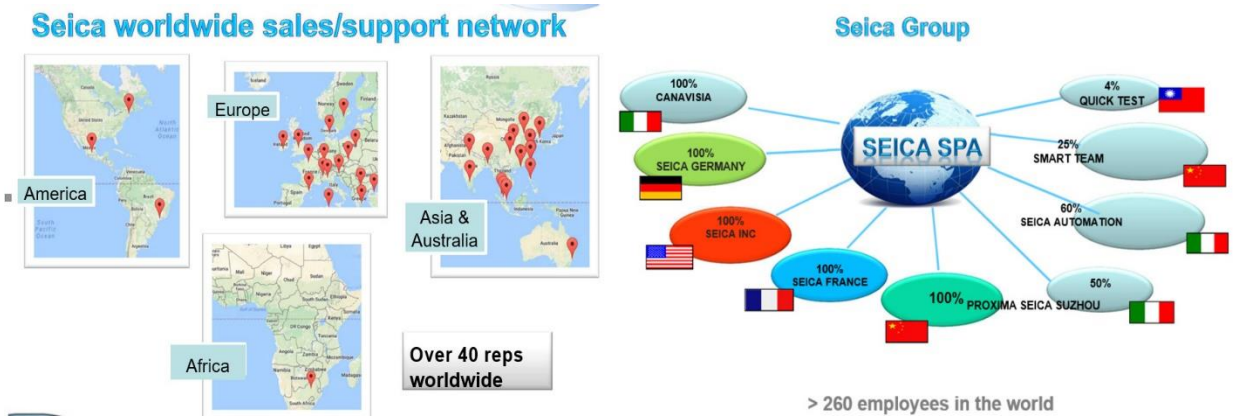

Figure 4: Seica network

Figure 5: Employees and customers of Seica

2.2 SEICA - Test Solutions

Seica in Strambino, a small town located in the Canavese district of Italy (long noted for its high concentration of electronic and information technology companies) it has progressed from developing its first in-circuit test system for the domestic electronics industry, to becoming a world leader in Flying Probe and functional test systems. Seica quality certified by UNI EN ISO 9001:2015 and tests solution has a lot of good qualities i.e. Innovation, flexibility, continuity, innovation and and have cost cost effectiveness. (see fig.6)

Today Seica is one of the major suppliers of test equipment, with more than 1800 systems installed on five continents and over 300 testers sold in the Automotive market. Throughout the years the Company has grown and now has subsidiaries in France (2000), United States (2003), China (2004) and Germany (2008), with a global distribution network covering market needs worldwide.

Figure 6: Seica quality

2.2.1 Solutions and systems integrated in a single platform

All Seica products are based on its unique hardware and software platform, called VIVA Integrated Platform (VIP). The VIVA software offers a complete set of automated instruments to develop, execute and maintain in-circuit and functional test programs for analog, digital and hybrid boards; the VIP hardware includes: integrated, DSP technology, delivering fast, accurate, comprehensive solutions which are extremely cost-effective.

2.2.2 Research and implementation of new technologies

From the beginning, Seica has led in innovation and implementation of new technologies, with a significant yearly investment in Research and Development. In 1994, Seica was the first European company to design and manufacture a Flying Probe tester; in 2003 it presented a revolutionary, laser-based selective soldering solution and in 2006, the first vertical Flying Prober was installed.

2.2.3 Solutions

Seica can support customer even the most complex environment, offering solutions for all types of tests requirements ranging from military to consumer electronics. Today, thanks to 30 years of experience investments in research, design, and dedicated work alongside our customers, Seica is able to propose a wide range of technologically advanced:

a) ***Parametric and in-circuit test:*** parametric testing can save a considerable amount of product costs: it decreases repairs, eliminates defects which cannot be detected with a functional test, enables production technicians to autonomously screen for process faults and stabilize the quality in output, especially when functional test is not mandated.

b) ***Functional test*****:** a board or assembled electronic module needs a functional test typically defined by a design specification. There's the need to simulate the real operation of the board under test, power it, supply the stimuli to execute the required measurements and automatically collect all the statistical data. A functional test system is a flexible structure which, properly configured, can be used to characterize several kinds of boards.

c) ***PCB electrical test:*** the PCB manufacturing process includes a final electrical test to verify net continuity and the absence of shorts on the board. In some markets, the increased complexity and variety of PCBs, along with decreasing volumes, have determined an extensive use of flying probe type test systems for electrical test.

d) ***Repair and Reverse engineering:*** the repair of electronic boards imposes considerable investments in experience and expertise, Seica has utilized the know how acquired as a leading manufacturer of flying probe test systems to create specific solutions dedicated to board repair and reverse engineering.

e) ***Selective Soldering:*** automated selective soldering was developed to help in those cases where neither wave soldering, nor soldering by reflow can be applied. It is also an alternative to hand-soldering, which has issues in terms of repeatability, as is too subjective and in many instances and cannot provide the targeted levels of throughput and, consequently, is not cost effective.

f) ***Process control*****:** from the solder paste printing process, to the component placement process up to the reflow process, defects are created, which must be intercepted using modern optical inspection systems, based on cameras or x-ray.

2.3 Customers

Seica has supplied turnkey and custom installations for diverse market sectors from telecommunication, automotive and IT to medical and avionics, as well to multitude of contract manufacturers parts. Seica customers range from small companies to multinationals such as: Boeing, Philips, Alcatel. Sncf, China aerospace, Magneti Marelli and Galileo Avionica, with locations all over the world. Seica serves three main groups of customers operating in different market sectors: mil-aero, industrial electronics manufacturing and printed circuit board manufacturing. Among the customers operating in the industrial sector, many are OEMs (Original Equipment Manufacturers) in the field of industrial automation, autronics, security, consumer electronics, telecommunications, transportation, heating/ refrigeration and medical, or ECMs. A group of Seica support customers for everything's concerning after-market service, like issue related to applications, implementation of the test fixtures and staff training.

2.4 Products

Seica is able to offer a full range of flexible, cutting edge solutions due to continuous investment in research of new technologies and the development of new products. Seica monitoring systems are general purpose therefore they are applicable to any type of production:

a. *In-circuit test Compact Line*

   The new Compact Line (Fig. 7) builds on the legacy and success of the historic line of SEICA in-circuit and functional testers and has been designed to meet "lean production" standards,

with specific attention to the requirements of electronic board manufacturing. It is ergonomically sophisticated and technologically competitive, offering a high level of flexibility, measurement accuracy and test speed in small spaces with a minimum footprint and low energy consumption, making it cutting edge and sustainable product. Compact systems represent an optimal solution for Analog and digital in-circuit test, Analog, Digital and power functional test, Boundary scan type tests, High voltage test and Digital components programming. All the systems of the compact lines are based on the Seica VIP Platform.

The compact line includes different model to meet the widest range of economic and technical requirements such as Compact Tk, Compact SL, Compact multi, Compact power, Compact digital next and Compact slim next series.

Figure 7: The new Compact Line

b. *PCB test - Rapid Line*

The Rapid Line (Bare Board Tester) (Fig. 8) offers a complete test solution for flying probe test of printed circuit boards and includes a fully integrated automation option. Rapid is the line of Flying Probe testers for printed circuit boards (Bare Board Testers) with the highest performance available on the market. It meets the requirements of industry segments through models with horizontal or vertical architecture, 4 or 8 independent flying probes and a complete range of measurement techniques. Through architecture flexibility all unique market segments can be easily addressed due to the advanced hardware and software integration. To better meet the requirements of different operational and manufacturing process flow, Seica

is the only ATE manufacturer that offers the rapid Next> series Line with 2 complementary architectures. The horizontal architecture presents systems oriented to the in-line configuration for the complete automation of test process, eliminating the need for operator presence. In today's market, in-line automation does not necessarily mean "High Volume", BUT the ability to test dozens of unique batches or "part numbers" of PCBs in small quantities OR large quantities.

