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Tesi

Hacking and frugal innovation in the North East of Italy

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INTRODUCTION

Frugal Innovation is the art of doing more with less, this approach is well-developed in Eastern economies; countries like India or China have always exploited this attitude toward innovation in order to bring efficient solutions in cases of emergencies or generally speaking in environments characterized by scarcity of resources.

This approach is now gaining momentum also in Western economies but its features are different from what Indian people define as *Jugaad Innovation* since it derives from abundance of resources and market-driven necessities.

Classical innovation processes are characterized by large investments and sequential phases at the end of which a board of senior managers decide if the project is worth proceeding or not.

Frugal innovation is totally different: it relies on capabilities and know-how as main drivers of innovation, it is based on existing products and the development phase is based on tinkering and attempts.

Despite the fact that the two methods are different they are not substitute but rather complement, in fact in Western enterprises the combination of the two often drives companies to achieve remarkable results with respect to invested results.

The objective of the thesis is to explain the features of the Western Frugal Innovation; demonstrating which are the key elements to obtain innovative solutions minimizing investments in R&D activities.

Two case studies have been analysed, TEXA S.p.A. and INglass S.p.A. are two Italian small-medium enterprises that currently pursue this coexistence of R&D investments and frugal attitude to achieve results and compete with international corporations.

The analysis of the companies have been done in first person by the candidate during his working experiences at the companies; basing on everyday personal experiences, interviews with employees and internal data provided by the two companies.

CHAPTER 1 - TWO APPROACHES TOWARD INNOVATION

1.1 NPD: the mainstream approach

Under a traditional view innovation can be defined as the act of introducing a new device or material (product innovation) or a new method (process innovation) in order to pursue commercial objectives (Schilling, 2010).

A successful innovation knocks down entry barriers, fulfils needs and brings change, its importance is given by the fact that it is the most important driver of competitive success for firms operating in current markets. The need to be innovative is due mainly to globalization of markets and increased competition among companies on a worldwide scale. Foreign competition has driven firms to continuously innovate in order to offer differentiation.

Of course advances in technology and computer sciences have played a great role in speeding up innovation and making it easier, all these technologies have made production processes consistently shorter and reduced the importance of economies of scale in favour of differentiation of product portfolio.

Nowadays it is basilar to offer a wide variety of products to satisfy the needs of all potential customers in shorter terms.

Innovation has brought consistent changes and improvements also on society, in the last century the GDP per capita has risen like never before in the history of times and technological innovation has improved also efficiency of manufacturing, the amount of output achievable from a given quantity of labour and capital is obviously higher than the past.

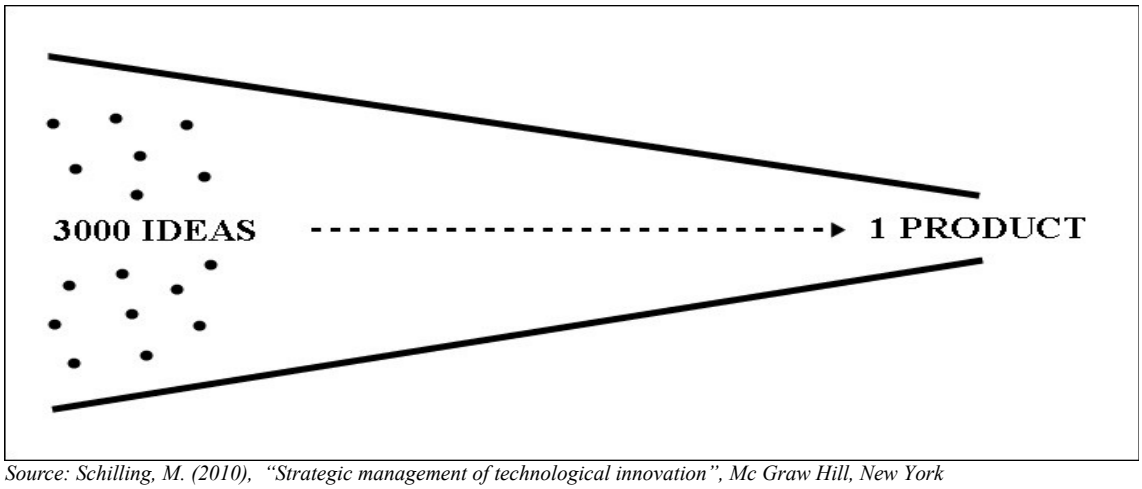
At the same time innovation has caused some negative externalities like pollution, erosion of natural habitats and moral dilemmas if referred to genetics. Innovation is also costly, in terms of resources like investments of money and time.

Since innovation is so important companies have always tried to apply rigorous and scientific methods to the innovation process, the idea is simply the starting point of innovation but then the process and the development is long and not always simple.

Most innovative ideas do not become successful new products, only few products out of several thousands projects results in a successful new item. Many prototypes do not result in technically feasible products and of those that are commercialized many fail to earn returns.

According to G.Stevens and J.Burley it takes around 3000 raw ideas to produce one significant novel ans successful commercial product. The process is often described as a funnel, with many potential products going through it but very few making it until the end (Stevens and Burley, 1997).

Figure 1. The Innovation Funnel



Source: Schilling, M. (2010), "Strategic management of technological innovation", Mc Graw Hill, New York

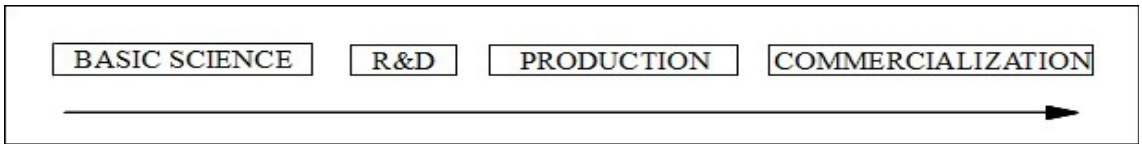
The prime source of innovation is creativity, of course, but then the process is managed in a different way, more scientific and rigorous. Modern firms have specific departments in charge of developing such ideas, these are the so called "Research and Development" (R&D) departments

Though the two terms are often put together, they actually mean two different things in the process of product innovation. Research is the effort of understanding more of a topic with or without a specific commercial purpose. On the contrary development refers to activities that exploit knowledge in order to produce useful commercial products. So the use of both words together refers to a range of activities and studies that goes from the study of materials and processes to the application and improvements

of the related results in order to obtain specific commercial improvements. In every firm the R&D department is considered the most important source of innovation and great amount of money are spent on these divisions.

In the past the method applied to innovation was defined as a linear science-push model, this approach stated that innovation proceeded linearly together with scientific discovery. The primary and more relevant sources of innovation were basically discoveries in the science field that were used and transferred to companies for commercial purposes.

Figure 2



Source: personal elaboration

The elaboration of an idea from a Research & Development department is typically a long process and it is managed following sequential phases.

This process is known as "New Product Development" (NPD), the process of monitoring and developing the flow that turns ideas into innovative and successful products.

The flow is structured and very précised, it can be represented as a funnel with a large number of raw ideas entering into it and few marketable products going out of it. This narrowing happens because not every idea is really feasible, marketable, value-adding or successful as described before every 3000 raw ideas just 1 product is generated.

The phases are typically discovery/idea, programming, development, testing and launch; the most known NPD model is the one developed by Robert G.Cooper (1991).

Separating each stage of the process there is a decision node, a gate or stage review, in which a decision is taken whether to continue with the project, go back to a previous phase in order to modify something or kill definitely the project trying to minimize its costs. Of course the last scenario is the worst and it represents a failure, especially if this decision is taken at an advanced stage in which considerable resources have already

been spent.

These meetings have multiple objectives: to ensure that the project is on track, to validate the project itself and to formulate contingent changes. These nodes must be set at the ideal timing since they determine the development of the project.

If the project is still valid, the previous phase is complete and meets all the requirements set before and the resources needed in the further phase are available then a decision can be taken.

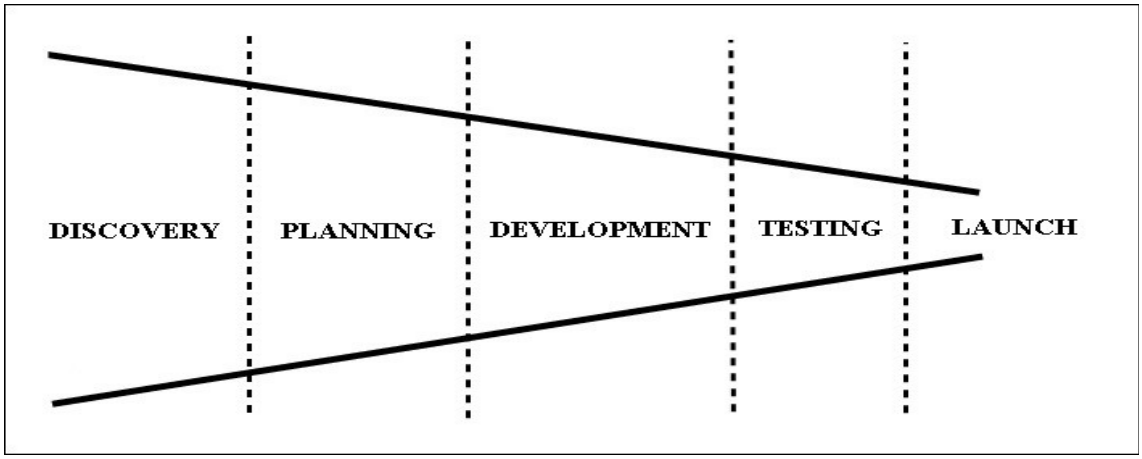
Decision-makers are senior managers or a committee , the call as described before is based on the informations available at every gate including the progress of the project, risks and the resources needed to proceed.

These gates are designed to control the overall quality of the project and be sure that it is developed in a efficient and proper way.

Gates along the funnel are made of three components: deliverables (the outcome of the previous phase and the inputs of the next one), criteria (the measures in order to take the kill/go decision) and outputs(the results of the examination in terms of decision and plans for the next phase).

Staffing of the decision-makers is as crucial as staffing of people in charge of developing the project since they have the task of controlling if the project is proceeding properly as planned.

Figure 3. Stage/gate process



Source: Schilling, M. (2010), "Strategic management of technological innovation", Mc Graw Hill, New York

1.1.1 The five steps of the innovation process

The first phase is the discovery phase, the one from which everything begins. It is often just an idea that came into mind of someone in charge of proposing raw ideas, this champion rapidly analyses this concept and tries to deliver a concept proposal that will be presented to a board for a further analysis and review.

The proposal in order to be effective should be as detailed as possible: it must include a description of the concept and the reasons for its distinctiveness, some technical features, a basic financial analysis of feasibility, a rough schedule and possibly the proposal of team members.

When the project is approved at the end of the first phase it can enter into the second one, maybe the most important, which defines the schedule of the project, the planning phase.

The purpose of this stage is to clarify and define the features and characteristics of the product that will be developed and to build a detailed business plan according to it.

It is during this phase that the decision of starting to work on the project is made, it is taken analysing more deeply the concept and the assumptions that were made before. There is a screening of the commercial and technical suppositions made on the first phase. Market researches are performed in order to see if the product might be competitive in the market. Also technical assumptions are verified in order to see if the product is physically feasible through design stages and tests.

The document that is obtained is then analysed and discussed at the relative decision gate and if approved it will be processed and sent at the next phase.

The development phase takes actions, plans from the previous two phases are implemented. The final product is designed and finally prototyped, the product is developed according to the previous specifications and business plan. It includes the hardware and software features and also the packaging of the product.

At the same time a production plan is carried out in order to set the basis for the future possible production in series and also the commercial plans related to the good like the marketing strategy.

This phase is important because it influences the results of the overall project, the

production and marketing plans will determine who will be the target of the initiative, when and at which cost.

Another factor that determines the importance of this stage is the fact that it requires cross-functional teamwork among the different departments, everyone must share the same objective and have a clear picture of the project's features. A misalignment during this phase may cause serious misunderstandings leading to inefficiencies and potentially the failure of the overall project. The last action of this phase is prototyping, from this the project will continue into the next stage. With the prototypes in hand the R&D department can proceed with the testing phase.

This stage is important too since it gives validation or invalidation of the entire project, in fact every consideration made on the product will be tested and reconsidered.

From the product itself to the manufacturing process and also the sampled customer reaction and the financial terms of the product.

The test undertaken are various, the first one is an in-house test of the product performed by the staff of the company and people related to it. The product is not anymore a simple prototype, it is close to the final good that will be commercialized but still modifications can be done if problems arise. It is important to underline the fact that this test is performed by employees who know the features of the products, what it should do and also what it should not. It is important for this reason, the product is tested on every single action that it can perform.

At the same time a *beta test* is carried on, this is different from the former since it involves people that are not familiar with the object or the company. The aim of this test is to evaluate and take notes of people's reactions to it in terms of acceptance, usage and segmentation.

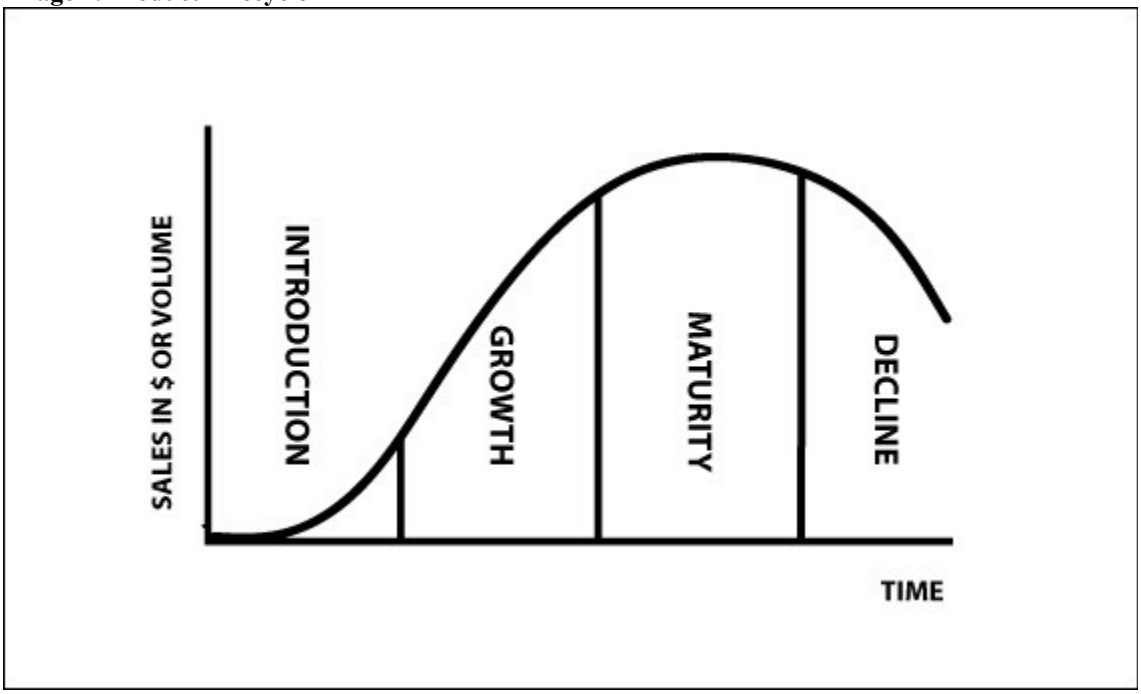
Often the company decides to launch into a specific area a small production in order to see the reaction of the market to it, this is not made in order to make it a niche product but rather it is a safe entrance into the market. The limited amount of pieces produced reduces the amount of losses in case of failure even if in that case the amount of resources already spent on the project are consistent and this would be a significant loss for the company.

The last phase is basically the exit from the funnel of the final product, at this stage it has passed all previous gates, tests and decision nodes and it is ready to be introduced in the market.
The launch phase is done according to the marketing plans and it has to create demand for the good, the production volumes are also consequence of previous decisions of senior managers.
At this stage pricing and training of the sales department together with the choice of the distribution channel are crucial in order to determine the commercial results of the project, an error committed in this final passage would ruin and waste all the efforts and resources invested.

1.1.2 Resources matter

It seems obvious, since there are multiple stages, that this kind of process is time-consuming and resource-consuming; in fact it requires continuous revisions and great efforts from different people in the company.
The time it takes to develop a proper project can vary from sector to sector and from product to product, time-to-market (TMT) is the time between an idea and its physical realization.
TMT does not go simply from the starting point of a project and its ending but from the initial conception to the moment in which the company will make it available to consumers.
TMT is crucial and important because time is one of the two fundamental factors in the determination of success of a product together with quality.
Under this view being late is an erosion of potential market and profits, the market is then smaller and competition is much more intense because other companies are selling that product since before and have gained experience and know-how.
If an idea is worth being developed then it must be worth getting it to the market as soon as possible.

Image 4. Product Lifecycle



Source: Schilling, M. (2010), "Strategic management of technological innovation", Mc Graw Hill, New York

Even if a product can reach a close fit with customers requirements and needs then it may fail if the company take too long to launch it in the market.

Bringing a product to consumers in a short time can create brand loyalty, can acquire scarce assets and set high switching costs. In addition to this a company that brings its product early in the market can have the time to develop complementary goods that value the consumer experience.

Another important issue is the fact that more time means more costs, the two factors are directly related and tightly interdependent.

Especially in electronics a company that is slow in launching a product will find it difficult to recover all the fixed costs of its development before that particular product becomes obsolete.

This characterizes dynamic markets, markets in which demand jumps quickly from one product to another and being fast and responsive is crucial.

Even if the two things are directly related they are not so obvious and easy to manage, it may happen that a company urges to launch a product in a short time and then realizes that the possible revenues coming from that good will not be sufficient to recover all the

resources spent to be fast. Development efforts must be not only effective but also efficient, costs must be monitored and controlled.

This kind of process as mentioned before is long and complicated, proceeding from one development stage to the other in a sequential way and revising each phase at each gate in order to decide whether to proceed, send it back to a previous stage or kill the entire project.

One of the problems af such structure is at the design stage in which engineers fail to communicate explicitly with manufacturing engineers. As a consequence the project proceeds without clear manufacturing requirements and the results are unfeasible.

A sequential plan of actions has no warning that an error has been made and that some planned features cannot be undertaken. As a consequence the NPD process can last longer since it has to go back and forth between the product design and the manufacturing phase.

Often to shorten the overall length of the process and avoid time-consuming and costly repetitions between phases the companies try to adopt the same structure avoiding sequentiality and trying to work on different phases at the same time.

Simultaneous engineering, or partly parallel development process, tries to shorten the whole process performing different tasks in a parallel way, if possible.

Design is initiated before before the planning phase is complete, and process design before product design ends allowing higher coordination between the different stages and minimizing the risk of designing a product that are difficult to produce. In order to adopt such strategy a high level of coordination is required, every different team must be aware of what the other teams are doing and there must be shared informations.

In a period of economic downturn companies should learn how to produce higher value with fewer resources, nevertheless Western companies tend to consider more reliable the previously successful “more for more” strategy (Radjou, 2012).

To gain economic advantage and differentiate from each others such companies usually spend considerable sums on R&D activities to formulate expensive and sometimes not really effective products that consumers must buy at a high price.

This kind of reasoning was validated in the past by the stronger purchasing power of consumers that made possible the recoup of invested capital.

This approach to the market is currently no longer sustainable since consumers are more price sensitive and conscious, the companies still pursuing that strategy did not realize that premium and complex products have been substituted by affordable solutions offering better performances at lower cost.
For the seek of lower prices 78% of U.S. consumers have stated that they would be willing to switch from their usual brand to another one for personal goods (Menkes, 2001).
This consideration should not be misunderstood, these changes in customer preferences do not mean that lower price entail lower quality. In this new age of economic recession premium products are those showing the best price/quality ratio.
However traditional companies even if challenged by these new trends are still bounded to the existing corporate culture and incentive systems that are not structured to favour this philosophy of doing more with less.

1.2 A different approach is gaining momentum

The economic downturn characterizing recent years has made consumers more cost-conscious than they were in the past when expensive premium products were attractive and companies could recover R&D invested resources.
The main objective of consumers is the one of getting the best possible product at a lower price, a compromise between quality and price.
Opposed to the NPD method of pursuing innovation there is a different approach to the subject, the one of optimizing resource to get more from less; under this philosophy effective cost management, know-how, hacking and tinkering are the main driver of sustainable performance.
The modern "*bricoleurs*", a definition is given later, start from the existing to develop new concepts, improvements that will bring value to the manufacturing process.
The idea of sequentiality is completely disrupted, hacking plays between those phases with no scientific and rigorous method, identified the problem or the weakness the so called bricoleur tries to solve it or exploit it in order to improve the machinery or the product analysed.

It is in complete opposition to the classical R&D approach which requires time and resources, hacking or tinkering already has an existing base to start and then it just requires the spark of genius and the abilities of skilled minds.

This process of frugal innovation is represented by the certainty that it is possible to do more with less, exploiting existing resources to create value.

It requires capabilities and the courage of hacking a work of engineering but nothing else; there are no structured teams, no business plans or strict deadlines. In addition to this the probability of failing is accepted and managed, in the worst case scenario few resources have been moved.

Sequentiality is completely avoided and timing is sensibly reduced, hacking disrupts any logic and scientific approach to innovation in favour of concreteness and experience.

Hacking breaks barriers and it does not need big investments, it is often pursued and done by individuals who have the skills to think in a different way and see opportunities where others could just see uniformity and steadiness.

It has an organic and practical approach to innovation while usually firms adopt an high level of formalization and standardization in both manufacturing and R&D divisions.

Resources used are smaller, frugal innovation starts from the existing and requires small investments, it goes against the concepts of patents and it often exploits the advantages of diffusion.

As mentioned before hacking derives from abundance of available materials, it derives from the existing and it evolves thanks to the possibilities a bricoleur is given.

In current times resources are scarce and investments are made with difficulty but there is a plentiful array of materials and products that are suitable to be worked on.

Without this existing base, the power of internet and availability of materials this approach would not be practicable or at least would be performed in a different way like in emerging countries where the approach to innovation is often even more frugal than the one of the bricoleur.

In countries like China or India this availability or resources and materials is limited and the needs that drive such hackers are different from

those mentioned before, it is often not just an idea or a need for something different but

rather a necessity.

It is the case of Mansukhbhai Prajapati, an Indian potter who created a clay refrigerator for the poor people of India.

He took inspiration from necessity and particularly from the tragedy of the Gujarat earthquake of 2001 in Western India, in which thousands of people died and more were left with no home or electricity.

Prajapaty studied for some years a type of refrigerator made of clay that can keep food cool without using electricity, just the laws of physics. The fridge is now mass-produced and it is recognized as the poor-man-refrigerator that changed the lives of many people, the product reached a social impact operating from scarcity to opportunity.

This and other down-to-earth innovations carried on by Indian innovators are examples of what Naavi Radjou defines as "*Jugaad Innovation"*, doing more with less using the instinct and capabilities (Radjou, 2012).

This approach to innovation is similar to the one of hacking and tinkering mentioned before but it differentiates from the former for the availability of resources; they are both driven by genius and opportunities but they rely on different grounds, abundance and availability of resources for the first and scarcity for the second.

The principles of frugal innovation and hacking in the Western world are older than expected and can be traced in ancient times.

In the U.S. this approach to problem solving and this attitude toward tinkering objects to achieve different scopes and potentialities is defined as the "*Yankee ingenuity",* which refers to the typical American pragmatism (Florida, 2004).

An example is the story of Cyrus McCormick (1809-1884), a Virginian farmer recognized as the inventor of the mechanical grain reaper. For several years Cyrus and his father, who were living on agriculture, tried to develop a machine that could improve the lives of farmers.

His father worked hard for several years prototyping different machines but when he gave up his son took his place and basing on his practical discoveries he hacked what he had at hands into to the first mechanical reaper that changed (not initially, farmers were skeptical) the lives of many harvesters improving the agricultural practices all over the country.

Another American personality that showed similar traits is certainly Benjamin Franklin, he developed in the 18th century a particular and innovative (for that period) type of stove that consisted of a front enclosure and an air box in the rear that could burn wood more efficiently.

