



Critical success factors of Six Sigma implementations in Italian companies

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ABSTRACT

The present paper discusses the results of a research project going on at Politecnico di Milano, aiming at analysing the idiosyncrasies of Six Sigma implementations in Italian companies. In particular, the project addresses the following research questions, regarding the approach of Italian companies towards Six Sigma: are Italian companies implementing Six Sigma exactly as it was originally conceived at Motorola or, rather, is there an Italian way to Six Sigma? do Italian companies which implemented Six Sigma recognize the same set of critical success factors singled out in the international literature?

Bibliographic analysis showed a lack of literature concerning Six Sigma implementation in Italian companies. The research was then based on the study of real life application of Six Sigma in an Italian company and on discussion through a set of workshops organized at Politecnico di Milano with Six Sigma experts. In particular, we will concentrate on a set of case studies and on one workshop specifically addressing the second research question.

The insights coming from the analysed case studies and discusses with industry experts – if further explored, validated and reorganized – could constitute a Road Map for Six Sigma implementation in Italian companies; the validation and re-organization process is still on-going and its completion could constitute a further research objective.

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1. Introduction

The present paper describes the results of a research project focused on Six Sigma implementation process, with a particular attention to understand which is the situation of the enterprises operating in Italy and, consequently, which are the managerial implications of a Six Sigma implementation in the typical Italian company.

As it is well known, the Six Sigma methodology, born at the end of the 80s in Motorola, is strongly oriented to measurement, and in particular to the adoption of statistical techniques, since long used in other quality philosophies and approaches, and now encompassed in a comprehensive framework advocating the adoption of some basics quantitative tools for the resolution of the most common problems which characterize the organizations.

The objective of the present research work consists in proposing a reference model for Six Sigma implementation in Italy, based on four macro-areas considered as critical, following the analysis of some cases of implementation:

- sponsorship;

- approach towards training;
- number of staff involved in the project;
- performance measurement.

The paper is structured as follows:

Section 2 is devoted to a brief overview of the literature on Six Sigma, both from an international and an Italian perspective, showing the lack of bibliography, describing Italian implementation case histories.

Starting from this simple finding, the research going on at Politecnico di Milano along with its research questions are then presented in Section 3.

In Section 4, a selection of the most significant case studies will then be presented, in order to highlight with practical examples the peculiarity of the Italian context and how managers and entrepreneurs are trying to adapt an original Six Sigma approach for a better fit with the idiosyncrasies of an Italian company.

In Section 5, the results of a workshop with Six Sigma experts are presented, in terms of critical success factors of an implementation of Six Sigma in an Italian SME, as compared with the set of factors singled out in the international literature.

In the concluding section, the authors argue that such insights could serve as a basis to build a road map for Six Sigma implementations in Italy.

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2. Scientific background

2.1. TQM, the “father” of Six Sigma

It is here interesting to devote a short paragraph to the main concepts of total quality management (TQM), since it can be considered as the father of Six Sigma: many of the principles constituting the basis of TQM are also paramount in Six Sigma.

TQM is a management philosophy originated in the 50s and has steadily become more popular since the early 80s. Total quality is a description of the culture, attitude and organization of a company striving to provide customers with product and services satisfying their needs.

Total quality control was the key concept of Armand Feigenbaum’s 1951 book “Quality Control: Principle, Practice and Administration” – a text that was lately revised under the title “Total Quality Control” – and many other quality gurus, like Deming, Juran and Ishikawa—also contributed to the body of knowledge now known as TQM.

The International Standards Organization (ISO), TQM is “a management approach. For an organization centered on quality, based on the participation of all its members and aiming at long-term success through the customer satisfaction, and benefits to all members of the organization and to society”. TQM seeks to integrate all departments (from marketing to finance, to design, engineering, manufacturing, customer service, etc.) to focus on meeting customer needs and company-wide organizational goals. TQM views an organization as a collection of processes, arguing that every company should strive to continuously improve these processes by exploiting the knowledge and the experience of every worker in the organization.

Albeit originally applied to manufacturing operations, TQM is now becoming recognised as a generic management tool, just as applicable in service companies and in the public sector.

The key principles characterizing TQM in its most general conception are (Hashmi, 2006):

- Management commitment: in TQM, management should be the driver of change.
- Employee empowerment, through training, measurement and recognition (for both the teams and individuals), and teamwork.
- Fact-based decision making tools.
- Focus on the customer.
- Continuous improvement.

Lately, TQM also received strong criticisms because it provides only very broad guidelines for implementation. As Pydzek reports, “true, solid research showed that organizations which succeeded in successfully implementing TQM, reaped substantial rewards. But the low probability of success deterred many organizations from implementing TQM. Instead, many organizations opted for ISO 9000, since this promises not world-class performance levels but standard performance, and provide clear criteria and a guarantee that meeting these criteria will result in recognition. In contrast, TQM offered a generic set of philosophical guidelines and no way to prove that one had accomplished their quality goals” (Pydzek, 2006).

2.2. The Six Sigma revolution

As it is well known, the Six Sigma programme was first launched at Motorola in 1986, thanks to the joint efforts of some key figures, among which Mikel Harry (Senior Engineer of the Government Electronics Group), Bill Smith (VP and Senior Quality

Assurance Manager) and Bob Galvin (CEO). “Motorola invented the Six Sigma quality improvement process in 1986. Six Sigma provided a common worldwide language for measuring quality and became a global standard.” (source: www.motorola.com; other sources frequently report that the official launch of Six Sigma took place in 1987). This allowed Motorola to become the first American company to win the Malcolm Baldrige Quality Award, in 1988.

The Six Sigma methodology, originally conceived as an approach to improve manufacturing processes, has been then utterly revised by General Electric, in the mid-90s, first in the form of a Total Quality programme, to be then promoted to the rank of “managerial approach” by which to manage the entire organization.