Figure 8: PCB test -rapid line

c. *Functional test Valid Line*

The Valid Line (Fig.9) is the ultimate integrated functional test solution, capable of providing high-performance analog, digital and mixed-signal testing for second level test. This series includes comprehensive fault diagnostics, with powerful guided probe algorithms, driven by simulated or learned data. The Valid Line benefits from Seica's unrivalled experience in testing complex types of electronic boards and assemblies, featuring advanced DSP and FPGA-driven digital technology and a comprehensive set of test generation, debug and diagnostic proven solutions. The Valid line for functional testing includes a system range able to meet today's and tomorrow's requirements of military and aerospace electronics. The flexibility of the hardware and software tools enable providing in several configurations, test solutions which cover the third-level test requirements (Factory and Depot), as well as second level requirements (Intermediate) and first level (Operational).

Figure 9: Functional test valid line

d. *Laser selective soldering Firefly Line*

The Firefly line (Fig.10) is a laser-based, selective soldering solution that has been developed to satisfy the ever-growing need of modern electronics manufacturing for maximum flexibility, and to address the particular problems related to the introduction of the new lead-free alloys, quality control and manufacturing traceability. Firefly line which introduced a laser beam which is orthogonal to the solder joint, and the donut spot, to improve the focusing of laser energy where required and offering suitability for a very small-sized pads providing clear advantages in terms of applicability and process repeatability. A minimized footprint, efficiency and cleanliness (low maintenance), accompany a flexible, monitorable and certifiable soldering process making the Firefly Next Series Selective Soldering the ideal solution to resolve manufacturing issues both in EMS (Electronic Manufacturing Services) and OEM industries such as automotive.

Figure 10: Laser selective soldering line

e. *Flying Probe - Pilot Line*

The Pilot Line (Fig.11) is the most versatile and complete line of automatic flying probe test systems on the market today, offering the widest range of solutions and performances for testing electronic boards. Models range from 2 to 8 test probes, accessing simultaneously one or both sides of the board, which can be positioned either horizontally or vertically. Eliminates fixturing costs and time, Fast test program development, easy integration of design changes, Process flexibility, Circuit access, even in the absence of test points, Controlled probe contact, programmable for any type of board, Different test solutions and approaches integrated in a single test system, Intrinsic positioning and measurement precision.

Moreover, all the Pilot Next Series testers feature the Industrial Monitoring solution **"**4.0 ready**"** by Seica, to monitor current absorption, supply voltage, temperature, light indicators and other parameters useful to indicate the correct operation, to ensure predictive maintenance and make the systems compatible with the new standards of the fourth industrial revolution ongoing nowadays.

Figure 11: Pilot Line

f. Optical Inspection CC and THT

Dragonfly (Fig.12) is the Seica AOI line solutions for conformal coating and pin through hole inspection. It has similar architecture like selective laser soldering but thanks to additional UV light to inspect conformal coating on boards, to identify where coating is missing or excessive and useful for solder ball detection. Dragon fly system are fully Smema complaints and can be available in single side or double side configurations. This system helps to forecast the highest test coverage and achieving reliable outputs from the analysis process.

Figure 12: Optical inspection CC and THT

CHAPTER 3

OPERATIONAL PROCEDURE OF SEICA FOR EVALUATION OF INDICATORS OF SUPPLY CHAIN QUALITY.

3.1 Introduction of indicator

The UNI 11097 (2003) standard classifies as quality indicator "the qualitative and/or quantitative information on an examined phenomenon (or a process or a result), which makes it possible to analyze its evolution and to check whether quality targets are met, driving actions and decisions".
Some critical points in the construction of indicators are: (1) They should appropriately represent the process of interest; (2) They should be easily understood and accepted by process managers and employees; (3) They should be traceable and verifiable.
The indicator entails some basic requirements are (UNI-11097, 2003):

- indicators should represent targets effectively;
- they should be simple and easy to interpret;
- they should be able to indicate time trends;
- they should "respond" to changes within or outside the organization;
- the relevant data collection and data processing should be easy;
- they should be updated easily and quickly.

3.1.1 General Classification of Indicators

Indicators should provide precise and clear information about the evolution of a process.

There are three types of indicators, which are shortly discussed as (Franceschini, Galetto, Maisano, 2019):

1. ***Initial (or structure) indicators:*** These indicators are also used to qualify the skill and involvement level of human resources, with the final purpose of improving the project planning/management. These indicators are supposed to answer the question: "What are the available assets and the working patterns of the process, considering all the resources involved (e.g., facilities, human resources, technological and monetary assets, services provided by

suppliers, and so on)?" (Franceschini, Galetto, Maisano, 2019). For example, Indicators concerned with the quality of materials or quality of services provided by suppliers.

2. ***Intermediate indicators (or process indicators):*** These indicators measure the consistency between process results and process specifications, providing useful information on the process state. These indicators show the stability of process conditions. Process indicators may provide a synthesis of the organization competitive advantages. A limitation of some indicators is the loss of sight of the organization complexity (Bitici et al 2006). These indicators are supposed to answer the question "How does the process work?". For example, indicators related to the efficiency of a manufacturing process.

3. ***Final (or result) indicators:*** These indicators are very important because they represent the final results of the process, both the positive and the negative ones. These indicators answer the following questions.

    - "What is the cost-benefit ratio?".
    - "What are process outcomes?";
    - "What are the expected/unexpected effects produced by the process?";
    - "Has the process met the purposes?";
    - For example, they may deal with customer satisfaction or cost of products/services.

3.1.2 Functions of Indicators

Indicators provided a lot of functions, but the main three functions are;

- *Improvement*: Indicators identify gaps (between performance and targets) that ideally point the way for possible improving actions. The size of these gaps and their direction (e.g., positive or negative) can be used to adjust/plan corrective actions.
- *Communication*: Indicators communicate performance to internal workers and managers, and to external stakeholders too. On the contrary, incomplete/inappropriate indicators may produce frustration and confusion.
- *Control:* Indicators enable managers and workers to evaluate and control the performance of the resources that they are supposed to manage.

The critical point is to identify the "right" indicators to properly represent the process: i.e., the so-called Key Performance Indicators (KPIs) (Petersen et al. 2009). it provides a way for companies to measure their performance in specific activities that relate to projects, products or other parts of the company's workflow.

I am evaluating the key performance indicators of the quality supplier's chain of seica company.

3.2 Process evaluation

A system to evaluate a process required two important steps:

1. *Definition of indicators:* Indicators are selected depend on the critical aspects and growth potential of the process. This activity deal with the definition of the indicators to collect relevant data and implement.

2. *Decision:* It depend on the difference between target and measured performance level, there are three different courses of action:
    - process reengineering
    - individual problem solving;
    - incremental improvement (step by step).

Process implementation is very important and should be followed by a systematic monitoring plan and periodical performance recording, in order to identify critical aspects and/or reengineer process activities. (Fig.13) show this concept.

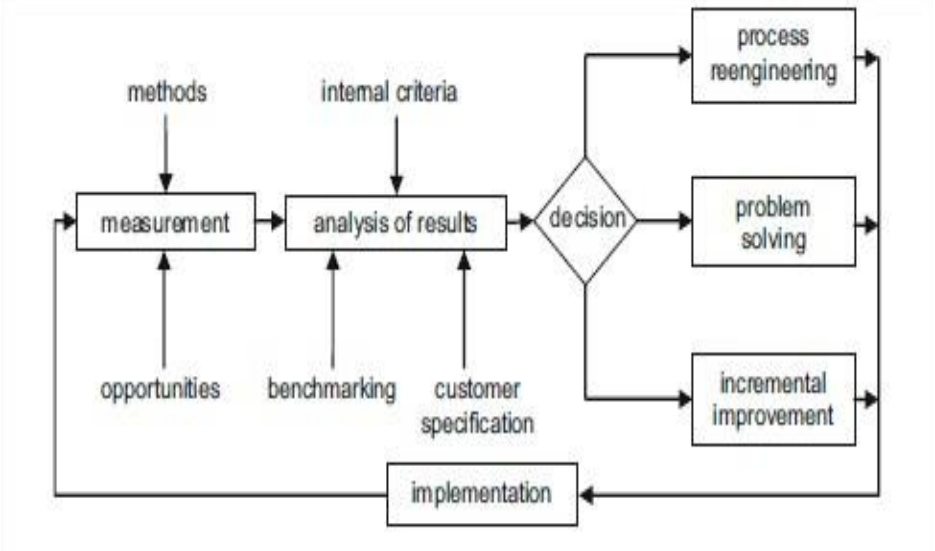

Figure 13: process improvement chain

3.3 Seica Purpose

This Operating Procedure establishes:

Criteria, responsibilities and methods for the selection, qualification and control of the suppliers of products / services used in the realization of our product / service; responsibility for the management and definition of the data necessary for the correct issue of purchase orders and for processing and the relative updating and / or modification procedures.