A peculiar characteristic of this invention is that Benjamin Franklin has been one of the first promoters of open source technology, Franklin did not patent his creation because he wanted to improve it and wanted people to work on it and improve its features if possible. During his life he did not patent any of his inventions.

These men are just a couple of examples of people who managed innovation under this attitude but actually this has been a common feature of the industrial revolution, as described by Joel Mokyr in his book *The British Industrial revolution: an economic perspective (1993).*

All the inventions and innovations developed during the industrial revolution has tight connections and are a product of intuitions and mechanical abilities rather than a product of science.

Innovations have been brought by brilliant hackers, manipulators like Richard Arkwright (inventor of the water frame), John Wilkinson (boring machine) or Robert Stephenson (*"father of railways"*).

Mokyr explicitly states that these famous British investors had the merit of developing microinventions, making incremental changes and improvements of existing machines. This has been the merit of those engineers and this is why Britain is considered the homeland of the industrial revolution even if developed technologies and processes were already present in France, Germany or Italy. Their works have been more focused on perfectionism rather then originality.

Great Britain took great inventions from every part of Europe and then improved and refined them.

Often inventors and engineers were capable merchants or entrepreneurial artisans which ideas were often a product of coincidences , serendipities or inspiration mix with great capabilities, skills patience and determination.

In the twentieth century this approach to innovation changed and companies started formalizing their innovation centres, creating such specific R&D departments and

standardizing and structuring the innovation process.

Companies have started thinking that they could treat innovation as they could treat any other industrial activity, limiting the creative side of innovation imposing processes, budgets, formalization and restrictions. This approached that has been described before has some limitations.

First of all it is time-consuming and too expensive. The common belief is that the more a company invests in innovation and the more will benefit from it. It requires resources that in this economic period are scarce basing on the thought of “more generates more” while the latest philosophies are supporting the slogan “money can't buy innovation”.

Another point that plays in favour of hacking and against the classical sequential approach is the fact that those companies lack of flexibility and are generally risk averse in front of innovation since it may be cause of financial damages and are usually suffering of the “pro-innovation bias” which consists of believing that their innovation is close to perfection, will be adopted by the whole society and needs no alteration because it has no weaknesses (Rogers, 1962).

Since that companies are built and rotate around those static departments they are often not able to detect the rapid changes that are characterizing modern times and those deviant and creative behaviours that nowadays are the drivers of innovation.

Another point against the traditional approach is the fact that this huge resources needed in order to manage such enormous structures have made the innovation field accessible to few people or companies.

This has been proved wrong in recent years thanks to the movements mentioned before that has democratized innovation and technologies and it is the core feature of the hacking supporters.

Malcolm Gladwell, a journalist of *The New Yorker,* published an interested article on Steve Jobs titled “The Tweaker”. According to him the real genius of Steve Jobs has been the one of being a truly brilliant tweaker, able to take rough or incomplete ideas and develop them into the extraordinary objects he launched during his career.

Gladwell also cites Mokyr, as seen before many factors might be noted in order to explain why the industrial revolution took place in Britain: they had coal resources, an efficient patent system and high labour costs that could encourage the development of

innovations in order to increase efficiency and resource savings but the main reason that he mentions is the fact that Britain had a huge amount of human skills. British engineers were excellent “tweakers”, skilled and creative men who took several inventions of that period and improved and refined them into revolutionary industrial tools.

As these skilled artisans and engineers in Britain Jobs took inspiration, and even more, from competitors and launched improved products in terms of usability and design.

As described in his biography (Isaacson, 2011) Jobs was a complicated and very precise man, in some cases even obsessive. The book describes jobs as a successful tweaker rather than a visionary inventor, he took from Xerox the mouse and the icons on the screen, peculiar features of the Macintosh. Apple launched the iPod in 2001 but the first portable players came out in 1996 and the iPhone came out in 2007, roughly 10 years after the first smart phones.

Jobs' gift was the one of looking into existing products and prototypes and being able of refining them into excellent products that must be sold through intelligent marketing campaign, a great process of imagination and continuous and small refinements.

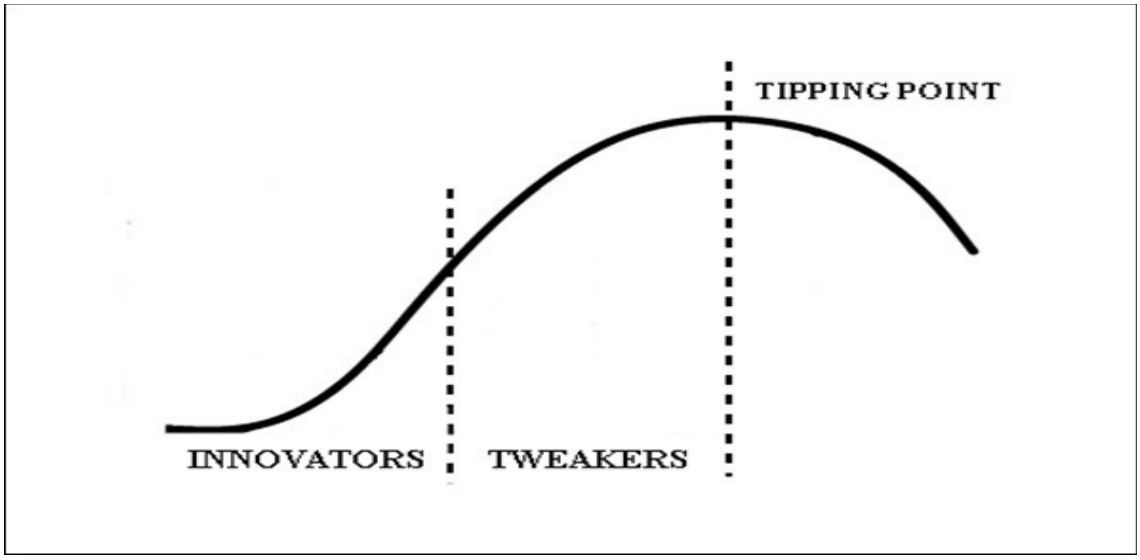
What Mokyr stressed and Gladwell reinforced is that this type of innovation is essential to progress and it has always been so. The visionary starts from a blank sheet of paper and draws something novel while the tweaker or the bricoleur starts from the existing, from that paper, and pushes it and refines it toward perfection. This task is not of less importance and sometimes brings more recognition.

Mokyr brings the example of Samuel Crompton, a British inventor who invented in 1779 the spinning mule, a machine that made possible the mechanization of the cotton industry.

The invention was brilliant but the key moment came some years later during a strike promoted by cotton workers, essentially the mules must be controlled by men and the strike put mill owners into serious troubles. The situation was solved not by Crompton, not interested in developing his machine, but by Richard Roberts, an artisan who improved the mule and made it automatic.

The history shows how recognition and benefits are often given to those gifted men who are able to improve and put things in the best direction, towards users.

Figure 5. Tweakers in the product lifecycle



Source: personal elaboration from "The Tweaker", Malcolm Gladwell, The New Yorker

According to Meisenzhal and Mokyr two groups of key workers exist: those who actually invent things and those who carry out the refinements (2010). The first one is extremely small while the second is larger and made of skilled craftsmen capable of putting their hands and ideas at the service of incremental innovation.

According to them:

"Those who had the dexterity and competence to tweak, adapt, combine, improve, and debug existing ideas, build them according to specifications, but with the knowledge to add in what the blueprints left out were critical to the story"

Meisenzhal and Mokyr, "The Rate and Direction of Invention in the British Industrial Revolution: Incentives and Institutions", 2010

1.3 Innovators as Bricoleurs

The invention of the wheel is probably one of the most important ones in the history of all times together with some other exceptional discoveries. Despite the fact that it is considered the mother of all inventions par excellence, it has always been difficult to trace the exact period and place in which it has been discovered.

Evidence of wheeled vehicles appears from the 4th Millennium BC, it is still a matter of discussion who first discovered it. It might be traced in Mesopotamia, Northern

Caucasus, Asia or central Europe, several theories and several academics are still on debate.

What is certainly sure is the fact that it did not come out of nowhere, wooden wheels were already used in pottery. The use of wheels with the purpose of transportation has been an evolution of that prior usage, a development of the wooden plate they used during the Neolithic to shape vases. After the invention of agriculture and pottery some millennia passed on with no wheel usage for transportation, the evolution of the wheel from part of a pottery machine to part of a transportation machine required several years, no one ever thought to put an axle through it and make it rotate to move things and people.

Someone in that period thought of that wooden plate not only as a tool to create a vase but also as something new, something simple but revolutionary. With a dash of imagination we might suppose that he took it from the pottery tool and make it rotate on the ground. Then he drilled it in the centre and put an axle on it, later on he or someone else decided to add another wheel on the other side of the plank, then to build something on it and push it, then to fasten it to a cow and so on. Sooner or later the chariot is on the streets, moving thousands of people. From pottery to transportation.

What is relevant in this imaginary story is the spark which made that man think of that plate in a different way, something to modify and rebuild into something new. He hacked the pottery plate and turned into the most important invention of all times.

Even if we absolutely cannot identify that men and he will have no glory we can define him with a term introduced by Claude Lèvi-Strauss, famous anthropologist and ethnologist. That man in the 4th Millennium BC has been one of the first bricoleurs of all times.

Bricolage is a French term which has no suitable English equivalent, so the best way to describe it these days is to start from a passage of Levi-Strauss book, *La Pensèe sauvage* (1962):

"*The bricoleur is someone who works with his hands, using devious means. His universe of instruments is closed and the rules of his game are always to make with*

"whatever is at hand", that is to say with a set of tools and materials which is always finite and is also heterogeneous because what it contains bears no relation to the current project, or indeed to any particular project, but is the contingent result of all the occasions there have been to renew or enrich the stock or to maintain it with the remains of previous constructions and destructions. The set of the bricoleur's means cannot therefore be defined in terms of a project. It is to be defined only by its potential use, because the elements are collected or retained on the principle that "they may always come in handy". The bricoleur derives his poetry from the fact that he does not confine himself to accomplishment and execution: he speaks not only with things, but also through the medium of things: giving an account of his personality and life by the choices he makes between the limited possibilities."

The bricoleur works with his hands but he is not an executor, he does not execute his repetitive task but rather he thinks about it in an innovative and different way. He uses his mind to perform a task in the most efficient way, finding creative solutions or his imagination to combine different tools or things to compose a new one.
Other times the bricoleur has an object but he sees in it another use or another feature that is invisible to others. He sees in things peculiar aspects or uses that other people cannot spot. He observes tools, machines, materials and objects and through its imagination and dynamic thinking he can find new patterns, recombining those parts or hacking others.
In some occasions he might start from a problem and put its skills in finding a solution but most of the times he starts from an idea to bring an improvement or an invention.
The concept of the bricoleur, the man who uses his hands to produce something or hack something, is some way similar and parallel to the one proposed few years ago by the "maker movement".
Everything begun in the US, where some people (Chris Anderson, Cory Doctorow…) carried on the idea that using hands to produce something is better than just buying it.
The so called Generation Y is the one of North American and European youth, who have seen large corporative scandals and iniquities and are skeptical about multinationals.

This generation prefer to build their own career and business, acting flexibly and frugally believing that doing more with less is practicable (Anand, 2011).

This idea has deep roots in the American culture, US citizen have always spent a lot of time performing home improvements and other "do it yourself"(DIY) hobbies. The maker movement is a technology based evolution of the DIY culture. The fields in which the makers operate are various, from electronics and robotics to craftsmanship. The culture stresses the importance of new and creative ways of doing business, from 3D prototyping to the application of home-made technologies. At the same time there is the continuous stress and appreciation of practical skills and creativity (Micelli, 2011).

Behind this mentality there is also a philosophical perspective, the maker culture emphasises values like networking and sharing in a typical informal environment. It is constantly increasing the number of Fab Labs and "maker spaces" around the world but actually no specific or particular location is required, at the origin the so called makers were operating in basements and garages, that is why it escalated so quickly.

Another important aspect of this subculture is also the satisfaction that derives from using hands to build or fix something tangible, some people took it so seriously that they changed their all lifestyle and totally embraced this movement. It is the case of Matthew Crawford, a well-educated man that after completing his brilliant academic career and working for a short period of time for an established think tank institute decided to leave his highly respectable job to dedicate himself to his real passion, motorcycles. At the beginning of the millennium Crawford was the executive director of the George C.Marshall Institute, an American politically conservative association located in Washington D.C. , but he left after few months unsatisfied of his considerable position. His job consisted of making scientific reviews of publications but ,according to him, they were just positions taken to validate the interests of political parties and multinationals.

After leaving Washington in 2001 he opened a workshop in Virginia where he still fixes old motorcycles for friends and clients. In 2009 he wrote a book about this big change in which he declares that he now receives much more satisfaction as a mechanic rather than as an executive, even if his salary is consistently lower. In his book Crawford argues and struggles to give back dignity to old fashioned jobs, he gives a new view of

skilled labor giving importance and value to those works in which people get their hands dirty (Crawford, 2006).

Moving away from mechanics and coming back to the maker movement it is important to admit that a great role has been played by accessibility of resources, materials and technology.

Those makers that build robots or drones are often working on open source software that allow them to program their machines according to their purpose, probably twenty years ago it would not be as easy as it is now. Open source software and hardware are relatively easy to set and run by people who have a minimum knowledge of electronics and computer science.

Arduino is one of those tools which made it possible. It is an open-source hardware with a microcontroller board created to let environments and objects interact and perform actions. In order to set the software no extreme skills are required and the overall cost of Arduino (pre-assembled or as a DIY kit) is accessible to everyone. Its creator, Massimo Banzi, firstly developed Arduino for his students in Italy at the Interaction Design Institute of Ivrea in order to give them a cheaper microcontroller to work on. The idea have been developed throughout the years and nowadays Arduino is recognized as one of the most successful examples of frugal innovation.

Arduino has democratized production and let thousands of makers create special objects.

One example is the “cat feeder”, it has been invented by a man who had two cats who had to eat different kind of food. In order to let them eat the proper food ho invented a feeder that recognizes the cat from a chip on the collar and open a sliding door that allow the cat eat the food. He used ad Arduino board to control the sliding door which has been recycled from an old CD player, then he added some cardboard, some tape and the cat could eat easily and without his supervision.

Other people invented a TwitterLamp which changes the intensity and colour of its light according to the tweets related to an hashtag or an account.

A part from these likable but light creations other more useful things have been developed, from flying drones called AeroQuad to artificial body parts.

Easton LaChapelle, a 17-year old student from Colorado, is using an Arduino software

and a basic 3d printer to develop a cheaper and functional prosthetic arm and hand.
When he was 14years old he decided that he had to build a Lego robotic hand, pretty essential but functional.
Later on this game evolved and Easton started taking it seriously, the spark that fired the creativity of this young bricoleur has been a 7-year old girl who was wearing a professional prosthetic that cost a consistent amount of money and that had to be replaced continuously to follow the growth of the girl. Easton decided that he had to create a cheaper alternative.
He started to design with a 3d modelling program called "Solidworks" and thanks to a friend who had a 3D printer and ready-made parts he initiated his inventing process. The final version of his robotic prosthetic costs around 400$ and earned him an invitation to the annual White House Science Fair. Nowadays Easton is working at NASA on a telerobotics control project but at the same time is still working on his previous prosthetic project in order to launch it in the market and create some kind of social value.
All these examples are useful to stress the fact that modern bricoleurs can nowadays build or hack something into something that is not on the market, they can develop their ideas easily thanks to new, open and cheap technologies. A various amount of technologies are emerging: intelligent software that drive robots, new materials lighter but also cheaper, new processes like 3D prototyping and internet services. Manufacturing is becoming digitalized and The Economist defined this process the "third industrial revolution".
The first occurred in Britain during the 18th century thanks to the mechanisation of the textile sector and the it defined the birth of the factory.
The second occurred in the 20th century by Henry Ford who developed the concept of the assembly line and transformed the previous factories into the modern firm. Now manufacturing is going from mass production to mass customization.
It is possible to produce smaller batches of a wider variety, in this way it is possible to match perfectly the desires of the clients who are focusing back toward original and high quality products.
Moving from the garages of the makers to manufacturing firms the stress and the

importance of details, quality and sustainability are characterizing the present and will shape the future of manufacturing.

The aim of this dissertation is not on this new way of producing things but rather on a peculiar aspect of it, the change in the innovation pattern and process. Latest trends show constant and growing diffusion of frugal innovation and hacking methods, like the bricoleur mentioned by Levi-Strauss, developers nowadays start from the existing to build a better and improved future.

These modern bricoleurs are named “hackers”.

The term hacker has been very discussed and popular in the last two decades, a lot of attention has been placed on the actions of an elite of computer experts with exceptional skills that illegally entered into the databases of several government entities for various reasons.

The terms hacker and hack are defined and characterized by opposite positive and negative connotations in computer science. Computer geeks often use those words to express respect and admiration for the abilities and skills of software developers.

At the same time in the rest of the world the term hacking has a negative connotation, hacking means entering into databases evading and disabling security measures to cause damages at the system. An hacker is a person who intentionally follows and pursues weaknesses in an informatics system or network in order to crack into those environments and steal or destroy informations.

The aims are various, from profits to protest or simply self-glorification. Computer enthusiasts in such cases prefer the term cracker.

This subculture traces its origin in the 1960s, it took place in the computer faculties and campuses of some high level colleges and universities, especially the Massacchussets Institute of Technologies in Boston.

In that period hacking meant “messing about” a computer or “goofing”, it was a term coined to describe the increasing interest of students towards jokes and actions that could prove their abilities and skills.

Moving away from computer science the term hacker has a similar but different meaning, a hacker is a person that overcome boundaries and existing limits to find new solutions and alternative means regarding hardware (not limited to computers).

These modern bricoleurs modify hardware to expand their capabilities or improve their performance, they belong to the culture of hobbyist inventors.

This kind of hacking might consist of either making novel objects or simply modifying existing things, known as “modding”, in order to satisfy modders' needs or test the limits and possibilities of what can be done with such hardware.

Modding, in the computer field, refers to the practice of modifying computers or accessories in order to obtain superior performances or for aesthetic reasons but can be also expanded to any other hardware. It is typical of hobbyists, people who redefine or reshape things in order to obtain a unique piece of art or simply to improve its utility and exploit its features.

Among watch collectors one of the latest trends is to mod watches according to personal tastes and preferences, this trend is becoming popular and it is also influencing watch companies.

Everything begins with an idea, most of the times a collector wants to have a unique piece of art personalized according to his taste without spending considerable amounts of money.

Customization is the key word, people wants to wear unique pieces that are products of their minds.

The watch market is wide, there are wonderful time pieces that can be considered art but often their cost exceed the spending power of watch enthusiasts. At the same time most of affordable watches respect the laws of industrialization, those reliable watches are simply cheaper but often anonymous.

In order to compromise with these two different faces of the same coin watch collectors prefer to create their own watch. Basing their work on reliable Japanese movements they work on cases, bands, dials in order to obtain the perfect watch, their creation.

Watch modding has become among watch collectors a strong subculture and community and there is a small group of people and producers that went strong in making parts for watches.

The best part about watch modding is that people can learn to do it by themselves with few instructions and a basic tool kit for watch repair that can be bought online at a ridiculous price.

Those instructions are given by some experts that trough the power of internet are inspiring watch geeks, the famous American forum WatchUSeek.com has already a subforum dedicated to this passion.

The inspiration often comes from the past, from the icons that wrote the history of time keeping. Getting inspiration from these watches modders can mix the aesthetic of those masterpieces with the modern precision of Japanese movements.

One of the first pioneers of this trend has been a Japanese modder named Harold who became the master of such modifications thanks to a series of images of its creation on a Photobucket account, a platform for free image hosting.

This person is know by the name Yobokies ("Seiko boy" reverse), there is no online commerce but just an email address to write to with ideas and requests and then the watch modder will give feedback about the feasibility of the project. Nowadays among watch collectors it is a privilege to own and wear one of his creations.

The art that in the past was owned by few Swiss artisans can now be replicated (partially and poorly) by everyone who has some basic skills and a lot of patience and passion.

People do movement swaps, swift bezels and finish dials to fit particular watch cases and so on.

The same subculture and trend has invaded the poor furniture industry, the modularity of the Ikea product has let a subculture of modders grow on the internet.

IkeaHackers.net is a website regarding modifications and refurbishments of Ikea products.

The original idea was born in 2006 from a girl named Jules Yap (not her real name) living in Malaysia. After surfing the web in order to get ideas to refurbish her Swedish furniture the girl decided to group them all in a unique website, at the very beginning it was a blog.

From 2013 the website has become a real incubator and aggregate of ideas, informations and tutorials. Anyone, an hobbyist or a designer, can share his idea on how to transform an Ikea piece of furniture and furnishings into something new, simply better looking or completely different.

In the "Hack" section of the website modern hackers can find more than 3000 ideas and

projects divided into categories referring to the different living environments. Every project is made of photos, explanations and instructions of how to perform such modification.

Despite the clear referring to the Swedish company Jules declares that she has no professional relation with Ikea, the website is simply a community of people who share the same passion: Swedish furnishings and the will to play with them.

Everything has been made possible by the modularity and simplicity of those products, together with their low cost pricing and then powered up by the web and the willingness of people we encountered so far of using their hands to obtain something unique and personalized.

As kids playing with Lego to obtain their own robot or house these grown kids are nowadays playing with watches or pieces of furniture to have personalized and low cost unique pieces.

Until this line the discussion has been around final users, consumers hacking everyday life objects to recondition them or exploit completely their features.

The same analysis can be done at a higher level, on a industrial perspective.

There are some examples of industrial hackers who modified and reshaped industrial tools or machines to obtain new uses or different products.

An example is a company set in New Jersey (USA) that applied this concept to manufacturing, Camatron Sewing Machines is a designer and producer of highly specialized industrial sewing machines for the apparel and non-apparel markets. The company is the major supplier of all the most important sewing machine dealers. Camatron specialized in industrial machines and computerized sewing. Camatron sells new but also reconditioned sewing machines, part of their revenues comes from the used but rebuilt machines.

Thanks to this hacking attitude the company is able to provide the cheapest but at the same time efficient tools for sewing every type of decorative designs and shapes to all types of apparel.

Camatron uses CNC and pneumatic technology to hack industrial machines, their product is an impressive machine (Camatron has a Youtube channel) that uses compressed air and computers to drive precise tools to perform pre-designed operations.

The company has been in business since 1970 and thanks to its quality products has been able to set high manufacturing standards and nowadays all the military bags and uniforms are produced using Camatron machines.

The company maintains an R&D staff in order to be innovative and updated and is an example of a modern way to conduct innovative business. Customization and frugality are the principles behind this company, Camatron hacked machines can allow smaller and independent producers to achieve good results with low labour force. The way they combined existing technologies to obtain new ones has let them compete with Chinese producers and overwhelm them with better manufacturing machines.

On the other coast of the United States there is another company that applies similar schemes to its products.

Founded in 1983 in Pleasanton, California, Adept Technologies is the largest US manufacturer of industrial robots. The company offers specialized, cost effective robotic systems and services.

Adept strongly believes that smart automation is the key to the success for any manufacturing company. The company mission is to provide a broad portfolio of products which must be reliable, configurable, intelligent, controllable and helpful in order to let manufacturers maximize their production in terms of quality and timing.

In order to do so Adept has contacted another U.S. independent company named Willow Garage to cooperate on a specific project. The company has developed a software called ROS (Robot Operating System) which is free and open-source. This software enables developers to build and sell capable robot applications quickly and easily.

The two companies joint together to develop this software that will let developers program their robots in a completely free way, they will be able to set machines and hack them according to their needs and requests.

"Bringing together the factory proven performance of Adept robots with the enabling open source software technology of ROS extends the state-of-the-art in industrial robotics, and makes the largest library of reusable robotics applications software available to a demanding industrial community to lower their total cost of ownership."

