POLITECNICO
MILANO 1863

Ingegneria Industriale e dell'informazione

MASTER DEGREE COURSE in

MANAGEMENT ENGINEERING

STREAM : **INDUSTRIAL MANAGEMENT**

A.Y. : 2015/2016

"DESIGN OF A COST ACCOUNTING SYSTEM AT RAPITECH S.r.l."

Developed by : Marco Donizetti

matricola 841755

Academic tutor : prof.ssa Deborah Agostino

TABLE OF CONTENT

EXECUTIVE SUMMARY

The thesis starts with an introduction of the objective of the work : the design of a cost accounting system, applied on a real case (during an internship program at a local company). The introduction highlights briefly which are the scope of the work done and what was effectively developed during the internship.

After the introduction, the thesis continues with a presentation of the basic theory necessary for the understanding of the work done. Basically an overview on cost accounting and its elements is done, underlining also why it is important and how it is applied in small and medium-size companies. All the theory part is supported by academic literature that gives another instruments for sustaining the thesis developed.

Finally, the design of the cost accounting system is presented, referring to the internship program. All the steps are described, showing all the choices done and the reasoning behind them. Tables and graphs are shown in order to demonstrate effectively the subdivision of cost centers, the drivers choice and the mechanism for the evaluation of the unitary product cost.

Before concluding, the use of cost accounting are presented. In particular:

- a trend analysis of some relevant voices (cost accounting for supporting decisions);
- efficiency indicators for the centers, in order to monitor performances of centers overtime;

The thesis finishes with the conclusion in which the utilities of the work developed are presented, both for the company itself and for other companies, naming the literature that supported this work.

THANKS

Before starting with the presentation of this thesis, I want to thanks all the people that with their work allow me to reach this goal.

First of all I want to thanks my family that supports me in these years of studies and allow me to complete them in the best way, supporting both psychologically and economically, giving me the right advices.

It is important to thanks also all the people around me during these years, such as friends and colleagues that played a fundamental role with the positive environment that facilitates my success.

Speaking more in detail about this final thesis work I want to thanks Luigi Pescosolido and his wife Daria that give me the possibility to understand and implement what I studied on books at university in their company Rapitech S.r.l. and to present it in my final thesis.

Then I want to thanks my friend and collegue Lorenzo Riccardi that works with me during the internship program at this project developing with me what will be presented in the next chapters.

Finally, my academic tutor prof.ssa Deborah Agostino that supports and helps me during these months of writing of the final thesis.

1. INTRODUCTION - THESIS OBJECTIVE

The objective of this thesis is the design of a system of cost accounting. In particular the work is referred to the case of small metal mechanic companies. The scope of cost accounting is in first place operative, that means that helps the management of the company to take efficient and effective decisions (support decision making). The work starts with an analysis of business costs of the company in the first place in order to identify the resources of the chart of accounts and then, following the cost accounting steps, to reach the unitary cost of each product, passing through the division of the company in cost centers and the allocation methodology chosen for allocating costs to the final product. The main issue is related to cost allocation, in particular of indirect costs (overheads)that can generate problems. Considering the context a full costing methodology has been chosen and applied. Instead, as regards the allocation methodology, a traditional method has been considered the most appropriated.

The analysis was carried out during an internship program at a local company, Rapitech s.r.l. This analysis is particularly important for the company for different reasons. In fact, in this way Rapitech, a little manufacturing company located in Lecco producing fastening systems, can apply an appropriate price. Secondly, an accurate analysis of the business costs, can bring out some critical issues, that can be studied in order to understand the cause and so to take the correct management decisions. Once made this analysis it is important to try to understand what can be improved in the company and make proposals based on the logic of continuous improvement .

At this point cost accounting can help management of the company in supporting decisions making behaviors (e.g. trend analysis) and in taking actions that can monitor the performance of the company (e.g. efficiency indicators).

In particular the company asks to pay attention to the issue of transport and for this reason my proposal was to evaluate the unitary costs with and without the "transport cost item" in order to clearly see what is the entity of the impact that this item has on the unitary product cost in order to put the company in a position to implement a different pricing policy: propose a price not including transport and one with transportation paid by the company itself. This way the end user can do his accounts and evaluate which proposal is the best in his case. After an accurate analysis this solution cannot be applied, so an alternative has been found (price list).

This work is not an innovation in general but is an innovation for the company in which it is applied: a cost accounting system, a method to reveal and evaluate costs, to detect them,

consideration and monitoring of some costs voices of the last years to see the trend and the variation (trend analysis) , consideration about the transport problem (price list) and the quality of the products delivered by the company. All these elements are fundamental in a logic of continuous improvement and can help to take efficient and effective decisions. Literature suggests that a cost accounting system is very important and it is needed also in small companies because general accounting is not sufficient. Cost accounting can help management understanding what really succeed in the company and for this reasons , as it has been already said, support decisions and lead to correct pricing policies. Of course the system used is simple and effective for the context of the small company that does not have an office dedicated to costs and that for this reason cannot apply sophisticated methods. The literature also in this case support what has been developed. In fact, frequently small and medium size companies prefer using a full costing methodology with traditional allocation cost methodology instead of using ABC or other innovative solutions that are useless in this context (the detailed literature citations will be presented in the first chapter).

The thesis starts with an overview on the basic concepts related to cost accounting (theory and literature part).
The second part is related to the methodology adopted and to the research setting : it starts with the presentation of the company, its organization and the production process.
Then, finally, the hearth of the work is presented : the phases of the cost accounting system designed are explained in details.
Before concluding some possible uses of cost accounting are shown.

2.THEORY : COST ACCOUNTING

This section, as said before, aims at introducing to cost accounting. It starts from the basic elements of accountability and arrives to describe each part of cost accounting.

2.1 INTRODUCTION TO COST ACCOUNTING

This part aims at introducing to basic concepts of costs and planning in companies, explaining why it is so important nowadays to detect costs. Accordingly, it is structured into three main sections. The first section presents the definition of costs and their classification; the second part discusses the structure of a cost accounting system; the third part shows the research setting of the work.

2.1.1COST DEFINITION AND CLASSIFICATION

Before starting, a premise is needed. It is possible to distinguish between two kind of accountability : general accounts and cost accounting .

GENERAL ACCOUNTS : monitor all the facts between the company and the external environment.
COST ACCOUNTING : monitor only facts of internal nature. It aims at complete general accountability .

This system (cost accounting) wants to determine all the costs of each single part of the company (organizational unit, activity, product).
(In my/our work we evaluate unitary product costs).
In particular cost accounting has three main objectives:

- Evaluate the value of WIP and finished products inventories; in order to do this it is fundamental that a company can determine the degree of usage of the materials and its value;
- Monitor organizational units performances;
- Evaluate the profitability of the different products in order to decide the correct product mix and make or buy choices;

As already said, the scope of this thesis is the design of a cost accounting system. Before introducing in details cost accounting and its structure, an explanation of the definition of costs and the different classifications is needed.

The costs in which a company occurs are related to the resources' consumption in order to obtain the final product. So, in general terms, a cost can be seen as the value of resources used to create a good or supply a service. In other words, cost is the value of money that has been used up to produce or supply something.

There are a lot of cost classifications. According to their nature a first distinction is between product costs and period costs:

- **Product costs** are related to all the costs incurred, directly or indirectly, in the production of a good or service . Labor costs, material costs and overhead (OVH) are product costs.
- Instead **period costs** are the costs not directly related to creation of the good but necessary for the development of the structure : administration, selling expenses, research and development cost.

In details, products costs are composed by:

- Direct material costs : consists of the amount of material used for the creation of that product, valued at a purchase unitary price. Direct materials differs from indirect materials that are resources used in the production process but not directly related to the final product (e.g. lubricating oil);

- Direct labor cost : consists of the objective amount of labor related to the product, valued at a labor hourly cost;

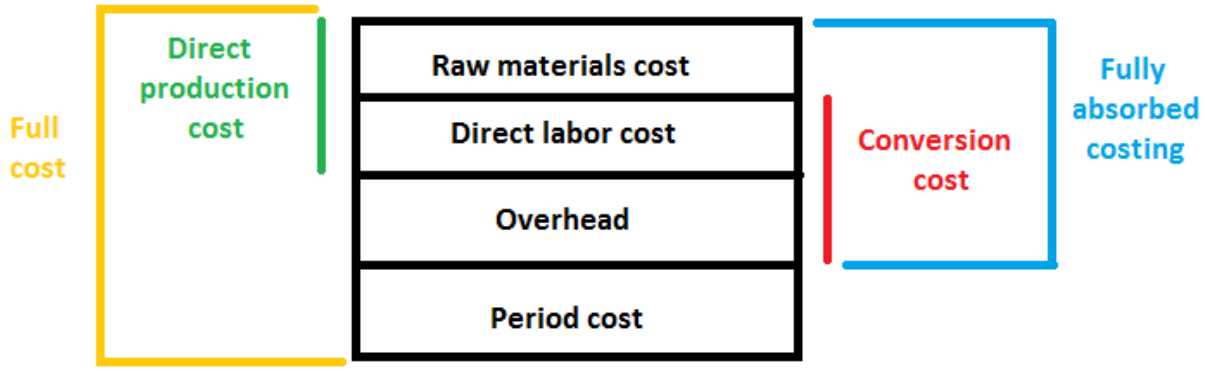
- Other direct costs : all costs that can be directly linked to a product;

- Overhead costs : consists of all the general production costs (e.g. indirect labor cost: cost of people that are not directly involved in the production process but that with their work allow it).

Direct material costs, direct labor cost and other direct costs are called direct production costs while overhead are known as indirect production costs.

The other category of costs are period costs : all costs related to resources not related to the production process, e.g. administrative costs or marketing costs.

The allocation of direct and indirect costs to an output determines the fully absorbed costing of a product. Then, adding to this the allocation of period costs full cost is determined.



Picture 1 : cost classification

Another classification is between:

- **Variable costs** : they are those costs which , in a given period , varies continuously and proportional to the volume to which they are related.
- **Fixed costs** : they are those costs which remain constant , regardless of the volume to which they refer .

VARIABLE COSTS	FIXED COSTS
Costs that vary proportionally to volume. They are related to resources consumption, e.g. direct material cost.	Costs that do not vary with volume, e.g. taxes

Picture 2 : variable vs. fixed costs

2.1.2 THE RELEVANCE OF COST ACCOUNTING

In order to better understand the importance of designing a cost accounting system it is important to understand why it is important to detect costs in a company and which costs can help the decision making process. The literature supports this thesis with different reasons. An example, only to cite one, comes from an article published in 2009 by Giancarlo Barbarisi entitled "Cost control : why is it so important in a company?". In fact, in the article the author said that cost control is one of the most important functions in a company and that it is crucial not only for the price choice but also in order to understand what really succeed in the company. He continues saying that a cost accounting system is needed nowadays. It is a powerful management instrument that can help to:

- control costs
- control prices
- control efficiency
- plan company activities
- control activities development
- give information

He concludes saying that only general accounting is not sufficient because it only suggests the cost of production factors without highlighting the factors that concur to the total cost of a product. It is for that reason that is necessary put beside a cost accounting system in order to help the management of the company to take efficient and effective decisions.
In addition to this, a cost accounting system is not crucial only for manufacturing companies. An article of 2009 written by Zamberlan, C.O., Zamberlan, J.F. highlights the importance of controlling costs also in small agricultural companies. This thesis is supported by the authors with a real case study.

In particular ,nowadays it is very important to control costs because of different factors :

- new production techniques;
- new products, new markets, more competitors;
- the increasing costs;
- Other issues;

All these factors have made essential the adoption of control systems in order to minimize unitary product costs. In fact frequently company failures are related to a lack of cost control.
Company activities have to be planned and controlled and the main tools to help in this are :

- Techniques for detection and recording data ;
- Techniques for Planning and Control;
- Organizational Techniques;

The purpose of a control system is to reduce costs. The cost reduction encompasses all business sectors . The screening shall be extended to all corporate activities ; each sector will adopt it according to its own characteristics .
The problem of control becomes complex because of :

- the lack of adequate tools for the work measurement ;
- the impossibility of use of traditional measuring instruments ;
- the particular characteristics of the job ;
- the non-rigidity of the production rate;

The costs can only be reduced by controlling the tasks that everyone is required to carry out and quantities of inputs used in the production process . By controlling tasks, it is possible to reduce costs closely associated with the office work , because:

- Everyone is responsible for the work that has been entrusted for ;
- The work is distributed on the basis of attitudes ;
- The work is measured by the time needed to do it , so it is possible to establish a standard time for the task ;
- Rational studies on tasks are done , in order to make faster and more streamlined work procedures ;
- studies are carried out on the working environment in order to make it more comfortable ;
- procedures are fixed , so the work can be done smoothly and without wasting time .

The volume control allows the company to reduce costs related to the actual production process because :

- quantitative standards of factors to be used are set;

- detections of the machining times are carried out;
- analysis of the working times and of the quantity of the products are carried out;
- studies on the efficiency of the machinery are carried out ;
- studies on waste are carried out ;
- studies on raw materials and other materials are carried out;
- workers are recruited on the basis of two main factors : qualifications and costs;
- It prevents the accumulation of excess inventories ;
- Quality of products is more uniform .

The company in order to plan and manage activities needs to know its cost structure, so it is important to understand which cost depends on.

It is used to distinguish between:

- variable costs VC, that depend on volume and have unitary cost constant in the short term :

$$VC = Cu * Q$$

- fixed costs FC, that do not depend on production volumes.

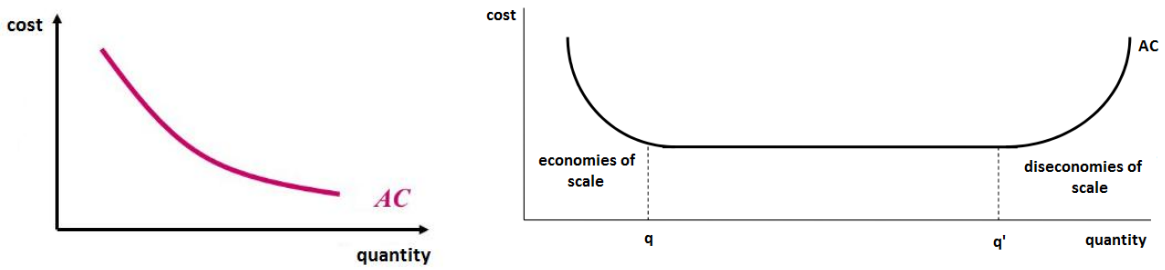
So total cost TC of a company are :

$$TC = VC + FC = Cu * Q + FC$$

This is real only under the hypothesis that in the short term period it is possible to consider constant the unitary cost. There are some cases in which this is not possible. An example is represented by economies of scale:

$$C(Q) < C(Q_1) + C(Q_2)$$

Economies of scale is when producing the total quantity Q is less costly than producing the two quantities Q1 and Q2 separately, given Q1 + Q2 = Q. This means that the average cost AC in this case is a decreasing function in relation to quantity(costs decrease increasing quantity).



Picture 3 : economies of scale

Usually economies of scales are the result of an increasing productivity of resources increasing volumes or to a decreasing of resources prices.

The output level after which the reduction of cost AC is not significant is called minimum optimal demand (in Italian domanda ottima minima DOM, represented in the picture by q) and represents the production volume under which it is possible to exploit consistent economies of scale.

There are different kind of economies of scale:

- pecuniary;
- real;

The former are related to cost advantages in the raw material procurement phase, e.g. companies that produces big volumes can have more bargaining power with supplier. Instead, the latter are related to the fact that increasing production volumes increase productivity of the system, e.g. plant productivity of some process technologies that increase more than linearly in relation to output quantity. When economies of scale in a sector are always verified (for each possible distribution of the production output) there is a natural monopoly.

Instead, multiproduct or scope economies are :

$$C(Q_A;Q_B) < C(Q_A) + C(Q_B)$$

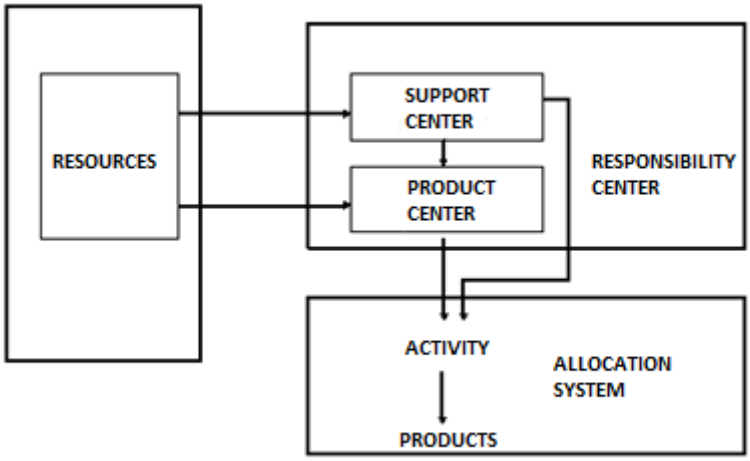
Scope economies is when producing the two lots Qa and Qb is less costly than producing the two products A and B separately. The strengths of scope economies are synergies related to :

- raw material consumption;
- energy;
- other common resources;

2.2 THE STRUCTURE OF A COST ACCOUNTING SYSTEM

This system is composed by three main parts:

- Chart of account(piano dei conti) : it is related to the acquisition of a resource
- Responsibility center : costs are classified on the basis of the destination; this means that each center contains costs related to activities done in that center;
- the cost of each responsibility center is divided among the different products made in that center in a reference period of time *t* (allocation system);



Picture 4 : cost accounting system structure

This reference scheme leads to four main consequences/choices:

- chart of account(piano dei conti) : choices in relation to resources to be used for the different products and organizational units;
- modality for the enhancement of resources : prevision vs. actual;
- centers : use a method in which all the centers are considered equal or one in which centers are distinguished between support centers and cost centers;
- choices in the cost allocation;

In the conference paper " The issue of overhead costs allocation according to labour inputs in target costing of metallurgical production " published in 2014, the authors Kutáč, J. , Samolejová, A., Stoch, D., Andruška, L. explain that the OVHs allocation is used for target costing through two main phases : in the first one OVHs of supporting cost centers (named "secondary centers") are

allocated to the production cost centers (called "primary centers"), and then in the second phase OVHs of primary cost centers are allocated to products. Commonly, labor input bases are chosen.

2.2.1 RESOURCES AND COST CONFIGURATION

Width of chart of account has consequences on the tradeoff between completeness and specific responsibilities; more the number of resources higher the completeness, but if some resources are not controlled costs do not really reflect the principle of specific responsibilities. It is preferable to maintain a wide chart of account maintaining a clear distinction among voices. In this way it is possible to use, thanks to new technologies, different cost configurations based on specific objectives.

2.2.1.1 COST CONFIGURATION : FULL COSTING VS. DIRECT COSTING

It's important to know product costs firstly in order to set the price in an appropriate way. In fact if you do not know exactly the amount of your product costs the risk is to set a price too high that does not correspond to the value of the good, or too low that means losses and in the long term could lead to the company failure.

There are two main different cost configurations to determine the product costs : full costing or direct costing. The first is the most used and it is calculated as raw materials cost plus labor cost plus a quota of general expenses :

$$C = c_{mat} + c_{lab} + c_{exp}$$

- C = product cost;
- c_{mat} = raw material cost;
- c_{lab} = labor cost;
- c_{exp} = quota of general expenses cost;

In this way the price of the product is chosen starting from the product cost adding the markup desired:

$$P = C + markup$$

The second technique instead considers only variable costs while fixed ones are considered as period costs. In this case the final price has to be set in order to fulfill not only variable costs but also fixed costs (period costs) and this represents the main difference between the two techniques. The innovation of direct costing regards period costs : price is not set on the basis of global cost but on the logic that it has to cover both variable and period costs.

Using the technique of full costing, direct costs and general costs are allocated to single products. Considering direct costs there are no problem of allocation, while taking into account general costs it is important to distribute them choosing an allocation base. The sum of direct costs and general costs gives the total costs; subtracting from the price the so obtained cost we find the mark up.

Instead using the technique of direct costing , variable costs and fixed costs are considered. Subtracting from the price the variable costs we obtain the contribution margin and subtracting from the so obtain cost the fixed costs we find the profit. The focus is on the contribution margin; in fact more is the contribution margin and more will be the profit because period costs are fixed.

FULL COSTING
Raw material
Direct labor cost
Other expenses
Production cost
Administrative cost
Cost of sales
Price
PROFIT

DIRECT COSTING
Price
Raw material
Labor cost
Other variable expenses
Variable cost
Contribution margin
Other fixed expenses
Administrative expenses
Period cost
Profit

Table 1 : full costing vs. direct costing cost configuration

In conclusion the difference between full costing and direct costing is the consideration about fixed general costs: for direct costing these costs are considered as period costs and not directly allocated to the final product while for full costing general fixed costs are considered as product costs and so the pricing choice has to take into account them.

To sum up:

- DIRECT COSTING: minimize errors due to the fact that allocates to single product only direct costs;
- FULL COSTING : highlight the fact that in a company indirect activities have a cost that has to be taken into account;

FULL COSTING VS. DIRECT COSTING - ADVANTAGES AND CONSTRAINTS (of the two methodologies)

ADVANTEGES	
DIRECT COSTING	***FULL COSTING***
Objective cost information	More appropriate for pricing decisions
Support short-term decisions	More appropriate to evaluate stock level
More flexibility in terms of pricing choices	Better nowadays because variable costs are decreasing
Facilitate evaluation of variable costs' trend in relation to the economic situation	Indirect costs allocation could have a behavioral impact
Facilitate evaluation of fixed cost trend in relation to changes in the company organization	
Facilitate market economic evaluation	
Facilitate planning	

Table 2: full costing vs. direct costing advantages

DISADVANTAGES OF FULL COSTING

- OVH allocation problem : choices among different criteria;
- discourage managers in the usage of common resources;

FULL COSTING MODALITIES :

- Full costing single base: each category of fixed cost is allocated to each product using the same allocation base;
- Full costing multiple base: different allocation bases for each cost category;

In literature different studies speak about full costing and cost allocation problems. An article of Morrogh, Ken and Zhu, Zhiwei, entitled " Full-cost pricing: a pricing strategy for a job shop ", shows that a job shop using direct cost as a basis for pricing choices faces problems with ensuring that all the overhead cost are covered. Applying a full cost methodology instead allows pricing to be based on full cost of the company so that the so obtained prices cover, with some degree of certainty, overhead costs. This is In line with the choices done during the work.

The allocation of indirect costs is one of the most critical and crucial part. As said by Osadchy, E.A., Akhmetshin, E.M. , in one of their works published in 2015, " the system of allocation of indirect costs is one of the key moments of management accounting and control as impacts significantly on the effectiveness of activities of various segments of the organization".

Generally in order to allocate indirect costs volume - based bases are used (e.g. machine hours). This choice usually regards the traditional accounting. This tendency is confirmed by a study of 2006 conducted on product costing practices lead by John A. Brierleya, Christopher J. Cowtonb, Colin Drury, entitled " A comparison of product costing practices in discrete-part and assembly manufacturing and continuous production process manufacturing ". In fact, in the part of the study concerning the allocation of the indirect costs and the bases used what emerges is that in Europe the most popular bases used among companies are "direct labor based or other volume based". In particular, after carrying out an accurate analysis, the research shows that "Direct labour hour rates were used significantly more often in discrete-part and assembly manufacturing, and units produced and production time based rates were used significantly more often in continuous production process manufacturing."
What emerges in this study is in line with the choices taken for the allocation bases, as will be shown in the next chapters.
The Motivations of this choice are that this system is : simple, immediate, easy to understand and detect, appropriate for the context, most used, confirmed by literature.

It is confirmed also by Kutáč, J. , Samolejová, A., Stoch, D., Andruška, L. that in the conference paper " The issue of overhead costs allocation according to labour inputs in target costing of metallurgical production " of 2014, said the most commonly used allocation base includes labor input.

2.2.1.2 RESOURCES EVALUATION : HISTORICAL COSTS VS. STANDARD COSTS

Another distinction is between systems based on historical costs and standard costs. In the former, actual values of resources are detected while in the latter a prevision with a target cost is carried out. Standard cost is defined as the theoretical cost that the company is able to reach in order to obtain the desiderate level of output in normal conditions.
Standard cost systems lead to:

- More efforts in the planning and design phase, in particular for companies which have a wide product mix, variable in time and frequently subjected to process innovation;
- Less efforts in the costs' detection, timeliness;
- Results are less precise; (low precision of results)

It exists an hybrid solution called "normalized costs system": direct costs are evaluated considering the actual costs while indirect costs based on standard coefficients.

2.2.1.2.1 STANDARD COST EVALUATION

Standard cost is evaluated during the planning and design phase considering an ideal production cycle (it does not consider extraordinary events).

The standard chosen has to be :

- Reachable and sensible in order to be an incentive;
- Related to the specific characteristics of the technological process;

Standard cost is calculated according to three voices:

- standard costs of direct material;
- standard cost of direct labor;
- standard cost of overhead;

2.2.2 RESPONSIBILITY CENTER : SUPPORT CENTER AND PRODUCT CENTER

It is the elementary unit of a company. It can be a department, a part of it, a group of machines and people or every operative unit. Cost centers or responsibility centers are autonomous units considering the costs in which they incur.

The main requirements of responsibility centers are :

- homogeneity from the technical and economic point of view;
- presence of a responsible;
- relevance;

In order to choose the responsibility centers is important to consider two different logics: from one side is better to have more centers in order to collect more data, but on the other side too much centers means too heavy measurement systems. The optimal number is that after which is not possible to collect relevant data.