3.4 Applicability

This Operating Procedure applies to suppliers of products / services / work that have direct influence on the customer's products and are considered critical.

The criticality level is defined according to a classification that takes into account:

- Direct influence on the quality of the finished product for the customer.
- Level of standardization
- Availability on the market.

Criticality levels are determined for each supplier, by the Procurement Manager, interfacing with the Quality Manager, by choosing a scale of numerical numbers from **1** to **3** and using the following classification:

A. Impact on the finished products

- **1** Value indicate Low, those service products or those processes whose lack of quality can only cause identifiable aesthetic or functional problems that do not compromise their functionality.
- **2** Value indicate Average those products or services of recognized intrinsic quality or in which the lack of quality can cause a partial disturbance, but the functionality of the spare parts or of the equipment's will be only partially diminished.
- **3** Value indicate High those products or services whose lack of quality will put the spare part or the equipment's to which it is destined out of use.

B. Level of standardization

- **1** Value indicate Product / Processing / Catalog services Standard products. Workings not considered special and standardized.

- **2** Value indicate Product / Processing on request Products that are modified in a minimal way compared to the standard ones. Processes considered special but standardized.
- **3** Value indicate Product on specific Products services that are supplied on specification. Special processes that involve critical processes.

C. Availability of products in market.

- **1** Value indicate High availability of those products that are widely used.
- **2** Value indicate Average availability of those products or processes that are commonly used in the professional sector.
- **3** Value indicate Low availability of those products or processes that are difficult to find on the market and with specific integration in the products provided by Seica industry.

Criticality Level

If A + B + C> 5

Significantly critical products / services.

Products with a criticality level greater than or equal to **6** must be obtained from suppliers included in the Qualified Supplier Register Module 06001.

For the purposes of inclusion in the Qualified Suppliers Register, in the case of suppliers that supply products with different levels of criticality, the highest level of criticality is considered.

Products with a level of criticality below **6,** corresponding to products purchased in the catalog and of extreme standardization and widespread and of good intrinsic quality, are supplied by suppliers who do not need to be previously qualified.

In this case the choice is made using suppliers belonging to the official distribution channels and companies of recognized professionalism and with good references in the sector in which they operate.

All suppliers used by Seica, regardless of the level of criticality and prior to the issue of the first order, must be coded collecting all the information necessary for the correct management of the technical-administrative aspects.

For this purpose, the Purchasing Manager makes use of the support and relative authorization of the Administrative Department, for the definition of specific accounting and administrative parameters and for the definition of advance payment terms, less than 30 days.

The Purchasing Manager therefore ensures the collection and registration on the management information system of:

- Personal data (Company name, address, VAT number, contact details, ...)
  (NB: The data relating to the address must coincide with the registered office of the supplier.)
- Accounting and administrative data (VAT Code, Bank accounts, ...)
- Business data (Payment terms.)

3.5 Responsibility

The Purchasing Manager, the Quality Manager and the Technical Body Managers who interface directly with the suppliers, are responsible for:

- Define the criticality of the service product, processing requested from suppliers;
- Establish the criteria for initial qualification and periodic assessment of suppliers as well as incoming checks on the products they supply;
- Participate in the group for initial qualification and periodic assessment and for audits at suppliers.

The Purchasing Office is responsible for:

- Identify new suppliers.
- Carry out the evaluation of the criticality of the product, processing required by the new supplier.
- Codify the supplier and update the contractual parameters related to him;
- Issue purchase orders for materials and services;
- Issue orders for machining;
- Manage the list of orders.

The Quality Manager is responsible for:

- Monitor the quality of supplies in collaboration with the Acquisition Office in order to periodically review acceptable suppliers.
- Issue and update the Qualified Suppliers Register Module 06001.

3.6 General

Seica suppliers are divided into four categories:

1. suppliers of finished products;
2. suppliers of components or semi-finished products in the catalog;
3. suppliers of semi-finished components made to specifications;
4. service providers.

The Purchasing office, for orders whose amount is greater than € 5000, always asks the various suppliers for the respective offer, if possible. On receipt of the offers it prepares the comparative table of the costs, of the characteristics of the materials and of the delivery times to evaluate, in collaboration with the Operational Management; both quality and convenience and to which supplier issue the order.

The types of purchase contracts that can be made are:

- for finished products: only closed orders, subject to market research;
- for components or semi-finished products in the catalog: only closed orders, with planned deliveries according to the delivery time of the supplier;
- for components or semi-finished products made to specifications: closed orders with planned deliveries for suppliers and subcontracting work orders;
- for services: closed orders for the execution of professional consulting services, agreements with couriers regarding transport.

3.7 Operating Modes

In the order development or order phase, the decision to obtained semi-finished components and finished products is conditioned both by their specific complexity and by the fact that their realization may require special techniques, special equipment and / or personnel specialized. Therefore, the company is assured, through the initial qualification process, that the global capabilities of the potential suppliers are sufficient to meet the technical requirements required by the applicable documentations

.

3.7.1 Initial Qualification Process

The need to proceed to the initial qualification of a supplier may occur because it is necessary:

- have a valid alternative to a qualified supplier.
- test a particularly interesting potential supplier.
- use a previously qualified supplier who has not made supplies to Seica industry for the last 2 years.
- to requalify a qualified supplier who, following the periodic assessment, has reached a qualification level of **1**.
- Insert in the Register of Qualified Suppliers, a supplier already used by Seica industry but not included in this register.

The initial qualification of new suppliers of products, services, processes classified as critical, takes place through the following steps:

1. ***Identification of the new supplier.***

   The following criteria are given priority.

   For service providers:

   - professionals whose professional qualities have been appreciated based on existing relationships;
   - indications of known professionals.

   For contractors:

   - presence in the territory;
   - organizations with which previous reports were made;

   For material suppliers, components:

   - official distributors included in the sector publications and in the exhibitors' catalogs to the specialized fairs;
   - organizations with which previous reports were made;

   Further aspects to be examined are:

- Respected compliance with mandatory requirements, registration with the chamber of commerce and VAT registration number.
- The work experience gained in the electronics sectors,
- The technical requirements of the products services indicated in the catalogs, information forms, etc.
- The location on the territory;
- Available brands and approval marks available;
- information / references relating to the activity provided;
- Available the technologies and equipment available;
- Eventually any quality certification;
- Lead the declared lead times and delivery times;
- Eventually any previous relationships;
- The cost effectiveness
- Customers' requests.

2. The collection of information

The Purchasing Office collects and analyzes the information in its possession, those transmitted by the technical bodies concerned offices that may have interfaced with the new supplier or those otherwise found (fairs, exhibitions, catalogs, brochures, data sheets, direct knowledge) information assumed by other companies).

If the available information (website, information form, etc.) is not sufficient to express a complete assessment of the supplier's ability to meet Seica needs, the Purchasing Manager can provide for:

- Sending the specific Information Questionnaire (Form 06004 Supplier Questionnaire).
- Organize a visit to the potential supplier site to gather further information for its assessment
- Proceed to the request of a sample, in order to evaluate the supplier more thoroughly and completely.

3. The request for proposal

The Purchasing Office contacts the potential supplier, requesting an offer for the product, service, work or professional service of interest and any other information necessary for the evaluation.

4. Analysis of the information collected

The Purchasing Manager evaluates the technical and economic information and the results of the analyzes conducted, in collaboration with the assessment team (Quality, the Services / Offices involved in the supply), drawing a first conclusion about the validity and reliability of the supplier.