John Dulchinos, president and chief executive officer of Adept

Together with these examples of companies adopting the principles of hacking and frugality there is also a venture fund that tries to apply such method, it is a different accelerator since it is composed of less consultants and more makers, on the tables there are mother boards and cables rather than laptops and business plans.
The venture is named HAXLR8R (pronounced "Hackcelerator") and it helps entrepreneurs building and assembling hardware devices. Since 2012 it has worked with 30 startups offering to the best selected ones office spaces(Shenzhen or San Francisco), fundings and mentoring.
Haxlr8r is for people who hack hardware and make innovative things and it is located in Shenzhen for simple reasons: the city, close to Hong Kong, is the world capital of electronics. Most of the devices sold all over the world are assembled in Shenzen and around the city there several companies and factories operating in the business.
Shenzen is the place to be for an innovator and HAXLR8R is the foundation that helps such people with financial support and mentoring.

1.4 Conclusions

In the previous pages the two different approaches towards innovation have been analysed , on one hand the classical approach made of sequential stage/gate steps and on the other industrial bricolage, characterized by experience, dexterity and in some cases a dash of chance and fortune.
Some similarities and differences can be traced between the two processes.
Traditional processes are associated to economies of scale, large resource enables companies to mass produce new products; this approach when successful delivers efficient economies of scale for standardized products in homogeneous markets.
Hacking and frugal innovation is on the contrary oriented toward economies of scope, the objective is to satisfy diverse customers tailoring solutions according to different needs. When successful this approach brings stand-alone value to individuals belonging to heterogeneous markets.
Timing is always crucial in innovation and it has been described before how it significantly changes in the two different methods.

In the classical stage/gate approach time to market is usually long, the process needs time in order to be developed and brought on by the different departments that have to be coordinated and must share the same objectives and beliefs, the vision and the traits of the project must be the same for everyone involved in the process otherwise it may occur the risk of increasing the overall length of the process. Time to market is extremely important and the linear approach is usually not rapid and dynamic as it should be, the process requires frequent analyses and discussions between senior managers at the go/kill nodes, at every gate some time is missed and lost in aligning different people from different departments and tasks.

Industrial bricolage on the other hand is much more rapid and faster, timing is sensibly shorter due to the nature of the process. Every phase of the process is concentrated in one singular action, the dexterity and the creativity of the bricoleur.

As seen before the bricoleur follows his intuition to spot new opportunities or potential resources to exploit,thanks to it dexterity he is able to trace new ways and seek new paths in a short length of time.

During the hacking process formality is minimized and there is less control over operations since risks and resources employed are lower.

Strict scientific rigour characterizes the traditional approach while flexibility and dynamism are key fundamental features of a frugal innovator.

Financial resources invested in a traditional R&D process are usually considerable due to the fact that several people are dedicated to the initiatives, there are different teams working on different phases of the same project while bricolage usually employs the bricoleur and few other collaborators that he personally chooses in order to exploit different skills and develop the project efficiently and minimizing costs. Traditional innovation requires resources also in terms of more materials and different and more sophisticated equipment, laboratories and appliances.

Structured innovation favours the theory of “big risks, big rewards” according to which the higher the investments and the higher the possible return. The fact that is just a possibility rather than a certainty puts this attitude in a risky position, in fact many big-budgets projects fail with serious consequences.

Bricoleurs develop their products on their own laboratory, without investing in new as-

sets and expensive machineries, they are able to obtain the most from what they have.

The final product of the two methods is usually different, bricolage is in most of the cases an incremental type of innovation. Bricoleurs start from the existing to generate something different or new, they analyse what they have among their assets and find new opportunities, new paradigms.

Traditional innovation contrarily starts with a blank page in which developers try to draw something innovative, different and new.

The sparks that fire the innovation processes are different, bricoleurs start from scarcity or necessity; basing on something that already exists to develop something new thanks to exceptional skills while classic R&D methods start from research studies and in-depth analyses, it is more complex and it requires more efforts.

The risks associated are also different, a stage/gate process is more risky not in terms of goodness of the final results but rather in terms of possible damages caused by failure of the project.

Since traditional methods require more efforts and resources invested the risk of failure, even if it might be lower due to more precision and better feasibility studies, could represent a significant bet for the company. Bricoleurs usually have less to risk since their projects are usually innovative but frugal intuitions. In recent years the second approach is gaining momentum also due to the fact that the economic scenario is not really stable and it does not encourage huge investments in risky projects. Even if it is deeply true that companies which are not investing on innovation are suffering more than the others it is also true that these new approaches to innovation are intelligent ways of dealing with this topic, investing less financial resources and valuing more human capital.

CHAPTER 2 - CASE STUDY: TEXA S.p.A.

2.1 Introduction

TEXA Spa is nowadays an important company, European leader in manufacturing diagnostic instruments for cars, bikes, trucks, off-highway vehicles and boats.
The company was founded in 1992 by Bruno Vianello, current owner and CEO, and it started as a small enterprise counting just ten employees. During the years the company has been able to catch and gain from all the changes that occurred in the automotive market, expanding also the product portfolio. Together with the diagnostic tools, which represent the core business of the company, there are also recharge stations for vehicle air conditioning systems and emission analysis stations.
The key variable for TEXA has been the ability to enter into a niche and unexplored market and move into it with focused strategies that drove TEXA to leadership.
The gradual expansion of the company has been followed by continuous modifications of the its structure, the company currently counts 455 employees all over the world: the average age of the employees is around 30 years old, 45% of them are graduated and 35% are dedicated to R&D activities.
Foreign branches located in Spain, Germany, France, United Kingdom, Russian Federation, Poland, Japan and United States operate in more than 90 countries.
This rapid and considerable growth is demonstrated by numbers, during the last years (2001-2012) the company has increased revenues by 12% on average (***Source: TEXA** S.p.A).*

Picture 1. TEXA headquarter in Monastier di Treviso (Italy)

Source: *TEXA S.p.A*

2.2 History

For the automotive sector the end of the 1980's has been a turning point characterized by the diffusion of electronic control units. The market faced important changes from the technological perspective determined by the new goal of performance optimization, safety and driving experience enhancement.

These control units are instruments able to set and control the new systems that drive the vehicles but at the same time bringing breakdowns and problems for workshops.

At that time Bruno Vianello himself was a car retailer and he was facing such changes, his personal experience drove him to the ideation and construction of new instruments, aimed at solving electronic malfunctions.

The possibility of testing such products directly and internally made possible to him their efficient development, even if still rough and simple the tools were appreciated among mechanics thanks to their ease of use and effectiveness.

Considering the success of such beta products and the deducible opportunities offered by the market Bruno Vianello decided to set together with Manuele Cavalli, current

technical director, a company to perform the design, manufacturing and commercialization of diagnostic instruments.

In 1992 the two partners founded TEXA (Electronic Technologies X Automotive) in Monastier di Treviso.

During the first years of activity the company acted as a pioneer in the industry, due to the characteristics of the market which was still young and unexplored.

TEXA grew rapidly during the years thanks to different factors: the skills of the two complementary founders who have been able to predict the market and anticipate competitors, the role of first mover in introducing innovative products, valued human capital and the ability to keep the company rooted in the territory.

Diagnostic tools are able to extract rapidly from electronic units all the information necessary to mechanics to solve engine breakdowns but the real issue has always been the need to have one instruments able to operate on different car brands. This is especially crucial for independent workshops which have to deal with a wide set of cars, the possibility of using a unique instrument of diagnosis placed TEXA as leader in the market. In fact TEXA since the first years has been able to develop diagnostic equipment integrated with most common brands, one device to serve thousands models.

Thanks to these features TEXA has been able, in a relative short period of time, to impose its presence on the market, levering also on high quality standards.

In addition to this the previous experiences of the founders and the ability to build a network of partnerships have played a great role in building its competitive advantage and consequently in reaching its achievements.

At the beginning of its trades TEXA decided to rely exclusively on retailers and distributors of diagnostic equipment in the Italian market, different story for foreign markets in which distribution channels are made of generic distributors of car equipment.

The key player in reaching those foreign markets has been an innovative solution launched in 1999, AXONE 2000. This has been the first product to allow the connection of thousands of customers with the headquarter that continuously release real time updates for software and yearly subscriptions.

Thanks to this product the company could tie customers to its product, guaranteeing constant and continuous support to them in exchange for fees.

This increase of revenues has let the company set and program precise growth strategies, from that moment on the company has counted various key events on its path of growth.

Since 2000 the company started acting directly in foreign markets, the following year TEXA opened the first foreign branch close to Barcelona in Spain, *TEXA Iberica Diagnosis*.

In 2002 the company inaugurated *TEXA Deutschland* in order to serve better the German market, considerably important, Switzerland and Austria. In 2004 a new headquarter has been launched in Monastier and the following years have seen the birth of new branches all over the world, in chronological order: *TEXA France* and *TEXA UK* (2005), *TEXA USA* (2006), *TEXA Poland* and *TEXA Russia* (2008), *TEXA Japan* (2009).

The manufacturing process at TEXA has always been central, for specific willingness of the founders the assembly process has been kept in Italy even in the years in which outsourcing toward Eastern countries was a common trend among Western companies, this decision has been taken in order to safeguard quality and it is reasonable to believe that the decision has paid in the long term.

During the years TEXA has continued to incorporate and bring forward in its products the latest technological developments, changing procedures to improve processes.

New technologies have been often implemented into products to make them ergonomic and pleasant-looking. In 2007 TEXA stipulated an agreement with Google that allows the connection of the diagnostic tools of the AXONE line with the technology "Google Search Appliance" in order to let mechanics find, trough a search engine linked to a database, shared information and experiences.

Along the years also the product lines have increased, in 2009 TEXA entered into the agricultural and nautical fields. The following year the KONFORT stations entered the market, mobile terminals for the recharge of vehicle air conditioning systems.

Other operations have been undertaken to improve also the image of the company and brand communication like the establishment of partnerships and joint ventures: currently there are several agreements with worldwide producers and manufacturers like

Ducati, MV Agusta, Benelli, Bimota, SYM, Keeway, Pagani, Mercedes Trucks, Renault Trucks, Magneti Marelli, FIAMM and many others.

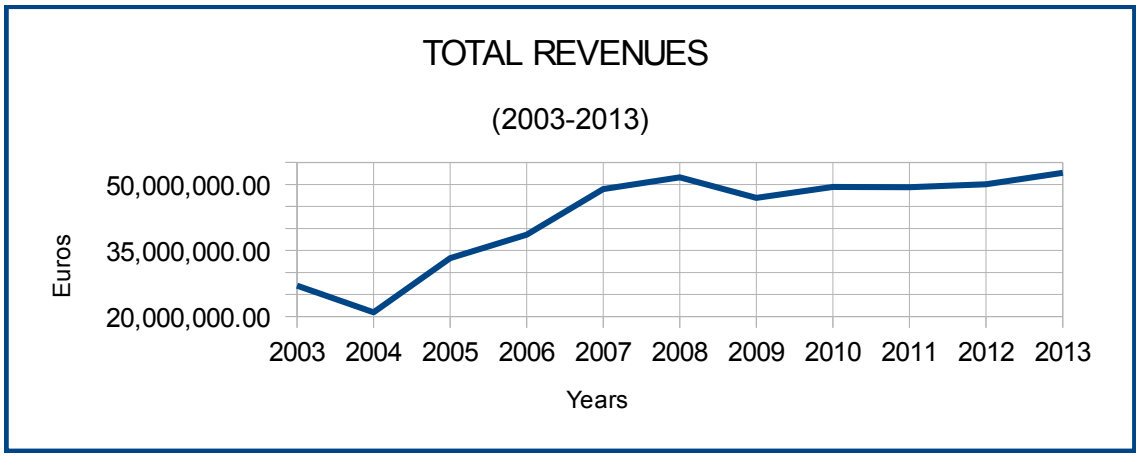
Another important brick to build the strong and positive image of TEXA has been the introduction of TEXAEDU, a complete formative program offered by the company to its clients and to young students.

In order to work in workshops mechanics need, together with basic mechanic skills, also the ability to work with TEXA products. TEXAEDU offers to everyone interested specific courses on matters regarding its products directly at its headquarter in Italy, the division can rely on rooms, materials and equipment solely dedicated to formation and training. At the end of every course the company releases a certificate recognized by the Italian Ministry of Education.

The image of the company has been reinforced also by the new headquarter inaugurated in September 2012, the ambitious plant is a monument against the common trend of outsourcing activities. This is expressed by the realization of a plant in which the worker can feel endorsed and motivated to take actions and participate to the company activities

The rapid growth described previously is demonstrated by numbers, revenues has increased by four times between 2001 and 2008. The world negative economic scenario that is characterizing these years has slightly affected also TEXA but after 2008 the company started again its path of growth.

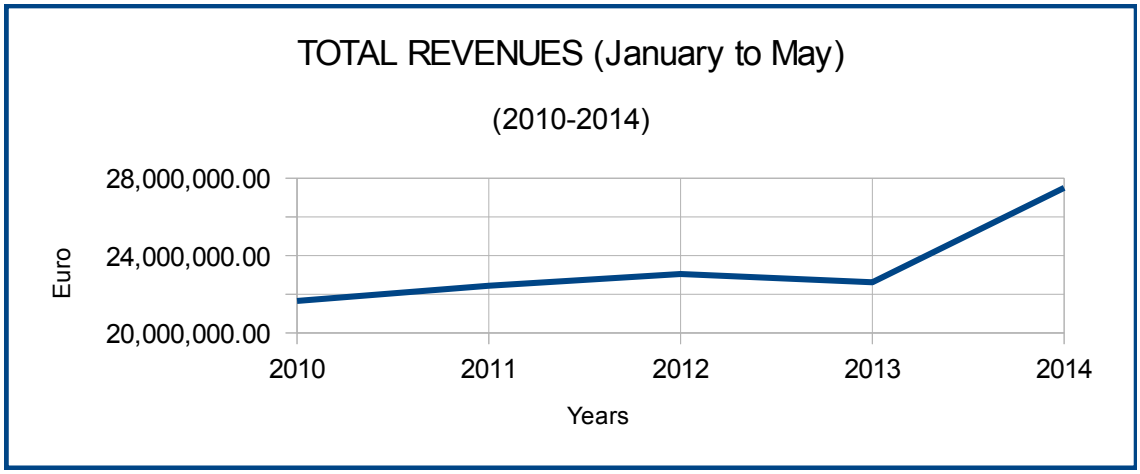
Graph 1. Total Revues 2003-2013



Source: *TEXA S.p.A*

Additionally the first five months of 2014 have seen a rapid growth of revenues, symptom that the company is currently operating efficiently.

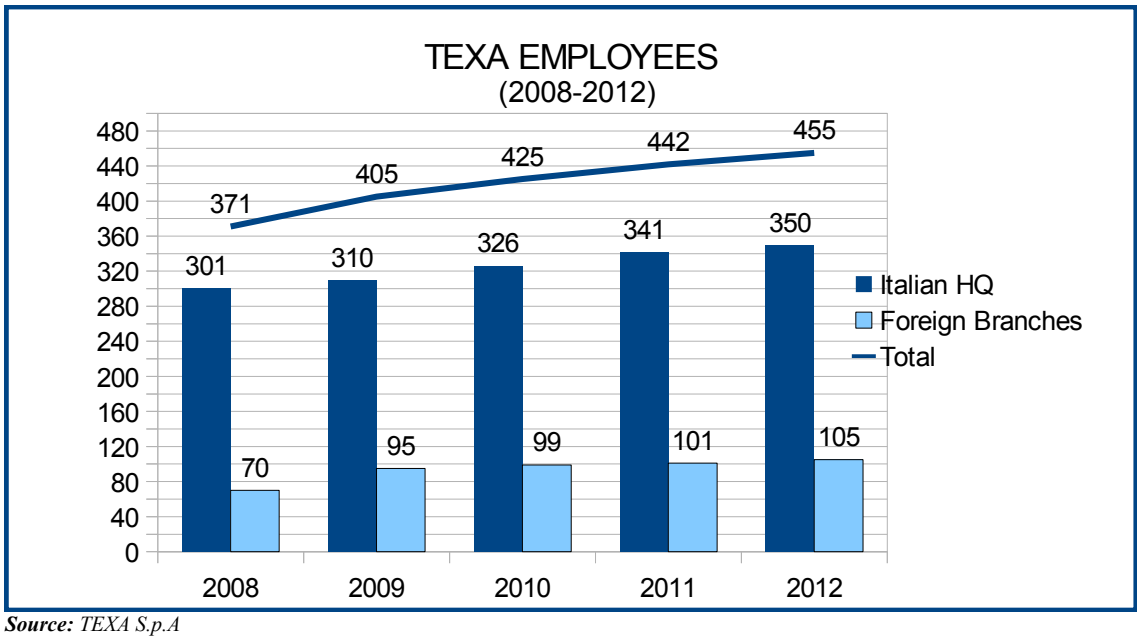
Graph 2. Total Revenues from January to May (2010-2014)



Source: *TEXA S.p.A*

Also the number of employees has increased significantly during the years, in less than ten years the company has more than doubled the number of employees since it is continuously seeking for young talents.

Graph 3. Employees 2008-2012



Source: *TEXA S.p.A*

2.3 Products

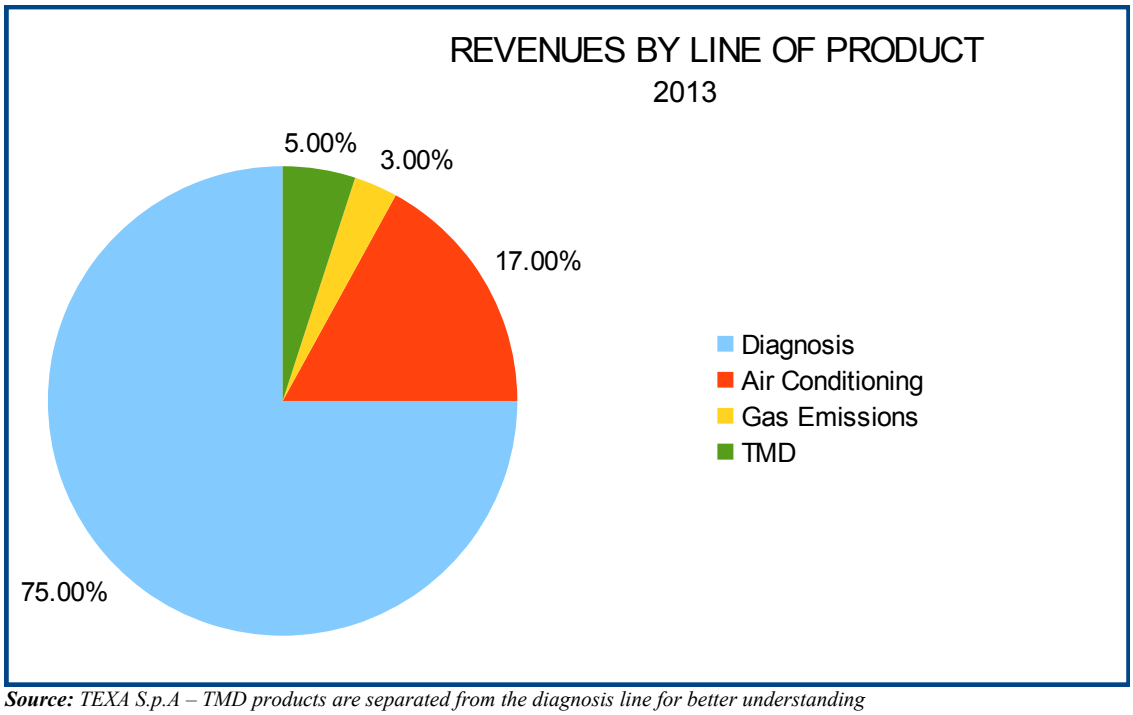
During the years the company has continuously changed and evolved its line of products, the portfolio has been enlarged depending on the typologies of vehicles involved and types of intervention.

This evolution has been determined by the needs of the market and the ability of the management of capturing those needs, exploiting all the opportunities given by the automotive sector.

There are basically three lines of products at TEXA: diagnosis(including OBD and TMD), analysis of gas emissions and renewal of vehicle air conditioning systems.

These three lines are operating in five different vehicle environments: car, truck, powersport, off-highway (agri and construction) and marine.

Graph 4. Revenues by line of product 2013



Source: *TEXA S.p.A – TMD products are separated from the diagnosis line for better understanding*

2.3.1 Diagnosis

The line of diagnostic tools working on electronic units has been from the beginning the core business of TEXA and it has mainly determined its success.
AXONE 2000, mentioned before, has played the role of game changer in the last decade and has been the basis for further product development. Since its launch the company has worked on it in order to improve its performance, the AXONE line is still the most recognizable and appreciated series of product of TEXA. It has kept similar design through the years but it has been technically developed with the latest technologies and appliances in order to keep them complete, intuitive and adaptable.
Current products of the AXONE line are AXONE 4 and AXONE MINI, these two tablet show charming design associated to extreme easy of use through the large touch screen that allows perfect visibility.

Picture 2. Axone 4

Source: *TEXA S.p.A*

Another important line for the company is the NAVIGATOR one, a series of multi-brand diagnostic interfaces which can be connected wireless to the vehicle electronic unit and display information through any personal computer.
Other tools enrich the diagnosis line of production, Twinprobe and Uniprobe are

acquisition devices for electric measurements that can communicate with any TEXA device or PC through an USB port.

NanoService is an ultra-compact interface which can serve multiple purposes: air conditioning, tyres services and other regulations regarding the braking system, balance of the vehicle, springs, steering wheel, lights and the electric system in general using the IDC4 software (the company software that runs all TEXA devices).

Additionally TEXA has developed portable diagnostic solutions, mobile units for acquisition and recording of errors and parameters regarding the engine, the gearbox, AC, Navigation and all electronic units of the vehicles. These tools, called OBD, are designed to record and monitor the functioning of the vehicle over a longer period of time, usually mechanics apply such devices on the vehicles of their customers and after some days they are able to see on the IDC4 software for PC how the car is responding on road to certain modifications or reparations, otherwise they can use these tools to better understand the dynamics of breakdowns and malfunctions and intervene properly.

Picture 3. TMD

Source: *TEXA S.p.A*

In parallel to these classic devices there is also the TMD line, telemobility solutions are considered a possible turning point for the company in the future. TMD devices are specific tools dedicated to fleet management, they let controllers access real time data generated by the control units on the use of the fleet. A company or an individual can access reliable data to control the functioning of their vehicles, manage efficiently

resources, increase safety, encourage ecological driving controlling the environmental impact of the fleet like emissions and consumptions and other information which may be useful for fleet management.
The TMD devices enable individuals to see where, when and how vehicles are used. Even in cases of accidents the tools are able to track the moments preceding the event in order to better understand the functioning and use of vehicles.
TEXA is dedicating resources and efforts to this segment since it is considered the future of self-diagnosis and a possible driver of competitive advantage and success.

2.3.2 Emission Analysis

In recent years the particular attention placed to environmental issues has produced strict regulations in terms of gas emissions of vehicles, workshops and inspection centres must deal with specific standards and laws and they need proper instruments to operate efficiently. Emission analysis must produce reliable and precise data, TEXA offers professional instruments that respect the severe international standards.
The gas analysis line is made of different products combined in order to serve different vehicles and different functions.GASBOX is the device used to analyse the emission of gasoline engines while OPABOX is the one for diesel-powered ones, these devices during vehicle inspections must be coupled with a rev counter(RC2 or RC3) and a visualization device.
In order to serve this need the company offers an operative station called MULTIPEGASO that match and combine this concept of modularity applied to gas analysis devices, the station combines a dual purpose since it can contain both emission analysis instruments and diagnostic devices in a unique and practical workstation.

2.3.3 A/C system diagnostics

The KONFORT range of products, launched in 2010, is a line of recharge stations for air conditioning systems of all types of vehicles. The station is able to identify the type of refrigerant, perform the diagnosis analysis and perform the recharge efficiently and

rapidly.

Also in this sector TEXA has proved to be farsighted and capable to predict the ongoing changes of the automotive market gaining competitive advantage. From 1st of January 2011 all new vehicles under the European legislation must adopt a new type of refrigerant (R1234yf) for their AC systems. The new refrigerant, more efficient and ecological, will definitively replace the current R134a at the end of 2016 but nowadays both can be used. TEXA has been able to foreseen this change and propose to its customer a single service station that can operate simultaneously with both refrigerants.

These devices have been accurately studied to perform efficiently and respect international standards, innovative as well considering the eight international patents they can rely on.

The series, which comprises six different models, is generally characterized by similar design.