It is effective for:

- Give to a responsible the resources management ;
- Organize production;
- Cost control;
- Define tasks and responsibilities;
- Identify with simplicity diseconomies;
- Cost centers structure can be designed according to different features:
- Type of production;
- Company organizational structure;
- Technologies adopted;
- Planning and management system.

Responsibility centers can be divided into :

- Product center : the relationship with product/service is direct, e.g. job shops in which there is the physical transformation of the products;
- Support center : give support to other organizational units (not directly involved in the physical transformation) ;

Product centers are related to different phases of the productive cycle, have different people and machinery involved and a responsible. The choices of the cost centers in a company is important and have to consider its needs, avoiding too much centers.

2.2.2.1 RELATIONSHIPS BETWEEN SUPPORT CENTERS AND PRODUCT CENTERS

Responsibility centers are divided in : product centers and support centers. It is important to understand the relation between the two.
Generally in support centers is more difficult to identify the amount of resources consumed by one single products (e.g. salary).
It is possible to allocate directly costs of support centers to products (one phase system or passing through product centers, that are used as intermediate elements (two-phases systems).
In this case, in the first phase costs related to support centers are attributed to product centers: e.g. considering salary, the cost will be shared among product centers based on the number of workers. Later, costs of product centers, that comprehend costs of support centers, are divided among products. This method is heavier if compared to the first one, but can lead to more complete information. For this reason it is preferable to use this second system.
The main problem is related to the cross consumptions . There are four main approaches that differs in the way they consider the relationship among different centers:

- direct method;
- direct two-phase method;
- sequential method;
- matrix method;

2.2.3 COST ALLOCATION METHODOLOGIES

These techniques allow to quantify the amount of resources used during the production process and so the cost of the output.

There are different methods :

- Process costing (PC);
- Operation costing;
- Job order costing (JOC);
- Activity based costing (ABC);

The methods differ each other for the voices attributed to products on a cause – effect (causal) base or simply on proportional base, as shown in the table below:

METHODS	DIRECT MATERIAL	DIRECT LABOR	INDIRECT COSTS
Process Costing	Proportional	Proportional	Proportional
Operation Costing	Causal	Proportional	Proportional
Job Order Costing	Causal	Causal	Proportional
Activity Based Costing	Causal	Causal	Causal

Table 3 : cost allocation methods

For example Guajardo, M. and Rönnqvist, M. in one of their study of 2016 entitled " A review on cost allocation methods in collaborative transportation", affirm that in the transportation sector a simple approach for cost allocation is to use a proportional allocation that can be based on the overall volume or weight of the products transported. They make an analysis on collaborative transportation, in particular on cost allocation. What emerges from the study is that proportional methods are preferred, so usually in this area traditional methods are diffused.
Precision and different costs of the four methods increases from process costing (PC) to activity based costing (ABC), but also the number of voices for which the allocation is done casually.
Now each method will be explained making the hypothesis of FULL COSTING. As regards a DIRECT COSTING is the same but indirect costs have not to be considered.

The first three methods are traditional, while the fourth (ABC) is more recent and innovative. An overview of the different techniques can be useful.

PC

In this case there is an evaluation of the global cost of each responsibility center and of the product volume. The unitary cost (c) is calculated as the ratio between the global cost (C_{tot}) and the product volume (V) :

$$c = \frac{Ctot}{V}$$

The method is very simple in case of companies that produce only one product or with invariable WIP. In this case the volume is represented simply by the quantity of the final output. If there is variation in WIP level, is important to make a correction because it is not possible to sum the unit of final product with the one of WIP; in fact they have different values (WIP cost is lower). In order to solve this problem the concept of equivalent unit needs to be introduced : the WIP units are transformed in equivalent units of final product. In general :

$$N_{eq} = Q_c + \sum_{i=1}^{N} Q_i \cdot gc_i$$

- N_{eq} = number of equivalent units; it represents the output that the company will obtain if all the resources were used to produce only final products;
- Q_c = number of completed units in the period;
- Q_i = number of units at the i-th stage;
- gc_i = stage of completion of the i-th stage;

At this point, PC can have a different structure according to the choice of enhancement of WIP and final products. There are two methods : average cost and FIFO.

In the former case the unitary cost during the period of time *t* is calculated as follow:

$$c_u = \frac{C_{tot}}{N_{eq}}$$

Where :

$$N_{eq} = Q_c + WIP_f \cdot gc_{WIP_f}$$

$$C_{tot} = CA + CI$$

- CA = costs effectively sustained during the period *t* ;
- CI = costs related to the initial WIP ;

Instead in the FIFO logic, it is considered only the output realized during the period, calculated subtracting from the available quantity the amount of initial WIP:

$$N_{eq} = Q_c + WIP_f \cdot gc_{WIPf} - WIP_i \cdot gc_{WIPi}$$

In this case total production costs are only the costs effectively sustained during the period, without considering the costs related to the initial WIP:

$$C_{tot} = CA$$

The unitary cost of an equivalent unit is calculated as follow :

$$c_{u_{eq}} = \frac{C_{tot}}{N_{eq}}$$

JOC

As the name suggests, this method uses as element for the costs allocation job, that is composed by a single product unit or by a homogeneous product lot. To each job a sheet is associated, that follows it during each phase of the cycle. On the sheet, for each phase, costs sustained for the realization of the job are marked. In detail :

- Cost of direct material is determined based on the stock value;
- Quantity of direst labor is detected and the hourly cost of the worker is used as reference cost;
- Indirect costs are shared based on an allocation base, usually the direct labor;

Allocation usually follows two phases: in the first one the allocation coefficient is determined, that is the ratio between the indirect costs sustained by the cost center and the allocation base usage in relation to the job that passed through it :

$$ac * ba_j$$

- ac = allocation coefficient;
- ba_j= usage of the allocation base by the j-th job;

Simply reading the sheet it is possible to determine the total cost of the job.
Finally, summing the job related to WIP with the finished products present at stock it is possible to determine respectively the value of WIP stocks and finished goods stocks.

Job order costing is a precise method, especially when the majority of the cost components are direct material cost and direct labor cost.

OC

This solution represents a good compromise between the two methods shown above.
In this case, the cost of direct material of each product lot is detected directly when the lot is picked up from the warehouse, as in JOC. Instead considering conversion costs, the logic is similar to the one of PC. In fact, for each operation the conversion costs are determined, summing the direct labor costs and indirect costs sustained in the reference period of time. Then, the total cost of the operation is divided among the single lots realized during the period on a proportional base. In particular, in case of products characterized by an uniform usage of operations, conversion costs are shared proportionally to the produced quantity. Otherwise, time of the single operation is used as reference: an hourly cost for each activity is determined and used in order to calculate conversion costs.
Operation costing can be used to detect precisely direct material costs related to each product.
It is appropriated when:

- Cost of direct material represents an important part of the total product costs;
- The process has a limited number of activities;
- Production processes of different products are similar;
- Product lots are homogeneous;

ABC

ABC is the most precise method in order to determine product cost because all the costs are attributed to the products based on causal relations. In particular is more precise, if compared with other methods, the allocation of the indirect costs. This is supported by the literature of the last years that shows the effectiveness of this method if compared to traditional accounting, in particular for pricing choices. In fact, on one side an inaccurate allocation of costs between

products can result in inappropriate pricing decisions and on the other side the achievement of product-costing accuracy is, however, becoming increasingly difficult. This difficulty is due to different factors such as technology automation etc. and in this way the entity of overhead represents more and more a big part of the total cost of a company, as noticed by Cooper and Kaplan. It is in this context that ABC is promoted by literature for arising problems of this new environment.

In this case, it is assumed that exists direct proportionality :

$$C_{ind} = k * ab$$

- C_{ind} = indirect costs;
- k = constant of proportionality that represents the allocation coefficient;
- ab = allocation base;

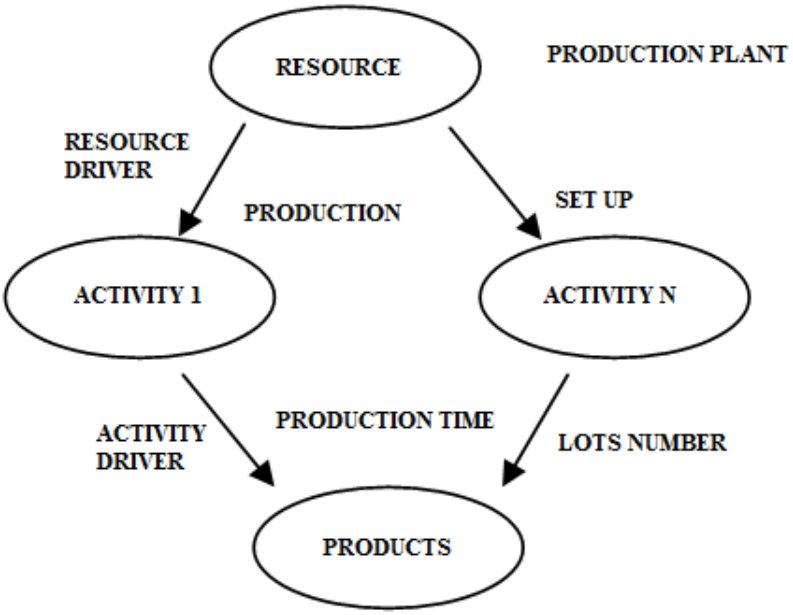
Unfortunately, the situation is not this in the realty. A traditional system tends to attribute indirect costs proportionally to volume, overestimating large scale production costs and underestimating product costs on small scale. This can lead to problems on the company competitiveness because in this way seems that products in a littler scale are more profitable, leading to dismissing of standard products in favor of customized ones.

ABC wants to increase precision of information. Of course, in order to have more precise information, costs increase. For this reason it is indicated where :

- Accounts information are more relevant;
- Innovation is crucial;
- Operates in dynamics environments;

An analysis conducted by Samaha, K. and Abdallah, S. in 2011, entitled " A comparative analysis of activity-based costing and traditional costing systems: The case of egyptian metal industries company" , compares ABC results with traditional accounting (volume based) ones in an Egyptian metal industry company. In fact traditional accounting, as said before in other paragraphs, can lead to price distortion. In particular the study highlights that volume based methods underestimate low volume products and overestimate high volume products while ABC, tracing overhead consumption, lead to more precise results.

In addition to this, as emerges in a study conducted by José A. Botín and Marcelo A. Vergara entitled " A cost management model for economic sustainability and continuous improvement of mining operations" , ABC can be adopted with other tools, such as the PDCA (plan do check act) Deming cycle in order to develop a cost management system for continuous improvement of operational efficiency and cost reduction. Their study was conducted on a mining company in Chile and they show their results in " A cost management model for economic sustainability and continuous improvement of mining operations", in which they prove the efficiency of adopting the two methods together in a logic of continuous improvement. In fact " the combined application of these tools (ABC and PDCA)to mine operation management as proposed here, produced an innovative and powerful tool that stands out for efficiency and ease of application



Picture 5 : ABC methodology

In addition, other new methods or versions of already existing methods were born in the last years according to different needs. Literature speaks about time driven ABC (TDABC), just in time (JIT) costing and throughput accounting (TA), just to name a few.

TDABC

Speaking about TDABC, Kaplan and Andersen proposed the second generation of the ABC system, called "TDABC" .This approach uses time drivers and would overcome some drawbacks of ABC. Using directly the words of the authors of this new techniques, In this revised approach, managers directly estimate the resource demands imposed by each transaction, product, or customer rather than assign resource costs first to activities and then to products or customers. For each group of resources, estimates of only two parameters are required: the cost per time unit of supplying resource capacity and the unit times of consumption of resource capacity by products, services, and customers. At the same time, the new approach provides more accurate cost-driver rates by allowing unit times to be estimated even for complex, specialized transactions. Otherwise, it has some limitations, such as difficulties in calculations, unavailability of reliable time drivers, variety of time drivers etc. An article written by Mortaji, S.T.H., Bagherpour, M. , Mazdeh, M.M. in 2013, shows a new mechanism of TDABC. It uses a "fuzzy logic" to estimate inputs required for TDABC and highlights deviations caused by deterministic estimates in TDBAC and makes the estimations more realistic.

instead, another article written by Zheng-Yun Zhuang and Shu-Chin Chang in 2015, entitled " Deciding product mix based on time-driven activity-based costing by mixed integer programming" shows how to determine product mix using time drivers.

An interesting example of application is described by Somapa, S., Cools, M., Dullaert, W. in their article " Unlocking the potential of time-driven activity-based costing for small logistics companies " published in 2012. Accordingly to the article, TDABC is particularly useful for small companies because of the use of simplified parameters if compared to ABC. In addition, it is particularly useful in the road transportation and logistics sector, even if problems related to quantitative data remains. It is suggested to redesign the recording system in order to overcome that problems.

TA

Another innovative method is Throughput Accounting (TA), that was born and developed during 90' and early years of 2000. It is an approach that identifies factors that limit an organization from reaching its goal, and then focuses on simple measures that drive behavior in key areas towards

reaching organizational goals. TA was proposed by Eliyahu M. Goldratt as an alternative to traditional cost accounting. It is one field of theory of constraints applications, together with strategy development using soft systems thinking tools, production control and project management. It has the aim to support managers taking decisions for profitability improvement. In particular, Throughput Accounting uses three measures of income and expense:

- Throughput (T) that represents the rate at which the system produces units in order to reach the goal (e.g. if goal are money, throughput could be net sales less totally variable cost);
- Investment (I) is the money tied up in the system, that is associated with inventory, machinery, buildings, and other assets and liabilities.
- Operating expense (OE) is the money the system spends in generating the units. For physical products, OE is all expenses except the cost of the raw materials.

This method is well presented in the article " Throughput accounting: An overview and framework " written by Parkhi, S. , Tamraparni, M. and Punjabi, L. in 2016, in which an overview of the method is shown, identifying its barriers and developing a theoretical framework.

It is important to say that, as succeed frequently, TA was criticized, in particular by Linhares in 2009, that shows how TA was not useful in an expanding product mix situation (adding to the original situation of Blackstone elaborated in 2001 a product called Alpha). Hilmola, O.-P. and Li, W. in " Throughput accounting heuristics is still adequate: Response to criticism (Article)" published in 2016 answer to that critics demonstrating that throughput accounting still outperforms any other approach in this referred hypothetical situation, if overall capacity availability of a constraint resource and total throughput per week delivered are being considered.

Another article written by David Dugdale and T.Colwin Jones, entitled "Throughput accounting : transforming practices", published in 1998, analyzes the development of different forms of TA, discussing its potentiality in changing accounting practices. In particular the article makes evidence of this considering UK enterprises.

JIT

As regards JIT costing, it is related to the philosophy of lean thinking and "Do it right the first time" methodology. In general terms JIT is an inventory strategy that wants to increase efficiency and decrease waste. From a costing point of view, it is possible to speak about JIT purchasing, that is a cost accounting strategy where you purchase the minimum amount of goods to meet customer demand. of course, in this case the supplier will deliver smaller shipments more frequently. A paper published by Rajendra Todalbagi , named " JIT & KAIZEN Costing", explains these concepts. In particular it highlights that JIT has the aim of identifying and eliminating wastes and that Keizen is a continuous improvement process. following this line, Keizen costing is based on continuous cost reduction in order to create value for the customer. In addition, the paper makes comparison between Keizen costing and standard costing and then between Keizen costing and target costing, demonstarting the supremacy of this innovative accounting method.

2.3 APPLICATION TO THE RESEARCH SETTING : COST CONTROL IN THE SMALL AND MEDIUM COMPANY

In a small company are not present big and structured administrative offices that can implement complex methods for evaluating costs. It is important to find simple but effective methods (efficiency + effectiveness). Usually small and medium companies are controlled directly by the owner and this limits the necessity of control. In this context cost control is based on the comparison between historical and current data, analyzing the trend along time. Possible decisions usually :

- act on those cost voices where the gap in comparison with past is more evident;
- analyze those voices where it is not clear the cause of the increase;
- search for the general causes that justify the increase in production costs;

It does not exist a department for the evaluation of costs: all depends on the evaluation of the administrator (owner) with maybe the help of some experts.

It can be useful to have a control prospectus if it is not difficult to detect costs and revenues. In particular the control system has to consider three main voices: revenues , costs, EBIT. It compares

budget previsions with effective values in order to analyze variation and try to understand the possible causes.
Literature suggests that in small and medium companies traditional methods are preferred if compared with more innovative ones. In an article of John B. Macarthur - "From activity - based costing to throughput accounting" published in April 1996, the author in the introduction highlights the fact that ABC, even if it is more precise, at least it is not cost-beneficial for small and medium realities because of all the additional data needed. in fact, in these realities, traditional accounting information can measure accurately enough for managers, in particular speaking about companies with little product or process diversification.

Another article published in 2015 by Beltrán, W.P.M., Kliemann Neto, F.J., Corrêa, R.G.F., Denicol, J. entitled" Cost management in small industrial enterprises: A case study on a company in the food sector " presents a case study on a small manufacturing reality, specialized in food production. In the article it is highlighted the importance of a cost accounting system in order to help the company in managing the financial, economic and accounting health of a small manufacturing company. It is important to make evidence that a pilot project is presented and the system created is in the view of continuous updating in order to be effective and useful.

This is real not only for small manufacturing companies. An article of 2009 written by Zamberlan, C.O., Zamberlan, J.F. entitled " Systems of costs in Agribusiness: A study in the area of the Fourth Italian colony", highlights the importance of controlling costs also in small agricultural companies. This thesis is supported by the authors by a real case study.

3. METHODOLOGY

This thesis starts from an internship program. The work was developed at Rapitech s.r.l., a manufacturing company located in Lecco that will be presented in the next chapter. The internship started at the end of September 2015 and ended at January 2016. During this period a project was assigned to me and my colleague, Lorenzo Riccardi. It consisted in designing a cost accounting system for the company in order to make an analysis of its business costs for arriving to define, in first place, the unitary cost of each product, considering all the different processes and variant. After that, a general look to the company in order to make proposals for improvements had to be done. In addition, the administrator asks us to focus on the transportation problem, related to the continuous increase of clients asking the company for the delivery at their expenses.

The majority of the internship time was devoted to the design of the cost accounting system and so to the analysis of costs in order to evaluate the unitary cost of each product. This was the focus of the project. Then, in order to make proposals for improvements, cost accounting was used for developing a trend analysis of some relevant voices(supporting decisions) and then also for evaluating some indicators in order to monitor the performances of the company. Of course, for this reason, a Pareto analysis was carried out . Starting from the trend analysis of the voice "transportation cost" a study on transportation was developed.

All the calculations and consideration were done on excel file, that are the starting basis for the development of this final thesis. In fact, this work is based on the steps followed into the company during the internship program and presents the methods chosen for carrying out this analysis, the considerations done and the conclusion of the work. The theory presentation is preparatory for the analysis of the work done. In particular, in the second part of the thesis will be presented the details about the methodology and results obtained. At the end of the project, an analysis of the quality was done, always related to the indicators presented for monitoring the company performances and to the continuous improvement logic. In fact, "doing the job right the first time is always cheaper", as said a Cosby, and for this reason he arrives to say that “quality is free” .

3.1 THE RESEARCH SETTING : DESIGN OF A COST ACCOUNTING SYSTEM AT RAPITECH S.r.l.

In this section the real design of the cost accounting system is shown. The work starts with the company presentation, then the accounting system elaborated is presented, with all the choices done.

3.1.1 COMPANY PRESENTATION

Rapitech was born in 1960, founded by Mr. Ratti and Mr. Piazza. Today it is one of the most important companies in the production and delivery of fastening systems. In particular the company produces small metal parts and it is leader in fastening systems. Its products can be used in different industries : automotive, household electrical appliances, machinery etc. There are different kind of finishing; the standard one is quenching (tempering), but according to the clients requests the company can deliver products with : white, yellow or black galvanization, phosphating or chrome.

There are two main type of customers :

- regular orders : frequently are big orders from usual clients and so easily manageable;
- unexpected orders : both small and big size orders from different customers maybe because they had problems with their habitual supplier ;

During the economic crisis of these last years, Rapitech S.r.l. demonstrates to be a solid company and to be able to deal with it in the best way. In fact, despite the crisis, the company is growing.

3.1.1.1 PRODUCTIVE PROCESS AND MAIN AREAS

Rapitech S.r.l. can be classified as manufacturing system because, as shown before, is specialized in the production of fastening systems and other small metal parts. It produces for lots because of repetitiveness in the product consumption. Of course, between one lot production and another , changeover are needed, considering the related time and costs, that are not negligible.

The different areas of the company are these:

- administration;
- technical office;
- three production departments (bend machine, cut machine, assembly machine);

- tempering department;
- packaging department;
- three warehouses (raw material, WIP, finished goods);

3.1.1.1.1 ADMINISTRATION

The administration is in charge of all the functions related to order management, production planning, warehouse, external manufacturing, accountability etc.
In relation to orders, a software is used (ESA). The software control in real time production, state of orders, warehouses etc. In this way the administrator has under control all the company.

3.1.1.1.2 TECHNICAL OFFICE

It deals with all the activities related to technical specifications (e.g. specification limits) in a continuous improvement view. Operators uses cad software for modeling and drawing molds and products. The operators in the technical office have two main tasks :

- design with AutoCAD software molds and products;
- plan and control of the machine for electrical erosion (elettroerosione);

The output of the technical office are : products, molds and molds parts drawings.

3.1.1.1.3 PRODUCTION DEPARTMENT

There are three production departments:
BEND MACHINE DEPARTMENT
In this area there are 18 bend machines that shear off and pierce raw material using defined molds based on technical specifications that comes from the technical office and then bend it. Also the changeover of the machine is done based on tables that comes from the technical department. The speed of the machines are between 60 and 120 bump/minute.
CUT MACHINE DEPARTMENT

There are 9 shearing machines in this department that shear off and pierce raw material using defined molds based on technical specifications that comes from the technical office. The work speed is between 80 and 260 bump/minute.

ASSEMBLY MACHINE DEPARTMENT

In this department are present 13 assembly machines that assembles WIP. The average speed of work is 60 pieces/minute.

3.1.1.1.4 RAW MATERIAL

The company uses mainly steel. The other materials used are : stainless steel and nichel – plate iron. Usually the company uses standard measures that are verified by the quality control when the raw material comes to the company. Of course it is not possible to control all the ribbon, so eventually problems on it can arise only during the manufacturing phase.

3.1.1.1.5 TEMPERING DEPARTMENT

This area is composed by : one furnace for tempering and recovering products, 4 dryers for removing oil from products and 3 ovens only for recovering.

The products are moved to and within the department with a forklift. The furnace/oven can work 600 Kg/day and it is composed by 2 parts : one for tempering products and one for recovering them. All kind of products can be tempered. The only thing to do is set the temperature and the time, based on the material and the particular product, and then download the case a time-based doser that puts the products into the oven in a quite precise way. After this phase products are ready for the finished goods warehouse. Depending on the client and the product, they can pass or not through the dryer. At the end of the tempering process an operator control the hardness of the product in order to verify if it meets specifications or not.

3.1.1.1.6 EXTERNAL PRODUCTION

There are some products that in order to be completed need some external production, such as zinc-coated or chrome. These productions are external because the company cannot do internally

and so it uses an external company (outsourcing of the production). These phase, if present, is the last one before the shipping phase. For some particular products the company buys some components.

3.1.1.1.7 PACKAGING DEPARTMENT

In the packaging department is present the finished goods warehouse and a packaging line. The products, based on type and depending on the quantity ordered by the customer, can be packaged with different cases of different size : small, medium and large. Products that comes from the assembly department are already counted and packaged.
In this department there are also two computer, one with a management software that control all the movements of the finished goods present in the warehouse and so, in this way, monitor the level of product available; the second is used for processing orders the and for printing tags.
The two durometers are used in order to verify the hardness of products after the tempering process.

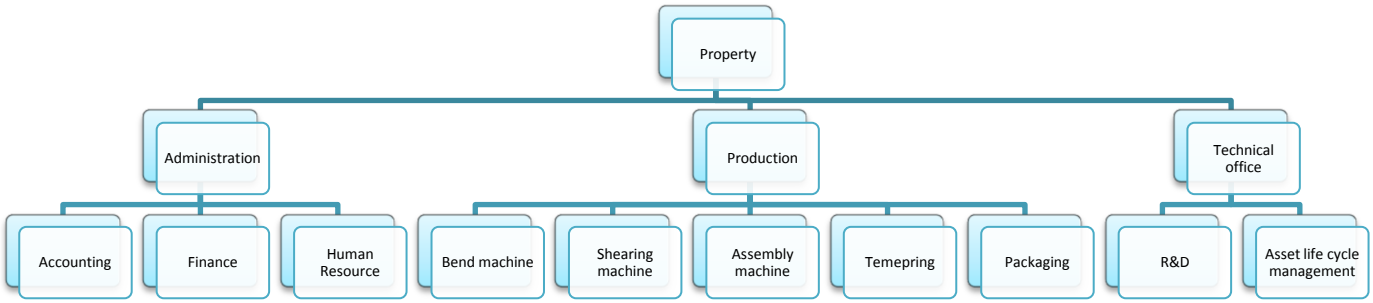
3.1.1.1.8 WAREHOUSE

As already said, in the company there are three warehouses ; one for raw materials, one for the WIP and finally one for the final products. A brief analysis of each of them is needed.
RAW MATERIALS WAREHOUSE
In this warehouse is possible to stock 40000 Kg (2000 Kg/shelf x 20 shelves). There are two main parts, one for raw materials use in the shearing machine department and the other for the raw materials of the bend machines department. There is no logic behind the way of stocking the raw material: the product is put on the shelf with space, only maintaining more or less the division among different materials.
WIP WAREHOUSE
In this warehouse is possible to stock 252 containers (36 cont./level x 7 levels). The way of stocking is equal to the one of raw materials warehouse.