The analysis relating to the evaluation of the supplier is carried out according to the following criteria:

- implementation of a management system certified by a Notified Body that ensures a production system that meets quality criteria and / or supplies products with quality marking in addition to the mandatory European markings, when required;
- application of balanced commercial conditions in accordance with the QUALITY - PRICE - SERVICE ratio.
- In the event that the supplier does not have a Certified Quality system, we proceed with the evaluation of the practices used by the supplier to monitor and control the production process or supply of the service provided.

5. The definition of the qualification outcome

The final result of the qualification is reported on the Module-06002 Supplier Qualification Sheet and foresees:

• **Approved**: From the preliminary assessment it appears that the supplier is able to guarantee the quality requirements of the product or processing expected by Seica. It is included in the Qualified Suppliers Register Module- 06001 with a qualification level of 2.

• **Approved with reserve**: These are the suppliers who, following the preliminary assessment, give rise to doubts about the quality of the products or services supplied, but due to market reasons, because at the moment there is no alternative or because requested by the customer must necessarily be used . Mod 06001 Qualified Suppliers Register is entered in the Qualified Suppliers Register with a qualification level of 1 and placed under observation by:

- Specific checks on incoming products supplied, or
- Trial order or
- Auditor
- Implementation of improvement plans.

The choice of the type, extent and duration of the surveillance actions is noted in the Module-06002 Supplier Qualification Sheet.

At the end of the observation period, depending on the outcome of the actions taken, the qualification of the supplier is reviewed.

• **Not Approved, rejected:** These are suppliers in which there are obvious problems with the quality of the products or services provided. They are not included in the Qualified Suppliers Register Module 06001 and cannot be used for the supply of critical products.

Module 06001 Qualified Suppliers Register is entered in the Qualified Suppliers Register with a qualification level of 1 and placed under observation by:

- For historical suppliers (supplies for at least 2 years) or in consolidation (supplies for more than a year but less than 2) which are entered for the first time in the Qualified Suppliers Register, the outcome of the initial qualification can be:
- *Approved***:** If it is a supplier on which no problems have ever been found regarding the quality of the product or processing, the qualification level is as follows:
- **3** if it is a historical supplier.
- **2** if it is a supplier in consolidation.
- *Approved with reserve*. If it is a supplier that has given rise to doubts about the quality of the products or services provided, but due to market reasons, because at the moment there is no alternative or because requested by the customer must necessarily be used, it is attributed to it the qualification level 1 and is placed under observation as provided for the new suppliers.

6. Definitions of the periodic assessment and supply control methods

Depending on the level of qualification and the type of product or service provided, the assessment team indicates in Module-06002 Supplier Qualification Sheet the periodic assessment and supply control procedures.

Please note that in the event that the checks on the supplier's supplies include types and sampling different from those established in paragraph (incoming inspection process), notification is given to the Acceptance Control Office for implementation. These indications are given in the check of supplies of the Qualified Suppliers Register.

3.7.2 Periodic evaluation

Periodically, at least once a year, the assessment of the qualification level of the suppliers is reviewed by the assessment team composed of the Quality Manager, Purchasing Manager and Technical Offices directly interested in the supply of services.

The evaluation, expressed on a scale between **0** and **10**, concerns the following aspects:

- Technical competence
- Flexibility and Availability
- Reliability in deliveries
- Product quality
- Economic evaluation

It is defined by the evaluation team, integrating it in the case of product / service quality aspects, with the index relative to the number of non-conformities and complaints attributable to the supplier.

The qualification level is then calculated, inserting the evaluations on the Module 06007 Evaluation of Qualified Suppliers, carrying out the weighted average of all the aspects subject to evaluation, on a scale of integer values between **0** and **3.**

Each aspect, subject to evaluation, is assigned a different weight so as to highlight the aspects considered most significant and qualifying according to the type of product / service being supplied.

For particular products and / or suppliers it is possible to modify the weights related to the evaluation aspects to better highlight the specific criticality; in particular, if an evaluation aspect is not applicable to a supplier, the weights are re-calibrated to obtain 100%.

The evaluation relating to the Quality of the product / service is obtained on the basis of the qualitative judgment of the evaluation team and the index of non-conformities / complaints attributed to the supplier, assessed on the basis of the number of orders. The two values are averaged through appropriate weights defined according to the type of product / service being supplied.

For suppliers of untested products (for example, work on cards, modules and assemblies, for which finishing, and testing are carried out in Seica), only the defects resulting from bad workmanship are evaluated for the purposes of reviewing the qualification and in any case serious. The evaluation of serious non-conformities is the responsibility of the Quality Management Manager together with the Operations Director.

The final score results of the evaluation described above, briefly expresses the opinion on the supplier by the company.

Value Assessment is evaluated accordingly:

- *0 Not Approved, rejected***:** The supplier is canceled from the Qualified Suppliers Register and cannot be used for new supplies of critical products
- *1 Approved with reserve***:** The supplier is placed under observation with the same methods provided for in the initial qualification process.
- *≥ 2 Approved***:** The supplier is not in doubt as to the quality of the products or services supplied

This judgment is reported by the Quality office in Module 06007 Evaluation of Qualified Suppliers and also tries to update the Qualified Suppliers Register Module 06001.

Qualified suppliers are the only ones to which the company tends to place orders for re-held critical products.

However, the company, based on the answers to the Supplier Questionnaire Module 06004, can also place orders with suppliers that are not yet qualified, allowing them to become qualified if they make repeated deliveries over a year without non-compliance.

This eventuality may be necessary in the case of special conditions such as:

- exclusive supplier
- availability for urgent or particularly flexible interventions
- technical assistance.
- supplier performance compared to those of competitors
- economic and financial capacity

An updated copy of the Qualified Suppliers Register must be kept by the Purchasing Department and managed in a controlled manner according to the criteria set out in operational procedure Documents of the Quality Management System.

The control and verification of what was purchased is carried out according to the criteria and operating methods, unless otherwise specified for the specific supplier in the Qualified Supplier Register.

The supplier that meets the above requirements must be informed of any non-conformities encountered on the material, product or service supplied, receiving from Seica written communication of the non-compliant situation.

3.7.3 Audit to suppliers

Audits must be performed at suppliers from:

- The Quality Management Manager, if deemed appropriate, before the cancellation of a supplier from the Qualified Suppliers Register;
- the Purchasing Manager (or his appointee) and the Quality Management Manager, in the event that, following the annual assessment, there has been a lower qualification transfer on product suppliers that involve special processes.
- the Purchasing Manager, if the information for the initial qualification of a new supplier is not sufficient to express a complete assessment of the supplier's capacity to meet Seica needs. After a survey on its activities and on the Company Quality System, it expresses an opinion of merit, to be reported on the Audit Report as Supplier Module 06003.

3.7.4 Material purchase process

Material purchase process include input data and in the face of production orders, issued by the Planning Function, of stock and warehouse commitments the company information system, ARCA, calculates the material and service requirements for a given period and issues Purchase Requests. The purchase requests issued by the MRP program of the information system are verified and integrated by the Planning Function, approved by the Operations Director and sent to the Purchasing Office for the issue of purchase orders.

In addition to Production Purchase Requests, the various Company Functions may issue Material Purchase Requests for any need. The specific procedures for the authorization and issue of Purchase Requests are described in the IST 1002 Operating Instruction.

Once the Purchase Requests have been received, duly approved, the Purchasing Department issues the orders in accordance with what is indicated in the IST 1001 Operating Instructions and with the following methods:

a) for the primary materials the order is issued to the company selected through the IT management system (Order / Purchase Order) highlighting:

- Order n °;
- Date,
- Delivery time;
- Shipment; Delivery;
- Type of payment;
- Terms of payment;
- Cost center,
- Analysis item or order number,
- Material code in order;
- Description of the material,
- Quantity,
- Unit price,
- Possible discount;
- Notes on the control or other documentation that must accompany the goods;
- Possible type of packaging.

b) for consumables (stationery, cleaning, lubricants, glues, silicone, gaskets, screws, rivets, tin wire, etc.) the order is immediately issued to the wholesaler based on the conditions initially agreed:

- The purchase order referring to the offer;
- Supplier data; is always issued through the information system, ARCA software.