There is a structural body that contains the working pump and the internal tank (one or two according to the model) and the upper structure that is the operating console, made of two distinctive gauges, an LCD display, the SD memory card that contains the vehicle database and allows the storage of service operations and a series of LEDs and buttons.

Image 5. Konfort 710R

Source: *TEXA S.p.A*

2.4 The automotive diagnostic market

In order to better understand the company dynamics and the distinctive characteristics of TEXA, before going deep into the enterprise, it is necessary to understand the external factors influencing its operations.

The performance of a company is determined by internal and external factors, both of them important and both influencing each other. The success of a company is both determined by the internal resources it can rely on and the capabilities it has but at the same time is strongly influenced by the characteristics of the market in which it is operating.

An interesting fact about the automotive diagnostic market is the fact that it was born together with the company, as seen before the market for diagnostic devices did not exist until the end of the 1980's, years in which electronic control units entered into the automotive sector.

The market is relatively young and TEXA has always operated in this sector from the very beginning, this gave the company the *first mover* advantage for several years and nowadays experience and capabilities acquired through the years and learnt by doing.

TEXA is operating in the automotive aftermarket business, this market represent all the enterprises that perform distribution and reselling of general equipment for commercial and industrial vehicles.

Despite the importance of the market it is difficult to analyse it in detail since it is really vast and differentiated in several sub markets with different characteristics and players.

TEXA operates in the field of ideation, production and commercialization of devices for the diagnosis of vehicles including also software development and education.

This sector is in constant growth, following the general trends of the wider automotive sector.

New technologies and new types of vehicles, like electric or hybrid cars, require electronic units in order to control them. The growing attention that is placed on safety and environmental issues is feeding the market for electronic devices of diagnosis.

At the same time the world economic recession has influenced the overall automotive sector.

On one side it has caused the closure of several dealers and workshops but at the same time it has increased the average age of the cars circulating in western countries. This has increased the need for maintenance and the need for diagnostic devices.

In addition to this emerging markets are getting motorized (two or four wheels) on a large scale and this, as before, increases the need for diagnostic and control solutions.

Another peculiarity of the market is the large amount of regulations and directives that regulate the automotive market and that continuously changes, often very rapidly. For this reason the providers of diagnostic tools and their users are obliged to update their devices and be reactive to changes.

TEXA has nowadays two different kind of consumers: OEMs (Original Equipment Manufacturer) and their dealers but mainly independent workshops called IAM (Independent AfterMarket) that represent the main driver of revenues for the company.

The former trends of the market have strengthen the power and the performances of independent players that changed their nature, from small workshops to new chains and reparation centres, aggregated and grouped. The strengthening of these more powerful entities enhanced the need for appropriate devices, sophisticated and built respecting high quality standards.

Previously the lines produced by TEXA have been described, it has been explained how each field and type of activity requires a specific device determining a particular segmentation of the market.

According to those specifications a peculiar segmentation of the supply according to the nature of the devices produced can be done.

Diagnostic tools for electronic units: as described before modern vehicles have dozens of electronic units that control different functions of the vehicles but at the same time that reciprocally communicate, diagnostic devices allow the reading and analysis of errors and breakdowns. In this category there must be also the telemobility devices, they provide real time diagnosis and are used especially for fleet management.

Devices operating on air conditioning systems: as seen before this is the most regulated of the automotive aftermarket sectors but at the same time the one of the most satisfying for TEXA.

Solutions for the analysis of gas emissions: also this sector is gaining importance since

the environmental issues are more and more central in latest years.
The fourth segment is the one of intangible services, specifically the supply of software services and yearly renewals and updates to let tools operate in the most efficient way.
The second and the third segments, air conditioning and gas emissions, are very delicate since they have to deal with the complexity of regulations and standards which are often rigid and very strict. The diagnostic segment is complicated due to the broadness of model circulating all over the world, the company in order to compete globally must adapt to local markets and this requires deep studies of great amounts of models.
Demand segmentation is much more complex due to the disparities of different national markets but can be done according to economic indicators and demographic factors (Day, Fox, Huszagh, 1988).
TEXA trades on industrial goods since its operations are business-to-business, and the criteria in order to segment markets for industrial products are mainly demographic and territorial.
The geographic segmentation is based on the true assumption that every country represents a peculiar market or shares the same features with just few other nations since in each geographical area there are different vehicles that requires different devices. This fact is not already relay stressed as an obstacle since the products offered by TEXA fit most of the European vehicles that are present all over the world. For this reason the products are almost homogeneous and TEXA does not necessarily need to differentiate products. The only differences regard pricing and the variety of the product portfolio present in single different nations according to market studies and economic indicators.
The differentiation between environments (*Car, Truck, Bike, OHW and Marine*) that can be seen also in pricing lists of TEXA is not a matter of segmentation. TEXA products are characterized by two dimensions, an hardware which is substantially the physical device and a software that is necessary to run the device and define the nature of the instrument, it contains the database and it must specific for the environment in which the instrument will operate. It must be mentioned the fact that more than one environment can be installed in a single device paying a license fee.
The only segmentation that is performed by TEXA occurs in the relationship with OEM,

the company has signed specific contracts with some manufacturers to provide branded devices to those companies according to ad hoc specifications. Those vehicles producers require software customizations according to their needs, a diagnostic device in this case would serve just the specific requirements of that producers while a standard device operates on multi-brand solutions.

This is the one and only driver of segmentation at TEXA for the moment but as mentioned before things in the automotive diagnostic market change rapidly and players must react accordingly.

2.5 Market analysis

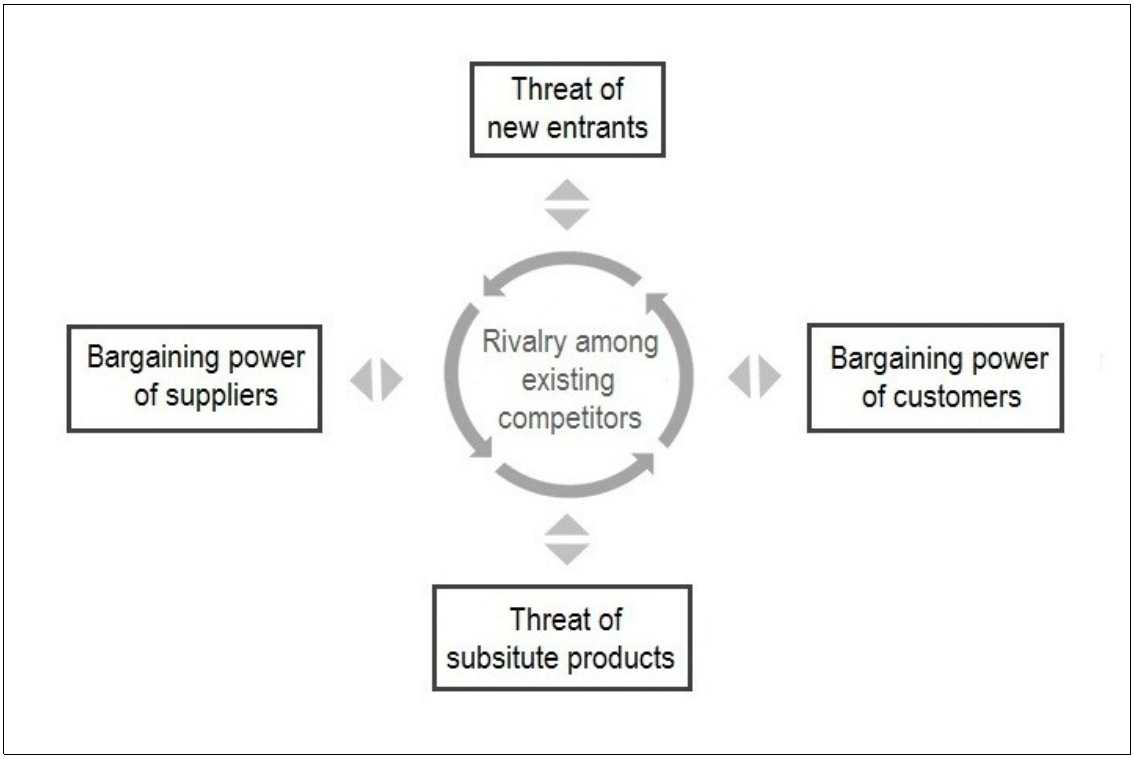
In order to analyse the diagnostic automotive market Michael Porter and his model of analysis might be useful to detect the intensity of competition and the features that shape it.

The Porter five force analysis is a classical tool to perform a standard investigation.

The model is made of five forces that influence the ability of the company of satisfying its customers and generate profits, three are determined by competition from external sources while two are internal factors of the company.

As depicted in the image the forces include investigations on the threat of substitute products, established rivals, new entrants, bargaining power of suppliers and the bargaining power of customers.

Figure 6. Five forces model



Source: *Michael E.Porter, 1979*

Applying this framework to the industry it is possible to determine which are the strongest forces that TEXA might consider as more important and that increase competition in opposition to those that are more under control and do not affect competition and performance.

Substitute products are currently not a threat for TEXA, in fact the market for diagnostic product is relatively young since it has gained importance in the 1990's and the technologies applied to diagnostic devices are still fresh and not replaceable. The current level of technology is for the moment not an issue, there are no substitutive technologies at the horizon and there are no incoming revolutions in the field of diagnostic instruments, at least in a short period of time.

The field of technologies is historically rapid and continuously evolving but currently no significant turning points have been foreseen and even in that case it has been mentioned before how TEXA has always been reactive to changes and capable of detecting future trends and apply latest technologies. Products like the OBD series and TMD devices are the example of how TEXA has been able to create alternative diagnostic products and be proactive in following new paths of innovation and diversification.

Established rivals are a more complex issue, in fact TEXA is competing in the market with giant companies that can count on established brands and consistent means.

The major rivals are the German Robert Bosch GmbH, Snap-On and SPX which are American and the Chinese Launch. Despite the difference in size between TEXA and those companies, TEXA has been able to retain a 10% World market share and a 20% European market share thanks to the quality of its products and the software service that TEXA proposes to its customers.

The market is lively, there are continuous changes and turnover of players that are often absorbed by the biggest players mentioned before through mergers and acquisitions.

The companies that can afford such acquisitions often prefer to buy smaller companies to acquire skills and market presence, SPX and Bosch are two of the most active in this sense.

The economic power of those entities grants them the possibility of reinforcing their position on the market, TEXA demonstrates a totally different approach based on the

establishment of its brand through innovation and quality products rather than enormous investments and acquisitions.

TEXA has focused on internal growth and gradual introduction in foreign markets while the other have sustained a strategy of acquisitions in order to reach markets and build relations, a typical approach of multinationals which can rely on vigorous resources and that operate in different sectors, for example Bosch counts more than 300 branches operating in different sectors like the automotive business, industrial machineries but also home appliances.

The Bosch group counted revenues for more than 46 billion € in 2013, 281 thousands associates all over the world and investments in R&D equal to 4,5 billion € (Source: Bosch).

These figures are enough to explain the difference between the German giant and TEXA, a SME located in Monastier di Treviso.

Those players can exploit this economic power and the establishment of their name to acquire resources and capabilities and protect themselves with barriers against emulation. Those multinationals are able to enter new markets relatively easily, they already have competences or in the worst scenario they can acquire them and they can lever on their established and well-known brand. They can work through solid relations and proprietary channels.

TEXA must compete with these multinationals adopting as described before different strategies, the advantage of being a first mover has harden the internal skills through the years and it has demonstrated good forecasting abilities. In addition to this the relatively small size of the company has played a great role in terms of reactivity to market needs and dynamism.

The diagnostic market is influenced more by the degree of innovation and differentiation rather than market power and the ruthless theories of economies of scale. TEXA has exploited these features of the market and levering on responsiveness, new technologies, customer service, design and reliability of its products and an in-house software has been able to build its competitive advantage and compete globally.

New entrants are also present in the market, these players (Launch and Autel in particular) are offering nowadays similar products but pursuing a different strategy, opposed to those of established companies.

Workshops, as most of the people in the world, are price sensitive and keeping decent quality standard it is possible to gain rapidly market shares through aggressive pricing policies.

Launch has been able to gain a dominant position in a relative short period of time, the company has been able to offer low cost products able to serve efficiently the Asian markets, in particular the huge range of Asian car companies that serve exsclusively Eastern markets.

In fact those brands offering specific products to specific markets are often not accessible to Western brands, TEXA cannot develop efficiently all the codes necessary to offer a wider range of diagnostic solutions for those specific cars. This is due mostly to the difficulty of having those vehicles in hands, those cars are domestic products that are not commercialized abroad so for the company it is difficult to work on them due to accessibility and distance, in other cases it is not even convenient to do so.

Another threat for companies operating in the automotive diagnostic market is the presence of extremely cheap products, in fact there several producers offering really low cost products assembled in Asia and sold in “black markets” or through the web .

These manufacturers operate especially in the Asian market, the cost of their products can be one hundredth of the cost of products offered by established Western companies. Often those producers copy the products of Asian manufacturer and compete with them harshly, TEXA must be aware of new entrants from Asia and at the same time of imitators.

Nevertheless the market for those products are still far from the main nations in which TEXA operates, it represents a threat but still not too close. Western workshops prefer to rely on high quality standards and reliable products rather than on cheap and poor-made products made by Asian imitators.

The market for diagnostic products as seen before is attractive and in continuous growth, the fact that new entrants entered lately the market is a demonstration that there is a lot of potential, even if the field is prolific and solid it is possible to determine some entry barriers that new entrants must overcome to enter the game. These barriers are not really strict and impossible to defeat but still they limit the access of new competitors and determine the success or failure of a company. Such obstacles might be overcome

through innovation and differentiation, as explained before also pricing strategies might represent effective but limited means of gaining market shares.

Barriers to entry are not equally important and relevant but still they are all efficient limitations to the possible entering of new players:

1. Technological gap, the barrier is not based on access to latest technologies but on the ability to manage it properly in order to obtain usable and user-friendly products. As described before imitators are able to offer similar products but technology is different, in terms of overall quality but mainly in terms of usage. Components poorly assembled or software poorly set up are consistent obstacles to success. In addition to this the non hardware side of the products is currently the main driver of competitive advantage, the ability to make products work efficiently is crucial and even more important is the ability to have an existent set of codes and car database accessible to customers. New entrants would crash against this wall, the necessity to have thousands of vehicles available for diagnosis push them behind.

2. Learning by doing / Know how, the market as seen is young but still the skills requested to operate in such business are essential to set operations and create competitive advantage. This barrier is tied to the previous one and it is complementary to it, more than access to technology and technology gap it is crucial to have and maintain the ability to manage it. The problem of new entrants is not having such technologies in hand but rather on the ability to exploit it and put it on products in order to create instruments able to satisfy clients. Incumbents can rely on experience and skills acquired through years of research & development, production and selling of diagnostic products. The acquired human skills that incumbents have in-house probably represent the most effective barrier to enter the market.

3. Distribution channels / Networks, the access to retailers and established distributors is the key to enter markets, especially foreign markets. Even the creation of networks and joint ventures is crucial in establishing successful strategies and products. For new entrants finding appropriate suppliers and distributors is often a problem and they have to leverage on other factors like prices, services, discounts and other incentives or otherwise build their own distribution service.

4. **S**witching costs / Brand loyalty, all the costs for the customers to switch from

one brand to another. The cost of the instrument itself and accessories and a completely different interface and software that requires time to get familiar with it. Also brand loyalty is a key factor in retaining customers, a satisfied customers is a loyal customer. An incumbent company has earned a long-lasting reputation that sustains its image and market share despite the entrance of new players in the market and gives it the ability to influence and shape the market and the customers.

5. Governments' restrictions, in particular states there are specific regulations that limit the import of foreign products or pose tariffs to foreign products. For example Brazil and India are two of the most careful nations in terms of import regulations, in the diagnostic sector tariffs amount to 14% in Brazil and 7.5% in India plus local VAT for the imported goods.

Suppliers provide components that are totally relevant in terms of the well-functioning of devices but at the same time those parts are easily available in their market, competition among producers is considerable and this lowers the bargaining power of suppliers.

Components provided by suppliers are not very specific and there are no switching costs related to them, as described before the real value of TEXA products rely on the software internally developed more than on the hardware, although really appreciated and high-quality.

Their contractual power is limited and even if TEXA depends on third parties the company can control them and work with no specific strategies or extreme cautions exploiting also the image of the company and the willingness of suppliers of operating with TEXA.

Even if suppliers can be considered quiet partners and managed serenely their importance is still high since they also determine the success and esteem of TEXA products guaranteeing quality and speed. This position of mutual cooperation and support is achievable only through solid and durable relations.

Probably the most important factor of analysis in the diagnostic sector, pursuing Porter's framework, is the bargaining power of customers. This external factor is extremely more important than the other external one (bargaining power of supplier) since it can truly determine the failure or success of a company more than any other variable.

The identification and satisfaction of their needs represent the essential ingredient for the success of a company. In this sector, as in many others, a satisfied customer is a loyal customer and a satisfied customers is unwilling to change provider of services.
Innovation is crucial but at the same time a key factor in order to retain customers is practicality and simplicity, the design and ergonomics of the diagnostic products is an important feature since mechanics must use them on a daily basis.
Customers are crucial since they can deeply influence the reputation and image of a company in the market, in addition to a privileged position in situations of negotiation.
As described before, analysing TEXA, customers can be separated into two groups: OEM (Original Equipment Manufacturers) companies and IAM (Independent AfterMarket) workshops. Their nature is completely different and also their bargaining power, independent mechanics represent the majority of trades while the collaboration with car and motorbike manufacturers represent an important marketing tool to improve services. Their contractual power is higher and their position is stronger than the one of independent workshop since they strongly influence investments and products, requiring constant dialogue between the two parties during the R&D phase in order to share information and capabilities.
From this analysis based on Porter's model the image of the industry in which TEXA operates is characterized by significant potentialities of growth in which the company can exploit its competences in order to increase its market share and reach new clients.
TEXA is considered a pioneer in the diagnostic sector and has gained from the benefits of being a first mover but at the same time must place attention to two important variables: competition (both incumbents and new entrants) and the bargaining power of its customers.
Bargaining power of suppliers and substitute products can be considered, for the moment, minor issues even if suppliers are crucial considering that quality is one of the peculiar characteristics of the company and a driver of differentiation.
Even if competitors are the main threats for TEXA since they can rely on infinite monetary resources and giant sizes the ability to differentiate its portfolio creating value for customers has limited the feeling of subjection or fear that can be felt competing with multinationals.

2.6 The competitive advantage of TEXA

The analysis of the success of the company must start from the identification of the key resources and the distinctive abilities of the organization that placed him above its competitors and let TEXA retain a profitable competitive advantage through the years.
According to Resource Based View (RBV) theories, the sustainability of the competitive advantage of a company is due to the internal tangible and intangible resources of the company in the case the business sector is characterized by specific features such as scarcity of resources together with durability and difficulty to replicate or move such assets (Peteraf, 1993).
The control of key assets let the company pursue a profitable growth and obtain an advantage at the expense of competitors, demonstrating the validity of those theories. The internal resources, more than external factors, are the main drivers of performance differentials among different companies (Tokuda, 2005).
The internal resources of TEXA has always been encouraged and fostered by the two entrepreneurs who constantly pushed employees towards excellence and organizational growth, the system of cultural values and attachment to the territory and to people have always been the common thread of TEXA managerial strategies and operations.

2.6.1 Internal resources

The determination of the assets that characterize TEXA starts primarily from the identification of internal resources as a key factor in every operation and strategy that the company pursues.
These tangible and intangible assets determine the uniqueness of the company and its ability to forecast future trends and sudden changes of the marketplace.
As described before the business sector in which TEXA operates has a specific and peculiar characteristic of dynamism since technology evolves rapidly and standards regulating the market are often changed and modify determining the absolute need of being rapid and flexible to spot and satisfy the needs of the market and the drivers of success.

The company performance is therefore determined by the ability of identifying the key resources necessary to run the business, take decisions and set operations efficiently.
The RBV approach is characterized by the adoption of a perspective based on resources and skills of the single company in opposition to an industry-based approach in which the performance is determined by the features of the market and the overall industry. This theory does not exclude the importance of external factors as drivers of success, internal resources and their value are strongly influenced by the changes of the external environment but still those resources are the main driver ingredient and factor influencing the enterprise final performance. Internal assets are tightly related to the environment in which they operate since they are influenced by external factors but they are mainly constituted by the company structure and the values transmitted by the organization.
The definition of internal resources includes activities, operations, competencies, knowledge, organizational processes and informations that are acquainted and retained by the enterprise and let it take decisions and actions that improve in terms of efficiency and effectiveness its operations.
Resources and capabilities are the starting point of any managerial strategy and the features of assets owned by the company are the ones that drive performance and achievement (Grant, 1991).
Scarcity and relevance are the two fundamental conditions, scarcity in terms of presence of that resource inside the market and consequently relevance is a direct consequence of the former, the value that derives from that asset.
These two characteristics are not enough to shield the acquired advantage and exploit the consequent benefits, the company assets requires other features and values that would let the construction of a solid basis in order to build a long-term solid growth.
So it becomes relevant the durability of such assets and their repeatability, despite the high rate of obsolescence that characterize the technological marketplace it is important to retain durable resources in order to build a solid advantage. Repeatability works in that direction too since the only possible way to acquire resources would be to transfer them entirely with the associated costs and difficulties.
Those problems are tightly related to a low grade of geographical mobility, the business

is related to the territory in terms of company image and complementarity among assets, this concept is extremely important and at the same time complex since it involves a tacit knowledge and know how that can be replicated indeed.
The tangible side of manufacturing and the value of human capital are the real drivers and the main influencing factors that stand out in the history of TEXA.
Differently from other players in the business the company has kept this concept alive and has stressed it to make it the real driver of competitive advantage, also the size of the company has let it happen since TEXA is still a small-medium size company. This could not happen to competitors since the enormous size of multinationals and the number of activities in which they take part let them loose, obviously, the human side of creating value.

2.6.2 The role of the entrepreneurs

As seen in the paragraph regarding the history of the company the role of the two entrepreneurs, Bruno Vianello and Manuele Cavalli, has always been crucial in the development and growth of the business. The role of the entrepreneurs in small-medium companies in terms of capabilities and competencies is source of benefits and value creation for an enterprise, the attitude of a charismatic leader is capable of influencing the behaviour of his followers creating heterogeneity and consequently determining the entire performance of the organization (Tokuda, 2005).
Under this vision the capabilities of the entrepreneur are the main human resources of the company since he is the responsible for staffing and motivating their employees in order to get the best from them and create an efficient team.
In addition to this small-medium enterprises usually show vertical structure in which the owner stands on top, coordinating and monitoring the functioning of lower levels of management.
If TEXA has been able to set itself among the top producers in the automotive diagnostic sector some merits must be given to the entrepreneurs who always monitored operations in the organization in first person perceiving the incoming trends of the market and pursuing new paths of innovation.

Vianello and Cavalli have been able to build a solid organization, a company able to exploit the unexplored opportunities of the market thanks to a system of values and a combination of resources that let the enterprise adopt a Blue Ocean Strategy that will be explained on the next paragraph.

The two founders have been able to discover a niche market and create a valuable team in a period of drastic changes in the automotive world, the diffusion of electronic units has been the spark for the creation of an entire business sector.

The previous experiences in the automotive sector as dealers have let the entrepreneurs acquire specific knowledge of the dynamics of the market from both sides, the needs and strategies of suppliers and car producers but at the same time the needs and desires of independent workshops.

TEXA has been able to notice the problems of traditional diagnostic instruments and create new devices pursuing the continuous technological changes that were characterizing the automotive sector and forecasting future trends.

The merit of the two partners has been a forward-looking attitude and a rapid reaction to emerging opportunities but mostly an exploitation of a frugal approach to innovation that should serve customer first. The period of time in which TEXA started operations and its position of first mover has given the company the opportunity of creating and anticipating competition, exploit its position of advantage to strengthen its distinctive competencies and foster its attitude toward innovation and exploration of new markets.

The entrepreneurs have the merits of foreseeing the opportunities the market was giving them, putting their competencies at the service of innovation and coordinating and building an efficient and coherent organization that shares the same vision and enthusiasm of the property.