FINISHED GOODS WAREHOUSE

In this warehouse is possible to stock 160 containers (10 containers per 4 levels and 4 rows),85 large cases (17 large cases per 5 levels) and 65 small cases (13 small cases per 6 levels). Also in this case there is no logic behind the choice of where to put the products. All the products are stocked in the different containers. Firstly, they are put in a container where the number of pieces is indicated; then, when the material is packaged sometimes a part of the material exceed. In this case material present in surplus is put in large or small cases (based on the quantity). The products assembled are stocked already packaged because during the assembly they are counted and packaged in a predetermined way. This products generally stay in the warehouse for little time because products are assembled only to answer to an order.

3.1.2 ORGANIZATIONAL CHART OF THE COMPANY



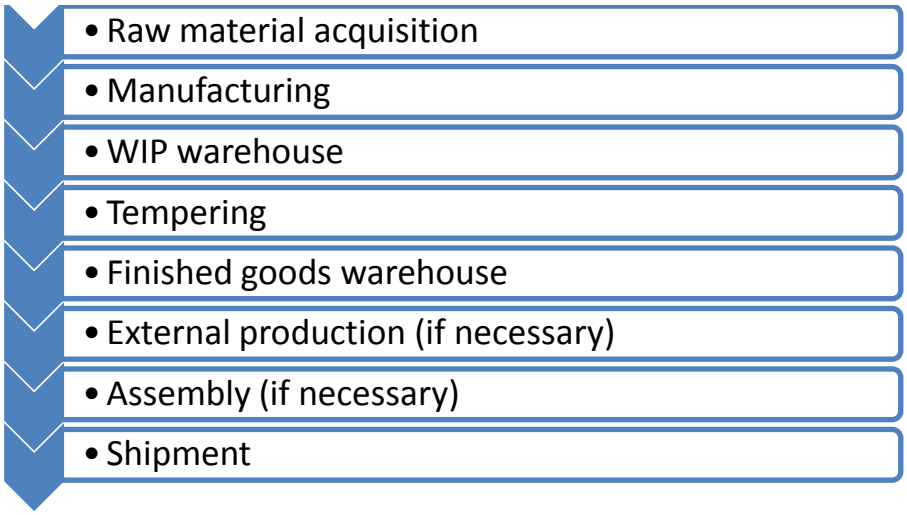
Picture 6 : organizational chart of the company

The organizational chart of Rapitech srl can be approximated at a simple structure that is characterized by the division of labor based on the degree of skills and uses as coordinating mechanisms mainly mutual adaptation, the direct supervision and standardization of capacity . His strength is flexibility . Otherwise , the Rapitech srl fits perfectly in the context of small businesses to which is typical the organization described .

This establishment has the following features :

- Few organizational units ;
- Operational management ;
- Efficiency and standardization ;
- Direct supervision and mutual adaptation

3.1.3 ORDER MANAGEMENT



Picture 7 : order management flow

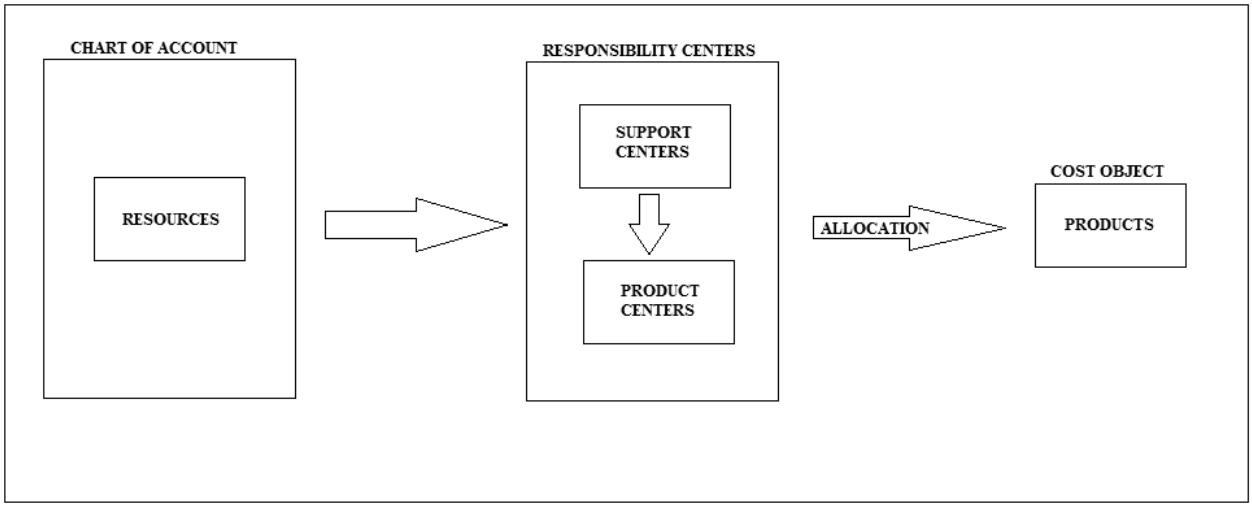
Generally companies contact Rapitech S.r.l. in order to have a budget and to check the availability of products requested. The management system allows the administration to detect the level of quantity of all the warehouses: in this way is possible to make an estimation of the delivery date (e.g. if the product is present at the finished goods warehouse until one week, depending on the charge of work of the packaging department). If the client agrees with the conditions he has to send and order via fax or e-mail. In case the product necessary was not present at the finished goods warehouse, a production order has to be sent in order to start the production. The responsible of the production checks if the quantity of raw material needed to make the products is present at the materials warehouse; in this case he starts the production of a lot of the products needed .The quantity of the lot depends on the quantity of final products requested by the customer and if a part of it is present at the finished goods warehouse or not; a part from these conditions usually the company tends to finish the tape of raw material because suspending could lead to problems with the loading of it. Of course, before starting with the production a changeover on the machines interested is needed. All the production until the WIP warehouse is done generally without an order request. Then, the last part of the production process (from tempering) is done following the orders. When the product has been subjected to all the final processes necessary it is stocked in the finished goods warehouse, waiting for the packaging phase and the shipment. Until few years ago shipment was totally in charge to the client. In the last years some client asks to the company also the shipment.

4. COST ACCOUNTING - MEASUREMENT SYSTEM

It is fundamental starting by saying that :

- Cost evaluation in needed in order to take effective decisions in relation to: product mix, productivity, efficiency, pricing and marketing ;
- Costs are calculated using well-known and defined methods, simple to use and update frequently without the necessity of a specialized person. This is particularly important in Rapitech S.r.l. context because it is a little company without a supervisor of costs;
- Data collected has to be simple, not too much (only the ones needed) and real;

For these reasons is important to adopt a simple and effective measurement system.



Picture 8 : cost accounting system structure

4.1 COST CONFIGURATION

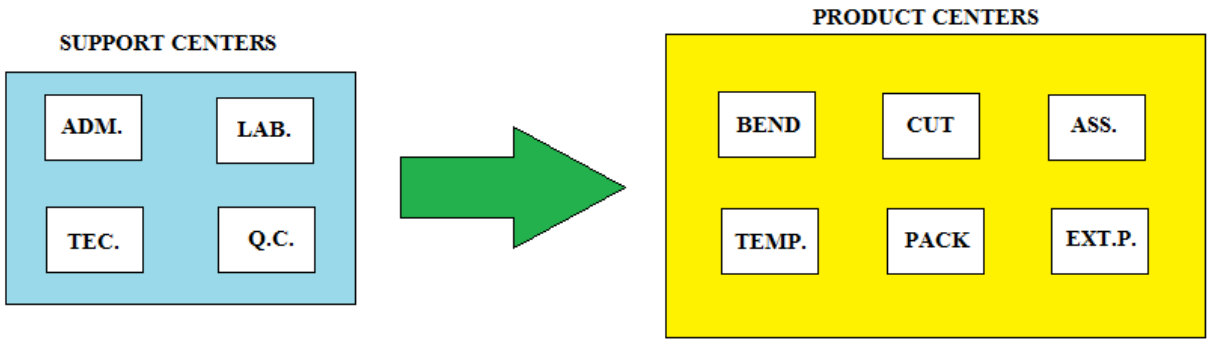
The first step for designing a new cost accounting system regards the chart of accounts. In this part resources are considered and decisions about the cost configuration and the way of enhancement have to be taken. In this project only production costs and revenues are evaluated (that represents the resources), adopting the technique of full costing (configuration chosen)that, as shown in the first part of this thesis, allocates all the costs to the product in order to arrive to

the unitary cost. Adding to this the wanted mark-up the final price is obtained. All the costs taken into account refers to 2014 (historical way of enhancement) and the values calculated are considered a standard for the calculation.

Direct costs are allocated without problems to the single product, while general costs are shared using an allocation base. In fact, in the full costing methodology also general costs are product costs and so they have to be covered by the final price. This highlights the fact that also indirect activities have a cost and impact on the profitability of the company. Based on this, the costs considered are classified as:

- Direct costs : are the production costs directly linked to the manufacturing process ; they are direct labor cost and direct material cost;
- Overhead (OVH) : all the production indirect costs, that are all the costs related to the resources used to produce, but not directly related to a specific product or production lot;
- Period costs : costs not directly related to the manufacturing activity, but to supporting activities that, with their job, allow production(e.g. administration);

4.2 RESPONSIBILITY CENTERS



Picture 9 : division between support centers and product centers

Following this method, the second step is to divide the company into costs centers, that represents autonomous units in relation to costs. They are divided in :

- Support centers: they are not directly linked to final products but allow production with their support activities;

- Product centers: organizational units directly linked to the final products;

Then, for each center a plan of all the costs sustained by that center is done. Considering the cost allocation to each center, for direct costs are considered final statement data(of 2014), while indirect costs are calculated as :

- For resources independent from the level of activities : $C = \frac{OVH_{tot}}{BA_{tot}} \times BA_{eff}$
- For resources whose level is variable with the activities level : $C = c \times a_{eff}$

In this way the standard cost of each cost center, in relation to year 2014, is calculated and the cost of each cost center is allocated to the final products through the allocation system.
At this point, it is important to consider the relation between cost centers and the products. In fact, considering cost centers it is difficult to identify clearly the percentage of cost for each final product. For this reason a two-phase system is used :

- Firstly, costs of support centers are allocated to product centers;
- In the second phase instead, costs of the product centers are allocated to different products (cost object);

4.3 COST OBJECT

As already said, the cost object are all the single products of the company. They produce small mechanical parts for B2B market, generally automotive or household. In particular they are specialized in fastening systems. The company offers to clients a wide products portfolio with different kind of finishing, developed by an external production (outsourcing of the process).
The allocation is done on a proportional base, without considering the eventually exchange among support centers, following the operation costing approach . In particular to the i-th product center is allocated, for the j-th support center, a cost : $C = S_j \times \frac{CP_{ji}}{\sum_{i=1}^{N} CP_{ji}}$

Costs of direct material are evaluated on the basis of the value to which they are recorded in the warehouse. Instead, conversion costs are evaluated considering the single activity as reference unit. For each activity the total conversion cost is calculated as sum of total direct costs and indirect costs. At this point, based on a proportional base, the total conversion cost is allocated to each product. In particular an hourly cost for each activity is calculated, in order to obtain the conversion cost.

5. DEVELOPMENT OF THE MEASUREMENT SYSTEM CHOSEN

Operatively, the company is divided into different areas that are chosen as cost centers. All the expenses, direct and indirect, sustained by the company in a certain period of time are grouped based on their nature and then shared considering the manufacturing unit. This means divide the company into product centers and support centers and so, for each center, determine the respective expenses in order to calculate costs. More in details:

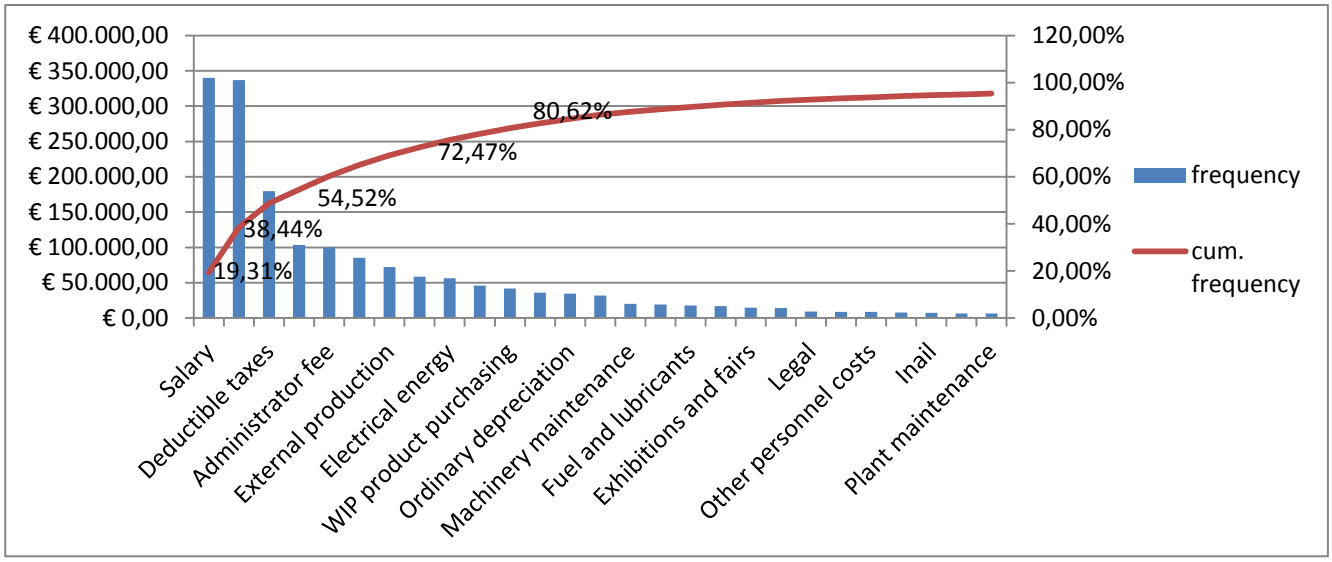
- Chart of account : resources, cost configuration and enhancement method chosen;
- Responsibility centers : support centers and product centers;
- Allocation of the labor force - responsibility centers;
- Costs allocation for support centers - responsibility centers;
- Allocation and driver choice for product centers - responsibility centers;
- Standard costs evaluation in order to determine the unitary product costs - responsibility centers;
- Calculation of the product costs - cost object;

The reference period considered is 2014 (from 1st January to 31st December 2014). The work was done in the period from September 2015 to January 2016.

5.1 CHART OF ACCOUNT : RESOURCES, COST CONFIGURATION AND RESOURCES EVALUATION METHOD CHOSEN

Firstly, an analysis of all the company costs incurred during the year 2014 is needed. This is important firstly to identify the resources of the chart of accounts, and then in order to classified them (costs) into direct, indirect and period that is fundamental for the cost configuration definition. This is important also for looking at trends and to most significant voices. For this reason a Pareto analysis was done. Pareto said that the 80% of the costs depends on the 20% of the voices. In this way it is possible to highlight and concentrate on the highest voices, that is fundamental in order to decrease company costs.

The graph with the most significant costs is :



Picture 10 : Pareto chart of the most relevant cost voices

Then, a classification of the costs into direct, indirect and period is done.

CODE	VOICE	DIVISION	NOTES
04.07.001	Retribuzioni dipendenti/Salary	CD/CIND	*
04.01.001	Acq.materie prime/ Raw material purchaising	CD	
04.03.001	Lavorazioni esterne/External production	CD	
04.03.002	Energia elettrica/ Electric energy	CD/CIND	*
04.01.003	Acq.prodotti semilavorati/ WIP products purchasing	CD	
04.01.006	Acquisti semilavorati/ WIP purchasing	CD	
04.01.005	Acquisti di imballi/ Packaging purchasing	CD	
04.01.002	Acq. Prodotti finiti/ Finished goods	CD	

	purchasing		
04.01.009	Acq. Acciai per stampi/ Steel purchasing for molds	CD	
04.03.003	Gas, metano ed acqua/ Gas, methane and water	CD/CIND	*
04.03.011	Spese elettriche/ Electrical expenses	CD/CIND	*
04.02.001	Trasporti su acquisti/ Transport on purchases	CD	
04.07.002	Oneri sociali su retribuz/ Social charges on salaries	CD/CIND	*
04.01.022	Variaz.acq.per resi,abbu./ Purchasing variation on returns	CD	
04.11.001	Rimanenze iniziali/ Opening stocks	CD	
04.01.011	Attrezzature e utensileri/ Equipment and tooling	CIND	
04.08.001	Ammortamenti ordinari/ Ordinary depreciation	CIND	
04.03.012	Manut.Rip.macchinari / Machinery maintenance	CIND	
04.03.013	Manut.riparaz.autoveicoli/ Vehicle maintenance	CIND	
04.07.099	Altri costi per personale / Other personnel cost	CIND/CD	
04.04.003	Trasporti/ Transport	CIND	
04.03.015	Manut.riparaz.fabbricati	CIND	

	/ Manufactured maintenance		
04.03.016	Manut.riparaz.impianti/ Plant maintenance	CIND	
04.03.007	Assistenza tecnica/ Technical assistence	CIND	
04.03.006	Consulenze tecniche/ Technical consultant	CIND	
04.05.020	Cancelleria/ Stationery	CIND	
04.03.004	Manut.esterna beni impres/ External maintenance company goods	CIND	
04.04.021	Spese qualità/ Quality expenses	CIND	
04.01.004	Acq. Materiali di manuten/ Maintenance materials purchasing	CIND	
04.03.009	Carburanti e Lubrificanti/ Fuel and lubricants	CIND	
04.03.020	Prestazioni occasionali/ Casual performance	CP	
04.13.002	Imposte e Tasse indeducib/ Non deductible taxes	CP	
04.07.005	Compenso amministratori/ Administrator fee	CP	
04.06.003	Affitti e locaz. Passive/ Rent	CP	

04.04.013	Spese pubblicità/ Advertisement expenses	CP	
04.14.012	Perdite su crediti/ Credit losses	CP	
04.07.006	Oneri sociali su comp.amm./ Social charges on administrator fee	CP	
04.07.003	Accantonamento per T.F.R / TFR fund	CP	
04.04.007	Mostre e fiere/ Exhibitions and fairs	CP	
04.05.003	Legali,l aborat.e cert.bil./ Legal	CP	
04.07.004	Inail	CD/CIND	
04.07.008	Indennità TFR fondi pensione/ TFR benefit for retirement	CD/CIND	
04.05.006	Assicurazioni diverse/ Different insurances	CP	
04.04.016	Sconti passivi e abbuoni/ Passive reductions	CP	
04.13.001	Imposte e tasse deducibil / Deductible taxes		
04.10.021	Svalutazione crediti/ Credit depreciation	CP	
04.05.021	Quote associative/ Membership quotas	CP	
04.04.017	Spese pulizia/ Cleaning expenses	CP	

04.05.001	Assicurazioni-bolli auto/ Vehicle insurance	CP	
04.04.019	Spese viaggi e trasferte/ Trip Expenses	CP	
04.05.004	Servizi telefonici fissi/ Fixed telephone expenses	CP	
04.04.012	Spese ristoranti e alberghi/ Hoteland restaurants expenses	CP	
04.04.020	Spese Sicurezza e Ambientale/ Security and environmental expenses	CP	
04.04.011	Spese su appart.Ballabio	CP	
04.07.007	contributi fondi pensioni/ Contribution to retirement capital	CP	
04.07.009	Contributi EBAV/EBT/ Contributions	CP	
04.14.020	Spese effetti s.b.f./ Expenses	CP	
04.14.016	Spese bancarie/ Bank expenses	CP	
04.05.005	Postali ed affrancazione/ Post expenses	CP	
04.06.005	Rete Metalfastener / Net Metalfastener	CP	
04.05.024	Servizi telefonici mobili/ Mobile phone services	CP	
04.04.006	Omaggi-	CP	

	Beneficenza/Charity		
04.17.004	Sopravvenienze passive/ Unexpected passive occurences	CP	
04.13.005	Tasse comunali e varie/ municipal taxes	CP	
04.04.005	Imponibile omaggi/Homage taxable	CP	
04.14.019	Spese bancarie bonifico/ Bank transfer expenses	CP	
04.14.018	Spese banc.incasso estero / Foreign bank takings	CP	
04.05.009	Multe e Sanzioni/ Penalties	CP	
04.14.021	Spese insoluto / Unpaid expenses	CP	
04.14.009	Interessi passivi vari/ Passive rates	CP	
04.05.013	Spese amministrative/ Administration expenses	CP	
04.01.010	Arrotondamenti passivi/ Passive approximation	CP	

Table 4 : cost classification among direct, indirect and period

LEGEND CD= DIRECT PRODUCTION COSTS
CIND= INDIRECT PRODUCTION COSTS
CP= PERIOD COSTS

* CD/CIND= COSTS THAT HAVE TO BE SHARED BETWEEN DIRECT AND INDIRECT

These voices represent the resources of the chart of account. The configuration chosen is the full costing, so all the costs are allocated in order to obtain the final unitary product cost while the enhancement method is the historical one because all data considered refers to 2014 and are

taken as standard for the calculations. Also the literature shows full costing is the most used, as presented in the first part of the thesis.

5.2 RESPONSIBILITY CENTERS : SUPPORT CENTERS AND PRODUCT CENTERS

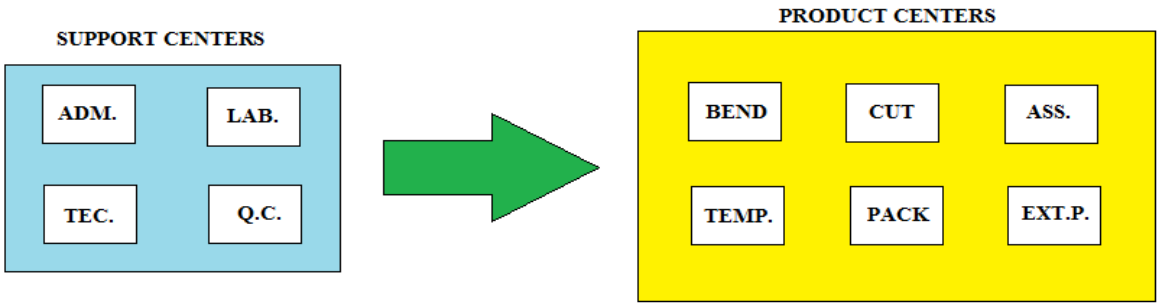
The second step, after having identified the resources, is to determine the responsibility centers of the company. Cost centers can be determined grouping equal machinery. This is possible because Rapitech S.r.l. is divided in job shop. For this reason the product centers are:

- bend machine;
- cut machine;
- assembly machine;
- tempering department;
- packaging department;
- external production;

This last cost center is fictitious because it does not correspond to a job shop of the company, but takes into account the outsourcing of some final productions.

The support centers instead are:

- administration;
- laboratory;
- technical office;
- quality control;



Picture 11 : division between support centers and product centers

5.2.1 ALLOCATION OF THE LABOR FORCE

Rapitech S.r.l. has 12 workers, divided in this way among the different centers:

CENTERS	NUMBER OF OPERATORS	NOTES
BEND MACHINE DEPARTMENT	2	
SHERING MACHINE DEPARTMENT	2	
ASSEMBLY MACHINE DEPARTMENT	0.9	Part of the personnel is dedicated also to Quality control *
TEMPERING DEPARTMENT	1	
LABORATORY	1	
TECHNICAL OFFICE	1	
ADMINISTRATION	2	
PACKAGING DEPARTMENT	1.7	Part of the personnel is dedicated also to External production**
EXTERNAL PRODUCTION	0.3	**
QUALITY CONTROL	0.1	*
Total	***12***	

Table 5 : labor force allocation

*The number of operators is calculated considering the time that they spend to each activity. Based on this it was evaluated that the operator responsible for the assembly machine department uses 10% of his time to make quality control analysis.

**In the packaging department are present two operators. They do not spend all their time for packaging but they use a part of time, estimated as 15% for each one (0.15+0.15=0.3), for preparation and activities inherent to external production.

5.2.2 COST ALLOCATION FOR SUPPORT CENTERS

Firstly, total costs for support centers are calculated. All the costs used are taken from the management system of the company that contains all the costs incurred over years since he was developed by the administrator (total allocation). As said before, the data costs used for the analysis are the ones of 2014 in order to have available the total costs of each voice (it was not possible to use 2015 as reference year because it was not completed). In this way, considering how is organized the management system and the fact that we are considering a little company without an office for the cost detection, instead of comparing costs with standard costs it is possible to compare actual costs with historical costs, looking at trends and analyzing them.