The processing account is managed by the Planning Department in collaboration with the Purchasing Office. The Purchasing Office issues the processing account to the supplier on specific request of the Planning Department stating:

- The contractual conditions;
- Payment methods;
- The technical characteristics of the work;
- Delivery terms;
- penalties, when agreed;
- Supply of materials;
- Technical control documentation.

The third-party supplier, when requested, must be provided with the operating instructions relating to the controls to be followed during processing and the forms for the documentation of the execution of said controls. These forms must be filled in with the processed product if required.

The economic and contractual aspects relating to processing account orders are managed by the Purchasing Office in collaboration with the Planning Department.

Order management and closing: the quantities delivered and referred to the same order are loaded onto the information system by the Arrivals Office upon entry of the goods.

The documentation produced by the supplier must clearly refer to the company's order number and must be archived, in order of number and sub-order by delivery dates, by:

- Purchasing Office for order confirmations and any communication relating to the order;
- Arrivals Office for Transportation Documents;
- Quality Management Manager for quality documents;
- Administration for administrative documents.

The closing of the supply and / or processing account is done automatically by the Arrivals Office on delivery of all the goods in order. In the event of orders having residues, the Purchasing Department, after consulting the Planning Function, requests evasion with the delivered goods.

Orders issued are archived in original by the Purchasing Office for a period of 5 years and are transmitted to the Arrivals Office through the information system.

3.7.5 Incoming inspection process

The incoming good delivery arrive to in arrival office with packaging and delivery note after verification of DDT timber and order number if the result is positive it will be forwarded for further inspection otherwise refused the delivery. The delivery information's shared with quality control office and warehouse. Quality control office verify the quantity, order number and identification of materials after verification in quality control office if there is found any non-conformity than order is registered in a Module 10020 inbound inspection.

3.7.5.1 Document Control - Visual Quantity

a) Checks on arrival of the material

The Arrivals and Forwarding Office receives the Transport Document (DDT) from the transporter, carries out a first examination of the correspondence of the number of packages indicated in the transport document and a visual check on the integrity of packaging and in case of discrepancy, not clarified by the courier, refuses delivery. If there are no problems affix the following stamp on the transport document (DDT):

Seica arrival office

day - month – year

with control reserve

b) Unloading of the material in a specific area

The authorized material is unloaded from the vehicle and deposited in the specific "Acceptance Control" waiting area identified by the specific indicator sign. the Arrivals and Forwarding Office verifies the existence of the order of the material arrived, checking the copies of the orders sent to it by the Purchasing Office (at each issue). In the absence of the order, the Purchasing Department is notified and is awaiting provisions.

The Arrivals and Forwarding Office notifies the warehouse and the Acceptance Control Office (ACO) of the delivery.

c) Check integrity and correspondence to the order

The Acceptance Control Office carries out the following checks and checks:

- Arrival date check,

- Identification of the material, on the packaging and in the packaging,

- Verification of the quantities and correspondence to the order,

- Visual verification of the integrity of the material in the packages,

- Verification of the presence of any accompanying documentation required: declarations of conformity for materials with CE marking, technical sheets for finished products, etc.

3.7.6 Check in Acceptance on incoming products

The provisions contained in this paragraph are applicable to all purchasing products in the catalog and / or on the manufacturer's specifications (electrical and electronic components, accessories, equipment, electronic modules and assemblies, cables, pins, fasteners and hardware).

Checks during the incoming inspection:

The Acceptance Control Office fills out the Module 10020 Incoming Inspection and Non-Conformance Detection form or affixes the test attestation stamp on a copy of the bill in the following cases:

- The technical data sheet of the component (Mod 04007) prescribes controls other than those provided for in the Document Control - Visual Basic section
- A non-conformity is detected
- Is specifically prescribed by the technical data sheet
- Specific tests are indicated for the supplier in the Qualified Suppliers Register.

In the Module 10020 model or on the stamp of attestation of the tests all the data of the order and the type of control to perform (indicated in the technical sheet) are reported.

In other cases, the Acceptance Control Office stamps the check on the DDT:

- Seica S.p.A. check Acceptance
- Outcome positive or Negative and Signature Date

In accordance with the relevant technical data sheet, some products must be subjected to parametric checks in addition to those provided for in the Document Control - Visual Basic section;

The Acceptance Control Office performs the parametric sample checks and uses, in some cases, production support in order to perform such checks.

The execution of the tests must take place as described in the processing instructions / or specific tests.

The Module 10020 or the copy of the DDT on which is affixed the stamp of attestation of the test report:

1. supplier
2. reference to the DDT
3. reference to the order
4. product code
5. description
6. date and signature of the controller.

The test instruction shows:

- list of controls and / or verifications
- equipment to be used for the execution of controls
- methods of carrying out checks
- possible normative references
- registration document
- acceptance criteria.

Note: parametric tests are always carried out on materials from unqualified suppliers and on materials of a supplier, even if qualified if the required documentation is missing.

3.7.6.1 Check in Acceptance on semi-finished products and electronic assemblies on account of machining and printed circuits.

The provisions contained in this paragraph are applicable to all products and semi-finished products assembled according to Seica specifications, in particular PT electronic boards, AA assembled assemblies, WC wiring, PM mechanical parts and PC printed circuits.

Checks during the incoming inspection**.**

a. electronic boards**:** The Acceptance Control Office fills out the Module 10025 Project Progress and Non-Conformance Detection form which contains all the order and lot data.

The electronic boards that are assembled outside are subjected to the checks indicated in the Document Control - Visual Basic paragraph, as well as to the checks indicated in IST-1109 Welding verification procedure and in the standard IPC-A-610 Acceptability of Electronic Assemblies.

The Acceptance Control Office performs checks on each individual lot sheet and may use Production support to perform these checks.

b. printed circuits**:** The Acceptance Control Office fills out the Module 10042 Inbound Inspection of Printed Circuits in which it shows all the order and lot data. (IPC-A-600G (2004)).

The printed circuit boards are subjected to the checks provided for in the Document Control - Visual Basic paragraph, in addition to the checks indicated in the IST-1110 printed circuit verification procedure and in the IPC-A-600 Acceptability of Printed Boards standard. (requirements for Class 3).

The Acceptance Control Office performs checks on each individual printed circuit of the lot.

c. mechanical parts**:** The Acceptance Control Office fills out the Module 10020 Incoming Inspection and Non-Conformance Detection form or affixes the test attestation stamp on a copy of the bill, showing all the order data. The mechanical parts are subjected in addition to the verifications provided in the Document Control - Visual Basic paragraph, to the parametric checks indicated in the technical sheet (if present) and to the dimensional checks in accordance with the mechanical drawings. The lot number of the parametric checks is indicated in the technical sheet while the dimensional checks are carried out on a piece for each new lot.

d. assembled assemblies and cables**:** The Acceptance Control Office compiles the Module 10020 Incoming Inspection and Non-Conformance Detection form or affixes the test attestation stamp on a copy of the bill, in order to include all order and lot data. (IPC/WHMA-A-620A (2006)).

Assembled assemblies and wirings are subjected to the checks foreseen in the Document Control - Visual Basic paragraph, to the controls, where applicable, indicated in:

- IST-1109 Welding verification procedure
- IST-1115 Cable and wiring inspection
- IPC-A-620 Acceptability of Electronics Wire Harnesses and Cables.
- IPC-A-610 Acceptability of Electronic Assemblies.
- Relative technical sheet

The Acceptance Control Office performs checks on each product in the lot.

3.7.7 DDT registrations

The Arrivals and Expeditions Office records the incoming DDT on the information system so that it is available to the Administration for the verification of competence and after arrival to office DDT has communicated to different departments to review the order has been issued from your office .The DDT of the material sent to the warehouse is archived by the Arrivals and Forwarding Office in the appropriate binders.

3.7.8 Quality registration documentation for Controls and instrumental tests

The Acceptance Control Office keeps the following documents:

- Test certificates,
- product data sheets,
- declarations of conformity, when present,
- Module10020, Module 10042, Module 10025,
- Copy of the DDT with the stamp of attestation of the tests

The Acceptance Control Office delivers to the Quality Management Manager a copy of Module 10020, Module 10042, Module 10025, Copy of the DDT with the stamp of attestation of the tests in the case of detections of non-conformity on the lot.