The knowledge that the founders could rely on have always been shared and transferred to the organization, enriched by precise learning paths and fostered by a strong shared organizational culture in order to build solid networks and partnerships to improve the quality of operations.

All these features and merits can be summed into a set of dynamic capabilities that the entrepreneurs, and consequently the company, have and use to manage the firm assets to develop precise strategies for profitable and durable internationalization processes.

The previous considerations promote the founders as the principal source of competitive advantage but it is really important to stress again the fact that the company is not just made of two men but of an entire set of people and their capabilities.
In addition to this it is also important to note that this dependency of the organization on its leaders might represent at the same time a critical issue for the sustainability of the company performance.
The generational turnover, the change of the organizational structure or the happening of critical events or environmental changes toward a different orientation of business dynamics might represent in the future crucial issues for the continuation of the business operations.

2.6.3 Blue Ocean Strategy

TEXA since the beginning of its operations has been a proof of the efficacy of the Blue Ocean Strategy, attitude that creates a sustainable and profitable growth.
Under a typical "Red Ocean" strategy a firm tries to overcome competitors eroding market shares and increasing its market size at the expense of other players.
Under these circumstances there is a fierce competition for the control of the market following precise strategies and best practice theories that try to emulate winning strategies of other successful companies in order to obtain a better performance in comparison with others.
The Blue Ocean Strategy states the opposite, stressing the fact that in order to obtain a profitable growth it is necessary to pursue the research for an innovative solution (Kim and Mauborgne, 2004). The principles that should drive the companies are the creation of new trends and products in order to attract new customers and satisfy their new needs. In order to do so it is necessary to study the needs of the customers or know them, in this way it is possible to create elements bringing an interior source of value added.

2.6.4 Organizational culture

The company culture, together with reputation, has always been for TEXA a fundamental asset.

In fact Bruno Vianello and Manuele Cavalli have always set their business on solid values rooted in them and peculiar of the territory. Tradition and respect of the territory are the values promoted by TEXA as fundamental during its operations, the company is tightly tied to the local area in which it was born and it tries to transfer the values of the Treviso area to its products and clients.

This entrepreneurial vision can be seen into the attention that the company places toward the environment and health of the people.

Materials are selected also considering their potential future recycling, various charity initiatives are promoted by the company that personally organize and hosts events in order to raise funds and also in the way the working environment is considered.

The new headquarter, inaugurated in 2012, is a celebration of the excellent growth of the company and represents the possible results that can be achieved through commitment and creativity, two of the several characteristics that has made TEXA and other Italian companies successful firms.

The building is projected into the future and it serves the willingness of future expansions and the creation of a technological centre intended to form and train young talents.

It has been designed as a working environment in which people can feel appreciated and valued, participating in a creative and proactive way to the company life.

The design of the building recalls the features of the products that the company offers, highlighting how particular attention is usually placed to quality and functionality in the same way of design and ergonomics.

The attention placed toward young human resources located in the surrounding area, as described before, takes action into the program called TEXAEDU which, in association with the Italian Ministry of Education, has the objective of promoting and supporting the diffusion of the diagnostic technologies.

The formation centre, set up in 2004, is a company division that offers specific courses

to both young students and professionals.

The courses and contests dedicated to students have merely a social objective, the company offers free courses to professional schools interested in cooperating with the company.

Those offered to mechanics and workshops usually require a participation fee and try to help professional get in touch with TEXA instruments and technologies applied to electronic units of vehicles. The courses are various and divided into subjects concerning the type of instruments or the type of vehicle the students want to get acquainted with.

Another peculiar characteristic of the organizational culture that stress this territorial legacy is the absolute willingness of the management to keep manufacturing activities in Italy and refusing the past trends of outsourcing. Since quality and attention to details have always been sources of pride for the company and the owners TEXA always refused moving abroad facilities and disrupting know-how in favour of desperate seek of cost minimization.

From one side the choice represents the core values of the company but from the other side it crashes against a competitive market in which lower prices might be appreciated and proximity to customers would be an additional benefit. This anti-outsourcing decision is a congruent position that the founders took and it represents coherently the image and values that drove TEXA through its path of growth.

2.7 Frugal innovation at TEXA: the RCM rev counter

Despite the continuous willingness to innovate and offer updated and sophisticated products TEXA tries to invest on Research and Development activities with wisdom and sagacity.

Innovation represents the key principle guiding the company toward successful results.

As mentioned before 35% of the employees at TEXA are involved in R&D activities and 12% of its revenues are devoted to such operations in order to study the technological changes characterizing the market and absorb them into its production lines before competitors.

The fact that TEXA does spend fair resources in innovating its products does not mean that it has the possibility to invest that money on a wide range of products or ideas. It is necessary to invest those resources carefully in order to avoid the risk of wasting resources.

TEXA constantly wants to refresh its instruments and often it does so upgrading or modifying them with better solutions or performances, sometimes these changes are driven by necessity.

The fact that TEXA always wants to innovate it does not mean that spendings on R&D activities must be undertaken in an unscrupulous way and it does not mean that money can buy innovation. Obviously multinationals might invest huge resources on developing new products but the fact that TEXA can compete with them spending amounts much lower than them it validates this theory that money is not the way to get to innovation, or at least not automatically.

As seen previously the automotive market is regulated by standards and directions so it is fundamental to be always ready with the latest solutions and ready to capture and spot the changes occurring to the market.

Sometimes the need to change is driven by other factors, one of the main driver of innovation is necessity. Like Mansukhbhai Prajapati created the clay refrigerator after the earthquake in order to keep food fresh with no electricity (see Pag.13) in the same way Western innovators take out of scarcity and necessity brilliant products, relatively speaking.

In a market in which regulations change quite often and vehicles innovate constantly an equipment provider as TEXA must be ready to follow such trends and need and take out from necessity innovative and useful devices.

The resources spent on R&D activities, although remarkable, are clearly not sufficient to pursue high technological standards especially if compared to those invested by competitors.

The value-added exploit by TEXA during its development operations can be traced on the capacity of matching capabilities, being flexible and open to tinker its own products, the art of bricolage to bring innovation and limit expenditures.

This allows the company to obtain results that would be unreachable if sought solely through the amount of resources that TEXA place on classical R&D activities.

Bricolage and tinkering are the additional values that the development staff is able to exploit, experience and skills have voided the gap in investments between TEXA and the competing multinationals.

These theories can be explained analysing one of the products developed by the company, it is the case of the RCM rev counter launched in spring 2014.

Due to the last Italian regulations in terms of vehicles inspections that accounted motorcycles inspections as car inspections into the MCTCNet authorized workshops must rely on precise rev counters in order to provide trusty measurements.

TEXA had in its price listings, until 2014, two reliable and sophisticated rev counters: RC2 and RC3. These two instruments are high performance devices measuring temperature and RPM for complete gas emission analysis of cars and motorbikes, RC3 also trucks. These two devices, still on sale, measure engine speed acquisition via inductive clamps that must be connected to the spark plug wires. Despite the fact that they are high quality and high performance rev counters the motorbike market needed something different. This was caused by the changes occurred in the motorcycles industry in latest years, in fact in modern motorcycles engines sparks are difficult to reach ad a lot of labour must be performed to reach the wires.

In dated motorcycles or models with still old fashioned spark plug wires RC2 and RC3 are still very functional devices but in latest motorcycles models the tendency has been to put them in hardly accessible places and components must be removed before

initiating the measurement.

In the first half of 2013 TEXA noticed this need and immediately started considering alternative solutions to the problem.

The R&D staff started working on the subject in partnership with one of the two founders and technical director, Manuele Cavalli, and the gas emission analysis supervisor, Emiliano Pasin.

Competitors and existing products were working via wires but also via microphones.

Another possibility was to let the new device work counting the vibrations of the engine and then calculating the RPM. A third but remote hypothesis was coming from an old project of a competitor, then dismissed, that measured the engine speed counting the electric arcs generated by the sparks via electric signal captured by an antenna and then turned into a numerical value.

The developers, among which Alberto Carraro, started feasibilities studies on the three methods proposed giving priority to the first two methods, vibrations and sounds captured by a special microphone.

After some studies and counts the developers realised that a novel and reliable device working on those two technologies, in order to be qualitatively valid, must be sold in the market at a price higher than its production costs and close to those of RC2 and RC3, sophisticated rev counters usable also for cars and trucks.

Since this new device had just to accomplish the needs of the new Italian regulation and was developed uniquely for the motorcycle sector the price had to be fairly low, obviously not exceeding production costs and lower than the other two rev counters.

The first two measurements methods in order to be reliable must be high-priced in materials and technologies so the need to restrain the cost of the device moved the attention of the R&D staff toward the third method, the measurement of the electric arcs via antenna. The team started considering this option and the idea of measuring the electric ignitions of the sparks became a valid hypothesis to take into consideration.

The development phase took somewhere around one year of trials and setting-up but eventually the team developed a brand new instrument measuring the electric pulse of the sparks through specific micro controllers that could then calculate the precise value of engine RPM .

This can be done without the need of attaching wires in uncomfortable places around the engine since it entirely works via an integrated antenna, guaranteeing extreme manageability to the mechanic and reducing the preparation time with respect to devices working via cables.

RCM is then totally portable and it is powered by USB rechargeable batteries. The mechanic just need to set some parameters like strokes and number of cylinders using the simple keyboard and then the device can run the measurement.

Picture 5. RCM rev counter

Source: *TEXA S.p.A*

RCM signals the correct reception of the electric arcs through a green led placed on the upper part of the device that then communicates the value to the PC via Bluetooth or serial RS232.

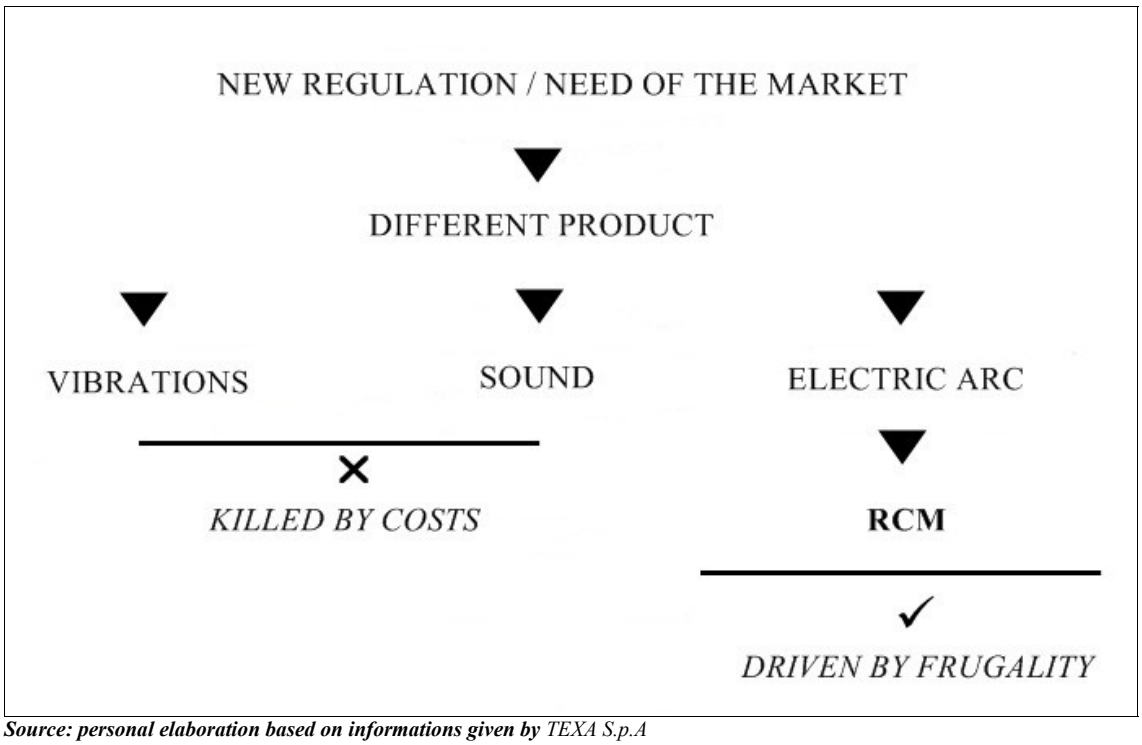
The device, for sale since spring 2014, does not substitute the other two rev counters but rather extends the production line that exclusively serve the Italian market for motorbike rev counters.

The project has been developed entirely internally, except to the electromagnetic tests that must be performed by an authorised centre that can certificate the CE mark.

The team in order to balance overall quality of the device and its costs had to pursue

some decisions and had to exploit existent components of other instruments. The necessity to develop an affordable device drove the team to exploit modularity principles, in fact the display, the plug for charging the batteries and the cables are obtained and taken from other instruments. Also the design of the device influenced the decisions regarding the materials and the specificities. As seen before design and ergonomics are key principles for TEXA and distinctive factors. A plastic frame for the new instrument required a specific mould that obviously could not be amortised by the small amounts of goods sold so the R&D team decided to adopt an aluminum shell that result more detached but it actually is cheaper.

Figure 7. Development process of RCM



Source: personal elaboration based on informations given by *TEXA S.p.A*

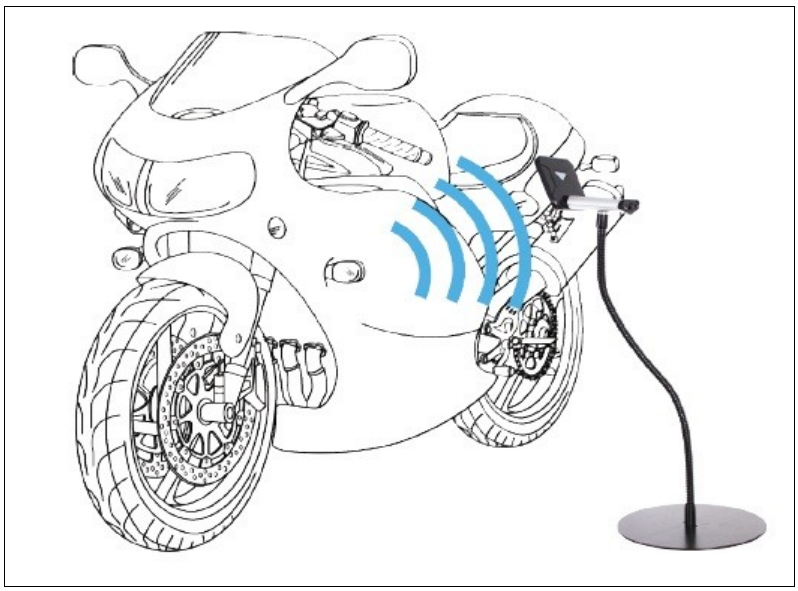
The development of the RCM rev counter has been influenced by several factors and its birth and features are a consequence of needs and restrictions.

A new regulation promoted by the Italian Government that changed the motorbike inspections and the need of mechanics of more comfortability in measuring the engine RPM, avoiding wires and their implications, have driven TEXA toward the necessity of producing a new instrument of analysis.

The choice then could be made between three different types of mechanisms to measure engine RPM: measuring vibrations of the engine, recording sounds trough a microphone or receiving electromagnetic pulses through an antenna. Even in this case the development staff had been influenced by the necessity and willingness of the company to keep production costs low in order to price the product effectively in the marketplace. The final decision was then made on the third type of technology despite the fact that in the past had resulted in inefficient products, the R&D staff has been able to develop efficiently this kind of mechanism conscious that the necessity of TEXA was to keep costs low, since the company cannot afford high expenditures on prototypes and the characteristics of the product had to push it in the lower price range with the respect to the other two rev counters.

According to these priorities also the final prototype has been influenced by the needs of TEXA, mainly the coexistence of design and ergonomics with cost minimization.

Picture 6. RCM rev counter



Source: *TEXA S.p.A*

The result has been the development of an efficient product that has revolutionized the nature of all rev counters, the main advantage is the one of being able of measuring engine RPM without the need of attaching cables and wires dismantling the motorcycle

fairings or the engine itself.

The mechanic can operate on the motorcycle standing by its side, the RCM has on the back of the frame a magnet that allow the positioning of the instrument on a tripod letting the mechanic the maximum freedom of operations, it is not even necessary to keep the device on hands.

The characteristics of the rev counter allow savings of time, and consequently of money, higher comfort and precise measurements.

The factors influencing its development forced the company to adopt a frugal approach toward this innovative product, its ideation has been driven by necessity and the development phase has been undertaken going through attempts, ideas, intuitions and cost savings that did not generate a poor product but rather encouraged the staff to get the best from the resources they could have.

The R&D department despite it worked with the priority of minimizing costs has been able to develop a brilliant and practical product, working with a frugal approach did not seem a constraint but rather a stimulus to do their best and use all the skills and abilities they had in order to obtain the maximum with the minimum.

2.8 Conclusions

The history of TEXA has highlighted how the first step for the developing of the business has been determined by the capabilities and personal know-how of the two partners in order to facilitate their operations in the workshop. The original idea has been generated by a set of technological skills coming from their personal background. Additionally a deep understanding of the dynamics of the market and needs of the customer has determined the creation of a particular environment with great potential that has evolved into a constant sustainable growth.

Technological products usually have short life cycles so they require constant search for innovative ideas able to keep the competitive advantage through the years.

For this reason solutions developed by TEXA are upgrades or frequent modifications in order to simplify or optimize the user experience through hacking or modding.

The ability to innovate is useless if it is not associated to the ability of doing it rapidly since it is crucial to anticipate needs and trends or in some cases regulations, this is traceable in many cases like the one regarding the normative mentioned before that in 2011 has obliged manufacturer to use a specific type of refrigerant for the conditioning system of vehicles.

The ability to create networks and partnerships has been described as another skill of TEXA, this relational capability drives the company to better performances thanks to cooperation and shared information. In addition to this, partnerships with OEM grant TEXA additional credibility at the eyes of consumers, they serve a double pursue: optimizing products and create new solutions but at the same time reinforcing the image of the brand.

The approach of the company toward innovation has always been of great attention, as described before TEXA considers innovation the main driver of competitive advantage and this must be accomplished only through a wise use of internal resources. The necessity of innovating is caused by the characteristics of the market that is continuously changing and requiring new solutions but this does not mean that TEXA must place significant amounts of money in every intuition it senses.

TEXA indeed spends fair resources on innovation, 12% of its revenues, but such

amount is a crumb of what other competitors actually spend on developing new projects. The relevant fact is that this disparity of budgets does not preclude TEXA the possibility of being competitive and offer quality products, the differential must be traced on the abilities the company have in retaining and disposing of brilliant internal resources that adopt a frugal approach to create innovative products.

The fact that TEXA is one of the main players in the diagnostic market demonstrates that a frugal approach made of hacking existent products and exploiting modularities can be an efficient answer to the enormous budgets placed by multinationals.

TEXA often starts from the existing products to develop modifications and improvements, hacking what is present in the company and disposing of limited materials and resources is not an obstacle in providing innovative solutions. The opposite vision is then demonstrated, from necessity and frugality something good can be obtained.

It is the case of the RCM rev counter described before, the company had to develop a new product due to different legislations and needs of the market. It analysed the internal resources it could dispose of and then started a developing project operating efficiently, saving money but not with the suffocating weight of cost minimizations. The developers tried to develop an innovative product embracing a frugal attitude, from necessity a project was started and thanks to frugality and capabilities it was completed in a relatively short period of time and in the best possible way.

A classical approach would involved a planning process, deeper feasibilities studies, researches on materials and features, a long and precise development phase, testing, beta tests, market researches and then finally launch in the market. Hypothetically the whole process could have been shorter, it could involve agencies or research institutes, third parties and great expenditures of efforts and money. This is a classic multinational approach made of sequent phases, revised at each dead line by a group of managers, analysed, discussed, maybe paused, maybe postponed, maybe killed and then producing a prototype which had to be tested, revised, modified and then eventually launched.

At TEXA things occur more rapidly, or at least in a different way: cheaper and informal. The company saw the necessity, which actually is an opportunity, and thought practically at what it could do, what it had in hands. Fast feasibilities studies to spot the

right idea and then its skilled people working on the project, modifying, testing, solving issues in an empirical way.

The fil rouge characterising the classic approach to innovation by multinationals is strictness and science while the one characterizing TEXA is know-how, capabilities and experience.

CHAPTER 3 - CASE STUDY: INGLASS S.p.A.

3.1 Introduction

INglass S.p.A. is currently an important company operating in the plastic injection industry with foreign branches and offices all over the world and continuous growth in terms of size and revenues.

Internationalisation and diversification have always been the two paradigms of the founder and chairman of the company, Maurizio Bazzo.

The company and its divisions produce machines and tools for plastic injection, the product line is currently divide in four broad categories: moulds, hot runner systems, SLM (Selective Laser Melting)technologies and control units.

In addition to these products the company delivers a broad selection of activities useful to the customer like consultancy services, feasibility studies, production processes optimization studies and constant support during the design phase, selling, mould try-out and in case of necessity guaranteeing after-sales service in extremely short periods of time.

INglass and its hot runner division, HRSFlow, bring continuous search and commitment to find innovative solutions to enhance the customer experience and simplify processes reducing costs and time and improving the quality of the end user products, mainly plastic components for the automotive sector.

INglass is nowadays a worldwide reality, the group counts two production sites: the headquarter located in San Polo di Piave (Treviso, Italy) and another one in Hangzhou (China) serving the Asian market.

The commercial branches of the company are spread all over the world: France, Canada and USA, Spain, Portugal, Brazil, Germany, Hong Kong and Turkey. Recent events saw INglass very active in its process of internationalisation, the company acquired in may 2014 an area in Michigan (USA) where it plans to set a producing facility that should employ more than one hundred people over the next four years.

In addition to this few days later INglass announced the acquisition of a French

company, ERMO, operating in the plastic injection industry and specialized in the production of moulds for the medical, cosmetic and packaging businesses. With this acquisition INglass will reinforce its international presence, entering into new fields of operation and will create an aggregation of more than 800 employees.
INglass group showed in 2012 a consolidated turnover of 79,967,000.00 € counting 538 employees all over the world, 270 in Italy (***Source: INglass*** *S.p.A).*

Picture 7. INglass headquarter in San Polo di Piave (Italy)

Source: INglass *S.p.A*

3.2 History

The company has been founded in 1987 under the name of Incos (Industria Costruzione Stampi) in a garage on the outskirts of Treviso operating in the design and production of moulds for the plastic industry. Some years later in 1991 the company decided to turn its focus on a niche market, the one of rotating multicolor and multicomponents moulds for the automotive lighting(front and rear lamps), the decision was challenging since the market could offer great potential but also risk of failure due to its selective and demanding nature.

After 10 years of expertise in producing moulds the company decided to enlarge its set of operations to the production of hot runner systems for plastic injection moulding. The acquisition of an Italian company specialized in this field, A.S.(Attrezzature Speciali), helped the creation of the HRSFlow division (Hot Runner Solutions). The combination of the two realities, the experience of A.S. and the Incos know-how in moulds enabled the company to produce a line of solutions capable of reaching the needs of the automotive industry moving from solely lighting to the whole appliances. This strategic choice has been largely repaid by the market in terms of international recognition and turnover.

In 2004 the company set up the INglass (Instead of Glass) division specialized in injection moulding for the production of large transparent polycarbonate surfaces for the automotive industry (Plastic Glazing). This solution stood as an alternative to glass products and rapidly replaced glass in the production of large transparent surfaces for vehicles. The decision to set up the glazing division turned so good that the company achieved so much visibility on the market that finally decided in 2006 to change the company name from Incos to INglass.

The technological complexity of producing moulding devices highlighted the need for reliable and high-quality equipment for process monitoring and control giving birth to the creation of the division dedicated to producing control units capable of monitoring the whole moulding process.

Since 2007 the company offered customers an optimization service for mould cooling time and the production of tailor-made inserts using SLM technologies (laser-melted metal powder).

Another important step was taken in 2009 with the decision to set a manufacturing plant in Hangzhou in China to serve the emerging Asian markets. This new plant has a total surface area of 12,200 m², 75% of which are dedicated to the production of hot runner systems.

In 2010 another step toward diversification was taken, the HRS MultiTech line that offers the possibility of moulding parts with reduced weight and high volume productions. This branch of products was launched with the precise willingness of tackling new applications and new fields other than the automotive sector. In fact this

type of technology is used mainly in the medical and packaging sectors which nowadays represent major businesses, the majority of global plastic market.