ADMINISTRATION

ADMINISTRATION	CODE	COST YEAR 2014	% INCIDENCE ON THE CENTER	VALUE	NOTES
COST OF LEASED ASSETS OF THIRD PARTIES					
deductible financial leasing	04.06.001	€ 0,00	50,00%	€ 0,00	
rent	04.06.003	€ 85.269,94	8,986%	€ 7.662,64	
Metalfastener net	04.06.005	€ 575,31	100,00%	€ 575,31	
PERSONNEL					
personnel	04.07.001	€ 89.203,84	100,00%	€ 89.203,84	
TFR fund	04.07.003	€ 16.997,73	16,67%	€ 2.833,52	2 PEOPLE ON 12
inail	04.07.004	€ 7.386,26	16,67%	€ 1.231,29	2 PEOPLE ON 12
administrator fee	04.07.005	€ 99.999,96	100,00%	€ 99.999,96	
social charges on admin. fee	04.07.006	€ 19.170,23	100,00%	€ 19.170,23	

contribution to retirement fund	04.07.007	€ 1.030,93	16,67%	€ 171,86	2 PEOPLE ON 12
retirement TFR fund benefits	04.07.008	€ 6.455,07	16,67%	€ 1.076,06	2 PEOPLE ON 12
other personnel costs	04.07.099	€ 8.560,96	16,67%	€ 1.427,11	2 PEOPLE ON 12
ordinary depreciation	04.08.001	€ 34.576,31	5,00%	€ 1.547,58	
MATERIAL COST					
misleading goods purchasing < 516,46	04.01.021	€ 0,00	100,00%	€ 0,00	
INDUSTRIAL SERVICES					
electrical energy	04.03.002	€ 56.127,01	2,00%	€ 1.122,54	
electrical expenses	04.03.011	€ 6.143,34	100,00%	€ 6.143,34	
gas, methane, water, heating	04.03.003	€ 14.252,48	6,44%	€ 917,18	% VOLUME
technical consultant	04.03.006	€ 3.554,93	100,00%	€ 3.554,93	
technical assistence	04.03.007	€ 4.032,77	75,00%	€ 3.024,58	3/4 ADM.1/4 TEC.
geenral expenses	04.03.008	€ 0,00	100,00%	€ 0,00	
fuel and lubricants	04.03.009	€ 17.529,49	10,00%	€ 1.752,95	
vehicle maintenance	04.03.013	€ 8.768,99	100,00%	€ 8.768,99	
manufactured maintenance	04.03.015	€ 5.393,00	100,00%	€ 5.393,00	
disposal and eco-friendly services	04.03.099	€ 0,00	10,00%	€ 0,00	
PURCHASING SERVICES					
iva cost	04.02.004	€ 0,00	100,00%	€ 0,00	
COMMERCIAL SERVICES					
commission to	04.04.001	€ 0,00	100,00%	€ 0,00	

intermediaries					
transportation	04.04.003	€ 7.959,22	100,00%	€ 7.959,22	
homage taxable	04.04.005	€ 186,00	100,00%	€ 186,00	
charity	04.04.006	€ 515,00	100,00%	€ 515,00	
exhibitions and fairs	04.04.007	€ 14.525,85	100,00%	€ 14.525,85	
apartment expenses	04.04.011	€ 1.355,55	100,00%	€ 1.355,55	
reastaurant and hotel expenses	04.04.012	€ 1.609,06	100,00%	€ 1.609,06	
advertisement expenses	04.04.013	€ 1.790,00	100,00%	€ 1.790,00	
representation expenses	04.04.015	€ 0,00	100,00%	€ 0,00	
passive reductions	04.04.016	€ 3.967,94	100,00%	€ 3.967,94	
cleaning expenses	04.04.017	€ 2.988,34	100,00%	€ 2.988,34	
trip expenses	04.04.019	€ 2.246,21	100,00%	€ 2.246,21	
ADMINISTRATION SERVICES					
vehicle insurance	04.05.001	€ 2.597,56	100,00%	€ 2.597,56	
legal	04.05.003	€ 8.977,71	100,00%	€ 8.977,71	
fixed telephone services	04.05.004	€ 1.683,35	100,00%	€ 1.683,35	
postal services	04.05.005	€ 700,30	100,00%	€ 700,30	
different insurance	04.05.006	€ 5.319,81	100,00%	€ 5.319,81	
notarial expenses	04.05.011	€ 0,00	100,00%	€ 0,00	
stationery	04.05.020	€ 3.480,18	84,00%	€ 2.923,35	ADM.+TEC.+Q.C
associative quotas	04.05.021	€ 3.026,00	100,00%	€ 3.026,00	
mobile phone services	04.05.024	€ 531,10	100,00%	€ 531,10	
TAXES AND MANAGEMENT COMMITMENT					
deductible taxes	04.13.001	€ 3.548,65	100,00%	€ 3.548,65	

not deductible taxes	04.13.002	€ 179.512,00	100,00%	€ 179.512,00	
Municipal taxes	04.13.005	€ 355,00	100,00%	€ 355,00	
RATES AND OTHER FINANCIAL COMMIT.					
passive rates on loan	04.14.001	€ 0,00	100,00%	€ 0,00	
bank passive rates	04.14.002	€ 0,00	100,00%	€ 0,00	
passive rates	04.14.009	€ 23,64	100,00%	€ 23,64	
bank expenses	04.14.016	€ 870,36	100,00%	€ 870,36	
foreign takings bank expenses	04.14.018	€ 84,04	100,00%	€ 84,04	
bank transfer expenses	04.14.019	€ 132,75	100,00%	€ 132,75	
general expenses	04.14.020	€ 970,75	100,00%	€ 970,75	
unpaid expenses	04.14.021	€ 39,00	100,00%	€ 39,00	
loan expenses	04.14.022	€ 0,00	100,00%	€ 0,00	
occasional performances	04.03.020	€ 1.000,00	100,00%	€ 1.000,00	
			TOTAL COST	**€505.015.45**	

Table 6 : cost allocation for the support center "Administration"

LABORATORY

LABORATORY	CODE	COST YEAR 2014	% INCIDENCE ON THE CENTER	VALUE	NOTES
deductible financial leasing	04.06.001	€ 0,00	50,00%	€ 0,00	
rent	04.06.003	€ 85.269,94	10,21%	€ 8.707,45	
personnel	04.07.001	€ 41.551,71	100,00%	€ 28.476,46	
TFR fund	04.07.003	€ 16.997,73	8,33%	€ 1.416,48	1 PEOPLE ON 12

inail	04.07.004	€ 7.386,26	8,33%	€ 615,52	1 PEOPLE ON 12
contribution to retirement fund	04.07.007	€ 2.352,71	8,33%	€ 196,06	1 PEOPLE ON 12
retirement TFR fund benefits	04.07.008	€ 6.455,07	8,33%	€ 537,92	1 PEOPLE ON 12
other personnel costs	04.07.099	€ 8.560,96	8,33%	€ 713,41	1 PEOPLE ON 12
ordinary depreciation	04.08.001	€ 34.576,31	10,00%	€ 3.457,63	
gas, methane, water, heating	04.03.003	€ 14.252,48	14,13%	€ 2.014,40	
electrical energy	04.03.002	€ 56.127,01	4,00%	€ 2.245,08	
electrical expenses	04.03.011	€ 6.143,34	0,00%	€ 0,00	
maintenance material purchasing	04.01.004	€ 1.132,02	100,00%	€ 1.132,02	
steel purchasing for molds	04.01.009	€ 1.479,93	100,00%	€ 1.479,93	
equipment and tooling	04.01.011	€ 35.688,47	95,00%	€ 33.904,05	
machinery maintenance	04.03.012	€ 20.096,84	100,00%	€ 20.096,84	
general maintenance	04.03.014	€ 0,00	100,00%	€ 0,00	
plant maintenance	04.03.016	€ 6.407,47	100,00%	€ 6.407,47	
fuel and lubricants	04.03.009	€ 17.529,49	5,00%	€ 876,47	
disposal and eco-friendly services	04.03.099	€ 0,00	5,00%	€ 0,00	
machine fund		€ 20.000,00	100,00%	€ 20.000,00	
			TOTAL COST	**€ 132.277,19**	

Table 7 : cost allocation for the support center "Laboratory"

TECHNICAL OFFICE

TECHNICAL OFFICE	CODE	COST YEAR 2014	% INCIDENCE ON THE CENTER	VALUE	NOTES
deductible financial leasing	04.06.001	€ 0,00	0,00%	€ 0,00	
rent	04.06.003	€ 85.269,94	10,21%	€ 8.707,45	
ordinary depreciation	04.08.001	€ 34.576,31	5,00%	€ 1.728,82	
personnel	04.07.001	€ 41.551,71	100,00%	€ 41.551,71	
TFR fund	04.07.003	€ 16.997,73	8,33%	€ 1.416,48	1 PEOPLE ON 12
inail	04.07.004	€ 7.386,26	8,33%	€ 615,52	1 PEOPLE ON 12
contribution to retirement fund	04.07.007	€ 2.352,71	8,33%	€ 196,06	1 PEOPLE ON 12
retirement TFR fund benefits	04.07.008	€ 6.455,07	8,33%	€ 537,92	1 PEOPLE ON 12
other personnel costs	04.07.099	€ 8.560,96	8,33%	€ 713,41	1 PEOPLE ON 12
gas, methane, water, heating	04.03.003	€ 14.252,48	7,63%	€ 1.087,77	
electrical energy	04.03.002	€ 56.127,01	1,00%	€ 561,27	
electrical expenses	04.03.011	€ 6.143,34	0,00%	€ 0,00	
stationery	04.05.020	€ 3.480,18	14,00%	€ 487,23	ADM.+TEC.+Q.C.
technical assistence	04.03.007	€ 4.032,77	25,00%	€ 1.008,19	3/4 ADM.1/4 TEC.
			TOTAL COST	**€ 58.611,82**	

Table 8 : cost allocation for the support center "Technical Office"

QUALITY CONTROL

QUALITY CONTROL	CODE	COST YEAR 2014	% INCIDENCE ON THE CENTER	VALUE	NOTES
personnel	04.07.001	€ 29.485,41	10,00%	€ 2.948,54	
TFR fund	04.07.003	€ 16.997,73	0,83%	€ 141,65	0,1 PEOPLE ON 12
inail	04.07.004	€ 7.386,26	0,83%	€ 61,55	0,1 PEOPLE ON 12
Contribution to retirement fund	04.07.007	€ 2.352,71	0,83%	€ 19,61	0,1 PEOPLE ON 12
Retirement TFR fund benefits	04.07.008	€ 6.455,07	0,83%	€ 53,79	0,1 PEOPLE ON 12
Other personnel costs	04.07.099	€ 8.560,96	0,83%	€ 71,34	0,1 PEOPLE ON 12
gas, methane, water, heating	04.03.003	€ 14.252,48	0,00%	€ 0,00	
electrical energy	04.03.002	€ 56.127,01	0,50%	€ 280,64	
electrical expenses	04.03.011	€ 6.143,34	0,00%	€ 0,00	
stationery	04.05.020	€ 3.480,18	2,00%	€ 69,60	ADM.+TEC.+Q.C.
technical assistence	04.03.007	€ 4.032,77	0,00%	€ 0,00	
Equipment and tooling	04.01.011	€ 35.688,47	5,00%	€ 1.784,42	
rent	04.06.003	€ 85.269,94		€ 0,00	
			TOTAL COST	**€ 5.431,14**	

Table 9 : cost allocation for the support center "Quality Control"

It is important to explain some voices:

- "personnel": it considers the cost of the personnel allocated to each center, according to the table of the “labor force” . The cost is calculated considering the voices of the profit and loss account “retribuzioni” and “oneri sociali su retribuzioni”, and multiplying it for an incidence index that takes into account the hourly cost of each worker, as shown in the table below:

WORKER	€/h	%	COST	NOTES
	20,40	0,1376	€61.004,30	ADMINISTRATION
	9,28	0,0626	€27.750,98	WAREHOUSE
	16,05	0,1082	€47.996,03	BEND MACHINE DEPARTMENT
	11,00	0,0742	€32.894,48	BEND MACHINE DEPARTMENT
	11,07	0,0747	€33.103,81	TEMPERING
	14,52	0,0979	€43.420,71	TECHNICAL OFFICE/LABORATORY
	11,86	0,0800	€35.466,23	CUT MACHINE DEPARTMENT
	9,28	0,0626	€27.750,98	WAREHOUSE
	12,26	0,0827	€36.662,39	CUT MACHINE DEPARTMENT
	9,43	0,0636	€28.199,54	ADMINISTRATION
	9,86	0,0665	€29.485,41	ASSEMBLY MACHINE DEPARTMENT
	13,27	0,0895	€39.682,70	TECHNICAL OFFICE/LABORATORY
TOTAL	148,28	1,00		

Table 10 : hourly personnel cost

- " rent": it is calculated multiplying the annual value of rent for a percentage, calculated as the ratio between the surface of the center and the total surface .
  The surfaces of the different centers are shown in the table below, starting from some data: Administration surface is 100mq, guardian home is 76mq, WIP warehouse is 156mq and the rest is 1186mq.

	SQUARE METERS	PARTIAL	ALLOCATION INDEX	OTHER	TOTAL	%
ADMINISTRATION	100,00	100,00	1,00	36,41	136,41	8,99%
TECHNICAL OFFICE	1.186,00	118,60	0,10	36,41	155,01	10,21%
LABORATORY	1.186,00	118,60	0,10	36,41	155,01	10,21%
BEND MACHINE	1.186,00	237,20	0,20	36,41	273,61	18,02%
CUT MACHINE	1.186,00	237,20	0,20	36,41	273,61	18,02%
PACKAGING	1.186,00	177,90	0,15	36,41	214,31	14,12%
TEMPERING	1.186,00	177,90	0,15	36,41	214,31	14,12%
ASSEMBLY MACHINE	1.186,00	59,30	0,05	36,41	95,71	6,31%
					tot	tot
to share:	TOTAL SQUARE METERS	PARTIAL	ALLOCATION INDEX		1.518,00	100,00%
MP WAREHOUSE	1.186,00	59,30	0,05			
WIP WAREHOUSE	156,00	156,00	1,00			
GUARDIAN HOME	76,00	76,00	1,00			
		tot				
		291,30				
		ALLOCATION				
		36,41				

Table 11 : centers' surface

- "electric energy" : it is calculated considering a percentage of use by hypothesis . In particular, the hypothesis are done on the basis of the number of machines in the center and the power of each of them.
- "heating": it is evaluated considering the volume of each center that is heated. The table below show the results:

	SQUARE METERS	HEIGHT	CUBIC METERS	%
ADMINISTRATION	100,00	2,70	270,00	6,44%
TECHNICAL OFFICE	118,60	2,70	320,22	7,63%
LABORATORY	118,60	5,00	593,00	14,13%
BEND MACHINE	237,20	5,00	1.186,00	28,27%
CUT MACHINE	237,20	5,00	1.186,00	28,27%
PACKAGING	177,90	2,70	480,33	11,45%
ASSEMBLY MACHINE	59,30	2,70	160,11	3,82%
			tot	tot
			4.195,66	100,00%

Table 12 : centers' volume

- "depreciation" and "technical assistance" refers to the software used by the company and for this reason is shared between administration(75%) and technical office(25%).
- “stationary" refers to administration and the technical office, but with different percentage if compared to the previous voices: respectively 85% and 15%.

5.2.3 ALLOCATION AND DRIVER CHOICE FOR PRODUCT CENTERS

At this point, it is possible to evaluate costs for cost centers, considering direct and indirect costs.

BEND MACHINE

BEND MACHINE	CODE	COST YEAR 2014	% INCIDENCE ON THE CENTER	VALUE	NOTES
deductible financial leasing	04.06.001	€ 0,00	0,00%	€ 0,00	
rent	04.06.003	€ 85.269,94	18,02%	€ 15.369,51	
electrical energy	04.03.002	€ 56.127,01	16,00%	€ 8.980,32	
electrical expenses	04.03.011	€ 6.143,34	0,00%	€ 0,00	
personnel	04.07.001	€ 80.890,51	100,00%	€ 80.890,51	
TFR fund	04.07.003	€ 16.997,73	16,67%	€ 2.833,52	2 PEOPLE ON 12
inail	04.07.004	€ 7.386,26	16,67%	€ 1.231,29	2 PEOPLE ON 12
contribution to retirement fund	04.07.007	€ 2.352,71	16,67%	€ 392,20	2 PEOPLE ON 12
retirement TFR fund benefits	04.07.008	€ 6.455,07	16,67%	€ 1.076,06	2 PEOPLE ON 12
other personnel costs	04.07.099	€ 8.560,96	16,67%	€ 1.427,11	2 PEOPLE ON 12

gas, methane, water, heating	04.03.003	€ 14.252,48	28,27%	€ 4.028,79	
fuel and lubricants	04.03.009	€ 17.529,49	20,00%	€ 3.505,90	
disposal and eco-friendly services	04.03.099	€ 0,00	20,00%	€ 0,00	
ordinary depreciation	04.08.001	€ 34.576,31	25,00%	€ 8.644,08	
ADMINISTRATION QUOTA		€ 505.015,45	25,00%	€ 126.253,86	
LABORATORY QUOTA		€ 132.277,19	40,00%	€ 52.910,87	
TECHNICAL OFFICE QUOTA		€ 58.611,82	40,00%	€ 23.444,73	
QUALITY CONTROL QUOTA		€ 5.431,14	20,00%	€ 1.086,23	
machine fund		€ 60.000,00	100,00%	€ 60.000,00	
			TOTAL COST	**€ 392.074,99**	

Table 13 : cost allocation for the product center "Bend machine"

CUT MACHINE

CUT MACHINE	CODE	COST YEAR 2014	% INCIDENCE ON THE CENTER	VALUE	NOTES
deductible financial leasing	04.06.001	€ 0,00	0,00%	€ 0,00	
rent	04.06.003	€ 85.269,94	18,02%	€ 15.369,51	
electrical energy	04.03.002	€ 56.127,01	21,00%	€ 11.786,67	
electrical expenses	04.03.011	€ 6.143,34	0,00%	€ 0,00	

personnel	04.07.001	€ 72.128,62	100,00%	€ 72.128,62	
TFR fund	04.07.003	€ 16.997,73	16,67%	€ 2.833,52	2 PEOPLE ON 12
inail	04.07.004	€ 7.386,26	16,67%	€ 1.231,29	2 PEOPLE ON 12
contribution to retirement fund	04.07.007	€ 2.352,71	16,67%	€ 392,20	2 PEOPLE ON 12
retirement TFR fund benefits	04.07.008	€ 6.455,07	16,67%	€ 1.076,06	2 PEOPLE ON 12
other personnel costs	04.07.099	€ 8.560,96	16,67%	€ 1.427,11	2 PEOPLE ON 12
gas, methane, water, heating	04.03.003	€ 14.252,48	28,27%	€ 4.028,79	
fuel and lubricants	04.03.009	€ 17.529,49	25,00%	€ 4.382,37	
disposal and eco-friendly services	04.03.099	€ 0,00	25,00%	€ 0,00	
ordinary depreciation	04.08.001	€ 34.576,31	25,00%	€ 8.644,08	
ADMINISTRATION QUOTA		€ 505.015,45	25,00%	€ 126.253,86	
LABORATORY QUOTA		€ 132.277,19	55,00%	€ 72.752,45	
TECHNICAL OFFICE QUOTA		€ 58.611,82	55,00%	€ 32.236,50	
QUALITY CONTROL QUOTA		€ 5.431,14	20,00%	€ 1.086,23	
machine fund		€ 80.000,00	100,00%	€ 80.000,00	
			TOTAL COST	**€ 435.629,27**	

Table 14 : cost allocation for the product center "Cut machine"

TEMPERING

TEMPERING	CODE	COST YEAR 2014	% INCIDENCE ON THE CENTER	VALUE	NOTES
deductible financial leasing	04.06.001	€ 0,00	50,00%	€ 0,00	
rent	04.06.003	€ 85.269,94	14,12%	€ 12.038,48	
electrical energy	04.03.002	€ 56.127,01	50,00%	€ 28.063,51	
electrical expenses	04.03.011	€ 6.143,34	0,00%	€ 0,00	
personnel	04.07.001	€ 33.103,81	100,00%	€ 33.103,81	
TFR fund	04.07.003	€ 16.997,73	8,33%	€ 1.416,48	1 PEOPLE ON 12
inail	04.07.004	€ 7.386,26	8,33%	€ 615,52	1 PEOPLE ON 12
contribution to retirement fund	04.07.007	€ 2.352,71	8,33%	€ 196,06	1 PEOPLE ON 12
retirement TFR fund benefits	04.07.008	€ 6.455,07	8,33%	€ 537,92	1 PEOPLE ON 12
other personnel costs	04.07.099	€ 8.560,96	8,33%	€ 713,41	1 PEOPLE ON 12
fuel and lubricants	04.03.009	€ 17.529,49	25,00%	€ 4.382,37	
disposal and eco-friendly services	04.03.099	€ 0,00	25,00%	€ 0,00	
ordinary depreciation	04.08.001	€ 34.576,31	20,00%	€ 6.915,26	
ADMINISTRATION QUOTA		€ 505.015,45	10,00%	€ 50.501,54	
QUALITY CONTROL QUOTA		€ 5.431,14	20,00%	€ 1.086,23	
machine fund		20.000,00	100,00%	€ 20.000,00	
			TOTAL COST	**€ 159.570,59**	

Table 15 : cost allocation for the product center "Tempering"

ASSEMBLY MACHINE

ASSEMBLY MACHINE	CODE	COST YEAR 2014	% INCIDENCE ON THE CENTER	VALUE	NOTES
deductible financial leasing	04.06.001	€ 0,00	0,00%	€ 0,00	
rent	04.06.003	€ 85.269,94	6,31%	€ 5.376,42	
electrical energy	04.03.002	€ 56.127,01	4,50%	€ 2.525,72	
electrical expenses	04.03.011	€ 6.143,34	0,00%	€ 0,00	
personnel	04.07.001	€ 29.485,41	90,00%	€ 26.536,87	
TFR fund	04.07.003	€ 16.997,73	7,50%	€ 1.274,83	0,9 PEOPLE ON 12
inail	04.07.004	€ 7.386,26	7,50%	€ 553,97	0,9 PEOPLE ON 12
contribution to retirement fund	04.07.007	€ 2.352,71	7,50%	€ 176,45	0,9 PEOPLE ON 12
retirement TFR fund benefits	04.07.008	€ 6.455,07	7,50%	€ 484,13	0,9 PEOPLE ON 12
other personnel costs	04.07.099	€ 8.560,96	7,50%	€ 642,07	0,9 PEOPLE ON 12
gas, methane, water, heating	04.03.003	€ 14.252,48	4,00%	€ 570,10	
fuel and lubricants	04.03.009	€ 17.529,49	5,00%	€ 876,47	
disposal and eco-friendly services	04.03.099	€ 0,00	5,00%	€ 0,00	
ordinary depreciation	04.08.001	€ 34.576,31	5,00%	€ 1.728,82	
ADMINISTRATION QUOTA		€ 505.015,45	10,00%	€ 50.501,54	
LABORATORY		€ 132.277,19	5,00%	€ 6.613,86	

QUOTA					
TECHNICAL OFFICE QUOTA		€ 58.611,82	5,00%	€ 2.930,59	
QUALITY CONTROL QUOTA		€ 5.431,14	20,00%	€ 1.086,23	
machine fund		€ 5.000,00	100,00%	€ 5.000,00	
			TOTAL COST	**€ 106.878,07**	

Table 16 : cost allocation for the product center "Assembly machine"

PACKAGING

PACKAGING	CODE	COST YEAR 2014	% INCIDENCE ON THE CENTER	VALUE	NOTES
deductible financial leasing	04.06.001	€ 0,00	0,00%	€ 0,00	
rent	04.06.003	€ 85.269,94	14,12%	€ 12.038,48	
electrical energy	04.03.002	€ 56.127,01	1,00%	€ 561,27	
electrical expenses	04.03.011	€ 6.143,34	0,00%	€ 0,00	
personnel	04.07.001	€ 47.176,66	100,00%	€ 47.176,66	
TFR fund	04.07.003	€ 16.997,73	14%	€ 2.408,01	1,7 PEOPLE ON 12
inail	04.07.004	€ 7.386,26	14%	€ 1.046,39	1,7 PEOPLE ON 12
contribution to retirement fund	04.07.007	€ 2.352,71	14%	€ 333,30	1,7 PEOPLE ON 12
retirement TFR fund benefits	04.07.008	€ 6.455,07	14%	€ 914,47	1,7 PEOPLE ON 12
other personnel	04.07.099	€ 8.560,96	14%	€ 1.212,80	1,7 PEOPLE

costs					ON 12
gas, methane, water, heating	04.03.003	€ 14.252,48	11,45%	€ 1.631,66	
package purchasing	04.01.005	€ 4.523,93	100,00%	€ 4.523,93	
ordinary depreciation	04.08.001	€ 34.576,31	5,00%	€ 1.728,82	
ADMINISTRATION QUOTA		€ 505.015,45	20,00%	€ 101.003,09	
QUALITY CONTROL QUOTA		€ 5.431,14	20,00%	€ 1.086,23	
machine fund		€ 10.000,00	100,00%	€ 10.000,00	
			TOTAL COST	**€ 185.665,11**	

Table 17 : cost allocation for the product center "Packaging"

EXTERNAL PRODUCTION

EXTERNAL PRODUCTION	CODE	COST YEAR 2014	% INCIDENCE ON THE CENTER	VALUE	NOTES
personnel	04.07.001	€ 8.325,29	100,00%	€ 8.325,29	
TFR fund	04.07.003	€ 16.997,73	2,50%	€ 424,94	0,3 PEOPLE ON 12
inail	04.07.004	€ 7.386,26	2,50%	€ 184,66	0,3 PEOPLE ON 12
fuel and lubricants	04.03.009	€ 17.529,49	10,00%	€ 1.752,95	
lubricants disposal	04.03.099	€ 0,00	10,00%	€ 0,00	
contribution to retirement fund	04.07.007	€ 2.352,71	2,50%	€ 58,82	0,3 PEOPLE ON 12
retirement TFR fund benefits	04.07.008	€ 6.455,07	2,50%	€ 161,38	0,3 PEOPLE ON 12

other personnel costs	04.07.099	€ 8.560,96	2,50%	€ 214,02	0,3 PEOPLE ON 12
ADMINISTRATION QUOTA		€ 505.015,45	10,00%	€ 50.501,54	
			TOTAL COST	**€ 61.623,61**	

Table 18 : cost allocation for the product center "External production"

It is important to make some explanation of the voices. Firstly, it is important to highlight in which way the support centers are divided among the different cost centers. The method chosen is direct, without considering eventually internal exchange among the support centers. Furthermore all the costs of support centers are shared among product centers (total allocation).