The Quality Management Manager keeps the documentation as established in the Quality Manual Documented Information. In the event of non-compliance, the Quality Management Manager proceeds according to what is prescribed in the Quality Manual Checking Non-Conforming Outputs.

The state of the material following the checks described above is identified by the Module 10020 model, by the Module 10042, by the Module 10025 or by the copy of the DDT with the stamp of attestation of the tests.

3.7.9 Storage

The Acceptance Control Office places the controlled materials on the appropriate shelf and warns the Warehouse. The Warehouse transfers the materials in the warehouse and records the delivery in the information system by placing the material in the available location.

Products that do not comply with the receipt are segregated in specific areas defined in the Quality Manual Identification and Traceability.

The Purchasing Function, in collaboration with the Quality Department, provides for their management in accordance with what is described in the internal operating procedure Checking the non-conforming product.

Any product that is injected into the production cycle due to urgency or other particular causes without having undergone the incoming checks, must be registered in the special register of uncontrolled incoming materials Module 10009 which shows:

- Registration date and signature
- Code and description
- Quantity
- Supplier
- DDT reference and Purchase order
- Job order / Target product.

With regards to non-critical products, unless otherwise indicated in the technical data sheets, the acceptance check simply concerns the verification of the correspondence of the type and quantity between what is indicated on the shipping documents and what is actually delivered.

3.8 Sampling plan on components, materials and finished products

Acceptance checks during the entrance inspection are carried out in accordance with the sampling-nature methods indicated on:

a) Register of qualified suppliers

b) Technical Data Sheet file relating to each product.

The incoming checks will always take place, taking into account the most restrictive degree of control between that indicated on the component's Technical Data Sheet and the indication included in the Register of Qualified Suppliers.

Choice of sampling and determination of acceptability.

The sampling plans are determined considering the number of the lot, the impact that the product can have on the final quality and the cost-effectiveness of the controls.

The methods used on the components, materials and finished products are the following:

1. The sampling plan on products, established in accordance with the UNI ISO 2859/1 standard provide for:

- The number of units to be examined for each lot (i.e. the sample size)
- The criteria for accepting the lot (i.e. the Na acceptance number and the Refusal number Nr).
- The sample size is determined using a Current Test level equal to II.

- The acceptance and rejection number are determined using:
  - Simple sampling plan,
  - Ordinary, Reduced or Reinforced Testing according to the switching rules indicated in the UNI ISO 2859/1 standard
  - Acceptable quality level (AQL) indicated in the Product Data Sheet.
- In the case of non-compliant units found in the sample, it is equal to or less than the acceptance number, the lot must be considered acceptable. If the number of non-compliant units is equal to or greater than the refusal number, proceed according to the number of the lot and the production requirements:
  - To a second check using a Simple sampling plan and Reinforced test with AQL level equal to that indicated in the Technical Sheet
  - For a second complete inspection of the lot

We therefore proceed with the detection of non-compliance and, as the case may be, with the rejection of the entire lot or only the defective parts.

2. For products that include indications in the technical data sheet of the complete lot, the only defective product is rejected, and the non-conformity is detected.

In some cases, Production and Quality Management managers can jointly decide on the entire batch.

3. For products that include sample checks on the lot (n / lot) in the technical sheet, proceed as follows. The finding of at least one defect involves a second check on the complete lot and the reject of any defective products. The detection of non-compliance is in accordance with what is defined in the Quality Manual Control of Non-Conforming Outputs.

3.8.1 Sampling plan on semi-finished products and electronic assemblies on account

The limited number of lots and the impact that defects can have on the final quality of the products entails checks on the complete lot.

In the event of a finding of defectiveness, only the defective product is discarded, and the non-conformity is detected. In some cases, Production and Quality Management managers can jointly decide on the entire batch.

Sampling takes place according to the sampling methods indicated in the following documents, considering the order of priority:

- In the register of qualified suppliers (CONTROL SUPPLY CHECK)
- In the Technical Data Sheet file relating to each product.

3.9 Process indicators

In order to ensure that the process maintains the requisites necessary to guarantee quality levels of services and activities adapted to the Policy and the Quality Objectives defined, the Company has established to monitor the following indicators of effectiveness and efficiency:

- Non-Conformities detected in Production on incoming inspected products.
- Non-compliant supplies detected during incoming checks or during the production cycle, due to incorrect purchase referring to the calculation methods, periodicity and the reference values indicated in the Module 20004 Process indicators calculation sheet.

3.10 Archiving of Documents

Supplier evaluation and supplier Audit Reports Are Quality Registration Documents and are filed by the Purchasing Office in the manner described by above Operational Procedure. Incoming inspections and non-compliance detection of incoming supplies are archived instead by the Quality Management Manager in the event of defect detection. The Qualified Supplier Register is updated and archived by the Quality Office.

Module List: Seica has different modules list and has been given numbers and they are revised by each department when they update data because these modules are present in the form of excel files and word. By strictly speaking about quality of supply chain we are only interested in quality modules in which data of suppliers given along with different characteristics and requirements to evaluate critical level and level of quality of supply chain products and services.

Module 06001 Qualified Supplier Register of Seica

Module 06002 Supplier Qualification Tab of Seica

Module 06003 Supplier Audit Report of Seica

Module 06004 Supplier Questionnaire of Seica

Module 06005 Purchase Order of Seica

Module 06007 Evaluation of Qualified Suppliers Seica

Module 06006 Request for Purchase of Material of Seica

Module 10009 Register of uncontrolled materials in input of Seica

Module10025 Work Progress and Non-Conformance Detection Seica

Module 10020 Inbound Inspection of Seica

Module 10042 Inspection in Printed Circuits of Seica

CHAPTER 4

KEY PERFORMANCE INDICATORS OF SUPPLY CHAIN SEICA

Supply chain performance indicators are key tools for monitoring and improving the supply chain performance to gain competitive advantage (Taylor, 2004, p. 173). According to Wang, Heng and Chau (2007, p. 333), performance indicators support supply chain management (SCM) goals and provides useful information on long-term decisions. It effectively links supply chain partners to achieve breakthrough performance in satisfying end-customer needs and provide feedback regarding customers' needs and the supply chain's capabilities (Wisner, Tan & Leong, 2008, p. 486). Aramyan, Alfons, Lansink, Van der Vorst and Van Kooten (2007, p. 304) asserted that performance indicators are the criteria with which performances of products, services and production processes are evaluated. Indicators of supply chain performance have an important role to play in setting objectives, evaluating performance, and determining future courses of actions (Lee, Kwon & Severance, 2007, p. 444).

Using indicators for the measurement of SCM performance creates an understanding of supply chain's processes, guides collaboration efforts and optimises supply chain excellence (Fawcett, Ellram & Ogden, 2007, p.409). As indicated by Gunasekeran and kobu (2007, p.2820), ''No measures, no improvement,'' and it is necessary to measure the right things on the right time in a supply chain. The effectiveness of a company supply chain management can be measured in different ways and the measurements chosen by a company are usually specific to the kind of business being done, so they will include those aspects of effectiveness which are most important to the business. For instance, a company focused on transportation would probably want to measure it on time deliveries, and a company focused on sales might prefer to measure inventory against customer service. In general, though, the key performance indicators established by a company illustrate the gap between planning and execution in the supply chain and are metrics set up to monitor one or more of the following: Cost, value, service and waste. There are more than 200 KPIs identified by the supply chain management and some of the them are commonly used KPIs which are relatively independent of the kind of business being conducted.

4.1 Critical key performance indicators for best supply chain management

Selecting the right key performance indicators for supply chain analytics isn't an exact science by any means. It's a process that requires companies to clearly identify goals and then develop the performance indicators that allow you to track your progress towards those goals.

- *Quality:* Quality is conformance to requirement or fitness for use. According to Hugo, Badenhorst and Van Biljon (2004, p. 165), managing product quality in the supply chain is the shared responsibility of all participants. Managing quality in the supply chain is the integration of the quality philosophy of the supplier quality system, the internal system of the vantage point firm and the quality the customer expects. Some of the indicators of quality include a formal quality assurance system, continuous improvement, statistical process control, six sigma limits, fail-safe lot traceability and incoming quality assured (Hugo et al., 2004, p. 166).