In 2011 the company initiated a process of restructuring of its operations, heavy investments have been posed on the simplification of processes and producers, automation of tools that enable monitoring and control on every phase and department of the company.

The following year another step toward global activities has been taken with the launch of an operational software controlling CRM (Customer Relationship Management) dynamics, this allowa the company to benefit from worldwide alignment and clarity.

The same year the company reinforced its position in Asia with the inauguration of an Indian facility.

In spring 2014 other relevant announcements have further consecrate INglass as a global player operating on a worldwide scale.

INglass declared in late April that in the first half of 2015 it will open a new manufacturing facility in Michigan to serve the American market. The positioning of this new plant, Grand Rapids, is important since it is on a strategic positionfor the plastic injection market, close to Detroit and close to the Canadian commercial offices.

Under this scenario INglass will rely on three different production plants in three different continents in order to satisfy local markets.

The company, as it happened for the Chinese plant in 2009, took this decision to better support local customers assuring them just-in-time production and assistance, the overall objective is to be able to serve customers rapidly and efficiently in order to reduce their time-to-market.

The company wants to assure the same machinery and quality standards present in Italy guaranteeing equal and high-quality processes wherever they are performed.

At the beginning of May 2014 INglass announced also the acquisition of ERMO, a French company leader in the production of multicavity moulds.

The company took this important decision, as said before, in order to become leading supplier of moulds and services in most of the plastic moulding sectors, in fact ERMO is specialized in the production of moulding machineries operating in the fields of personal care, medical and packaging. This acquisition will help the company in its

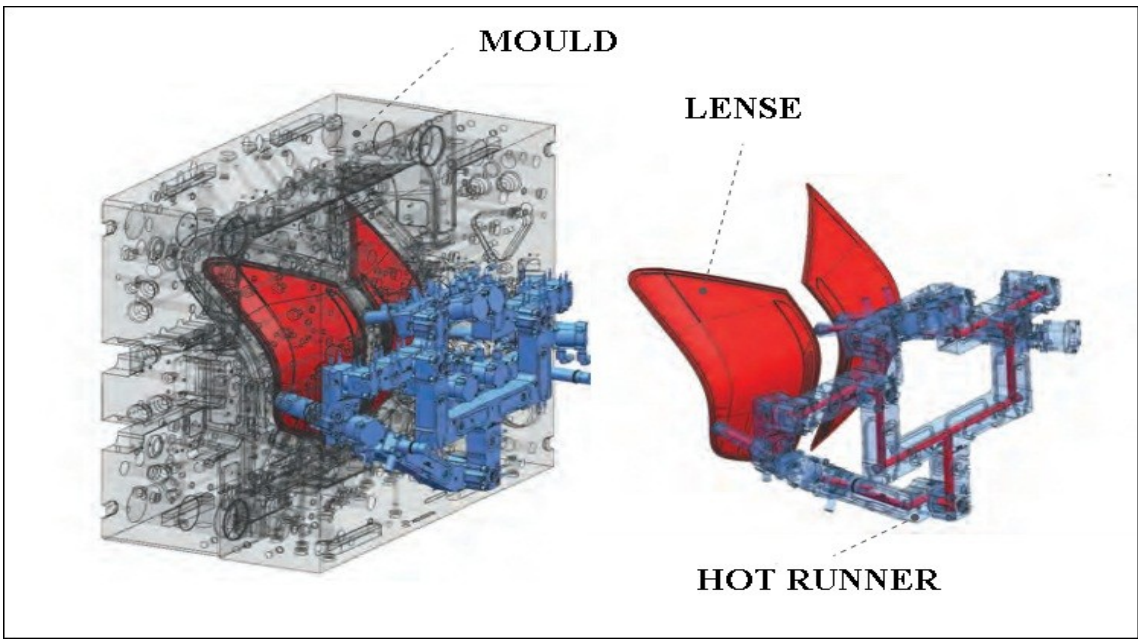
process of diversification since the majority of its business is currently performed for the automotive industry.
ERMO currently operates in Europe with five production plants located in France and Poland.
The companies jointly amount of more than 800 employees and expected total revenues for more than 110,000,000.00 € in 2014.
The ability of the company through the years has been the one of being capable to exploit the opportunities the market was offering with a forward-looking attitude and being able to become not only a provider of supplies for its customers but rather a partner in helping them with their decisions and let them achieve superior performances in a challenging and changing industry.

3.3 Products

INglass activities aim to provide engineering services for the realization of plastic components.
Its operations and range of products are divided into two divisions: INglass and HRSflow.
The first one operates and it is specialized in the design and manufacture of moulds for the production of headlamps and rear lights in the automotive sector, what has been described before as plastic glazing. The HRSflow division designs and manufactures hot runner systems for all application sectors.
The features of such products are not immediately accessible since they require a minimum understanding of the dynamics of their functioning.
Injection moulding is an industrial production process aimed at producing plastic components, the plastic material is melted and injected at high pressure into a closed mould that is then opened once the component has cooled. The machine is made of a nozzle (or more) followed by a press for moulding. The nozzle pushes the melt material into the mould, which shape the components with the two parts forming it(cavity and core), while a press holds it closed. The hot runner ensures that the melted plastic injected by the nozzle stays at the preset temperature. When the injection is finished and

the temperature has cooled the two parts forming the mould can be separated and the plastic part is obtained.

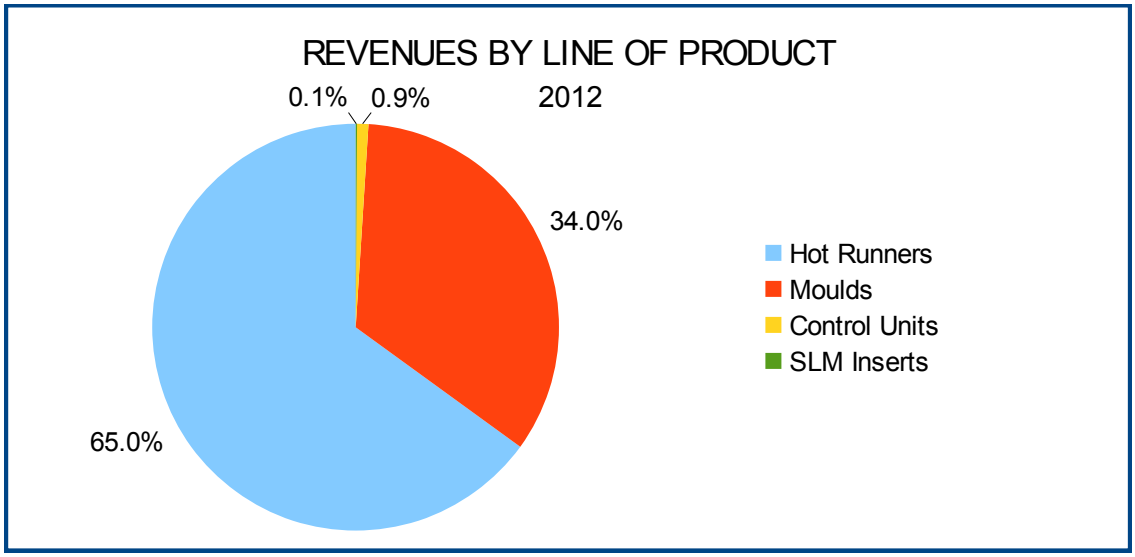
Picture 8. The components of a moulding machine



***Source: INglass** S.p.A*

The broad ranges of products that can be defined in INglass product portfolio are four: moulds, hot runner systems, SLM inserts and control units.

Graph 5. revenues by product line



***Source: INglass** S.p.A*

3.3.1 Moulds

The oldest business of the company, from the beginning of its operations under the name Incos the company has specialized into the production of such components.
As seen before moulds are made of two parts facing each other(cavity and core) that will literally shape the plastic components, into the mould the melted plastic is injected at high pressures and temperatures and it stay there until it cools and it can be finally removed.
The critical factor during this operations are the stresses under which the mould is placed in terms of pressure an temperature. The types of mould are basically two: Multicolor and Multicomponent.
The main feature of the former is the simultaneous injection of more than one colour in order to produce for example rear lights. The injections of the two colours take place at the same time in order to let the component be finished in a single cycle. The other type of mould, Multicomponent, applies the same techniques with the difference that several chemically-compatible materials are injected at the same time.
The third type of mould offered by INglass to its clients is the one concerning plastic glazing.
One of the main features of these Injection Compression moulds is the direct injection that results in the moulding of a glazing surface without limits of size. This technique allows the production of large panels without any stress or aesthetic defect. The company has several patents associated to these machines and it is the only world manufacturer able to produce large-scale transparent polycarbonate surfaces such as sun roofs and rear windows, this has driven cooperation with several OEM like Mercedes, Ferrari, Honda and so on.
The glazing technology, first launched in 2004, has been constantly improved by the company in order to offer customers better and better performances. Among the main advantages of this solution the high design freedom that leads to more innovative solutions in terms of aerodynamics and aesthetics, increased passenger safety since polycarbonate has much greater elasticity than glass and it is more shock-proof and finally 40% reduction in vehicle weight since polymers allow vehicle weight to be

drastically reduced and consequently reductions in fuel consumption and gas emissions. Despite the fact that manufacture of moulds has been the initial business of the company nowadays it has been overcome numerically by the production of hot runners but still it is a work of art due to the complexity of the machine, the design of an injection mould can take months and great resources.

3.3.2 Hot Runners

Hot runners, as seen before, are the devices that keep the temperature of the melted plastic constant and correct. An hot runner usually consists of a manifold, which takes the plastic material from the press nozzle and let it flows, and the injection nozzles that distribute the plastic into the mould to produce the plastic part, their structure and shape can take various forms depending on the type of injection, number of nozzles etc.
The functioning can then be divided into two types of hot runners, those systems for large-scale applications like in the production of vehicles or white goods or the MultiTech line made of hot runner systems for high production volumes and reduced weight like packaging, caps, closures and medical.

3.3.3 SLM inserts

This technology offers a cooling optimization support in order to reduce cycle time, improve quality, reduction of defects. Going through deep analysis it is possible to identify hot spots and critical points that then can be solve through SLM (Selective Laser Melting) methods.
SLM technology enables to manufacture steel inserts thanks to laser fusion, melting successive metal powder layers. Those inserts can be designed with waterlines perfectly shaped to the moulding surface geometry. This technique is recommended for injection moulding where the cooling process is a key factor for production optimization. It is also an efficient solution for highly conductive materials, with poor mechanical properties and resistance.

3.3.4 Control units

These devices are electronic units that regulate and control the parameters during the moulding process. During the entire moulding process parameters like temperature, nozzle opening/closing, energy consumption and so on need to be constantly adjusted in order to avoid anomalies and breakdowns. INglass supplies control units that perform indispensable support for ensuring correct working of the press and capable of optimizing performance.
Different control units exist in order to perform different tasks and functions.

Picture 9. Electronic Units

Source: INglass *S.p.A*

3.4 The plastic injection market

The INglass/HRSflow group was initially set up to serve the automotive sector with the design and manufacture of equipment.
The business has constantly grown since the beginning of the Millennium showing a slight inflection in 2009 caused by the financial crisis that drove the whole world to an

economic recession. This led the group to a process of diversification regarding the production of hot runners, not only for the automotive sector but also for all application sectors.

The company disposes of capabilities in managing all kind of applications nowadays, obtaining good results both in the production of hot runner systems for the automotive applications and more complex and high quality fields like the medical one, caps and closures sectors.

This choice and its abilities in developing efficient tools determined an incredible growth for the company, averaging an Average Compound Growth(CAGR) of 25% during the years as a group.

The current global scenario obliged the company, in order to be successful, to internationalise its operations, with the opening of branch offices in strategic locations and the Chinese plant in order to serve the fast-growing Asian market.

3.4.1 Mould market

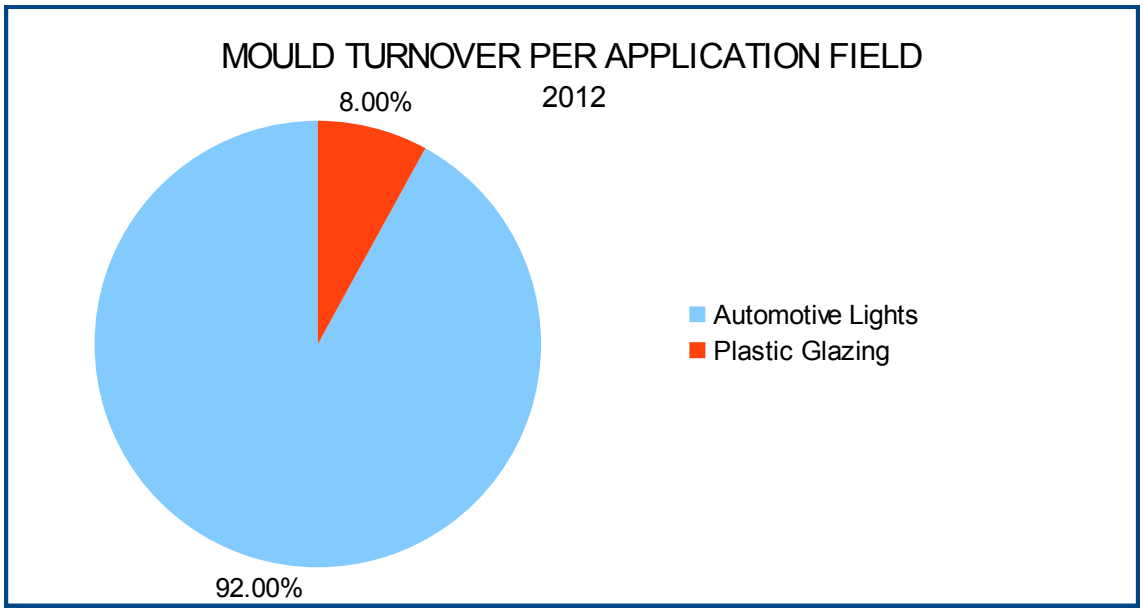
As seen before INglass, originally Incos, started its operations as a mould producer and then diversified its operations into the manufacturing of hot runners.

The main field of application for plastic moulds is the automotive industry with particular attention to the applications for lighting (front an rear lenses) and plastic glazing, the process for the production of large polycarbonate surfaces (sunroofs, windscreens etc.).

As many other sectors it is difficult to obtain exact values for the market, some estimates mention an overall value of the market of € 300 million (Source: INglass S.p.A) but this value is uncertain and approximated since several automotive manufactures have always preferred to have their own peculiar in-house production plants in order to preform operations in first person and manage entirely the process.

This market is solid and robust and constantly increasing its importance and its future potentialities, thanks also to the gradual extinction of glass in favour of cheaper plastic materials like polycarbonate fibres and innovative processes capable of reducing wastes and lowering the production environmental impact.

Graph 6. Mould turnover per application field



***Source: INglass** S.p.A*

A characteristic feature of the automotive mould market is that it paradoxically does not suffer of times of economic recession like other sectors but rather it may happen that it increases volumes. When there is a market slowdown car manufactures tend to launch new models into the market in order to increase sales with new solutions and designs.

The automotive mould market is then very concentrated, few players are dominating the market and this number will probably decrease in years since there is the tendency of conglomerating into associations and partnerships. In addition to this car manufactures are decreasing the amount of pieces outsourced to third parties, they prefer to keep in-house activities and outsource only a few niche production processes.

INglass is one of those few players controlling the whole market since it has established through the years a deep expertise on producing moulds.

Figure 8. Players in the mould market

***Source: INglass** S.p.A*

3.4.2 Hot runner market

The hot runner system of a moulding injection machine is the most critical part of it since it has different specificities customised according to the kind of material used, shape of the element and aesthetic features.

The world market for hot runners is currently worth € 1.8 billion, more than doubled since 2007 (Source: INglass S.p.A).

Its distribution is not linked to parts production but rather where the machineries are manufactured, this obliges companies to behave and act globally.

The market is spread all around the world, the largest market is in Asia, almost half of world sales are concentrated in East economies(22.5% of which in China).

The Chinese market is not only the most important but also the fastest growing, this is why INglass set up in 2009 the Hangzhou plant to serve uniquely Asian mould makers.

America and Europe are also growing but a lower and stable rate, despite this trend they still are crucial markets for the company since they are the oldest and the most challenging.

Compared to these numbers HRSflow, the hot runner division of the company, has shown faster growth than competitors reaching the 5th position in the global ranking and has been the fastest-growing company in recent years.

Hot runner systems are usually used for various applications, the two main fields are medium/large scale automotive applications and reduced weight applications like caps, medical, closures etc.

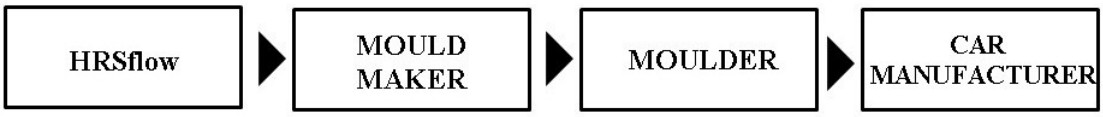
Each of them has different characteristics and requires specific features, every application has its own manufacturers and, despite the fact that products for different applications have similar basis and share the same principles, products differ for many things and technologies applied.

The automotive application for hot runners is the most important one and sees HRSflow as one of the most important companies in this field of application.

The industry is made of different actors, HRSflow's customers are mould makers who purchase the hot runner system in order to install it in the moulds they have to produce for the TIER1, the company who moulds components. The moulders buy the mould

from the manufacturers complete and ready to mould. Then they can finally mould the components, refine and sell them to the car manufacturer or in the industry.

Figure 8. Players in the hot runner market



***Source: INglass** S.p.A*

Each of the passages described above are equally important in the final result, at the head of the chain there is also the plastic producer who has to supply the moulder with the plastic grains necessary to mould.

Mould makers are the standard customers of HRSflow, since they buy hot runners and apply them into the moulds they produce.

In order to serve moulders efficient machineries there must be between the hot runner provider and the mould maker perfect harmony, cooperation and communication since the two elements, the mould and the hot runner, are complementary and must match perfectly in the process of assembly.

This requires the mould maker detailed and complete information to the hot runner manufacturer of specifications and characteristics of the hot runner system required.

The production of hot runners for the automotive industry is the core business for HRSflow but also for the entire group but over recent years the company has developed more the Multitech division to serve different markets, in fact this application is widely used for reduced-weight applications. This field of application represents the future of the whole industry since it is fast growing and numerically represents the major use of plastic materials for moulding.

For these reasons INglass has decided to develop further more these machineries in order to penetrate different and fast-growing sectors.

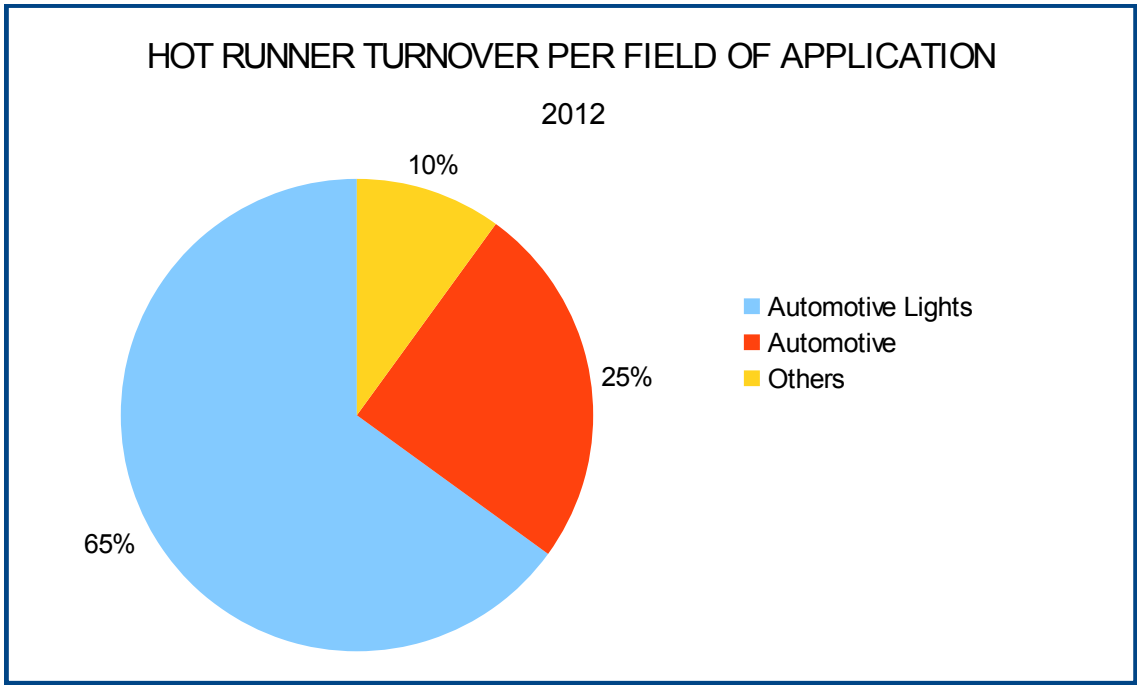
The supplier chain of the industry is similar but different than the automotive one, the main differences between the two applications are in terms of product type and

customer-supplier relationships.

The customers are as before mould makers who produce the moulds, purchasing from the Multitech division the hot runners, the entire machine is then sold to the moulders who produce the parts that then are finished and sold directly to the final customer who sells the product on the market.

Compared to the automotive industry the technological requirements are more strict and complex, more demanding and requiring tight cooperation between the hot runner supplier, the mould maker and the moulder.

Graph 7. Hot runner turnover per field of application



***Source: INglass** S.p.A*

The plastic injection market, in every application field and sub market, is closed but highly competitive. In order to be competitive and operate on a global scale a company must be present for its customers. Nowadays the value added of global players is given by quality products but mainly presence in the market, service offered must be rapid and precise. Customer service, intended as after-sales service, must be responsive and reactive in few hours since a breakdown in moulding machine might cost hundreds

thousands Euro.
The necessity of having a vast sales and service network is costly but at the same time it is necessary to grant optimal assistance to end users and OEM that typically have several plants all around the world.

3.5 Market analysis

In order to analyse the plastic injection market it is useful, as done in the other case study, the Michael Porter five forces model of analysis.
Since INglass is operating in different markets, hot runners and moulders, the analysis will take into consideration only the most important one in terms of revenues, the one that is currently bringing the company almost 80% of its revenues (Source: INglass S.p.A).
The hot runner market can then be decomposed and analysed examining the five forces characterizing this common model of market investigation: threat of substitute products, established rivals, new entrants, bargaining power of suppliers and the bargaining power of customers.
These are the common forces that influence the ability of a company of operating into a specific market, serving customers and generating profits.
Substitute products are not a real threat for the company, in fact an alternative to hot runners exist but it is not common and less preferred with respect to traditional tools.
Cold runners are simple channels formed between the two halves of the mould made to bring plastic from the nozzle to the cavities, every time the mould opens and components are extracted materials in the channel are ejected as well.
Th advantages of such technologies result in cheaper machineries in terms of production and maintenance but there are also disadvantages in terms of slower cycle times and the presence of waste from runners that must be removed.
Differently hot runners show faster cycle times, eliminates runners and plastic waste, no runners must be removed and bigger components can be produced.
Hot runners are the common technology used in the automotive sector despite the fact they cost more but they allow for costs savings in materials and shorter lead times.

For these reasons there are no threat of substitution expected in the coming years, no turning points are expected.

Traditionally hot runners are the most common instruments in the moulding industry, modifications and improvements have always been done in order to produce more efficient tools but no total changes will occur soon.

Differently competition among established rivals is a more delicate issue, HRSflow is currently competing with few companies but very powerful and efficient.

The hot runners market is characterized by few players that share a lot of trade and business, in fact the market is quite important in terms of size and revenues but the global players are not so many, INglass is among those companies.

In recent years many companies have been acquired by hedge funds that see in the market great potentials, in fact the market is really attractive since numbers are consistent and companies operating in it are not so many.

The worldwide hot runner market is divided between 15-20 top companies who manage more than 70% of it (Source: INglass S.p.A). This cause in the market relative tranquillity, competitors are widely known and surprise are difficult to come but at the same time competition is still high and technological dominance is harshly battled.