The percentage quotas are evaluated considering different drivers:

- "Administration": the choice of the quota to allocate to each cost centers is based on the professional experience of the administrator on the company, partially based on the number of people present in the center:

$$\%quota = \frac{\sum center\ personnel}{\sum personnel\ of\ all\ cost\ centers}$$

- "Laboratory": the choice of the quota to allocate is done considering the time dedicated to each cost center;
- "Technical office": the same as laboratory;
- "Quality control" : equally shared among the cost centers to which it is done.

To sum up:

% quota allocated to product centers	***driver***
Administration	Number of workers present in the center
Laboratory	Time dedicated to each product center
Technical office	Time dedicated to each product center
Quality control	Equally shared among the product centers where it is done

Table 19 : driver used for the total allocation of the support centers costs on the product centers

5.3 ALLOCATION SYSTEM

In this phase costs of the product centers are divided in order to obtain the standard costs of each of them for the year taken as reference (2014). Following this method, a target value , called standard, it is fixed and in this way it is possible to evaluate efficiency. Of course, it is fundamental to check periodically the current values in comparison with the standard. The first thing to do in order to apply this method is chosen a unit of measure (driver):

CENTER	MEASURE UNIT (DRIVER)
Bend machine department	h/year
Shearing machine department	h/year
Assembly machine department	h/year
Tempering department	Kg/year
Packaging department	Kg/year
External production department	Kg/year

Table 20 : unit of measure choice for each product center

Considering the Tempering department and the Packaging department , also h/year was considered as unit of measure, but the choice of Kg/year was the most appropriate. In fact, in the case of the tempering department, the furnace works at different speeds according to the different products and, as regards the packaging department it is all based on the Kg of product to prepare for the client. For these reasons in these cases Kg is the most suitable unit of measure. The analysis starts form real data that comes from the management system of the company, removing events considered particular or not common. In this way it is possible to obtain optimal data that represents the standard to which costs are referred to. The scope of this measure is to fix a base on which allocate product centers costs. It is important that the costs that are allocated to the products are related to the production capacity without considering the losses in time due to company inefficiencies. In fact in this way the risk is to propose a price to high if compared with competitors. In order to evaluate the effective hours , data from the management system were analyzed. Considering the productive departments, the data were divided in several categories:

1- Work
2- Mold set up
3- Test
4- Mold cleaning
5- Ordinary maintenance
6- Extraordinary maintenance
7- Corrective actions
8- Defective material
9- Lack of material
10- Lack of personnel
11- Lack of order

Table 21 : categories for evaluating the effective hours of product centers

The data were analyzed and used in order to calculate the employed hours, as shown in the tables below:

BEND MACHINE DEPARTMENT

Number of machines	18,00
Daily hours	8,00
Days/year	225,00
Active machinery contemporarily	7,00
Theoretical available hours/year	32.400,00*
Effective available hours/year	10.783,50
Set up hours/year	234,50
Employed hours/year	11.018,00

Table 22 : Bend machine department effective hours calculation

*the theoretical available hours/year are calculated as :

$$8\ \frac{h}{d} \times\ 225\ \frac{d}{y} \times 18\ machinery = 32400.00\ \frac{h}{y}$$

CUT MACHINE DEPARTMENT

Number of machines	9,00
Daily hours	8,00
Days/year	225,00
Active machinery contemporarily	6,00
Theoretical available hours/year	16.200,00*
Effective available hours/year	7.821,50
Set up hours/year	608,00
Employed hours/year	8.429,50

Table 23 : Cut machine department effective hours calculation

*calculated in the same way of bend machines

ASSEMBLY MACHINE DEPARTMENT

Number of machines	13,00
Daily hours	8,00
Days/year	225,00
Active machinery contemporarily	4,00
Total theoretical available hours/year	23.400,00*
Theoretical available hours/year per 4 machinery	7.200,00
Effective available hours/year	3.853,50
Set up hours/year	0,00
Employed hours/year	3.853,50

Table 24 : Assembly machine department effective hours calculation

*calculated in the same way of bend machines

Instead, considering the other departments, the unit of measure chosen was Kg/year. The management system gives the daily average Kg, so it is not difficult to evaluate the average annual Kg:

DEPARTMENT	[Kg/d]	[Kg/y]
Tempering	769.31	176172.00*
Packaging	628.00	141300.00
External production	//	116530.00

Table 25 : product centers that consider Kgs instead of hours as unit of measure

*The data is calculated considering 229 days/year because the furnace works more than the other departments every day.

At this point it is possible to calculate the standard cost for each center:

DEPARTMENT/CENTER	ANNUAL COST [€/year]	ANNUAL QUANTITY OF THE UNIT(DRIVER) [unit/year]	STANDARD COST 2014 [€/unit]
BEND MACHINE	392074.99	11.018,00 [h]	35.58
CUT MACHINE	435629.27	8.429,50 [h]	51.68
ASSEMBLY MACHINE	106878.07	3.853,50 [h]	14.84
TEMPERING	159570.59	173094.75 [Kg]	0.91
PACKAGING	185665.11	141300.00 [Kg]	1.31
EXTERNAL PRODUCTION	61623.61	116530.00 [Kg]	0.53

Table 26 : standard cost of each product center for the reference year 2014

*All the calculations are based on data of year 2014.

The standard cost is calculated as the ratio between the annual cost of the center and the annual quantity of the unit of measure chosen for the center, considering year 2014 as reference:

$$C_{std}[€/unit] = \frac{C_c[€/year]}{u[unit/year]}$$

It is important to make some clarifications regarding tempering and packaging departments:

- Tempering : for each product a speed is associated, expressed in [Kg/h]. For this reason it is possible to evaluate an unitary cost for each product. In particular:

$$c_{temp}[€/Kg] = \frac{hourly\ cost_{temp}\ [€/h]}{speed[Kg/h]}$$

  With this calculation it is not considered the lot dimension. In fact, producing time can be influenced by the lot dimension (e.g. manufacturing of small size lots);

- Packaging : for this department an average value is considered for making the calculations. In fact products are sold in standard boxes of three different sizes : small, medium and large. The choice for the calculations is the medium one, that is 14.34 Kg, because is the most used and correspond more or less to the average of the three sizes. In addition for each product different clients asks for different quantities and calculating different pricing

according to the different packaging costs, caused by the different sizes of the boxes, it is not useful and efficient. In particular:

$$c = c_{pack} \times \frac{Kg_{medium}}{Kg_{real}}$$

Then another problem has to be explained: frequently customers asks for caissons .
In this case it is difficult to quantify how much products or Kg are present, so the choice is to consider the time needed by the operators to fill up a caisson (that is more or less the same for the different products and also for quite different quantities). The estimation of the time was done as the average of different samples taken with timing. In this way, in the excel file created, at the voice packaging it is possible having the cost associated to a medium box or to the caisson. The system will output the cost of one or the other depending on the directions given in another excel paper in which for each product is signaled if the client usually wants a caisson or a box.

5.4 UNITARY PRODUCT COSTS

At this point it is possible to calculate the unitary product cost of each item using the technique of full costing . This means considering all the passages that the product follows, starting from the raw material until the finished good, including also fixed costs and period costs. It was chosen to use different reference scheme for products that have to be assembled and not. In particular, for products without assembling the table is this:

CODICE/CODE
COMPONENTE/COMPONENT
DESCRIZIONE/DESCRIPTION
NOTA/NOTE
CONTATTO/CONTACT
ACQUISTO/PURCHASE
PREZZO ACQUISTO/PURCHASING PRICE
FORNITORE/SUPPLIER
MATERIA PRIMA/RAW MATERIAL

TIPOLOGIA MATERIALE/MATERIAL TIPOLOGY
SVILUPPO (mm)/DEVELOPMENT
COSTO MATERIALE [€/kg] /MATERIAL COST
PESO LORDO PEZZO [kg/pz]/PIECE GROSS WEIGHT
COSTO MATERIALE [€/pz]/UNITARY MATERIAL COST
PESO NETTO PEZZO [kg/pz]/PIECE NET WEIGHT
SCARTO [kg]/SCRAP
RECUPERO ROTTAME [€/kg]/SCRAP RECOVERY
GUADAGNO SCARTO [€]/SCRAP PROFIT
COSTO MATERIA PRIMA [€/pz]/RAW MATERIAL COST
INCIDENZA PERCENTUALE / PERCENTAGE
TRANCIATURA/CUT
REPARTO/DEPARTMENT
COSTO ORARIO REPARTO [€/ora]/HOURLY DEPARTMENT COST
PEZZI/ORA TEORICI [pz/ora]/ THEORIC HOURLY PIECES
CALO PRODUTTIVO [%]/PRODUCTION DOWNTURN
PEZZI/ORA REALI [pz/ora]/REAL HOURLY PIECES
COSTO PRODUZIONE [€/pz]/PRODUCTION COST
LOTTO [pezzi]/LOT
TEMPO ATTREZZAGGIO [ore]/SET UP TIME
COSTO ATTREZZAGGIO [€]/SET UP COST
COSTO TRANCIATURA [€/pz]/CUT COST
INCIDENZA PERCENTUALE /PERCENTAGE
TRATTAMENTO TERMICO/TEMPERING
COSTO ORARIO REPARTO [€/ora]/HOURLY DEPARTMENT COST
VELOCITA' TEMPRA [kg/ora]/TEMPERING SPEED
COSTO UNITARIO [€/kg]/UNITARY COST
COSTO TRATTAMENTO [€/pz]/TREATMENT COST
INCIDENZA PERCENTUALE /PERCENTAGE
FINITURA/FINISHING
DESCRIZIONE FINITURA/FINISHING TYPOLOGY

FORNITORE/SUPPLIER
COSTO LAVORAZIONE [€/kg] /PRODUCTION COST
COSTO UNITARIO LAVORAZIONE [€/pz] /UNITARY PRODUCTION COST
COSTO REPARTO ESTERNO [€/kg]/EXTERNAL DEPARTMENT COST
COSTO REPARTO AL PEZZO [€/pz]/UNITARY DEPARTMENT COST
COSTO TRATTAMENTO [€/pz]/TREATMENT COST
INCIDENZA PERCENTUALE /PERCENTAGE
CONFEZIONAMENTO/PACKAGING
PEZZI PER SCATOLA/CASSONE STANDARD [pz]/PIECES PER STANDARD BOX/CAISSON
PESO NETTO SCATOLA [kg/scatola]/BOX NET WEIGHT
PESO SCATOLA MEDIA [kg/scatola]/MEDIUM SIZE BOX WEIGHT
COSTO UNITARIO REPARTO [€/kg]/UNITARY DEPARTMENT COST
COSTO UNITARIO REALE [€/kg]/REAL UNITARY COST
COSTO ORARIO REPARTO [€/h]/HOURLY DEPARTMENT COST
ORE IMPIEGATE PER UN CASSONE [h]/HOURS USED FOR CAISSON
COSTO CONFEZIONAMENTO [€/pz]/PACKAGING COST
INCIDENZA PERCENTUALE /PERCENTAGE
STAMPO/MOLD
COSTO STAMPO[€]/MOLD COST
PEZZI AMMORTAMENTO [pz]/ DEPRECIATION PIECES
COSTO STAMPO AL PEZZO [€/pz]/UNITARY MOLD COST
INCIDENZA PERCENTUALE/ PERCENTAGE
COSTI/COSTS
Acquisto/Purchase
Materiale/Material
Tranciatura/Cut
Trattamento termico/Tempering
Zincatura /Finishing
Confezionamento/Packaging

Ammortamento stampo/ Mold depreciation
TOTALE/TOTAL
COSTO TOTALE (€/pz)/TOTAL COST
PREZZO VENDITA (€/pz)/ PRICE
MARGINE DI GUADAGNO (€/pz)/ MARK UP

Table 27 : unitary product cost evaluation for not assembled products

Instead, for assembled products :

CODICE/CODE
DESCRIZIONE/DESCRIPTION
NOTA/NOTE
CONTATTO/CONTACT
ACQUISTO/PURCHASE
PREZZO ACQUISTO/PURCHASING PRICE
FORNITORE/SUPPLIER
DATI/DATA
PESO NETTO PEZZO [kg]/PIECE NET WEIGHT
COMPONENTI/COMPONENTS
ARTICOLO COMPONENTE 1/ ITEM COMPONENT 1
COSTO ARTICOLO COMPONENTE 1/ ITEM COMPONENT 1 COST
INCIDENZA PERCENTUALE /PERCENTAGE
ARTICOLO COMPONENTE 2/ITEM COMPONENT 2
COSTO ARTICOLO COMPONENTE 2/ITEM COMPONENT 2 COST
INCIDENZA PERCENTUALE /PERCENTAGE
ARTICOLO COMPONENTE 3/ ITEM COMPONENT 3
COSTO ARTICOLO COMPONENTE 3/ITEM COMPONENT 3 COST
INCIDENZA PERCENTUALE /PERCENTAGE
ARTICOLO COMPONENTE 4/ ITEM COMPONENT 4
COSTO ARTICOLO COMPONENTE 4/ITEM COMPONENT 4 COST
INCIDENZA PERCENTUALE /PERCENTAGE

ASSEMBLAGGIO/ASSEMBLY
REPARTO/DEPARTMENT
COSTO ORARIO REPARTO [€/ora]/HOURLY DEPARTMENT COST
PEZZI/ORA TEORICI [pz/ora]/THEORIC HOURLY PIECES
CALO PRODUTTIVO [%]/ PRODUCTION DOWNTURN
PEZZI/ORA REALI [pz/ora]/REAL HOURLY PIECES
LOTTO [pezzi]/LOT
TEMPO ATTREZZAGGIO [ore]/SET UP TIME
COSTO ATTREZZAGGIO [€]/ SET UP COST
COSTO ASSEMBLAGGIO [€/pz]/ASSEMBLY COST
INCIDENZA PERCENTUALE /PERCENTAGE
FINITURA/FINISHING
DESCRIZIONE FINITURA/FINISHING TYPOLOGY
FORNITORE/SUPPLIER
COSTO LAVORAZIONE [€/kg] /PRODUCTION COST
COSTO UNITARIO LAVORAZIONE [€/pz] /UNITARY PRODUCTION COST
COSTO REPARTO ESTERNO [€/kg]/EXTERNAL DEPARTMENT COST
COSTO REPARTO AL PEZZO [€/pz]/UNITARY DEPARTMENT COST
COSTO TRATTAMENTO [€/pz]/TREATMENT COST
INCIDENZA PERCENTUALE /PERCENTAGE
CONFEZIONAMENTO/PACKAGING
PEZZI PER SCATOLA/CASSONE STANDARD [pz]/PIECES PER STANDARD BOX/CAISSON
PESO NETTO SCATOLA [kg/scatola]/BOX NET WEIGHT
PESO SCATOLA MEDIA [kg/scatola]/MEDIUM SIZE BOX WEIGHT
COSTO UNITARIO REPARTO [€/kg]/UNITARY DEPARTMENT COST
COSTO UNITARIO REALE [€/kg]/REAL UNITARY COST
COSTO ORARIO REPARTO [€/h]/HOURLY DEPARTMENT COST
ORE IMPIEGATE PER UN CASSONE [h]/HOURS USED FOR CAISSON

COSTO CONFEZIONAMENTO [€/pz]/PACKAGING COST
INCIDENZA PERCENTUALE /PERCENTAGE
STAMPO/MOLD
COSTO STAMPO[€]/MOLD COST
PEZZI AMMORTAMENTO [pz]/ DEPRECIATION PIECES
COSTO STAMPO AL PEZZO [€/pz]/UNITARY MOLD COST
INCIDENZA PERCENTUALE/ PERCENTAGE
COSTI/COSTS
Acquisto/Purchase
Componente 1/ Component 1
Componente 2/ Component 2
Componente 3/ Component 3
Componente 4/ Component 4
Assemblaggio/ Assembly
Finitura/ Finishing
Confezionamento/ Packaging
Stampo/ Mold
COSTO/ COST
COSTO TOTALE/TOTAL COST
PREZZO VENDITA (€/pz)/PRICE
MARGINE DI GUADAGNO (€/pz)/MARK UP

Table 28 : unitary product cost evaluation for assembled products

The voice “purchase" is present because some products are acquired by other suppliers, in particular some components used to be assembled with other manufactured by Rapitech S.r.l. Then, as regards the voice “raw material", the characteristics of the material (e.g. name, cost [€/Kg], gross weight etc.) comes from the management system of the company. The calculations done are :

$$unitary\ material\ cost\ \left[\frac{€}{u}\right] = material\ cost\ \left[\frac{€}{Kg}\right] \times gross\ weight\ \left[\frac{Kg}{u}\right]$$

Considering the scrap recovery :

$$scrap = net\ weight - gross\ weight$$

$$scrap\ profit\left[\frac{€}{u}\right] = scrap\ recovery\ \left[\frac{€}{Kg}\right] \times scrap\ \left[\frac{Kg}{u}\right]$$

In this way the cost of raw material becomes :

$$C_{raw\ material}\left[\frac{€}{u}\right] = unitary\ material\ cost\ \left[\frac{€}{u}\right] -\ scrap\ profit\ \left[\frac{€}{u}\right]$$

Considering the section “Cut " , it includes both bend machine and cut machine, that is indicated at the voice “department". The cost of this manufacturing process is calculated as the sum of the cost of production and the cost of set up, as shown by the formula:

$$c_{cut} = c_{prod} + c_{set-up}$$

Where :

$$c_{prod}[€/u] = \frac{hourly\ department\ cost\ [€/h]}{real\ pieces\ per\ hour\ [u/h]}$$

And real pieces per hour are calculated as:

$$theoric\ pieces\ per\ hour\ \left[\frac{u}{h}\right] - \frac{\left(theoric\ pieces\ per\ hour\ \left[\frac{u}{h}\right] \times production\ drop[\%]\right)}{100}$$

Instead, as regards the cost of set-up :

$$c_{set-up}[€/u] = \frac{hourly\ department\ cost\left[\frac{€}{h}\right] \times set - up\ time[h]}{lot[u]}$$

All the data used in the formulas are taken from the management system of the company.
As regards “production drop" the percentage taken was 10%. During the project and evaluation of this was done, but data frequently were missing or not precise and so the calculation gave results not completely reliable. For this reason the value chosen with the administrator was 10% because was the most suitable.
In the “Tempering" section the calculation is very simple:

$$c_{temp}\left[\frac{€}{u}\right] = unitary\ cost\left[\frac{€}{Kg}\right] \times net\ weight\left[\frac{Kg}{u}\right]$$

As regards “finishing", this voice is related to external production. There are different kind of finishing process :

- White galvanizing (B) - zincatura bianca
- Mechanical galvanizing (BM) - zincatura meccanica
- Opalescent/iridescent galvanizing (chromiting)(C) - zincatura chromiting
- Tropical galvanizing (yellow)(T) - zincatura tropical (gialla)
- Black galvanizing (ZL-ZNR) - zincatura nera
- Grey galvanizing (ZL-Z20) - zincatura grigia
- Phosphating (F) - fosfatazione
- Nickel-plating (NK) - nichelatura

Of course all these finishing processes are not feasible for all the products (e.g. RPCO has only B,BM,C and F). Concerning the calculations, the formulas used are :

$$c_{fin} = c_{dep} + c_{process}$$

Where c_{dep} is the cost of the department (that is the external production) and $c_{process}$ is the unitary cost of the process, and they are evaluated as shown below:

$$c_{dep}\left[\frac{€}{u}\right] = c_{ext.prod}\left[\frac{€}{Kg}\right] \times net\ weight\left[\frac{Kg}{u}\right]$$

$$c_{process}\left[\frac{€}{u}\right] = c_{process}\left[\frac{€}{Kg}\right] \times net\ weight\left[\frac{Kg}{u}\right]$$

Then, in “packaging" costs are calculated in two different ways : if teh product has to be shipped with a box in this way :

$$c_{pack}\left[\frac{€}{u}\right] = c_{pack}\left[\frac{€}{Kg}\right] \times \frac{avg\ box\ weight}{net\ box\ weight} \times net\ weight\ [Kg/u]$$

Instead if the products has to be delivered with the caisson (container), packaging costs are :

$$c_{pack}[€/u] = \frac{hourly\ department\ cost[€/h] \times hours\ for\ a\ caisson[h]}{std\ quantity\ per\ caisson\ [u]}$$

The section “ mold" is for the molds created for a product. In this case the calculation is :

$$c_{mold}[€/u] = \frac{c_{mold}[€]}{depreciation\ pieces\ [u]}$$

At this point it is possible to calculate the total unitary cost of the each product as the sum of all the costs voices described above.

The price is calculated considering the mark up chosen by the company administrator:

$$p = c \times 1.3$$

And the profit margin is calculated as the difference between the price p and the cost c :

$$profit\ margin = p - c$$

As regards assembled products there are some differences. In fact the different components used are indicated with the relative name and cost. Considering the cost of "Assembling", it is calculated as in “Cut". At this point, the total unitary cost for the assembled products is :

$$c = \sum components\ costs + c_{ass} + c_{pack}$$

In order to better understand the calculations , here some examples will be shown .

To sum up :

COST	FORMULA ADOPTED
RAW MATERIAL COST (COSTO MATERIA PRIMA)	$C_{raw\ material}\left[\frac{€}{u}\right] = unitary\ material\ cost\ \left[\frac{€}{u}\right] - scrap\ profit\ \left[\frac{€}{u}\right]$
CUT COST (TRANCIATURA)	$c_{prod}[€/u] = \frac{hourly\ department\ cost\ [€/h]}{real\ pieces\ per\ hour\ [u/h]}$
TEMPERING COST (COSTO TRATTAMENTO TERMICO)	$c_{temp}\left[\frac{€}{u}\right] = unitary\ cost\left[\frac{€}{Kg}\right] \times net\ weight\left[\frac{Kg}{u}\right]$
FINISHING COST (COSTO FINITURA)	$c_{fin} = c_{dep} + c_{process}$
PACKAGING COST (COSTO CONFEZIONAMENTO)	$c_{pack}\left[\frac{€}{u}\right] = c_{pack}\left[\frac{€}{Kg}\right] \times \frac{avg\ box\ weight}{net\ box\ weight} \times net\ weight\ \left[\frac{Kg}{u}\right]$
MOLD COST (COSTO STAMPO)	$c_{mold}[€/u] = \frac{c_{mold}[€]}{depreciation\ pieces\ [u]}$
PRICE	$p = c \times 1.3$

Table 29 : formula used for each cost voice present in the unitary cost calculation

5.4.1 EXAMPLE OF TWO PRODUCTS CALCULATION

In order to better understand how the system works, an example of two important products in terms of revenues for the company is needed.

RPCO 3.020.09 B

Picture 12 : RPCO 3.020.09

This product is a “fissatore a corona” (crownlock washer). It can be used in different fields, with different applications in substitution of rivets. They allow to cut cost for produce and assemble toys, household appliances, wheeled goods and others. Can be used on metallic and plastic shaft. It is available in different size, from 3 up to 32 mm, also in steinless steel (inox). The allowable load vary from few kilos up to over 500 Kgs.