- *Customer service:* This KPI is monitored at the enterprise level and is comprised of demand variability, supply variability, and performance to plan. The favored approach to measuring customer service in its broad sense is with metrics for on-time full deliveries which are the most meaningful aspect of customer service. The overall goal of the two enterprise-level KPIs is to manage total delivered cost and customer service against the strategic goals of the company.

- *Flexibility:* Flexibility in the supply chain is its agility in responding to random changes in the marketplace in order to gain or maintain competitive advantage (Wisner, Tan & Leong, 2012, p. 451). Flexibility is thus a performance dimension that considers how quickly electrical and electronics manufacturers can respond to the unique needs of customers (Jonsson, 2008, p. 89). Flexibility has become particularly valuable in new product development. Some organisations compete by developing new products faster than their competitors. This requires supply chain partners who are flexible and willing to work closely with designers, engineers and marketing personnel (Bozarth & Handfield, 2006, p. 30). Supply chain response time and production flexibility are two indicators for flexibility (Cohen and Rousell, 2005, p. 208).

Supply chain response time measures the number of days it takes a supply chain to respond to marketplace changes without cost penalties (Bowersox, Close & Cooper, 2010, p. 392).

- *Innovation:* Innovation in the supply chain ensures that existing technologies, as well as technologies under development, always face the possibility of being pushed aside by alternative developments. In order to assess the technological and market potential of a given technology, its respective electronic parts must be analysed in terms of the key technologies being used, current trends and future innovations. Innovation involves research and development and originates mostly with suppliers.

- *Supply variability:* This kpi measure the status of inventory against conformance to lead times and promise dates. According to Wisner et al. (2012, p. 517), order delivery lead time encompasses the fulfilment of the average percentage of orders among supply chain members that arrive on time, complete and damage-free, satisfying customer requirements. Order lead time is an important and significant source of competitive advantage for top-performing supply chains and their member companies (Handfield, Monczka & Giuinipero, 2011, p. 746). Included are metrices for performance to the production plan, schedule attainment, asset utilization, capacity utilization, and item availability at all stocking locations.

- *Operating cost:* Cost is an important performance supply chain indicator. All department costs are rolled up in this metric, including distribution costs, procurement costs, warehousing costs, transportation costs and manufacturing costs. From these, it is possible to calculate cost of goods sold, cost per unit, or cost per kilogram, which are all useful kpi relative to total cost. Cost control and cost reduction capabilities must be intrinsic to structure, processes, culture and technology foundation for an organisation to survive and thrive.

- *Product variety:* According to Wisner et al. (2012b, p. 58), product variety measures the number of product families processed in a facility. Processing costs and flow times are likely to increase with product variety. Owing to the "law of variety" (satisfied customers changing brand because of variety attractiveness), many automotive manufacturers have extended their product range to retain clients, whereas the number of variants per car model grows as well. This affects the complexity of service offers, as well as the complexity of service operations, for example, mechanical parts (Godlevskaja, Van Iwaaden & Van derwiele, 2011, p. 66).

4.2 Supply chain of Seica

Several Performance measuring factors are used in industry to evaluate the progress and growth of all types of processes involved in an industry. Strictly speaking, in the context of electrical and electronic company Seica include supply chain quality management. These performing measure indicators are identified on the basis of their relevance and importance to the overall performance of the company. The 'performance indicators' term is now replaced by the new term KPIs in the industrial domain because of management's sole interest in the critical and key factors in the manufacturing company system.KPIs drive the industry towards success and play a more vital role in improving a company's efficiency and profitability. In this era of competitiveness electrical and electronic manufacturing industries are very keen to know the key factors of their supply chain to attract more customers. To have a better chance of self-assessment and improvement, identifying and evaluations the critical KPIs for their suppliers is the key.

There are more than Eight hundred suppliers of Seica company which supply different products and provide different services some important supplier of Seica are:

- ABCI s.r.l
- Alfamation spa
- Axiomtek Italia srl
- Barletta apparecchi scientifici srl
- Bridge srl
- Cognex Ireland Ltd
- Cpe italia spa
- E.v.r di Vassallo Roberto
- Esse B.M. srl
- Euporom srl
- Eurogi srl
- Feasa enterprises Ltd
- Gps Pruftechnik Rhein/Main Gmbh
- Igus srl con socio unico
- Ing. Pietropaolo & c. sas
- Ingun distribuzione srl
- Itw Eae USA (Vitronics)
- ITW EAE, A Division of Illinois Tool works, inc. (Speedline)

- ITW EAE, A Division of Illinois Tool works, inc. (Vitronics)
- Jet air service spa
- La technika due srl component elettronici
- Mectronix pte Ltd
- Micro mega electronica srl
- Modus high-tech electronics Gmbh
- National instruments srl
- Noffz technologies Gmbh
- Ombi srl
- Omron Europe B.v
- Pezzatti impianti elettrici snc
- Proxima s.r.l
- Quick test corporation
- Reed exhibitions china Ltd, Shanghai branch
- Rockwell automation srl
- Rohde & Schwarz italia s.p.a
- Rs components srl
- Seica automation srl
- Seica inc
- Spc group di vogliano igor
- Tecna srl
- Tecno master spa
- Tlm srl

Beside these, lists of supplier's chains are present in excel file. I have evaluated cost value of last two years of supply chain of Seica in which i assumed a scale of value 3 which represent high for those suppliers whose value of last two years is equal or greater than 100000 euros according to the instructions of quality manager. Similarly, I assumed value 2 as an average supplier who value of two year is greater or equal to 10000 euros. Value 1 represent low value of suppliers less than 10000 euros (Evaluation list of supply chain Seica in excel file). I evaluated result of last two years of supply chain of Seica by following the instructions of my quality manager. To Evaluate total value of KPI supply chain of Seica I followed these rates:

Total value = Critical products 30%+50% value of cost+20% number of orders.

After evaluation of values among suppliers we concluded that Omron Europe B. V supplier has the highest value and it supply Omron spare parts, raw materials, semi-finished assemblies and assemblies from external manufacturer. Similarly, L.B.A srl evaluated as an average supplier and it provided raw materials, boxes, accessories and packaging to Seica company.

4.3 Different products or services provided by supplier's chain of Seica

Seica has different suppliers which provided different products and services and some of the most important materials and services provided by different suppliers to Seica are:

- Cable connectors, Cables, cabling, Change adjustment, Connectors, Connectors for printed circuit boards, Consulting business, Consumables, Diode, Discount on purchases, Electrical and electronic small parts, Electronic control design spare parts, Exhibitions, External services, External work account for cabling, finished plates and mechanical parts, Ferrules, Filters, Finished plates and products, Fixture, Furnishings, Fuses, Inductors, Integrated circuit, Interfaces, Leasing fees, Maintenance fees, Measurement Tools, Mechanical parts and assemblies, Modular connectors, Motor, Power supplies, Printed circuit, Probes, Projects, Raw materials for mechanical parts, Relay, Resistances, Safety materials ,Screws, Semi-finished assemblies, Sensors, Software, Small equipment, Switches, Sponsorship, Tools, Transformers, Tools, Transistors and web service and internet subscriptions etc.

4.4 Structure of the code

Seica has given a structure code to each product and Each code consists of alphanumeric characters so used and each character represent different characteristics of products and services.

1	2	-	4	5	6	7	8	9	10	11	-	13	14

- 1 and / or 2: alphabetic characters that describe the product category of the object
- 4-11: alphanumeric characters that uniquely describe the characteristics of the object
- 13.14: numerical characters that describe the release of the object
- Only upper-case characters can be used

- The alphabetical character "O" cannot be used to avoid confusion with the numeric character "0" (zero)
- The numeric character "0" (zero) or "X" fills the unused boxes
- The alphabetical character "X" fills the boxes if the encoding criterion is not followed
- Usable characters ABCDEFGHIJKLMNPQRSTUVWXYZ0123456789 & $. All other characters cannot be used.