As described before since the market seems attractive international hedge funds have entered in it acquiring private companies all over the world and often merging them into big agglomerates and corporations.

These players often dispose of great amounts of resources in order to bring on R&D studies and look for innovative solutions, its dominance is favoured by the power they are given by solid funds and consistent resources.

Most of them are North American and older than HRSflow, INCOE is the only one among the biggest that is still privately held.

INCOE designs and manufactures hot runner systems since 1958 and it is considered a pioneer in the industry, the company has patented the fist commercial not runner nozzle.

The company is still 100% family owned, similarly to HRSflow, and it is an unusual fact in the plastic injection market since all the major companies are held by investments funds and corporations (Source: INCOE website).

The Canadian companies Mold-Master and Husky and the American Synventive are

considered the main companies in the business and they have all been acquired by investments funds that notice the potential of the market and are interested in acquiring solid companies that earn respectable revenues.

Husky Injection Molding Systems is the biggest one, it has been acquired in 2011 by OMERS, a Canadian pension fund, and Berkshire, a Boston-based private equity firm, for $2.1 million. The company revenues amount to over $1 billion and it employs more than 4,000 people worldwide(Source: Husky website).

Mold-Masters is a Canadian company located in Ontario, it has been acquired in 2013 by Milacron, a company held by a private equity firm, with a cash transaction amounting to $1 billion which, confronted to the $270 million of revenues declared in 2012 by the company, can give the idea of much money those investments funds are willing to place and spend in order to enter the plastic market (Source: Mold-Master website).

Synventive Molding Solutions, located in Massacchussets, has bee acquired by Barnes Group, an international aerospace and industrial manufacturing and service provider, with a cash investments of $355 million in 2012.

Synventive is one of the world largest hot runner systems manufacturers and probably the most important in the automotive sector, it has a customer list that counts more than 3,000 moulders and mould makers around the world and that has produced in 2012 revenues equal to $160 million (Source: Synventive website).

These numbers are helpful to understand how HRSflow is currently competing with multinationals and companies disposing of enormous resources and monetary possibilities. The main difference between HRSflow and competitors stands on the amount of money that the companies can spend on R&D activities and on the overall quantity of business they perform.

Nevertheless HRSflow is able to compete efficiently with those multinationals, the company is the one showing higher economic growth and the products offered are as efficient and technologically developed as those of other competitors.

New entrants are also present in the plastic market, rather than new entrants a better definition would describe them as emerging and local competitors.

Since there are not completely new companies entering the market due to various obstacles and barriers to entry the focus can be shifted towards hot runners producers in

emerging markets, especially in Asia.

These companies can be considered new entrants since the Asian market has developed in recent years and those companies are younger than North American players, despite the fact that such new realities are gaining momentum internationally their span of operations is anyhow limited to their markets and the closest ones. In fact companies like YUDO or Snake although efficient and competitive prefer to conduct business in familiar markets, avoiding global assistance and operating in Asia.

This is due to the fact that in order to be a global player pre-sale and after-sale services must be performed efficiently and rapidly and those companies are avoiding global trade since they are not able to offer customer services on a global scale. Another fact that limits their span of action is the overall quality of hot runners which are often lacking of the manufacturing accuracy that set North American and European companies as dominant players in the worldwide market.

These companies are adopting and pursuing price strategies in order to overcome competition, generally the price for an Asian hot runner is 50% lower than Western prices due to the fact that there are cost savings in the labour force and on materials.

This price strategy works in many cases and mainly on Asian mould makers since all they care is containing price at the expense of quality but Western mould makers working for OEM prefer efficient and lasting products.

The difference is on the mindset of companies, Western ones usually manufacture durable products with the aim of making them last forever or at least as long as possible. Differently Asian manufacturers show a more consumerist approach to business, pieces are made to be cheap and attract customers for their convenience.

The fact that those companies do not offer worldwide services is another difference between established and emerging companies, in this way they can limit costs and offer lower price products but if they would provide more efficient service the price of their products would inevitably raise and the cost savings for the mould maker would not be enough to justify the choice of a lower quality hot runner.

YUDO has its headquarters in South Korea, in 2011 revenues amounted to $530 million and the overall distribution of operations reinforce the theory explained before, 91% of its operations are held in Asia, 6% in Europe and 3% in North and South America.

The group was established by its founder in 1980 and it showed through the years constant and impressive revenue growth (Source: YUDO website).

As demonstrated by data YUDO is the leading company in the Asian market, HRSflow thanks to its Chinese plant has gained some market share and is able to compete with YUDO (Source: INglass S.p.A).

Generally speaking the plastic injection market is attractive and growing but at the same time is controlled by few players and barriers to entry are present.

These obstacles seems very strict and hard to overcome, they limit efficiently the access of new competitors. Innovation and differentiation are not valid methods to overcome such barriers and even pricing strategies might be effective as seen before but limited to certain markets.

Evident barriers to entry might be listed as three:

1. Technological gap, the barrier is not on access to technologies but on the ability to manage efficiently the production process in order to obtain durable and efficient hot runners. The abilities retained by incumbents limit the access of new entrants, the technological knowledge acquired through years would require enormous investments that would not pay back since the market is ruled by established relationships and managed by few companies.
2. Know-how, the market as seen is 50 years old but still the skills requested to operate in such business are essential to set operations and create competitive advantage producing efficient and long lasting hot runners. This barrier is tied to the previous one and they are complementary each other, technologies might be acquired but the ability to work on them and develop solid products is a skill that incumbents have matured through years and thousands of hot runners. Incumbents can rely on experience and skills acquired through decades of design, production and selling of hot runners. In some cases the manufacturing gap is physiological, Chinese workers are commonly less careful about details than Western ones. Attention to details, expertise and know-how defeat the executing capabilities and the terrific productivity rates of Chinese workers.

   This has been noticed also by HRSflow, even if the Hangzhou plant is an exact copy of the Italian one in terms of facilities, processes and materials used the

overall quality of hot runners is slightly inferior to Italian one, thi is due to the value added given by Italian workers who guarantee skills and knowledge of the product superior to the others and attention to details in order to develop a product that must be reliable and last through the years.

The acquired human skills that incumbents have in their facilities probably represent the most effective barrier to enter the market for new entrants.

3. Established relationships, the way in which business is conducted is based on established human relationships among suppliers and end-users of hot runners.

   The sales force must be capable of acquiring contracts, this happens being cited by moulders in the terms of contract given to mould makers.

   Under this view the personal relationships among people play a great role, pre and after-sales services are necessary to obtain the trust and the loyalty of mould maker whom, among different suggested producers, can choose their providers of hot runners.

   The key to access different markets is obtaining the trust of moulders at first and then the one of mould makers, this is based on personal bonds built on mutual respect, honesty and valid tools.

The bargaining power of suppliers is a relevant aspect of the plastic injection market since it influences the whole value chain, for hot runners manufacturers supplier are the companies providing materials, small components and elements of the final instrument.

In order to maintain the overall quality of the instrument materials and components must be chosen accordingly, procedures and method applied by virtuous companies would be then annulled by poor materials or components poorly assembled.

For this reason suppliers must be accurately chosen, to guarantee the optimal quality of final machineries.

For HRSflow the matter is fairly complex since two different production lines in different countries are present. The two environments are not only geographically distant but also different for various aspects, as mentioned before the working capabilities of employees are physiologically different by culture and traditions.

In addition to this the Chinese companies do not own the same technological but mainly

manufacturing knowledge of Italian suppliers. For this reason the company decided to set Chinese operations reflecting precisely the Italian structure but including important differences regarding components and materials.

In fact the risk of setting an Asian plant was the one of producing poorly assembled hot runners due to the differences in manufacturing skills of the two labour forces, lower quality components would then affect the overall reputation of the company since Asian hot runners despite the fact that are produced for local mould makers then travel around the world since moulds are often sold in other continents. For this reason hot runners produced in Hangzhou can be found all over the world and might possibly damage the image of the company.

For these reasons the company preferred to start a strict and precise plan of operation management, building the plant in the same way it is built the Italian one, ensuring same procedures and methods applied in Italy and outsourcing to local companies the least possible operations, many activities in China are performed internally while in Italy are outsourced to third parties. In this way the company can monitor operation and ensure high quality standards even in Hangzhou, in Italy this is not necessary due to the different abilities and trust that HRSflow relies on its suppliers.

In China every component is developed in-house to grant sufficient quality while in Italy many suppliers are working for HRSflow.

In Italy trust is higher toward third companies operating in the machinery industry, quality is proven by long-term relationships established through the years and validated by efficient service and reciprocal dependency. Like HRSflow is dependent on its suppliers in the same way HRSflow is an important customer for them since it provides them important and constant orders.

These suppliers are followed and assisted, given specific requirements and offered the possibility to deliver the best possible service that is necessary for both entities.

Suppliers are considered more than service providers, they are considered part of the company even if more than one company is providing the same component or service.

This has various reasons, the principal is that usually in this sector the quantity of labour and order is very variable, it is difficult to be predict not because periods of minor intensity occur but rather because it often happens that the company must face periods

in which orders challenge production capacity, the amount of production is so high that the company is forced to do its best in order to satisfy requests. In this periods supplier are challenged too and it is one of the reasons why HRSflow prefer to maintain relations with different companies in order to satisfy possible increases in demand for hot runners and also to diversify and lower the risk of facing defective supplies.

The bargaining power of customers is another hot topic in the industry, as mentioned before the relationships with customers and final users are crucial in order to obtain orders and provide services to mould makers.

HRSflow must work on two different frontlines, in fact from one side it has to convince moulders to include them in the list of possible hot runners producers in the terms of contract supplied to mould makers and then it has to convince mould makers to choose HRSflow hot runners between all the possible options they are given.

The company must be chosen, together with some other competitors, first when the moulders places the order to the mould maker and then by the mould producer, among competitors, when it comes for him the moment of choosing the provider of hot runners. HRSflow is therefore obliged to work on different fields and in different methods.

The TIER1, the company moulding parts, is more attracted by after-sales services an technical features since it has to work on the entire mould and it has to use it for its purpose.

The moulder uses the hot runner for moulding parts and it has to be assured that the component is valid and efficient and that in case of emergency the company is granting rapid customer services and local assistance since a short breakdown may cause serious losses for a TIER1.

Another peculiar aspect that is appreciated by moulders is represented by technical advantages offered by the company that would increase efficiency, reduce costs and wastes of materials.

The moulder is particularly sensitive to cost savings during production processes and it may represent the real key factor when the list of hot runner producers is given to mould manufacturers.

The latter are treated in a different way, since they have to build a mould they are more sensitive to cost saving in terms of price of the component, a cheaper hot runner or an

additional discount might be the way to get the order processed.

In addition to price, which is important but not crucial when it comes to choose a top-quality component, pre-sales services might result effective.

As for pre-sales services are intended all those services related to design and planning of the hot runners and even of the mould, HRSflow is able to grant full support and cooperation to mould makers in order to develop the best solution for moulders.

From this analysis based on Porter's model the overall image of the industry in which HRSflow operates is depicted as a competitive market in which few producers are managing and controlling the whole market. The level of technological progress reached by competitors quite high and innovation is a key driver of revenues, offering an innovative and durable products overcome price strategies. Substitute products are not a threat since hot runners are preferred to cold runners for various reasons and no foreseen substitutes have being developed yet.

Another important feature to gain market share is the adoption of efficient customer service departments all over the world, in the plastic injection market moulders do nott seek extreme cost savings but rather efficient and rapid after-sales services.

INglass has been a pioneer company in the production of moulds and transferred this knowledge at the service of hot runners production, HRSflow has gained from its previous experiences and then from the knowledge of an acquired company.

The relationship with suppliers is important but at the same time well managed by the company that follows and participates into the activities of its providers of services and components. Through long-term and established relationships and a wide list of suppliers the company is able to limit the risk of supplies shortages.

Established competitors are the relevant force in this model of analysis since they can benefit from enormous resources and experience acquired through their past, despite their capabilities HRSflow is one of the main companies operating in the market for hot runner systems.

3.6 The competitive advantage of INglass

The identification of the key resources retained by the company is the starting point in order to analyse and identify the reasons why the company is able to compete on a global scale with competitors disposing of higher resources and of bigger size.
As noticed in the other case study a Resource Based View(RBV) theory might be the best way to analyse a company like INglass, in fact it is evident how even in this case the ability to sustain the competitive advantage of a company can be traced to its internal tangible and intangible resources (Peteraf, 1993).
As stated by Tokuda's studies, the internal resources of a company are more influential than the external factors characterizing the environments in which it operates and they are the main driver of competitive advantage with respect to competitors (Tokuda, 2005).
These internal resources of INglass can be all gathered together into an uniform an unique mindset that characterize the whole company, a mindset focused on achieving high performance instruments, seeking fast pre and post-sales services and optimizing costs to develop efficient solution rather than exasperate cost minimizations to obtain higher profits.
All these features come the upper management of the company, Maurizio Bazzo is a competent self made man that exploited his previous experiences in the sector and his intuitions to pursue the best opportunities the market was offering.

3.6.1 Internal resources and know-how

Internal resources, tangible and intangible, are the main asset of INglass.
In fact the company owns to its employees major merits if it has achieved a respectable position in the plastic market, INglass is made of people working in it and the knowledge they have acquired during their working experiences.
Know-how is the key resource in developing top-quality products, the knowledge necessary to perform such activities have matured from the years spent on designing and producing hot runners and moulds.

In fact the history of the company teaches how the INglass background as a mould maker has favoured the rapid growth in the hot runner sector by HRSflow.
At the beginning of the Millennium INglass was producing moulds since a decade and it was enjoying its position of market leader in the field of lighting moulds.
The market for hot runners was even closer than it is now, really few players were competing for market leadership and the price for hot runners was incredibly high, justified by the presence of really few companies that could basically set the price they wanted.
The establishment of HRSflow reversed this trend and literally revolutionized the market, HRSflow was offering affordable products at the same quality levels of competitors. This advantage was due to the fact that HRSflow as a new entrant decided to pursue a different strategy and break the rules of the market, this strategy based on lower prices was not made possible by extreme cost savings but rather by more equal and fair pricing policies that automatically settled the whole market.
This was made possible by a deep knowledge of the market by people working in INglass thanks to the previous experience as mould makers, the knowledge of the market granted efficient manufacturing of products that the company knew in detail.
At the same time INglass was guaranteeing for HRSflow, using those hot runners in its moulds and proving the quality of the products.
The rapid growth of HRSflow, and consequently of the total revenues of the group, was made possible by the deep knowledge of the employees and by the position that the company was holding in the mould market.
This concept is described perfectly by the differences in terms of quality between Italian and Chinese hot runners produced by the company.
As described before the company in 2009 decided to open a production plant in Hangzhou to serve the Asian market, in order to grant sufficient quality standards the board decided to identically replicate in China the Italian plant.
The same machineries were installed in both facilities, the same materials were used and additionally provision of external supplies in China were internalize in order to control every passage of the production chain.
Nevertheless the overall quality of Italian hot runners is superior in terms of reliability

and assembly, this is due to the expertise and know-how that internal resources are putting in their job. The differences are slight and not always evident but in general and approximated terms the Chinese hot runners lack of that attention to details that Italian hands are posing especially during the assembly phase.
The Italian craftsmanship is also in this case a value added and the key factor in obtaining superior performance products.
The contemporary presence in the Italian manufacturing plants of three different lines of production(moulds, hot runners and control units) creates synergy and the overall result is deep competency in each of the fields.

3.6.2 Pre-sale and after-sale services

Another key resource for INglass to obtain economic and competitive advantage compared to other companies is made of service tightly related to the sales, before and after the product is realized.
There is a specific internal team that during the research and development phase uses specific software to simulate the plastic injection and its dynamics related to temperature and fluency into the mould and the structural reaction of the whole system to provide efficient analysis to the customer and facilitate the engineering phase of moulds and hot runners. Also other variables are measured during these tests like energy consumption, pressure changes, the overall structural characteristics of every moulded component and it is also used for cooling analyses.
In this way moulding problems can be avoided, it is some kind of feasibility study and in-depth analysis of dynamics regarding the flow of plastic materials.
These analyses are currently really appreciated by customers because they prevent the risk of wasting materials, money and time.
Before the product leaves the plant there is also the possibility of conducting a try-out to test it, there is a testing division where qualified technicians uses moulds of different types to be sure that the product realized is conformed to requests and needs of the customer.
After-sales services are equally important to set a stable competitive advantage and act

as a global players in the worldwide market.
HRSflow disposes of an efficient customer service structure that grants support from the system installation to maintenance and even possible problems related to the machinery. The time that passes between an issue and the intervention to fix it is crucial and determines ability of companies of retaining loyal customers.
Possible downtimes are reduced and managed by local after-sales centres that respond to emergencies 24/7, in addition to this the web platform of the company allows constant monitoring of machineries around the world. In this way the company has always at disposal the situation of the operating tools, can check customer needs and the quality of services provided by the company. The background of each tool is present in the web database of the company in order to align information and give complete data to all technicians around the world.
Worldwide HRSflow commercial branches can offer technical assistance to customers, having the necessary equipment and technicians to provide rapid support in the local language. These divisions have also spare part warehouses in order to guarantee faster response in case of emergency.
These kind of services which results in many branches and people employed around the world are necessary to be present on a global scale with the best solution and a rapid and prompt service. All these procedures are necessary to improve system reliability, gathering data and experiences on issue and problems, taking actions to solve those critical areas and improving overall performance of the group.

3.6.3 The role of the entrepreneur

As Tokuda states in his studies the attitude and capabilities of entrepreneurs on small-medium enterprise can affect the performance of companies more than many other factors(Tokuda, 2005).
The role of the entrepreneur in this case is crucial for the development and history of the firm, in fact he is the founder, owner and current chairman of INglass group and his choices deeply affected the history and economic growth of the company.
He has been able to form a striking workforce able to set efficiency as their main goal

and willing to put all their efforts towards paths of growth and innovation.
The ability of creating a determined workforce is his main merit together with the ability of taking good decisions at the correct time.
Maurizio Bazzo in 1987 could rely on his previous experience as a technician in a company operating in the plastic sector, he decided to set up his own company and founded Incos.
Incos was set up initially with the sole purpose of developing moulds for the plastic injection and then during years production has been diversified.
The key element in the history of the company has been the ability of diversifying production according to potential market developments and in this way exploiting synergies deriving from the production of different tools related to the same field of application.
The ability in making moulds helped the development of hot runners productions for the automotive sector that then have been diversified into different fields of application with also the production of related accessories and so on.
The first crucial decision taken by the entrepreneur has been the focus on the production of moulds for the automotive lighting. This choice has been taken at the beginning of the 1990's and it has paid back.
The development of such a niche market, the one of rotating multicolor and multicomponent moulds for the production of front and rear lamps, has been an hard and challenging decision since the market was still undeveloped but highly selective and demanding. This required the company a notable effort in order to develop new technologies for the emerging market but in some years Incos has been able to gain a solid reputation in this field and become one of the leaders in the market for automotive moulds.
The second relevant decision taken by Maurizio Bazzo was the one of manufacturing hot runners for the automotive industry. In 2001 the company enlarge its product portfolio with the production of hot runners for plastic injection machineries.
The process has been favoured by the acquisition of an Italian company specialized in this sector and the deep expertise matured in the mould market, the combination of the two realities let the company fulfil the needs and requirements of the market.

This choice determined an economic boom for the company which rapidly grew in terms of size, international recognition and in terms of revenues.
The entrepreneur saw into this different market an opportunity to pursue and he totally committed the company his intuition, putting resources and funds in order to pursue his beliefs. He showed determination and the courage of investing resources, the company embraced this vision and put efforts in order to develop efficient solutions and gain respectable market share.
The ability to select and motivate his employees is a peculiar characteristic that helped creating the solid and capable workforce that currently adds value added into the company's operations.

3.6.4 Organizational culture

The company has deep values rooted in its organization that form the core basis for building and established value added and provide efficient services.
This common set of values let the company acquire collective skills, abilities in innovating processes and the passion for challenges and improvements encouraged by strong interpersonal skills.
At INglass each person is encouraged to take actions, listen to others' people ideas and find common shared solutions that must be pursued with collective attitude, coherence and respect.
A certain degree of flexibility is required and asked to every person operating at INglass, responsibilities must be taken with an elastic and open-minded approach to everyday issues and necessity. At this point it is useful to notice how the average age of INglass employees is 34 years old, a significant value that expresses the willingness of the company of assuming young talents that can be trained and can offer their complete effort for the sake of excellence.
INglass wants from its employees continuous improvement and innovation in terms of personal skills and company performance, every worker is valued and motivated to do his best and trained to grow and increase his personal competencies.
Employees are encourage to pursue temporary experiences at foreign branches in order

to spread capabilities acquire new skills, training plays an important role in the company. People often change roles and opportunities for training across divisions and offices are constantly offered. Training courses are mostly given to technicians and designers in order to improve the level of technical service offered to customers.

INglass plants and offices all over the world are built and maintained properly, to make employees feel valued and appreciated.

The respect of the company for environmental issues is maximum and very careful, processes are not classified as activities with high environmental relevance since there are no dangerous chemicals but the treat of materials and wastes is considered very important.

Steel and copper are the main materials used by the company while water and electricity are necessary to perform manufacturing operations.

Waste water is collected in special tanks separated by the type of contamination and then entrusted to specific authorised companies.

The same attention is placed toward general waste produced, which is carefully collected.

Outsourcing is another issue that can be include in this list of principles, in fact the company has outsourced its operation to Eastern shores but for reasons other than the mere cost minimization and exploitation of cheaper labour force.

The company, as stated before, has opened its Chinese manufacturing plant in order to be closer to important markets and offer faster services, the same reasoning has been pursued with the recent decision of outsourcing manufacturing to United States.

3.7 Frugal innovation at INglass: the FLEXflow technology

Innovation and quality are the primary mission of INglass and great efforts are placed in order to reach this objective.

Research and development activities and product engineering have always been high priorities for the company, each product is the combination of in-depth analysis and trials.

Outstanding and remarkable results can only be achieved through excellence and innovation, this cannot be achieved without investing resources.

High quality technicians, engineers performing analysis of injection flows, tests, design and development of new products require approximately 150 people all over the world and a total expenditure on R&D activities amounting to 1.5% of consolidated revenues.

Despite the fact that investments and expenditures on R&D activities are necessary and mandatory INglass tries to minimise and monitor expenses on projects, management of resources is intended to get the best from investments placed carefully and with sagacity.

Those numbers, which are considerable, do not mean that a small-medium firm like INglass has the possibility of investing on a wide range of projects and ideas. Conscious of being an important but small reality in the plastic injection environment the company must invest those resources with care, avoiding possible failures that would represent important losses on the annual balance sheet.

Under this view it emerges the necessity of something else, an intangible plus that must be added during the R&D phases, this can be defined as practical skills owned by the company. The ability of matching capabilities, tinkering and recombining products and skills to reach innovative solutions that pure and traditional R&D processes could not reach.

In fact resources spent by INglass on R&D activities might seem remarkable, and indeed they are, but alone they are not sufficient to reach the level of technological innovation that the company offers; something else is brought during the development phase and it can be defined as the art of tinkering and bricolage.

What emerged from the market analysis was the dominance of multinationals and

companies owned by investments funds, which means that INglass is operating and competing with companies abundantly rich of resources and means.
The fact that the company is able to offer equal or similar products in terms of quality and specifications in comparison with competitors means that resources are managed efficiently and the research and development activities are well performed.
Innovation is often driven by necessity, as in the cases of jugaad innovation (Radjou, 2012), but also by fulfilment of market needs.
Under this view INglass and HRSflow are always careful about customer suggestions and hints because they come directly from the market and can offer great starting points for innovative solutions. Sole expenditures on R&D activities do not justify the overall achievements of the company, there are other values that drive performance.
In fact there are additional values that the company employs in order to bring innovative products.