The final B indicates that is necessary to add to the base product a white galvanizing. In the table below the detailed costs:

CODICE	RPCO 3.020.09	RPCO 3.020.09B
COMPONENTE	RPCO 3.020.09.P	RPCO 3.020.09.P
DESCRIZIONE		
NOTA		
CONTATTO		
ACQUISTO		
PREZZO ACQUISTO	0,00000	0,00000
FORNITORE	0,00000	0,00000
MATERIA PRIMA		
TIPOLOGIA MATERIALE	AC.0115.020	AC.0115.020
SVILUPPO (mm)	0,00	0,00
COSTO MATERIALE [€/kg]	2,25000	2,25000
PESO LORDO PEZZO [kg]	0,00013	0,00013
COSTO MATERIALE [€/pz]	0,00029	0,00029
PESO NETTO PEZZO [kg]	0,00013	0,00013
SCARTO [kg]	0,00000	0,00000
RECUPERO ROTTAME [€/kg]	0,20000	0,20000

GUADAGNO SCARTO [€]	0,00000	0,00000
COSTO MATERIA PRIMA [€/pz]	**0,00029**	**0,00029**
INCIDENZA PERCENTUALE	3,65%	3,58%

TRANCIATURA		
REPARTO	TRANCE	TRANCE
COSTO ORARIO REPARTO [€/ora]	51,68	51,68
PEZZI/ORA TEORICI [pz/ora]	8.000	8.000
CALO PRODUTTIVO [%]	10	10
PEZZI/ORA REALI [pz/ora]	7.200	7.200
COSTO PRODUZIONE [€/pz]	0,00718	0,00718
LOTTO [pezzi]	1.978.333	1.978.333
TEMPO ATTREZZAGGIO [ore]	2,0	2,0
COSTO ATTREZZAGGIO [€]	0,00005	0,00005
COSTO TRANCIATURA [€/pz]	**0,00723**	**0,00723**
INCIDENZA PERCENTUALE	90,18%	88,61%

TRATTAMENTO TERMICO		
COSTO ORARIO REPARTO [€/ora]	36,23	36,23
VELOCITA' TEMPRA [kg/ora]	40	40
COSTO UNITARIO [€/kg]	0,90577	0,90577
COSTO TRATTAMENTO [€/pz]	**0,00012**	**0,00012**
INCIDENZA PERCENTUALE	1,47%	1,44%

FINITURA	
DESCRIZIONE FINITURA	ZINC.BIANCA
FORNITORE	0
COSTO LAVORAZIONE [€/kg]	0,5670
COSTO UNITARIO LAVORAZIONE [€/pz]	0,00007
COSTO REPARTO ESTERNO [€/kg]	0,52882
COSTO REPARTO AL PEZZO [€/pz]	0,00007
COSTO TRATTAMENTO [€/pz]	**0,00014**
INCIDENZA PERCENTUALE	1,75%

CONFEZIONAMENTO		
PEZZI PER SCATOLA STANDARD [pz]	50.000	50.000
PESO NETTO SCATOLA [kg/scatola]	6,50	6,50
PESO SCATOLA MEDIA [kg/scatola]	14,34	14,34
COSTO UNITARIO REPARTO [€/kg]	1,31398	1,31398
COSTO UNITARIO REALE [€/kg]	2,89884	2,89884
COSTO ORARIO REPARTO [€/h]	60,67487	60,67487
ORE IMPIEGATE PER UN CASSONE [h]	0,35000	0,35000
COSTO CONFEZIONAMENTO [€/pz]	**0,00038**	**0,00038**
INCIDENZA PERCENTUALE	4,70%	4,62%

STAMPO		
COSTO STAMPO [€]	0,00	0,00
PEZZI AMMORTAMENTO [pz]	0	0
COSTO STAMPO AL PEZZO [€/pz]	0	0
INCIDENZA PERCENTUALE	0	0

COSTI		
Acquisto	0,00000	0,00000
Materiale	0,00029	0,00029
Tranciatura	0,00723	0,00723
Trattamento termico	0,00012	0,00012
Zincatura	0,00000	0,00014
Confezionamento	0,00038	0,00038
Ammortamento stampo	0,00000	0,00000
TOTALE		
COSTO TOTALE (€/pz)	**0,00802**	**0,00816**
PREZZO VENDITA (€/pz)	**0,01042**	**0,01061**
MARGINE DI GUADAGNO (€/pz)	**0,00241**	**0,00245**

Picture 13 : real example taken from the Excell sheet of a not assembled product

In the second table is shown the cost of the base product, while in the third the product with the particular finishing process.

Then it is possible to show an example of an assembled product:

RPC 4.030.12

Picture 14 : RPC 4.030.12

This product is a “fissatore con cappuccio” (crownlock washer dome capped). It can be used in different fields, where rivets cannot be used. The CrownLock washer can be used on mettalic and plastic shaft. The cap is typically in nichel steel, but it can be also colored depending on specific requirements.

It is composed by two components : RPCO 3.030.11B and RPCAP 012NK. In the table below the details of the costs:

CODICE	**RPC 4.030.12**
DESCRIZIONE	
NOTA	
CONTATTO	

ACQUISTO	
PREZZO ACQUISTO	0,00000
FORNITORE	0,00000

DATI	
PESO NETTO PEZZO [kg]	0,00053

COMPONENTI	
ARTICOLO COMPONENTE 1	RPCO 3.030.11B
COSTO ARTICOLO COMPONENTE 1	**0,00919**
INCIDENZA PERCENTUALE	40,01%
ARTICOLO COMPONENTE 2	RPCAP 012NK
COSTO ARTICOLO COMPONENTE 2	**0,00262**
INCIDENZA PERCENTUALE	11,40%
ARTICOLO COMPONENTE 3	
COSTO ARTICOLO COMPONENTE 3	**0,00000**
INCIDENZA PERCENTUALE	0,00%
ARTICOLO COMPONENTE 4	
COSTO ARTICOLO COMPONENTE 4	**0,00000**
INCIDENZA PERCENTUALE	0,00%

ASSEMBLAGGIO	
REPARTO	ASSEMBLAGGIO
COSTO ORARIO REPARTO [€/ora]	14,84
PEZZI/ORA TEORICI [pz/ora]	1.800
CALO PRODUTTIVO [%]	10,00
PEZZI/ORA REALI [pz/ora]	1.620
LOTTO [pezzi]	271.667
TEMPO ATTREZZAGGIO [ore]	2,0
COSTO ATTREZZAGGIO [€]	0,00011
COSTO ASSEMBLAGGIO [€/pz]	**0,00927**
INCIDENZA PERCENTUALE	40,38%

VERNICIATURA	
DESCRIZIONE FINITURA	
FORNITORE	
COSTO LAVORAZIONE [€/kg]	
COSTO UNITARIO LAVORAZIONE [€/pz]	
COSTO REPARTO ESTERNO [€/kg]	
COSTO REPARTO AL PEZZO [€/pz]	
COSTO TRATTAMENTO [€/pz]	
INCIDENZA PERCENTUALE	

CONFEZIONAMENTO	
PEZZI PER SCATOLA/CASSONE STANDARD [pz]	10.000
PESO NETTO SCATOLA [kg/scatola]	5,30
PESO SCATOLA MEDIA [kg/scatola]	14,34
COSTO UNITARIO REPARTO [€/kg]	1,31398

COSTO UNITARIO REALE [€/kg]	3,55518
COSTO ORARIO REPARTO [€/h]	60,67487
ORE IMPIEGATE PER UN CASSONE [h]	0,35000
COSTO CONFEZIONAMENTO [€/pz]	**0,00188**
INCIDENZA PERCENTUALE	8,21%
STAMPO	
COSTO STAMPO [€]	0,00000
PEZZI AMMORTAMENTO [pz]	0,00000
COSTO STAMPO AL PEZZO [€/pz]	**0,00000**
INCIDENZA PERCENTUALE	0,00%
COSTI	
Acquisto	0,00000
Componente 1	0,00919
Componente 2	0,00262
Componente 3	0,00000
Componente 4	0,00000
Assemblaggio	0,00927
Verniciatura	0,00000
Confezionamento	0,00188
Stampo	0,00000
TOTALE	
COSTO TOTALE	**0,02296**
PREZZO VENDITA (€/pz)	**0,02985**
MARGINE DI GUADAGNO (€/pz)	**0,00689**

Picture 15 : real example taken from the Excell sheet of aN assembled product

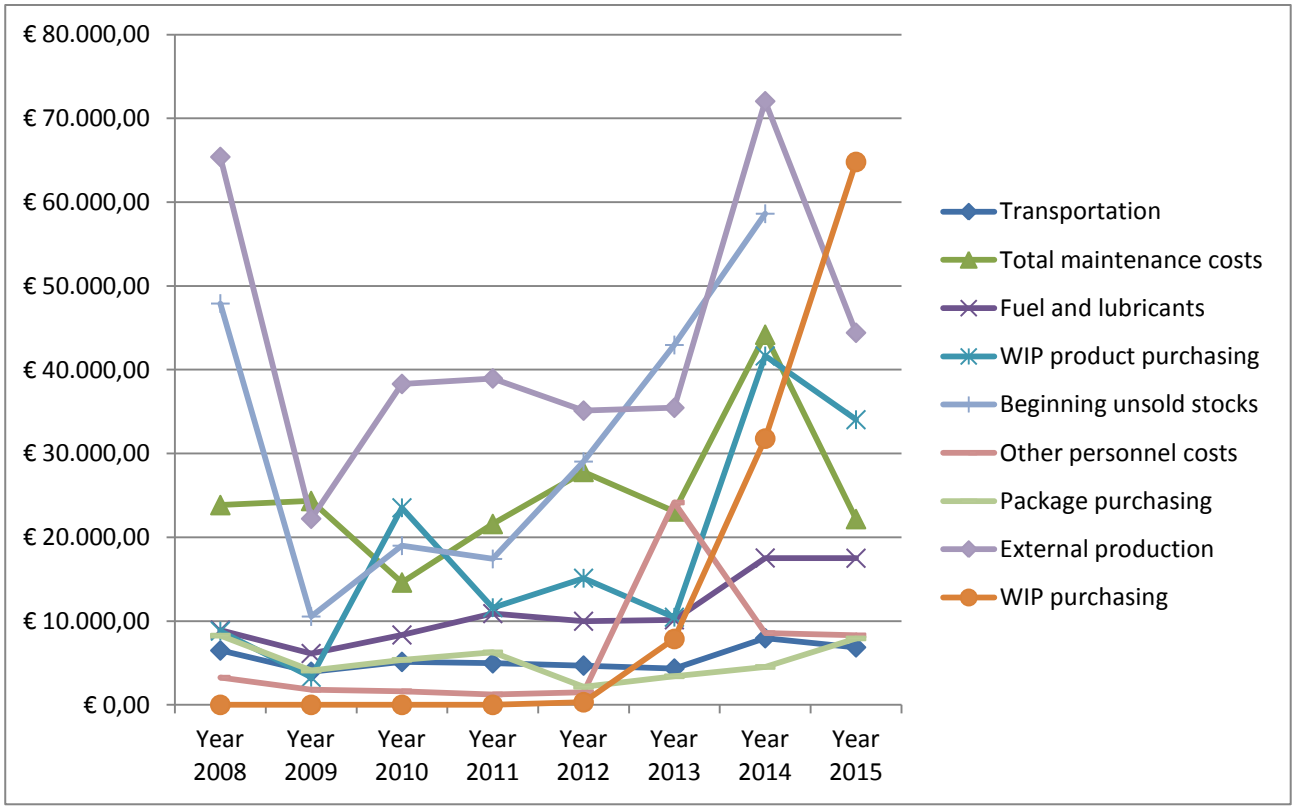
6. USE OF COST ACCOUNTING

At this point it is important to consider how cost accounting can be used and can help the management of the company. Here the main benefits will be presented:

- Supporting decision making process through a trend analysis (operative);
- calculate efficiency indicators to monitor organizational units performances (with a possible use in a balanced scorecard);

6.1 TREND ANALYSIS

The results taken from the cost accounting can be used for supporting decisions (operative scope), and in this way lead to improvements in the company. For this reason, a trend analysis is needed. The graph below shows the trend of all the cost voices considered together(except for "Raw material" because the costs are very high if compared to the others).



Picture 16: trend analysis of some relevant cost voices

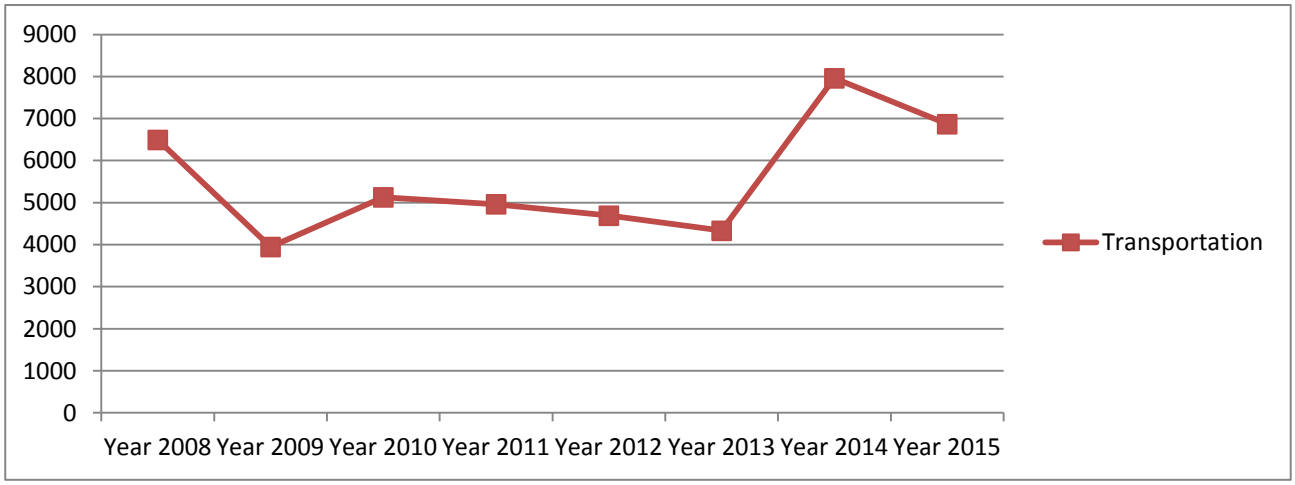
The first trend analyzed was related to transportation costs also because, a part from the increase in the last year, it was explicitly asked by the administrator of the company. Other interesting voices were taken into account because they show a non-constant behavior among years. The reference period in general was 2008-2015 (for the last years with the data available until that moment). The voices analyzed are:

- Trasporto (Transportation);
- Materie prime (Raw material);
- Manutenzione (maintenance – asset life cycle management);
- Carburanti e lubrificanti (fuel and lubricant);
- Semilavorati (WIP);
- Lavorazioni esterne (external production);
- Rimanenze iniziali (beginning unsold stocks);
- Altri costi personale (other personnel costs);
- Imposte e tasse (taxes);
- Acquisto imballi (package purchase);

6.1.1 TRANSPORTATION

Since the beginning of the internship the administrator asks us to focus on the transportation costs problem. He highlights, as shown analyzing costs trends, that until few years ago all the transportation costs were paid by client while now more and more frequently customers asks the company to manage also all the transportation issues and so the costs associated. The increase of the number of clients that ask for this, and the associated increase in costs, lead to the need of focus on this problem.

The first thing noticed was that at the moment the transportation cost voice does not represent one of the highest cost (it is evident considering the Pareto diagram developed at the beginning of the work). Although, considering the trend of the cost was evident an increase of the voice in the last here, as shown in the graph below:



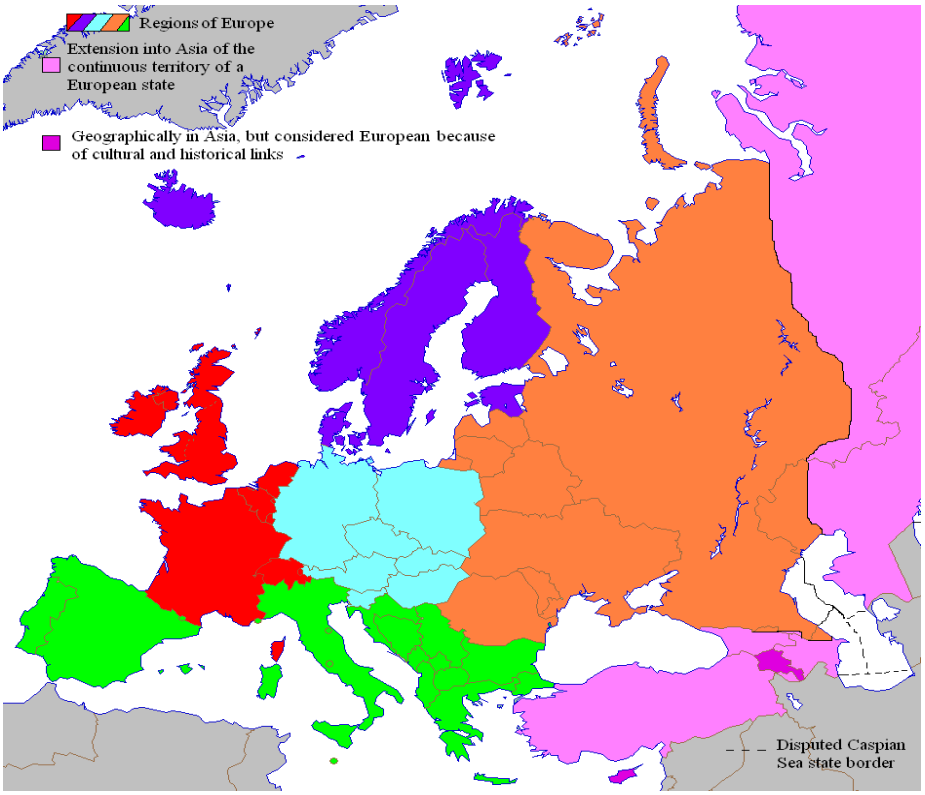
Picture 17 : transportation cost trend analysis

As shown in the graph, analyzing data from 2008 to 2015, after a first drop between 2008 and 2009, the costs were mainly constant until 2013 and they duplicate in 2014, maintaining high for the 2015 (not already finished at the time of the internship). This huge increase is due to the reason highlighted before: always more customers wants the product transport paid and managed by the company. In fact more than 90 % of the voice is due to the transportation to the final customer. The remaining percentage is related to internal transport issues of the company. Because of this increase the problem has to be analyzed. The first solution considered was to arrive defining two different prices for the client: one considering also the cost of the tranposrt and the second without it (in this case the client will pay only the product managing the transport itself). This was the original idea, but it was too difficult to apply for different reasons:

- Different couriers have different prices (even if the company uses mainly the same;
- Tariffs change according to the distance(Km);
- Tariffs change according to the load (Kg);
- There special tariffs for some particular countries;

For these reason creating an unitary transportation cost to add to the other costs was inappropriate and without meaning. In fact it does not reflect the realty and in the majority of the cases it could be too high or too small.

The only sensible solution was to elaborate a rate table . In order to create it, all the customers of the company were considered and grouped for regions. The division done is shown below:



LEGEND :

- South Europe
- North Europe
- Central Europe
- East Europe
- West Europe
- Other

Picture 18 : map of the European clients

Here the details of the countries of the clients :

ITALIA (CEE)/ITALY
SLOVENIA (CEE)
SPAGNA (CEE)/SPAIN
BELGIO (CEE)/BELGIUM
SVEZIA (CEE)/SWEDEN
FRANCIA (CEE)/FRANCE
REPUBBLICA CECA (CEE)/CZECH REPUBLIC
POLONIA (CEE)/POLAND
OLANDA (CEE)/THE NETHERLANDS
GERMANIA (CEE)/GERMANY
BRASILE (non CEE)/BRAZIL
SERBIA E MONTENEGRO (non CEE)
PORTOGALLO (CEE)/PORTUGAL
REPUBBLICA SUDAFRICANA (non CEE)/SOUTHAFRICA REPUBLIC
ESTONIA (CEE)
REPUBBLICA SLOVACCA (CEE)/SLOVAKIAN REPUBLIC
DANIMARCA (CEE)/DENMARK
SVIZZERA (non CEE)/SWITZERLAND
GRECIA (CEE)/GREECE
BULGARIA (CEE)
GRAN BRETAGNA (CEE)/ GREAT BRITAIN

TURCHIA (non CEE)/TURKEY
REPUBBLICA POPOLARE CINESE (non CEE)/CHINESE REP.
FINLANDIA (CEE)/FINLAND
AUSTRIA (CEE)
UNGHERIA (CEE)/HUNGARY
ARABIA SAUDITA (non CEE)/SAUDI ARABIA
THAILANDIA (non CEE)/THAILAND
RUSSIA (non CEE)
SINGAPORE (non CEE)

Table 30 : list of the country clients

As shown above, there are some clients that are not in Europe. For these it was not possible to insert in the rate table. The focus was on European clients, that are the majority.

In addition, in order to create the rate table a courier was taken as reference (the most used by the company).

The rate table elaborated considers distance (km) and load (kg) . In particular :

	TARIFFE										
	ITALY		EUROPA								WORLD
KG	NORTH-CENTER-SOUTH	ISLES	NORTH		SOUTH		CENTRAL	EAST	WEST		OTHERS
			SWEDEN	OTHERS	BULGARIA	OTHERS			SWITZERLAND	OTHERS	
0--10	€ 11,36	€ 11,61	€ 68,78	€ 24,85	€ 68,16	€ 19,32	€ 28,59	€ 28,28	€ 88,44	€ 52,20	
11--25	€ 12,31	€ 13,19	€ 88,85	€ 52,50	€ 70,64	€ 27,55	€ 36,93	€ 46,60	€ 95,47	€ 20,16	
26--50	€ 15,10	€ 17,23	€ 109,02	€ 81,10	€ 98,05	€ 38,20	€ 47,35	€ 65,20	€ 113,43	€ 41,33	
51--75	€ 20,69	€ 23,21	€ 137,36	€ 118,70	€ 139,53	€ 56,02	€ 64,82	€ 94,45	€ 124,53	€ 61,58	
76--100	€ 20,69	€ 23,21	€ 140,98	€ 151,32	€ 145,43	€ 74,08	€ 71,47	€ 123,66	€ 133,84	€ 78,92	
101--250	€ 41,37	€ 46,42	€ 215,00	€ 287,75	€ 282,58	€ 135,50	€ 128,26	€ 233,76	€ 217,21	€ 146,21	
251--500	€ 82,75	€ 92,84	€ 428,21	€ 575,50	€ 565,15	€ 271,41	€ 256,51	€ 467,52	€ 434,42	€ 292,40	
>500	€ 103,43	€ 139,26	€ 535,00	€ 719,00	€ 706,44	€ 339,26	€ 320,64	€ 584,39	€ 543,02	€ 365,50	
		*sicily		*Denmark			*Czech Republic				

Table 31 : price list for transportation

Then, an analysis of the clients that want transport at the expenses of the company was developed. What emerges was that the majority of customers that asks it are Italian companies and delivers different orders during the year. Based on this, the proposal elaborated was to calculate a transport price for these customers that asks to the company for the transportation.

The calculation was based on the quantity delivered. Here an example of some of these clients :

Client	Year 2014 [Kg]	n.DDT different	avg Kg per shipping	company office	cap.	shipping until	rate	[€/kg]
002038 - PRIMA EASTERN S.P.A.	10361,11	24,00	431,7129313	Chieti - Italia	66020 CH	66020 CH	€ 93,09	€ 0,22
001045 - SARIV-NEMCIK S.R.O.	3825,99	37,00	103,4051349	Třanovice-Repubblica ceca	739 53 Třanovice	35014 Fontaniva PD	€ 20,69	€ 0,20
000769 - TECHNOFAST DR.ING.NEDO PANICO DI PINI VERA	2001,52	10,00	200,152002	Milano - Italia	20122 MI	20123 MI	€ 20,69	€ 0,10
002014 - SIGIT SPA SOCIETA' ITALIANA GOMMA INDUSTRIALE	534,43	6,00	89,07166545	Torino - Italia	10121 TO	10122 TO	€ 20,69	€ 0,23
000140 - IPEA S.R.L.	368,82	6,00	61,47000122	Meda (MB) - Italia	20821 MB	20822 MB	€ 20,69	€ 0,34
002070 - SIGIT d.o.o.	213,20	10,00	21,31999969	Kragujevac - Serbia	34113 Kragujevac	10095 Grugliasco TO	€ 12,31	€ 0,58
000237 - PILONI S.R.L.	141,21	7,00	20,1728581	Lecco - Italia	23900 LC	23900 LC	€ 12,31	€ 0,61
001679 - BENERI S.P.A.	112,00	1,00	112	Valmadrera (LC) - Italia	23868 LC	23868 LC	€ 31,03	€ 0,28

Table 32 : list of some of the clients that asks for the transportation at the expenses of Rapitech

As shown above, for each customer a shipping cost is calculated. This evaluation is not precise because it was not possible to have the details of each deliver (DDT). Firstly, an average of the quantity (Kg) shipped is calculated in this way :

$$avg_{Kg} = \frac{annual\ quantity_{Kg}}{\sum DDT}$$

Where the number of different DDT represents the number of delivering in the year.

Then, as regards the voice "tariffa" (tariff), it is calculated considering the platform of the main courier used by the company ; in alternative, the rate table elaborated can be used. At this point the transport cost is calculated :

$$c_t[€/Kg] = \frac{tariff\ [€]}{avg_{Kg}\ [Kg]}$$

This cost can be applied to all the orders of the customers. In particular, knowing the number of pieces asked and the net weight of each product [Kg/unit] it is possible to calculate the unitary transport cost :

$$c_t[€/u] = c_t[€/Kg] \times net\ weight[Kg/u]$$

An example can be useful in order to better understand the logic.

E.g.