4.5 Definition of product categories (characters 1 and / or 2)

Seica has different product categories and each of the category is represented by their symbols and some of them are for internal uses of Seica and some of symbols have been chosen for external working. Some of the products are very important and use daily in Seica (consider Tab.1).

1	R*	Resistors
2	C*	Capacitors
3	D*	Diodes
4	LH	Inductances and core
5	KL	Rely
6	TR	Transformer
7	JJ	Connectors for cables
8	JC	Connector for printed circuit
9	SW	Switches
10	FF	Fuses and fuse holders
11	FT	Filters
12	WM WS WW	Cables
13	Q*	Transistor
14	IC	Integrated
15	PC	Printed circuit boards
16	PT	Finish plates
17	MR	Furnitures, rack and related accessories
18	PM	Mechanical parts

19	AC	Boxes, accessories and packaging
20	ML	Electronic small parts
21	ME	Electrical small parts
22	AA	Semi-finished assemblies
23	AE	Assemblies from external manufacture
24	PS	Power supply
25	PF	Finish products
26	M	Motors
27	SN	Sensors
28	SM	Measurement tools
29	VV	Screws
30	MM	Raw material
31	MP	Raw materials for mechanical parts
32	PP	End sleeves
33	PR	Receptacles
34	PN	Pneumatic parts
35	LS	Screen printing operations
36	LV	Processing painting
37	BR	Brochures and leaflets
38	AT	Tools
39	AP	Application programme
40	TA	Tastatori
41	AA	Interface
42	FX	Fixture
43	MA	Manuel
44	Z	Software
45	0E	External work account
46	0I	Internal work account
47	AM	Mechanical assemblies

Table: 1 Product categories

CONCLUSION

The purpose of my thesis was to evaluate key performance indicators of supply chain seica. Every company measure different key performance indicators for their supply chain management but Seica company considered three KPIs most critical for their suppliers. i.e. Quality of critical products, cost and number of orders at different rate. I focused on the quality of critical products and services of the supply chain of Seica and evaluated quality level of the last two years because quality is an essential requirement even if it cost more for the attraction of more customers. Besides this Cost and number of orders are the key requirements for Seica company. After evaluation of total value of the last two years the results revealed that, overall, Cost was considered the most important key performance indicator, followed by quality of critical products and then number of orders for seica. I also concluded that the workflow and goals of companies can be quite different depending on the industry that they operate in KPIs often vary greatly as well. In fact, they can even greatly vary within the company itself. Selecting a right KPIs is a process that required companies to clearly identify goals and then develop the performance indicators that allow you to track your progress towards their goals. The process of selecting the right KPIs for Seica company can't be underestimated but in order to facilitate improvement across the company, data need to not only be accurate, but useful as well. We focused only on three KPIs of supply chain Seica in runtime. For a future good supply chain management, I proposed the quality manager of Seica to increase percentage rate of these three KPIs and as well as increase numbers of KPIs i.e. Responsiveness, Innovation, product variety, Asset management and final product delivery reliability because these numerous key indicators are used to determine the progress towards achieving its goals and objectives, and to compare performance against other businesses in the industry. KPIs provide an objective way to measure how a business is performing. Without them, there wouldn't be an effective way to determine problems or adjust accordingly and just like any other area, supply chain analytics have their own set of the most important KPIs.

REFERENCES

Public Documents

Aramyan, L. H., Alfons G. J. M., Lansink, O., van der Vorst, J. G. A. J., & van Kooten, O. (2007). Performance measurement in agri-food supply chains: A case study. *Supply Chain Management: An International Journal, 12*(4), 304-315.

Barbarino, F. (2001). UNI EN ISO 9001:2000. Qualia, Sistema di gestione per la qualità e certificazione, Il Sole 24 Ore, Milan.

Bititci, U. S., Mendibil, K., Nudurupati, S., Garengo, P., & Turner, T. (2006). Dynamics of performance measurement and organisational culture. International Journal of Operations and Production Management, 26(12), 1325–1350.

Bolstorff, P., & Rosenbaum, R. (2003). *Supply chain excellence: a handbook for dramatic improvement using the SCOR model*. New York: Amacom.

Bozarth, C. C., & Handfield, R. B. (2006). *Introduction to operations and supply chain management*. Upper Saddle River, NJ: Pearson Prentice Hall.

Burt, D. N., Petcavage, S. D., & Pinkerton, R. L. (2010). *Supply management*. Boston: McGraw-Hill Irwin.

Cohen, S., & Rousell, J. (2005). *Strategic supply chain management: the five disciplines for top performance*. New York: McGraw-Hill.

Fawcett, S. E., Ellram, L. M., & Ogden, J. A. (2007). *Supply chain management: from vision to implementation*. Upper Saddle River, NJ: Prentice Hall.

Franceschini, Galetto, Maisano (2019). *Designing performance measurement systems. Theory and practice of key performance indicators*. Springer

Godlevskaja, O., Van Iwaarden, J., & Van der Wiele, T. (2011). Moving from product-based to servicebased business strategies: Services categorisation schemes for the mechanical parts. *International Journal of Quality and Reliability Management, 28*(1), 62-94.

Gunasekaran, A., & Kobu, B. (2007). Performance measures and metrics in logistics and supply chain management: A review of recent literature (1995–2004) for research and applications. *International Journal of Production Research, 45*(12), 2819-2840.

Hugo, W. M. J., Badenhorst-Weiss, J. A., & Van Biljon, E. B. H. (2004). *Supply chain management: logistics in perspective* (3rd edition). Pretoria: Van Schaik.

IPC-A-600G (2004) Acceptability of printed boards. (Developed by the IPC-A-600 Task group (7-31a) of the product assurance committee (7-30) of IPC.

IPC-A-610-E (2010) Acceptability of electronic assemblies. (Developed by IPC-A-610 development team including Task group (7-31b), Task group Asia (7-31Bcn) of the product assurance committee.

IPC/WHMA-A-620A (2006) Requirements and acceptance for cable and wire harness assemblies.

ISO 9000:2015. (2015). Quality management systems – Fundamentals and vocabulary. Geneva:

ISO. Norma UNI EN ISO 9001:2015 Control of processes, products and services provided externally.

Jonsson, P. (2008). *Logistics and supply chain management*. London: McGraw-Hill.

Petersen, J. A., Mcalister, L., Reibstein, D. J., Winer, R. S., Kumar, V., & Atkinson, G. (2009).

Choosing the right metrics to maximize profitability and shareholder value. Journal of Retailing,85(1), 95–111.

Taylor, D. A. (2004). *Supply chains: a manager's guide*. Boston: Addison-Wesley.

T. Gama and V. Cavenaghi, "Measuring performance and Lean Production: a re-view of literature and a proposal for a performance measurement system," in *Pro-ceedings of the Production and Operation Management Society (POMS) 20th An-nual Conference*, 2009.

UNI 11097. (2003). *Indicatori e quadri di gestione della qualità*. Milano.

Wang, W. Y. C., Heng, M. S. H., & Chau, P. Y. K. (2007). *Supply chain management: issues in the new era of collaboration and competition*. London: Idea group.

Wisner, J. D, Tan, K-C., & Leong, G. K. (2012). *Principles of supply chain management: a balanced approach* (3rd edition). Mason, Ohio: South-Western Cengage Learning.

Web Links

https://www.seica.com/it/

https://www.seica-na.com/

http://www.proxima-ate.com/azienda.html

http://www.seica-automation.it/

http://www.seica.fr/

http://www.smt.com.cn/

https://www.omron.com/

https://www.itweae.com/

https://www.quicktest.com.tw/

https://insights.brook.ie/blog/critical-kpis-for-the-best-supply-chain-management-process.

https://selecthub.com/supply-chain-management/5-kpis-supply-chain-analytics-tools/

Documents from Seica

Quality manuel documents seica 2018
Seica Istruzione Operativa per verificare cicuito stampo Rev.1 del 19/11/2007.
Seica Istruzione Operative per la ispezione di ingresso di cavi e cablaggi Rev.2 del 09/05/2018.
Seica Istruzione Operativa per manuale di codifica Rev.20 del 16/11/2018.