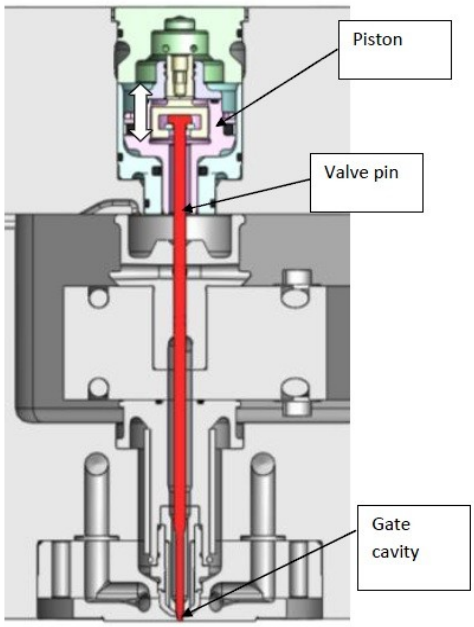
These introductory theories can be exemplified into one of the innovative products developed by INglass; it is the case of the FLEXflow technology, an electrical system for plastic injection that has been developed to fulfil precise requests of the customers and developed adding to the project peculiar capabilities that money cannot buy.
A serious problem faced by moulders is the impossibility of regulating the movement of the piston and consequently of the valve pin regulating the plastic flow, this issue stimulated INglass developers to think of something different.
The electrically-driven system precisely control the movement of valve pins increasing the gate quality and the overall quality of moulded parts.
The complexity of an hot runner is also made of its terminal, the nozzle which injects the plastic into the mould.
There are multiple systems in order to inject molten plastic into a mould, thermal gates are relatively cheap tools that are used whenever the aesthetic dimension is not relevant and the vestige quality is not mandatory. It is used for materials and products less complex and the shear rate is a secondary issue, whenever imperfections and flaws are not relevant.
A different method is the one mentioned before, the valve pin system.

It is more costly but it is essential in cases of components that must respond to precise and perfect aesthetic characteristics. These systems are used where a superior and longer quality of the vestige is required, the cost of such systems is higher but necessary in the automotive or medical sectors to produce extended and thin surfaces made of complex polymers.

The valve gate systems are divided into two main categories:

- Pneumatic systems, which generate pressure through the use of compressed air. Used mainly in the medical and packaging fields where the absence of oil leaks and contaminations is necessary to ensure quality. In these systems pressure is usually not high, generally 8 bar.
- Hydraulic systems, generally used in the automotive market where oil contaminations are not relevant and the maximum values of pressure obtained by a certain systems is considerably higher than an equal size pneumatic system.

Picture 9. Valve gate system



Source: INglass S.p.A

Both systems work in the same way, the piston through a double circuit (Open/Close) moves up and down the valve pin which opens and closes the gate cavity.
During the injection phase the piston stands on the top dead centre (TDC) of its cylinder and let the plastic flow while during the cooling phase the piston is on the bottom dead centre (BDC) of the cylinder determining the closure of the gate.
The stroke of the piston in the cylinder from the TDC to the BDC (determining the opening and closure of the gate) cannot be regulated through intermediate phases and consequently the gate is totally open or totally closed.
INglass owner, the sales force and the R&D staff noticed the need of developing an innovative solution to offer this possibility to the moulders.
The initial spark that started the entire project has been the market necessity of controlling this operation, in 2012 the project begun with some market analysis in order to pursue this path and spot the correct technology to solve this issue.
The new system had to overcome and solve some issues, the target points for the development of the technology were made clear:

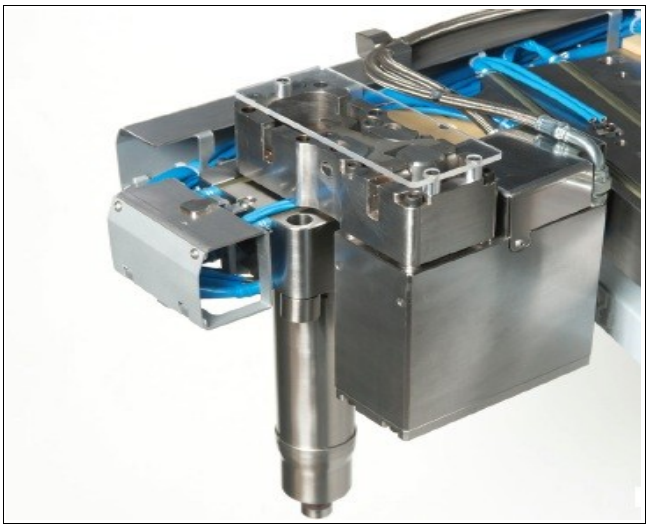
- the avoidance of a dedicated cooling system
- the avoidance of an air/oil circuit
- need for compactness
- ease of use through an electronic device

At that time, and still now, competitors were offering electric systems for the actioning of valve pins but the technologies associated to it were complex and high-priced.
INglass started reconsidering those prototypes and some ways to reduce their costs and complexity, after in-depth analyses the R&D staff proposed different solutions and different methods.
After some trials and accurate considerations the team chose the best solution that made possible the modular and gradual injection of plastic materials giving the needed pressure only in specific moments of the process.
The development of this technology has been made possible by an important company operating in the field of electric handling in order to provide for electric notions that are

not familiar and fully developed in the company.
After creating the mechanic part of the system the innovative valve gating system was ready for refinements and for the testing of its operations.
The product is currently sold in the market but the company still prefers to monitor sales in order to better control and supervise the functioning of this instrument.
The initial response has been positive since all the requirements asked by the sales time have been satisfied, its price is higher than traditional systems but in a long-term perspective cost-savings are validating the initial expenditure.
In comparison with the competitors' electric systems the one developed by INglass is certainly offered at a lower cost and less complex in its features and in the ease of use, in fact an important feature that developers have kept in mind has been the need for simplicity since the tools must be controlled by simple operators.
The overall results of the project are satisfying, more than expected.
The system has been developed and launched in order to include the best of the electric management techniques in a minimal amount of space.
The system assures an accurate, easy and flexible control of pressures and flow during the plastic injection phase.
This ability is reached through a series of small adjustments of each valve controlling the position during the stroke, the speed and the acceleration.
Each valve pin is independently controlled and managed to ensure sequential moulding for high-quality products.
Since the power is not generated by oil or air the final components are not ruined by typical flow marks and lines, defects that usually must be avoided on pieces that must respect specific aesthetic requirements.
Cost benefits are also present, in fact the overall clamping force is reduced (the force needed to close the gate), reduced part weight and reduced tool bending.
Additionally there are also some practical advantages of such technologies given by ease of maintenance, ease of use through a WI-FI monitoring tablet and increased cleanness and safety in smaller systems since no hydraulic or pneumatic devices are present.

Pictures 10-11. FLEXflow

Source: INglass S.p.A.



The product can be defined a frugal innovation for various reasons: the idea of developing such technology directly came by the market as a necessity and the intuition was promptly captured by INglass, the project in its initial studies was based solely on in-house knowledge and then turned also in cooperative activities, the developing has been pursued also by attempts and trials and during the whole process careful attention has been placed on restraining costs.

The intuition, the spark that started the project, has been taken by the sales team at the top of which there is Maurizio Bazzo who constantly dialogues with his sales force.

The need for a more regulated stroke of the piston in the cylinder gave the team the starting point, successively an analysis of alternatives offered the intuition of developing an out-of-the-stream solution. The brilliant idea has been the one of reinventing an expensive solution, hack that technology to obtain a more effective and less costly answer to the issue.

The R&D team then started tinkering around those electrical technologies and formulated valid alternatives, getting information, studying the subject and proceeding also by attempts and trials.

Attention to budgets and the willingness to limit expenditures have been the common and usual paradigm to follow, the overall project cannot be defined cheap because in any case it involved resources and investments but the final result can surely be defined a great product in comparison of what the company invested and what other

multinationals would have invested in order to obtain such innovation.
The product is the exemplification of how bricolage and tinkering drove the company toward remarkable results, demonstrating that scientific R&D is not sufficient to bring innovations.
The two dimensions are complementary to each other since only their balance can drive the company to superior performances.

3.8 Conclusions

The history of INglass has stressed how the entire process of growth has been influenced by the decision taken by the entrepreneur and the abilities matured through the years by its team.
The two constant words in this path of growth have been internationalisation and diversification, reached by innovation and in-depth commitment.
The original idea behind the creation of the company has been the past experiences of the entrepreneur and his personal background in the plastic injection field.
Following this initial intuition the company has grown through a series of key decisions taken by the board, in fact the decisions to diversify production into new fields have been crucial turning points. Specifically the decision to enter the hot runner market has been absolutely forward looking and intuitive, this let the company achieve additional international relevance and higher turnovers.
Those achievements are not only coming from intuitions, of course, but also are supported by valid processes of engineering and development of new products, done through valid human skills and capabilities matured during the years.
A solid advantage of the company is the possibility of relying on a proven workforce, capable of getting the best from what is available in the company. The ability of communicating, sharing ideas, learn from colleagues and the market are all features that helped INglass employees in their personal growth.
Networks and relationships have been fundamental for INglass, the established and durable relationships with its supplier are an advantage and facilitates the manufacturing processes granting reliability and quality.

Also the relationships with customers, moulders and mould makers, are crucial. Listening to customers is always an incredible advantage in order to anticipate their needs and capture future trends and technologies of the environment.

The approach toward innovation is proactive, great attention as always been spent on this field since it is considered one of the main causes of competitive advantage.

Despite the fact that INglass actually spend fair resources on R&D activities, 1.5% of its consolidated revenues, that amount of money is spent with sagacity and consciousness that competitors can afford higher budgets and consequently efforts to bring innovation must be even stronger. Innovation has a price to be paid but the resources spent by INglass are fair and brings efficient solutions, the amount that could be spent in order to do so could be higher without the skills and internal human resources that INglass has built during the years of activity.

The difference in budgets between INglass and its competitors does not preclude the company the possibility of achieving superior results thanks to experience and know-how,l that combined to a frugal approach to operations produce remarkable results.

In fact INglass is one of the main players operating in the plastic injection industry.

The ability to spot trends and needs of the market is the spark from which R&D people and the whole organization start operating, frugally analysis all the possible solutions and spotting the best one, the intuition that can bring superior performance and economic returns.

It is the case of the FLEXflow technology, the company listening to its sales force and its customers identified some targets and improvements that it wanted to achieve in the production of hot runners. Developers frugally analysed existing solutions, also those of competitors, in order to pinpoint the one that was offering the most interesting possible developments. Then through external cooperation, trials and attempts some solutions were neglected and other further developed until the moment in which the team achieved good results and superior performance in smaller amounts of space.

In fact the FLEXflow technology offers better solutions during the moulding process in smaller sizes, lower consumption and excellent results.

A classical approach would involved in-depth planning, supervising, auditing, feasibilities studies, beta tests and continuous kill/go decisions taken by a senior team

that would increase costs and extend the process.

Hypothetically a multinational could adopt such method, probably also acquiring external resources and suppliers.

At INglass the approach toward innovation is lean and informal, there is continuous dialogue between collaborators and departments and this synergy allows time savings and better development of projects.

Feasibility studies and market analysis are taken seriously but are facilitated by cooperation with other players and listening of the market, then rough ideas and intuitions are developed by skilled technicians and developers with latest means and knowledge of the subject. The practical phase is also important, there is an internal press in the manufacturing plant in order to test products, trials are fundamental to have feedback on the process and actions taken.

Internationalisation and diversification are the targets while know-how, expertise, and commitment are the drivers of innovation.

CHAPTER 4 - CONCLUSIONS

4.1 Introduction

According to Gianfelice Rocca, Chairman of the Techint Group, in Italy there is an extraordinary ability to innovate using creative solutions and experience; these features belong to the medium-tech Italian companies that constitute the excellence of the *made in Italy* brand.

This segment of the market is represented by all the fields of the advanced manufacturing: machine tools, car equipment, white goods and so on.

These companies are bringing important innovations characterized by an incremental dimension matured during the years, experience after experience; Rocca defines these as the companies stimulating the Italian economy thanks to their innovations and exports.

Innovation is performed levering on what he defines as "ordinary merit", those hidden talents operating in the Italian territory that must be spotted, trained and exploit to reach incremental innovation opposed to scientific innovation.

This kind of innovation is a combinatorial ability of the Italian enterprises that should be valued and nurtured; around an entrepreneur there is the real assets of those companies, its capable workforce (Rocca, 2014).

This vision is tightly related to the companies analysed in the previous chapters, TEXA and INglass. Those companies are enterprises born and grown around their entrepreneurs, matured and valued by their skilled human capital.

Innovation is not only the result of R&D expenditures as a classical stage/gate approach would require but it is the result of those resources applied and summed to a dash of creativity and skills, capitalised in tinkering and testing processes that bring effective incremental solutions.

4.2 Similarities between the two cases

The two companies analysed demonstrated various shared values and features.

First of all they are both tightly tied with the territory in which they operate, activities are performed to value capabilities of local workforce and there is high respect for people and the environment in which they operate.

TEXA did choose to keep manufacturing activities solely in Italy in order to maintain high-quality standards, retain capabilities and go against the common trend of desperate cost minimizations to increase margins.

INglass did pursue an outsourcing process but with different scopes than usual ones, in fact the only reason for outsourcing production is the need of offering fast services to customers in local markets.

The role of the entrepreneurs is a common feature of both realities, the entrepreneurs have been able of pursuing prolific opportunities with foresight and capable instinct.

The ability of surrounding themselves with talented people in the sales department and skilled professionals in the development and production departments has been the way to increment the overall quality of the internal resources of the company.

Technicians can be defined skilled tinkerers, people enabling innovation in a frame based on doing, using and interacting (Bettiol et al., 2013).

Motivation and commitment to excellence are the key values transmitted by the leaders who are constantly involved in operations, able to listen the market and its needs.

Tinkering and hacking are well-known methods for both companies to develop projects and innovative solutions. In this way the company is able to cut processes saving resources and money, the attitude of looking inside the company in order to start projects is typical of companies that are conscious of retaining in-house capabilities that are enough to reach superior performance.

Starting projects from existing internal resources, in terms of tangible and intangible assets, is the demonstration that the companies have voluntarily built during the years a solid base of skills and assets to exploit in order to pursue frugal innovations.

Frugality is another common topic for both enterprises, as seen in previous chapter the companies spend fair resources in their R&D activities but with the proactive attitude of

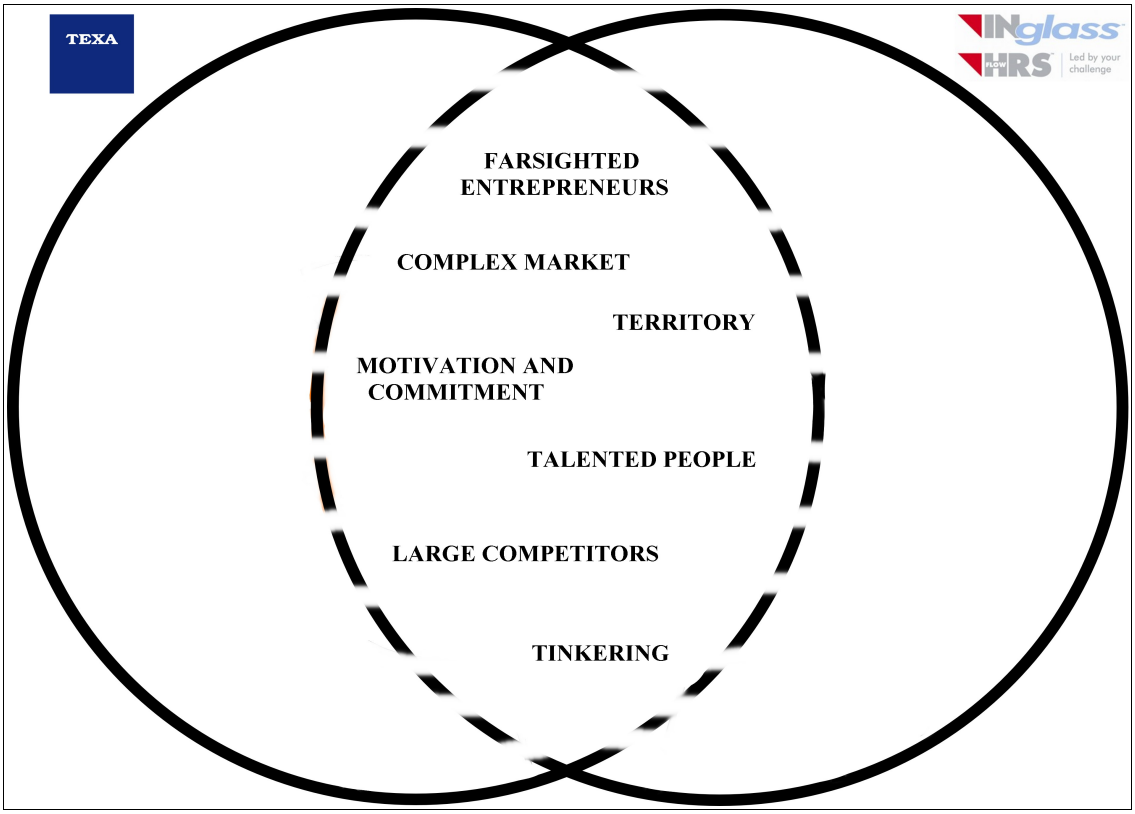
doing more with less. In fact competitors can dispose of huge amounts of funds given their position, TEXA and INglass compete with multinationals and internationals investment funds that grasped the potential returns of those market and invested capitals in acquiring companies and research facilities.

The amounts of resources invested by the two companies are significantly lower than those at competitors disposal but the achievements and the final results in terms of quality are similar, demonstrating that the factor balancing performances is the ability of pursuing effective innovation.

The markets in which the companies operate are complex, as just mentioned the role of competitors is relevant together with some other factors.

Suppliers must be tightly bounded to the company in order to serve prompt and high-quality supplies and this is obtained establishing durable and mutually profitable relationships. Both environments are fast and dynamics, the need for urgent solutions and changes in terms of regulations force the companies to be flexible and rapid.

Figure 9. Similarities between TEXA and INglass



Source:personal elaboration based on the two case studies

In the two case studies common features have been identified.

The starting point of both innovations has been driven by the market, TEXA developed the innovative rev counter because the market was requiring an alternative solution to existing methods of measurement and because the Italian regulations were changing.

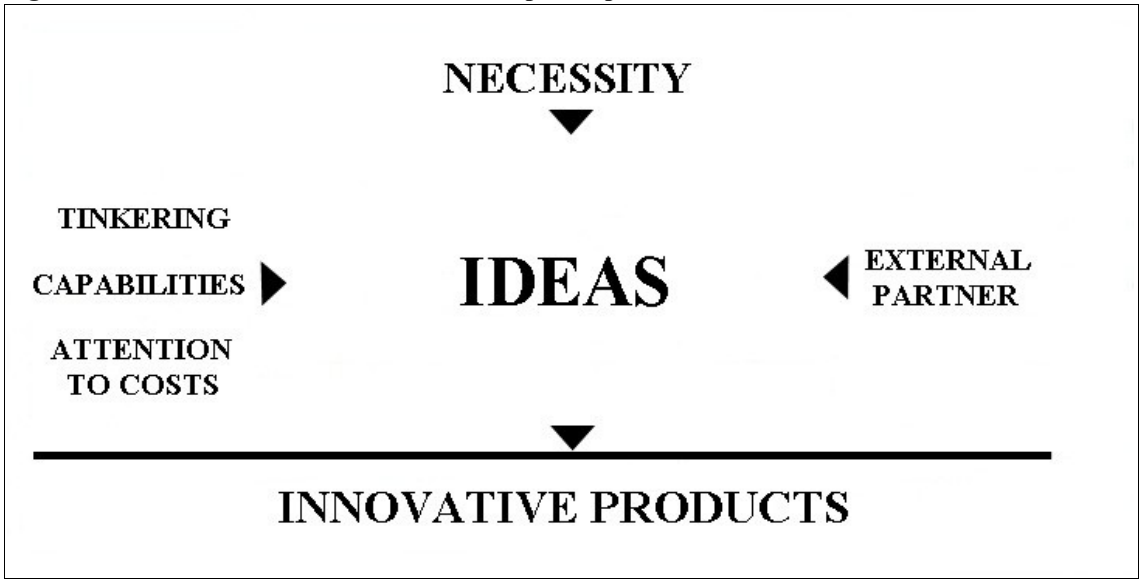
INglass started thinking about the electrical valve gate system because the market was asking for a superior solution that could overcome an existing issue typical of moulding machines.

In both cases the spark that started the projects has been the necessity of satisfying the market needs that have been previously listened by the companies.

The way in which the development phases have been managed is also similar, the companies performed market studies and feasibilities analysis and then spotted the correct path and solution basing on what the market and the companies were already offering. The companies applied tinkering skills to reverse and get the best from different alternatives, then the development has been done putting great attention on efficient management of resources and adopting a frugal approach.

The companies obtained the best from the resources they could rely on, both cooperated with external companies when internal resources and assets in specific fields were not sufficient and an external help was necessary and convenient.

Figure 10. Similarities between the two development processes



Source:personal elaboration based on the two case studies

4.3 Considerations on frugal innovation

Considering existing literature regarding the topic and considering the two cases studies previously depicted it is possible to derive some common aspects and guidelines regarding frugal innovation in Western economies.

This approach expresses its best application in markets characterized by rapid change, volatile market in which products are characterized by short lifecycles, unstable regulations and emerging competition. Environments in which flexibility is more valued than rigour and formality.

These features drive the companies toward the necessity of innovating products, frugal innovations often derives from necessity and scarce resources; companies with limited funds but high tangible and intangible assets exploit those capabilities to fulfil the needs and requirements of regulations and markets.

Economic downturn has made customers more cost-conscious than they were in periods of prosperity and economic growth, customers are seeking cost minimizations but not merely in terms of monetary savings but rather in term of optimization of the price/quality relationship.

As mentioned frugal innovation typically derives from scarcity, this is completely verified in emerging markets in cases like those of jugaad innovation, from really poor and scarce conditions Indian tinkerers are able to extract basic but efficient mass products.

The Indian definition is the extremism of the concept, in Western economies things are diverse: available materials and resources are abundant compared to those exceptional cases.

It must be clarified once again that frugal innovation is unproductive if it is not supported by classical R&D activities and expenditures on innovation activities.

The two dimensions and approaches to innovation are different but complementary rather than completely opposed.

Frugal innovation is not the answer to all innovation problems, it has also clear limitations; it is not a complete substitute for the traditional approaches but rather a complement activity that brings value-added.

If it is true that money cannot buy innovation it is also true the opposite, with no money there is no sustainable and remarkable innovation in Western economies.
The fact that frugal innovation often starts from the existent is a proof that it comes from something measurable and from resources previously spent.
Rather than developing something new from scratch, innovators more often reuse or seek new combinations of existing products.
These characteristics are more relevant in Eastern economies and emerging markets but actually also Western economies have started considering this approach to innovation since even developed economies have currently exhibited these characteristics of scarcity, necessity and instability.
The key variable in performing frugal innovation is to think frugally and flexibly at every level in the organization, the whole structure must be conscious of which are the methods and the priorities in achieving innovation and superior performance.
Compensations, motivation of the workforce, awareness and partnering are essential organizational elements are characteristics that can be traced as common in approaching this state of mind.
The company must become able of obtaining more from less by applying this mindset to every phase of the value chain. The organization must totally embrace those beliefs and exploit its potential to tinker and obtain something out of the stream.
This must be done not only mentally but also physically, taking actions and being flexible in everyday life situations.
Organizational barriers must be broken down if necessary, if a project seems to have great potential barriers must be removed from its path; ultimate discoveries must become ultimate products, in the shorter possible time.
Dynamism, positive thinking and elasticity are the answers to those necessities dictated by the market, those sparks that start the whole process. In fact not always necessities are opportunities, rather they often seem insuperable problems to face and overcome.
Adapting strategies and projects in a flexible way and with a positive attitude help developers analysing challenges in a more objective, creative and brilliant way.
Improvisation is also an option, as intuition can be a driver in the same way proceeding by trials and attempts might represent a possible way to overcome obstacles.

Last but not least innovation paths must also be driven by passion, this element simplifies the whole development. Passion opposed to science in order to discover things that the mind cannot reach.

Frugal innovators do not merely follow numbers and statistics but also are listening to the intuitions suggested by their experience, the scientific method is in this way overwhelmed by out of the box reasoning and intuitive development.

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