RPCO 0020 : net weight = 0.00033 Kg/u; unitary cost = 0.00869 €/u;

Number of pieces requested by the client : 200000 u

Deliver to Bergamo (BG) : tariff = 12.31 €

$$Kg_{del} = 0.00033[Kg/u] \times 200000[u] = 66Kg$$

$$c_t\left[\frac{€}{Kg}\right] = \frac{12.31[€]}{66[Kg]} = 0.1865\ €/Kg$$

$$c_t[€/u] = 0.1865[€/Kg] \times 0.00033[Kg/u] = 0.000061545\ €/u$$

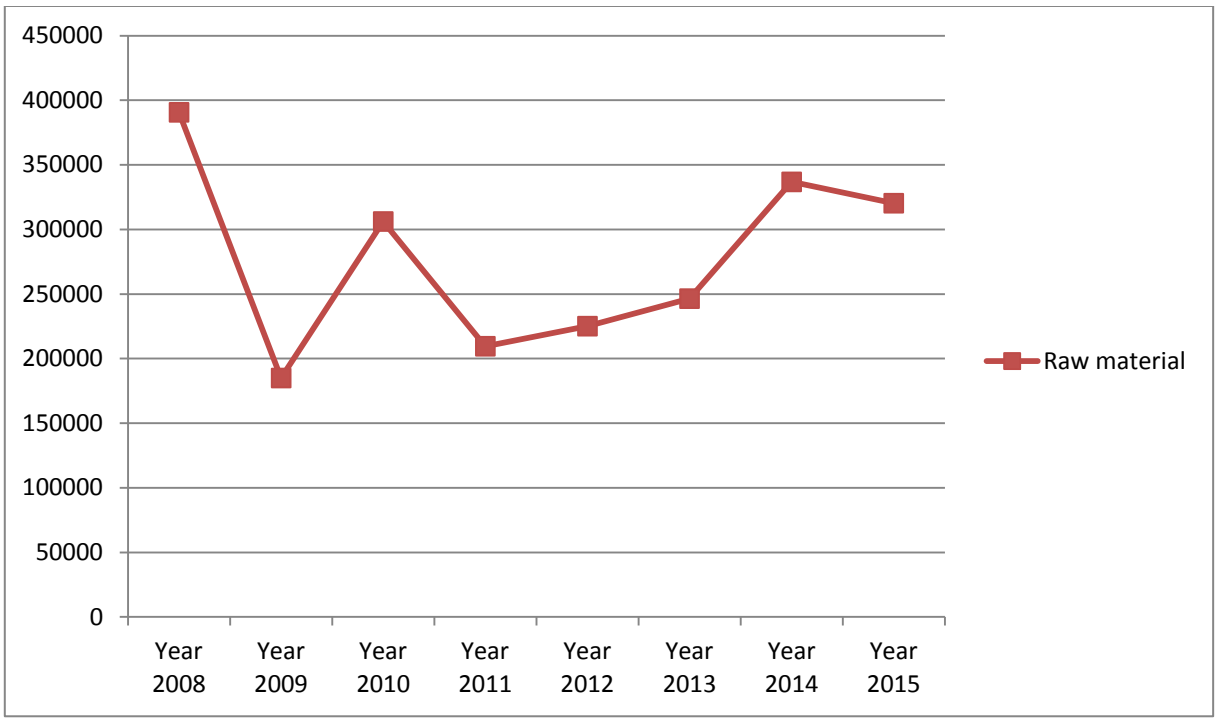
$$c = unitary\ cost + \ c_t = 0.00869 + 0.000061545 = 0.00875\ €/u$$

In this example are shown the calculations. In particular in this case is evident that the unitary cost of transport is negligible. In cases as this the most convenient solution is simply to add the cost of delivery to the final cost of the total lot that has to be shipped to the customer. In other cases, e.g. where the tariff is higher, it is m ore useful to apply the method described above.

Of course, in order to have more precise prices for each delivery could be useful saving the quantities shipped for each DDT.

6.1.2 RAW MATERIAL

The first trend analysis carried out was on raw material. In particular the data taken from the management system of the company show this trend :



Picture 19 : raw material cost trend analysis

As shown by the graph, this cost voices has a fluctuating trend, generally increasing in the last years (from 2011). This positive trend can be due to causes : an increase of the quantity ordered or an increase of the price. In the first case , the trend is positive because the purchasing of more raw material is related to more production (increasing in the demand). In the second case instead, it is important to make an analysis of the supplier in order to understand the entity of the increase in the raw material cost and the causes, and at this point make a comparison with other suppliers. Confirmed that, in this case, the increase was related to more quantity ordered, this is a positive trend that means more orders from the clients.

6.1.3 MAINTENANCE -ASSET LIFE CYCLE MANAGEMENT

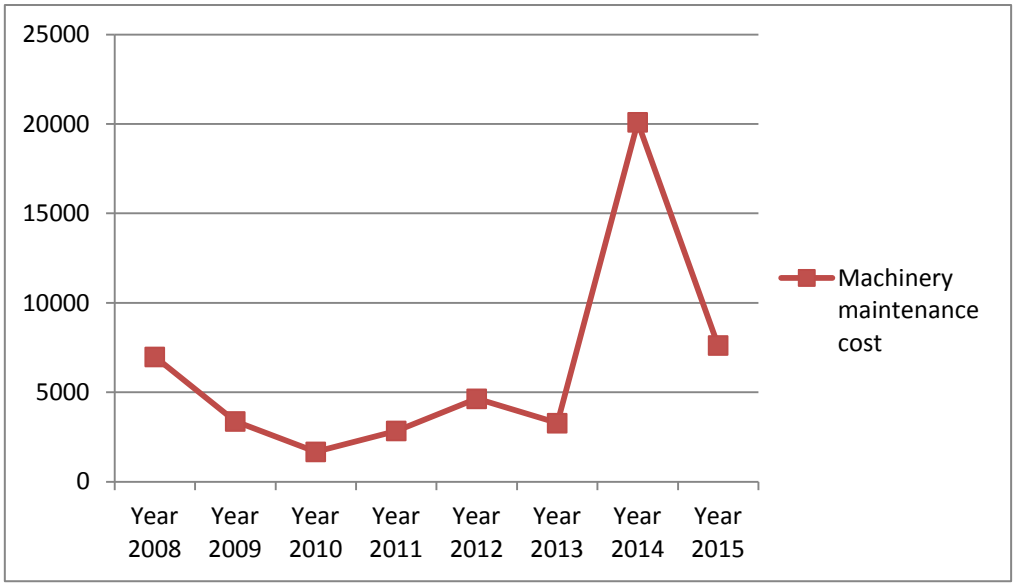
The second voice analyzed is related to maintenance. In realty there are different voices related to this. The first thing done was carrying out an analysis of some of these voices (the most meaningful) and then evaluate the impact of all the maintenance costs.
All the voices of costs related to maintenance are these :

Codice	Descrizione
04.03.004	External maintenance company goods
04.03.012	Machinery maintenance and repair
04.03.013	Vehicle maintenanc eand repair
04.03.014	General maintenance and repair
04.03.015	Manufactured maintenance and repair
04.03.016	Plant maintenance and repair
04.03.017	Industrial vehicle maintenance and repair
04.05.002	Office machine maintenance
04.01.004	Maintenance material purchasing

Table 33 : list of the different cost voices of maintenance

6.1.3.1 MACHINERY MAINTENACE AND REPAIR

This cost voice is related to all the actions taken in order to repair or apply maintenance to the machinery of the company. The graph in the next page shows the trend of this cost voice during last years, between 2008 and 2015.

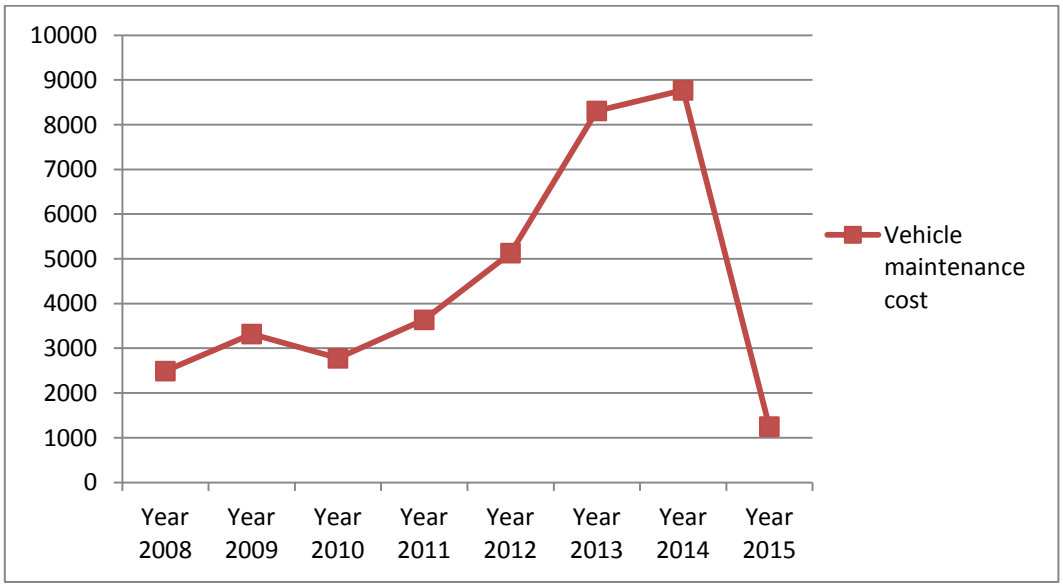


Picture 20 : Machinery maintenance and repair cost trend analysis

As shown by the graph, maintenance costs remain more or less constant over time except for year 2014 in which there is a peak. Speaking with the administrator emerges that in that year there was a big failure on a machine and this was the main cause for the increase of the cost.

6.1.3.2 VEHICLE MAINTENANCE AND REPAIR

This is another of the voices related to maintenance. The graph below show the trend:

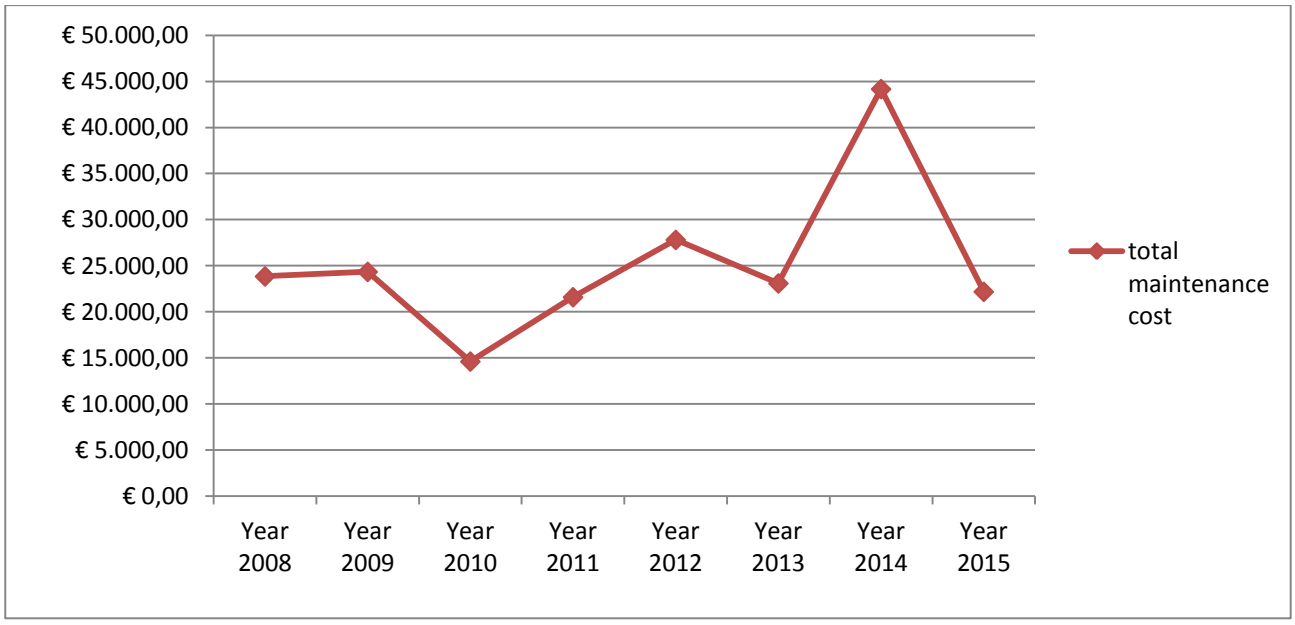


Picture 21 : vehicle maintenance and repair cost trend analysis

The graph shows that there is an increase of costs until 2014 (particularly high in 2013 and 2014), and then, for the moment, the curve drop in 2015. One of the causes of the high costs in 2014 was related to the maintenance of the company van, that is quite old and needs maintenance and attention.

6.1.3.3 TOTAL MAINTENANCE COST

At this point can be useful to evaluate and analyzes the trend of all the costs voices related to maintenance . The voices are the ones listed at the beginning of this section.
The graph below shows the curve of the total costs of maintenance:



Picture 22 : total maintenance cost trend analysis

It is evident that the situation is quite stable, a part from 2014 in which there is a peak, due to different problems (some of them have been already mentioned).
In particular analyzing year 2014, that is the year chosen also as reference one to evaluate unitary costs of products, emerges that total maintenance costs are not so negligible. In fact:

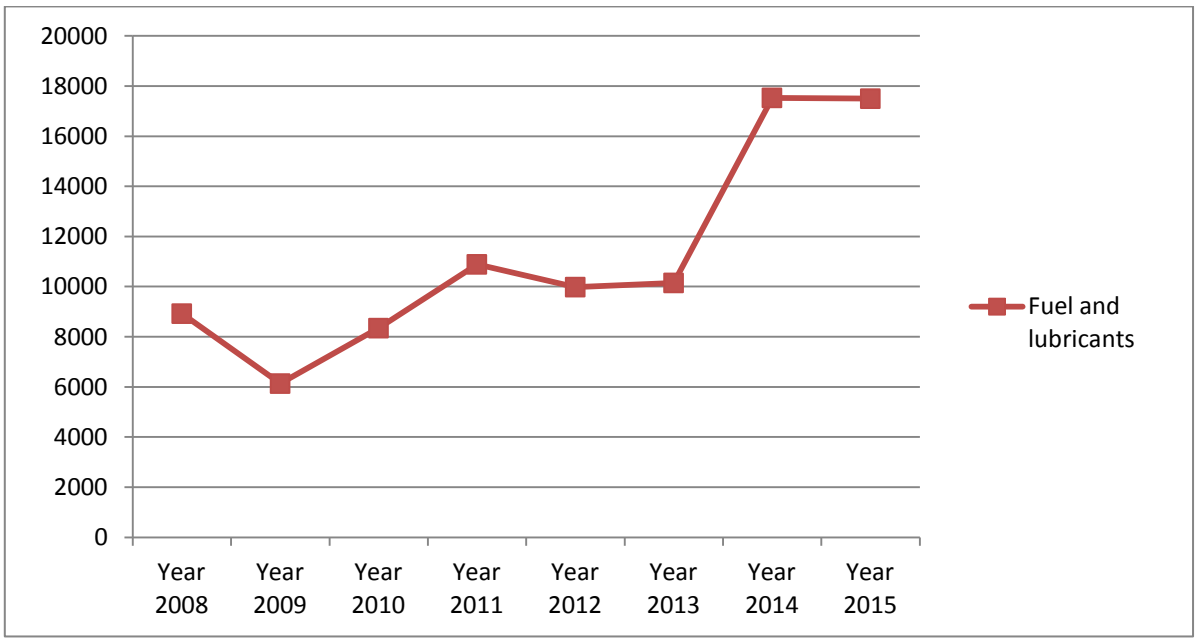
2014		
TOTAL MAINTENANCE COSTS	TOTAL COSTS	INCIDENCE%
€ 44.180,34	€ 1.760.241,00	2,51%

Table 34 : incidence of maintenance costs on total costs in 2014

The percentage of incidence demonstrates that, even if no one of the single maintenance costs voices compared among the first voices found with the Pareto diagram, considering the total cost of maintenance it compares. This means that these costs are not so negligible. In particular, in order to overcome problems such the ones of 2014 an analysis of the actual situation is needed. One thing that can be done is to evaluate if is more convenient use a corrective maintenance or a preventive one. In the first case when the failure occurs it is repaired, with all the pro and cons. In the second case there is the possibility to plan maintenance intervention, based on historical data and analysis, and for this reason it is possible to do it when the plant is not working, without production losses. Of course, if the work is done not in the working time the cost of the personnel is higher. For this, it is important to carry out a trade off analysis of all the different alternatives in order to select the best one.

6.1.4 FUEL AND LUBRICANT

The graph below will shown the trend of this voice :



Picture 23 : fuel and lubricants cost trend analysis

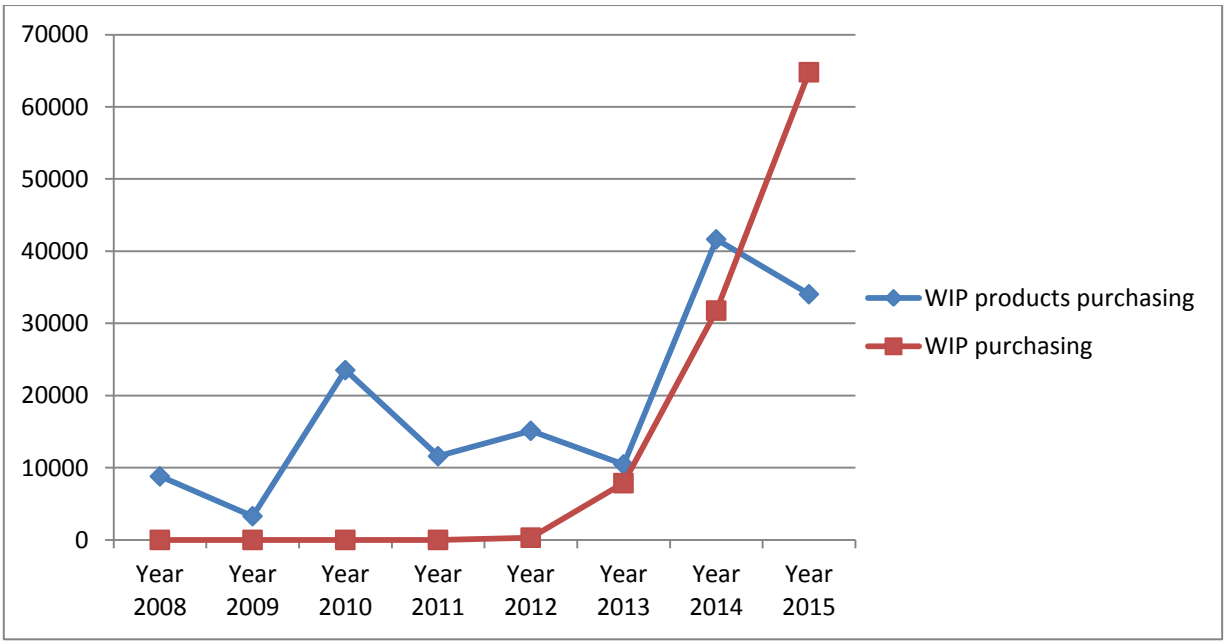
As shown by the graph, what emerges is that after a first decrease between 2008 and 2009, the costs start increasing until 2011 and then maintaining constant until 2013. After that period of time, costs duplicate in 2014 and maintain the same trend in 2015.
This voice increases because the company recently starts purchasing better and costly lubricants and similar products for machinery. This can be a good choice if it is verified that these lubricants are really better than the others. In fact in this way, if they are better this means that the machines can work better and this leads to less scraps, reworks, claims etc. At the end this could be translated in higher quality and as told by the quality gurus , spend in quality means not having cost of poor quality (scrap, rework, claim, complaint etc.). As said Cosby "doing the job right the first time is always cheaper", and for this reason he arrives to say that “quality is free” .

6.1.5 WIP

There are two cost voices related to WIP :

- Acquisto prodotti semilavorati (purchase WIP products);
- Acquisti semilavorati (WIP purchase);

The graph below will show the situation of these two voices :



Picture 24 : WIP trend analysis

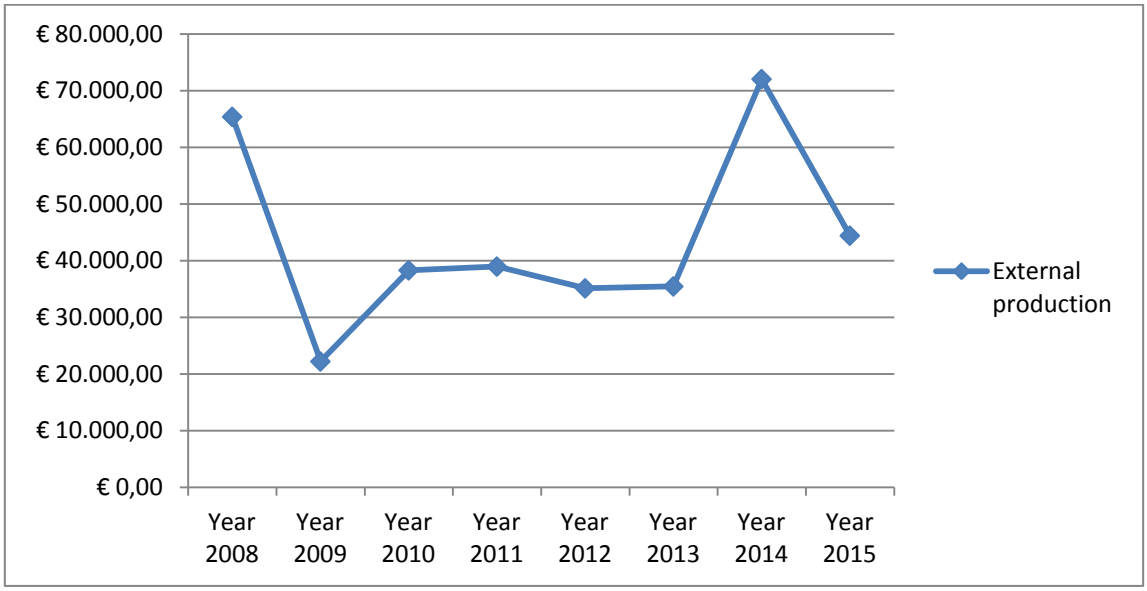
As demonstrated by the graph, the two voices increase a lot in the last years (in particular the voice “Acquisti semilavorati” that was null until 2012). This trend is justified by different reasons:

- An increase in demand (so they can’t produce all the products or they have to purchase more WIP to assemble with company products) ;
- It is cheaper purchase instead of produce;

In both cases, the trend is positive because is related or to more orders or to cost-reduction policy.

6.1.6 EXTERNAL PRODUCTION

This voice is related to the finishing processes (already listed) to which the company products can be subjected. The graph shows the trends of the last years :



Picture 25 : external production cost trend analysis

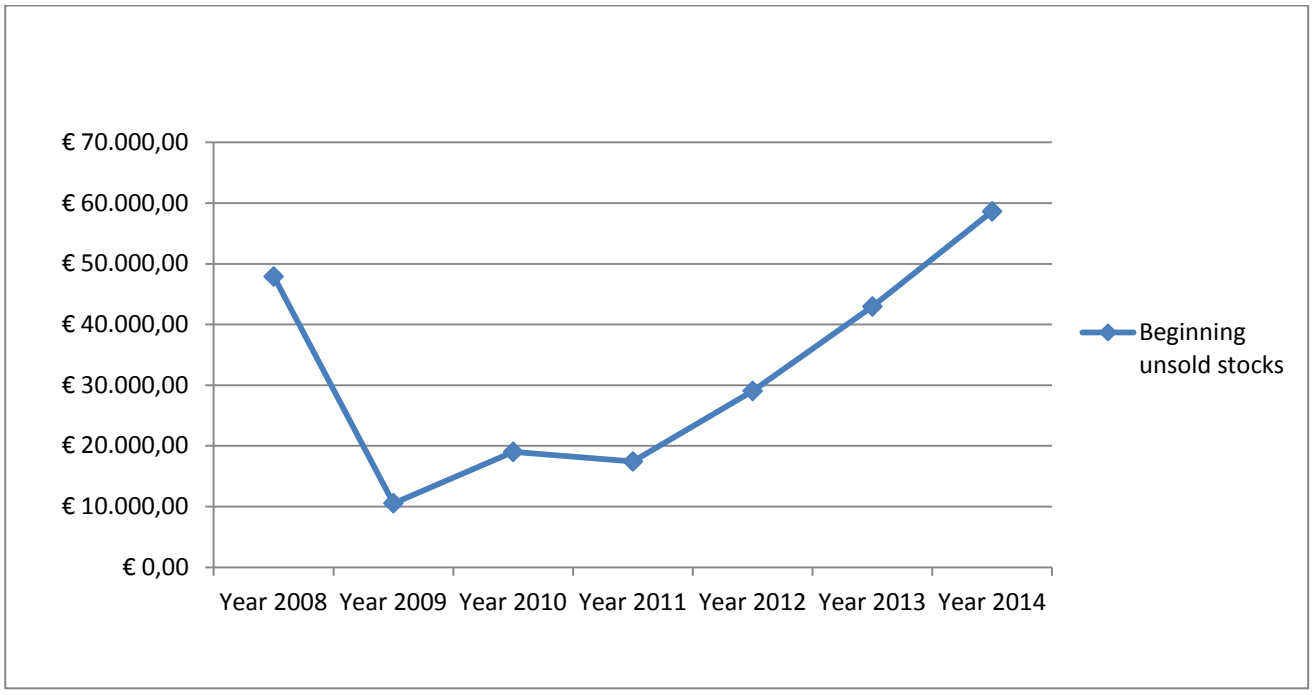
As shown by the graph above, a part from a drop at the beginning (from 2008 to 2009) and an increase in 2014, the value is more or less constant. The fluctuation of the cost can depends on :

- The number of products requested by the clients with a particular finishing process;
- The price of the finishing process;

Considering that the price fluctuation of the supplier of the finishing processes was not so high, the most of the fluctuation is due to the customers’ requests. In this context, the trend of the cost curve in 2014 is positive because is associated to a major number of orders.

6.1.7 BEGINNING UNSOLD STOCKS

This cost voice represents the monetary value of the stocks that remains at the warehouse. As shown by the graph below, after a first decrease between 2008 and 2009, the value continues to increase among years starting from 2011.

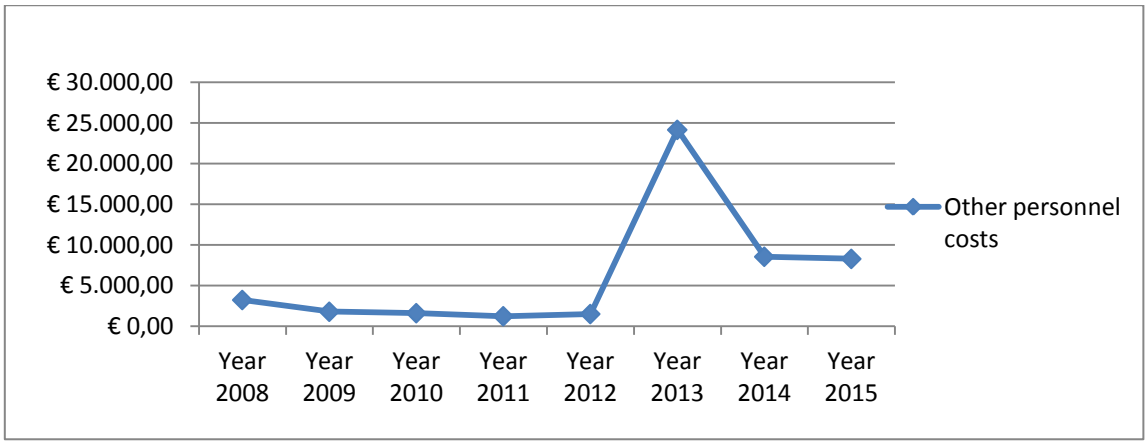


Picture 26 : beginning unsold stocks cost trend analysis

The main cause for this could be overproduction, so the fact of producing more than the quantity requested by clients and maintain it in the warehouse until an order for that particular product is sent. In order to better control this situation it is possible and useful to calculate a safety range of the stocks (e.g. calculate the ideal safety stocks, EOQ etc.) In this way the trend of this voice will remain more constant over time, except considering fluctuation of the price of the products. In addition to this, maintaining a lot of stocks is not efficient according to the last techniques of the lean thinking that starts from the Toyota experience. In fact, one of the suggestions that comes from this methodology id to minimize stocks in order to become more efficient and effective.

6.1.8 OTHER PERSONNEL COSTS AND TAXES

The decision to treat these two voices together is because there is not too much to say. In relation to the first voice, the graph shows that there were high costs (a peak) in 2013, due to a retirement.

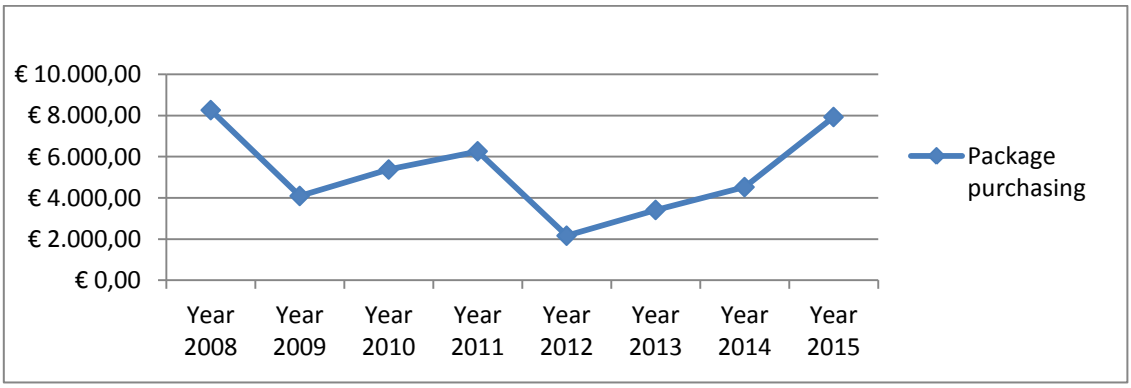


Picture 27 : other personnel cost trend analysis

The second voice instead, is related to taxes, so the company cannot do something on this. The only thing that can be noticed is that in the last year the municipality of Lecco decreases taxes.

6.1.9 PACKAGE PURCHASE

The last cost voice examined is related to the purchase of packages. In particular it can be noticed that, after a period of fluctuation, the trend is positive and continues to increase. This fact is positive because means more products sold . The graph below shows what has been described yet.



Picture 28: package purchasing cost trend analysis

6.2 INDICATORS TO CONTROL THE PRODUCTION PROCESS

Cost accounting, a part from being used for supporting decision making, can be adopted for evaluating indicators in order to monitor and control the production process. In particular two categories of indicators are particularly useful in this case:

- efficiency indicators;
- effectiveness indicators;

In a more generic view it is possible to calculate other kind of indicators not only related to the internal processes of the company and , in this way, elaborating a balanced scorecard (BSC).

6.2.1 EFFICIENCY INDICATORS

As already said, cost accounting can be adopted for evaluating indicators of the efficiency of the single product center. In this way it is possible to monitor the results and in general performances of each cost center and highlight eventually criticalities, in the view of continuous improvement of the company.

In general efficiency indicators are calculated by definition as the ratio between input and output, as shown below:

$$\frac{input}{output}$$

It is possible to apply the definition considering each product center, considering the most suitable data. In this case, the input can be considered the total cost of the center and the output the number of pieces produced (or assembled) in the reference time window. In this way the indicator will be :

$$\frac{c_{tot}}{q_{tot}} = [€/unit]$$

As input, in alternative to total cost of the center, effective work hours or total quantity of raw material can be used. The choice of taken into account the cost is considered the most suitable for the case because in this way it is possible to check the efficiency of the process considering also money. The time window chosen can be the year if there are not particularly issues. In particular the values for the product centers evaluated during the internship program are based on the whole year 2014.

This as regards product centers. Considering more in general the responsibility centers, efficiency indicators for the support centers has to be evaluated. In this case it is not possible to calculate the indexes in the same way of product centers because support centers, as the name suggest, develop supporting activities and so are not directly linked to the production of the good. A proposal of indicators, following the idea that they have to be a ratio between input and output, is shown in the table below:

SUPPORT CENTER	INDICATOR
Administration	$\frac{c_{eff}}{q}$
Laboratory	$\frac{usage\ life\ [h]}{number\ of\ pieces\ processed\ [u]}$
Technical office	$\frac{c_{tot}}{q_{tot}}$
Quality control	$\frac{c_{tot}}{number\ of\ pieces\ controlled}$

Table 35 : proposal of efficiency indicators for each support center

As regards "Administration", it is quite difficult to evaluate what can be an useful output for the indicator. In fact, the administration is in charge of all the bureaucracy. A way for evaluating an efficiency indicator could be to consider as input the effective hours dedicated by administration for planning and management of the production activities and as output the number of pieces produced in this time window (q):

$$efficiency\ indicator[h/unit] = \frac{effective\ hours\ [h]}{q[unit]}$$

Another step could be to give a monetary value of these effective hours, e.g. considering an hourly cost for administration and multiplying it for the effective hours, and arrive to define also the efficiency indicator of administration as an unitary cost :

$$c_{eff}[€] = c_{hourly}\left[\frac{€}{h}\right] \times effective\ hours\ [h]$$

$$efficiency\ indicator[€/unit] = \frac{c_{eff}[€]}{q\ [unit]}$$

Also for laboratory is difficult to evaluate an efficiency indicator because it is difficult to define input and output of the center.
In fact, this part of the company has a support role : it gives all the tools and equipments necessary for the production of the final products. As input hours needed for a particular tool or the cost of the tool can be used, and as output the number of product processed with that particular tool can be used. An alternative, that could be more efficient, could be to consider the usage life of a tool and the average quantity that it is able to process during it:

$$\frac{usage\ life\ [h]}{number\ of\ pieces\ processed\ [u]}$$

The efficiency indicators can be classified as key performance indicators and can be used for creating a management dashboard, e.g. a balanced scorecard, in order to monitor company performances in different areas. In particular, as regards these efficiency indicators in relation to the balanced scorecard, they can be considered for analyzing the internal processes area.
In addition, in order to check the efficiency of the cost centers MTTR(mean time to repair), MTBF(mean time between failures) or MDT (mean down time) can be used as indicators. In fact MTTR indicates the average time needed in order to repair a machine while the MTBF indicates the average time windows that occurs between two subsequent failures. Instead MDT refers to the average time the machine is down (that means that is not able to work properly). Of course, these kind of indicators can be useful in order to check and monitor the number and entity of failures that occurs overtime. In particular, based on these data and on the cost voices related to maintenance (as already shown) can be used to chose the most appropriate maintenance policy among :

- corrective : the reparation is done when the failure occurs,
- preventive : maintenance actions are taken periodically, independently from the failures that occurs overtime;
- predictive : based on historical data and trend analysis of the particular component or machine, the maintenance is done periodically; in theory it has to be done just before that the failure will occur;

6.2.2 EFFECTIVENESS INDICATORS

First of all it is important to highlight what is the difference between efficiency and effectiveness: efficiency is related to "do the things right with the less effort (less time, less cost, less labour force etc.)" while effective means "do the things exactly as the customer expects and wants" . Doing this premise it is possible to understand that these two elements are fundamental for the survival of the company: the first is related to deliver the work with the lowest possible costs while the second is related to the delivery of products as the customer wants. For this reason the first, efficiency, it is crucial for decreasing costs : if a system is not efficient there are losses and this early will become losses in money and increase in costs; the second, effectiveness, it is important for customer satisfaction. At this point, it is possible to evaluate different indicators in order to check these measures. As regards efficiency, unitary product costs or centers unitary cost only to named a few. Instead in relation to effectiveness it is possible to check delivery time or time to market, MTTR, MRTBF, MDT, availability.

In general terms it is possible to say that effectiveness is strictly related to customer satisfaction: in order to maintain and create loyal customer it is important that they are satisfied by the work delivered by the company; for this reason it is crucial to monitor their satisfaction with surveys and questionnaires in order to understand how improve if necessary;

For that the majority of effectiveness indicators are related to :

- Quality;
- Time;

Quality is a key point for different reasons; in fact, in general it can be referred to both internal and external perspective: in the first case it is related to efficiency, and so it is related to the conformance with specifications, reworks and scraps rate and so on, that can be used as indicators, while in the second case are related to the customer perspective, and so to effectiveness and customer satisfaction. In this case, the customer is satisfied if the product effective for the use or intent for that he buys it. For this reason, useful indicators could be complaints or number of delayed order in a reference period of time.

Also time has two perspectives, as quality. In fact, from an internal point of view it is related to efficiency and indicators could be throughput time or takt time. Instead from an external point of view, it is related to effectiveness and to the customer. In this case an useful indicator could be the average delivery time.

Nowadays also innovation is crucial also for small companies to be more efficient, delivering what the competitors are able to produce or something more interesting in order to gain new customers. In this case specific a way to monitor it is to count the number of new molds designed and created.

To sum up, the table below will show for each feature some possible indicators:

PERFORMANCE DIMENSIONS	**METRICS**
CUSTOMER SATISFACTION	SURVEYS, QUESTIONNAIRES
REPUTATION	INVESTMENTS IN ADVERTISEMENT AND PROMOTION
EFFICIENCY	CENTER UNITARY COST,UNITARY PRODUCT COST
EFFECTIVENESS	MTTR,MTBF,AVAILABILITY,MDT
QUALITY	% OF SCRAPS, REWORKS, COMPLAINTS
TIME	DELIVERY TIME, LEAD TIME
INNOVATION	N^ OF NEW MOLDS

Table 36 : proposal of indicators for the BSC

Of course, other kind of indicators can be evaluated in order to create a management dashboard of the company. The balanced scorecard is a visual tool that can efficiently help management to control the business of the company, under different perspectives. The ones adopted in this project is the most recent, elaborated by Kaplan and Norton.

The choice of trying to develop a balanced scorecard can be seen in the logic of continuous improvement logic. In fact, in order to have an efficient performance management system, this tool can be very useful because it helps administration to focus on the key issues for the success and surviving of the company in the medium and long-term.
Before evaluating a balanced scorecard, a strategy map could be useful in order to understand the relations among the different "objectives" of the company. In fact in the strategy map, that is at

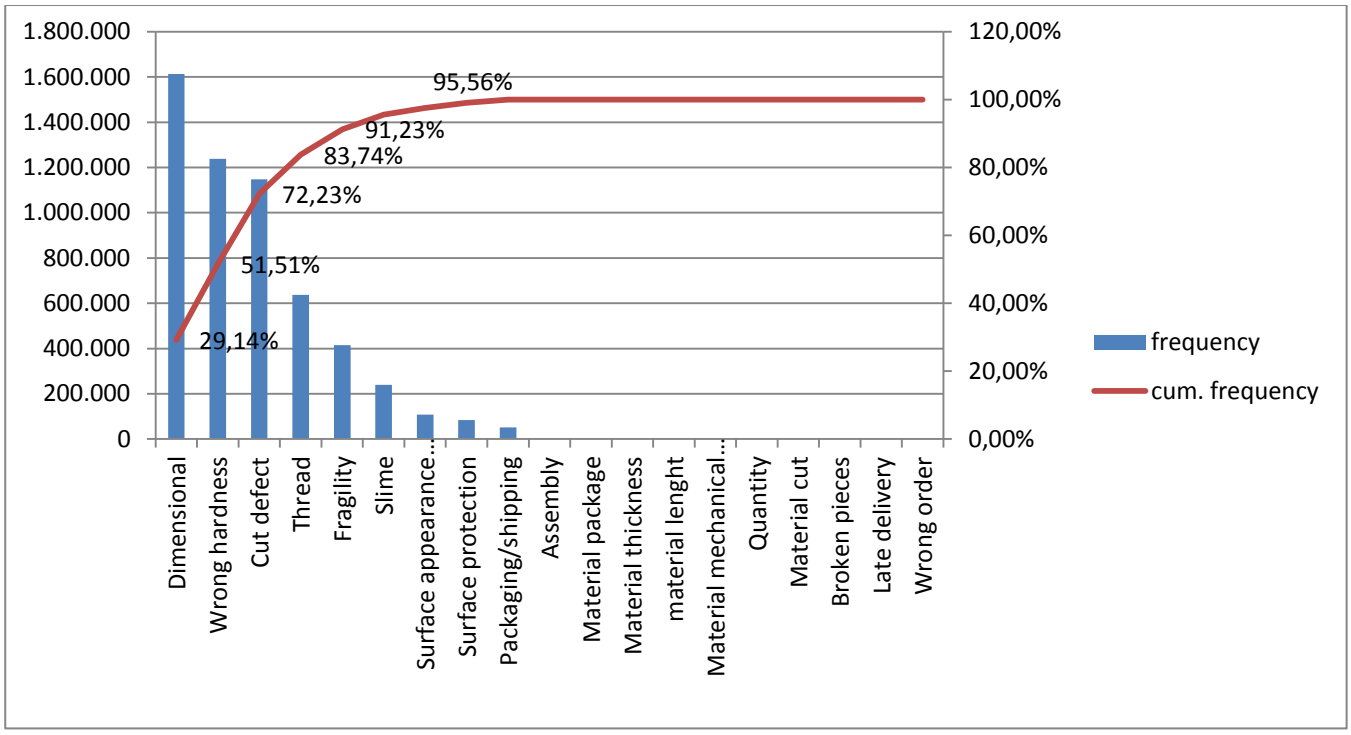
the base of the BSC, starting from the goal of the company through a cascade process all the cause-effect relations are identified. In this case specific a BSC has not been evaluated because was not in the interests of the company.

6.2.2.1 QUALITY ANALYSIS

In order to speak about quality indicators as measures of effectiveness, a quality analysis of the company is needed. In addition to this, a quality analysis is also an important step in the view of continuous improvement.

This study on quality will lead to understand which are the most critical departments and processes in order to focus on them for the quality control and improve it in the future, eliminating cost due to poor quality (scraps, reworks, claims, complaints etc.)

One efficient tool used, that is one of the seven tools of quality described and promoted by Ishikawa, one of the most famous quality guru that said that the 95% of quality problems can be solved with this simple tools, is the Pareto diagram (that has been used yet for the cost analysis).



Picture 29 : Pareto chart of the defects

What emerges from the analysis carried out is that around the 84% of the defects are due to four main causes :

- Dimensionale (dimensional);
- Durezza errata (wrong hardness);
- Difetto di tranciatura (cut defect);
- Filettatura (thread);

All the data used are referred to 2014. In absolute terms what emerges is :

TOTAL NOT COMPLIANT PIECES	5.536.186
TOTAL MANUFACTURED PIECES	927.205.504
TOTAL SOLD PIECES	856.145.728

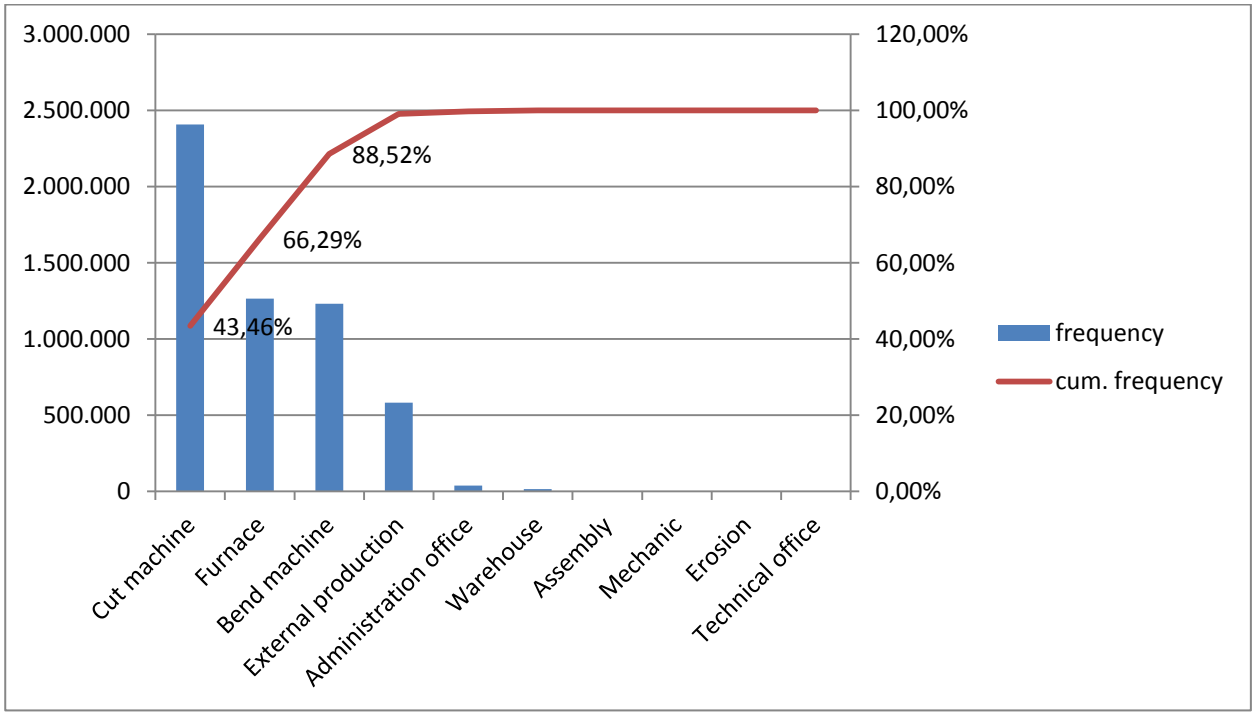
Table 37 : comparison among pieces not compliant, produced and sold

That means that, considering the total production:

$$ppm = \frac{5536186}{927205504} \times 1000000 = 5971ppm$$

This means that every 1000000 pieces produced around 5971 are defective. This data has not to be negligible and more efficient quality controls are needed.

To exploit better the situation, another Pareto analysis on the different departments was carried out in order to understand which is the most critical :



Picture 30: defects Pareto chart referring to company's departments

The study done shows that around the 89% of defects are present in three departments:

- Cut machine;
- Furnace (tempering);
- Bend machine;

It is particularly important to focus on the cut machine department because around 40% of the total defects comes from this department. It can be useful to reinforce the quality control and make a more detailed analysis in order to understand the real causes of these problems. Instead results particularly good the assembly department, that makes rarely defects.

7. CONCLUSION

The thesis lead to the design of a cost accounting system for a small manufacturing company. With the work done, in first place an evaluation of the unitary cost of each company product was carried out and then also proposals for improvements based on trend analysis and other kind of studies, already described, accordingly to the possible uses of cost accounting (operative and monitoring). For these reasons, the project has to be considered accomplished.

This as regards specifically the work done in relation to the internship program at Rapitech S.r.l. In fact, now that company can implement and update a cost accounting system, with all the correct information to set correct pricing and to take right choices in management.

The measurement system has been chosen according to different motivations :

- simple;
- easy to understand and apply;
- easy to detect;
- appropriate for the context (small/medium company without an office dedicated to costs);
- diffused ;

In a more generic view, overcoming the relation to the internship, the work done can be seen as a case study on cost allocation or cost accounting in small manufacturing companies. In particular it reinforces the positions in favor of full costing instead of direct costing, because in this way, considering also indirect cost, pricing choice will cover all the costs incurred by the company. As regards the choice of the base for allocate OVH, ABC method, as supported by the literature, is the most precise, but cannot be applied in a small context in which there are no the base for it (no office, no one specialized in economics or cost accounting). In particular, in order to be carried out over time someone competent is needed. In addition to this, it is particularly efficient when technology is more present, and so volume based and labor based bases are not the most appropriate. Otherwise, in simple and small manufacturing realities, more traditional allocation methodologies can be more useful, efficient and effective. In this way the system created can be understood and applied over time without particularly specific competences. In fact, different studies shows that volume based bases are the most diffused as bases for allocation, even if interests in ABC becomes more and more higher. This is real in particular in some industries, as shows literature already mentioned, e.g. transportation sector.

In addition to this, the cost accounting system designed can be used by other similar companies : small or medium size and mechanic. It can be easily adapted, with small adjustments related to the specific context of each single company.

To sum up, the thesis leads to :

- The design and implementation of a new and functional cost accounting system at Rapitech S.r.l., a small manufacturing company;
- a case study on cost accounting and cost allocation in small metal mechanic manufacturing companies, supporting full costing and traditional cost allocation methodologies where the most advanced methods are too time-and-cost consuming for the context;
- a cost accounting system that can be used as reference by other companies with similar characteristics to Rapitech S.r.l.

8. BIBLIOGRAPHY

- Beltrán, W.P.M., Kliemann Neto, F.J., Corrêa, R.G.F., Denicol, J. (2015), " Cost management in small industrial enterprises: A case study on a company in the food sector ", Espacios, 36(17), pp. 10;

- Botin, J.A. and Vergara, M.A. (2015), “A cost management model for economic sustainability and continuos improvement of mining operations”, Resources Policy, 46(2), pp. 212-218 ;

- Brierleya,J.A., Cowtonb,C.J., Drury , C. (2006), " A comparison of product costing practices in discrete-part and assembly manufacturing and continuous production process manufacturing " , International journal of Production Economics, 100(2), pp. 314-321;
- Dugdale, D., Jones, T.C. (1998),"Throughput accounting : transforming practices", British Accounting Review, 30(3), pp. 203-220;
- Guajardo, M. and Rönnqvist, M. (2016), " A review on cost allocation methods in collaborative transportation" , Source of the Document International Transactions in Operational Research, 23(3), pp. 371-392;

- Hilmola, O.-P. , Li, W. (2016), " Throughput accounting heuristics is still adequate: Response to criticism ", Article, Expert Systems with Application, 58, pp. 221-228;
- Kaplan, R.S., Steven R. Anderson, S.R. (2004) , "Time-Driven Activity-Based Costing" , Harvard Business Review, 82(11), pp. 131-138+150;

- Kutáč, J. , Samolejová, A., Stoch, D., Andruška, L. (2014), " The issue of overhead costs allocation according to labour inputs in target costing of metallurgical production " , Source of the Document METAL 2014 - 23rd International Conference on Metallurgy and Materials, Conference Proceedings, pp. 1767-1771;

- Macarthur, J.B. (1996), "From activity - based costing to throughput accounting", Management Accounting;
- Morrogh, Ken , Zhu, Zhiwei (1995)," Full-cost pricing: a pricing strategy for a job shop", Article, Production and Inventory Management Journal, 36(2), pp. 68-72;

- Mortaji, S.T.H., Bagherpour, M. , Mazdeh, M.M. (2013), " Fuzzy time-driven activity-based costing (Article)" , Source of the Document EMJ - Engineering Management Journal, 25(3), pp. 63-73;
- Osadchy, E.A., Akhmetshin, E.M. (2015)," Accounting and control of indirect costs of organization as a condition of optimizing its financial and economic activities ", International business management, 9 (7), pp. 1705-1709;
- Parkhi, S. , Tamraparni, M. and Punjabi, L. (2016), " Throughput accounting: An overview and framework ", Article, International Journal of Services and Operations Management, 25(1), pp. 1-20;
- Samaha, K., Abdallah, S. (2011), " A comparative analysis of activity-based costing and traditional costing systems: The case of egyptian metal industries company" , Source of the Document Cases on Business and Management in the MENA Region: New Trends and Opportunities, pp. 41-53 ;
- Somapa, S., Cools, M., Dullaert, W. (2012)," Unlocking the potential of time-driven activity-based costing for small logistics companies " , Article, International Journal of Logistics Research and Application, 15(5), pp. 303-322;
- Todalbagi, R. (2015), " JIT & KAIZEN Costing"
- Zamberlan, C.O., Zamberlan, J.F. (2009), " Systems of costs in Agribusiness: A study in the area of the Fourth Italian colony ", Article, Custos e Agronegocio, 5(2), pp. 2-14;
- Zhuang , Z.-Y., Chang, S.-C. (2015)," Deciding product mix based on time-driven activity-based costing by mixed integer programming" Article, Journal of Intelligent Manufacturing;