Any Six Sigma implementation aims at improving customer satisfaction, by mean of improved processes capability. This, in turn, is made possible by focusing on “Critical to Quality” (CtQ) characteristics and implementing improvement actions seeking to continuously reduce processes variability in terms of CtQ. These actions are carried out by involving every employee.

Most successful implementation of Six Sigma methodology have common characteristics:

- Six Sigma embeds quality in the company’s functions and departments, rather than maintaining it as a separate entity. The idea of a Six Sigma implementation being a private affair of the Quality Management Department is a profoundly distorted one: the Quality Management VP could not bear the responsibility of a companywide implementation of Six Sigma.
- In most successful implementations, the Six Sigma program has been extended to all company’s processes. It would have been a big mistake to limit the implementation only to the most relevant areas.
- Six Sigma takes management involvement and support for granted. It is paramount that the company board places quality as the first priority.
- Six Sigma focuses on well defined, measurable goals. Often the finance Department is involved, being in charge to validate economic savings resulting from the various improvement actions.
- The organizational structure of a Six Sigma implementation is based on precisely specified roles (e.g. Green Belts, Black Belts). A key driver of success of Six Sigma is the possibility to recruit the best resources in the company; linking career paths of the staff to personal achievements within the Six Sigma programme and to contribute to its success, is often useful to increase motivation and commitment.

It is then apparent that Six Sigma has been inspired by TQM, being based on a pretty similar list of principles. Among the main differences, it is worthwhile noticing that:

- while TQM is oriented to the final result of a process, Six Sigma aims at preventing errors, reducing the variability of the processes;
- TQM mostly provides broad guidelines for quality management, while Six Sigma commends precise applicative methodologies (DMAIC for existing processes and DFSS for new ones) and focuses its attention on numeric certification of improvements and associated savings;
- in Six Sigma, top-down management leadership plays a critical role in enabling the successful deployment of tools and techniques – much less in TQM – and this, in turn, ensures alignment of projects with strategic goals of the organization.

So there are authors considering Six Sigma as an evolution of TQM (“Six Sigma emerged from the fertile environment created by Total Quality Management,” (Black and Revere, 2006)), while others regard Six Sigma as a methodology to adopt “within the larger framework of TQM” (Klefsjö et al., 2001).

2.3. International literature

In the recent years, many papers and books have been written on the Six Sigma methodology.

In order to correctly direct the research project, the authors exploited an extensive literature survey encompassing 96 books and more than 100 papers published on international journals.

Most of the scientific production was written in the last five years. New methodologies, stemming from the original methodology, are mushrooming: authors worldwide are preaching second generation approaches like “New Six Sigma” (Barney and McCarty, 2003), “Lean Six Sigma” (Taghizadegan, 2006), (Wheat et al., 2003), “Fit Sigma” (Basu and Wright, 2003), “Customer-centered Six Sigma Quality Management” (CSSQM) (Kuei and Madu, 2003), but the “revolutionary aspects” of this initiative at an organizational level, differentiating Six Sigma from all the previous quality initiatives, remained virtually unchanged in time.

Many papers are presenting case studies of Six Sigma implementation. A useful exercise was to sort out the various aspects that, according to the authors, are at the base of a successful Six Sigma implementation. We will call those items “Critical Success Factors” (CSF) of Six Sigma.

We started from the work of Anthony and Banuelas, which analysed the “key ingredients for the effective implementation of Six Sigma program” (Anthony and Banuelas, 2002), (Banuelas Coronado and Anthony, 2002). More aspects than those highlighted in Section 2.2 emerged in their study.

Kwak and Anbari boiled down Anthony and Banuelas’ list in four points (management involvement and organizational commitment; project selection, management, and control skills; encouraging and accepting cultural change; continuous education and training) (Kwak and Anbari, 2006), yet their approach is the way too synthetic for our purposes.

We considered Anthony and Banuelas’ list presented in Banuelas Coronado and Anthony (2002) which, with respect

to that presented in Anthony and Banuelas (2002), contains Communication. We make only two small modifications by expanding “Training” to “Education and Training” (Kwak and Anbari, 2006) and “Organizational infrastructure” to “Organizational infrastructure and culture” (Zu et al., 2010). The resulting list follows.

- Management involvement and commitment.
- Cultural change.
- Communication.
- Organizational infrastructure and culture.
- Education and training.
- Linking Six Sigma to business strategy.
- Linking Six Sigma to customer.
- Linking Six Sigma to human resources.
- Linking Six Sigma to suppliers.
- Understanding tools and techniques within Six Sigma.
- Project management skills.
- Project prioritisation and selection.

Of course, the specific items pointed out by the single authors varied according to the type of industry, company size, etc.

Some of the CSF were also quoted in the paper focusing on successful total quality management implementations in general (i.e. including, but not limited to, Six Sigma), such as Bayazit and Karpak (2007) and Zehir and Sadikoglu (in press). This would allow, as a further development of present paper, a generalization of the analysis.

A statistic of the frequency of the various CSF out of a sample of 18 papers trying to analyse the reasons behind the success of real life applications is depicted in Fig. 1. Some additional factors emerged during the analysis (such as measurement system and information technology infrastructure); yet we decided not to include in the analysis those factors highlighted in only one paper.

Lately, some papers endeavoured to propose implementation roadmaps to facilitate the introduction of Six Sigma, such as the road map proposed in Chakravorty (2009), to prevent Six Sigma initiatives from lacking the above-highlighted CSFs, or the model in Kumar et al. (2008), supporting the selection of processes to improve, to avoid the risk of focusing on processes with small room for improvement which, in turn, would lead to poor return on the investment in Six Sigma.

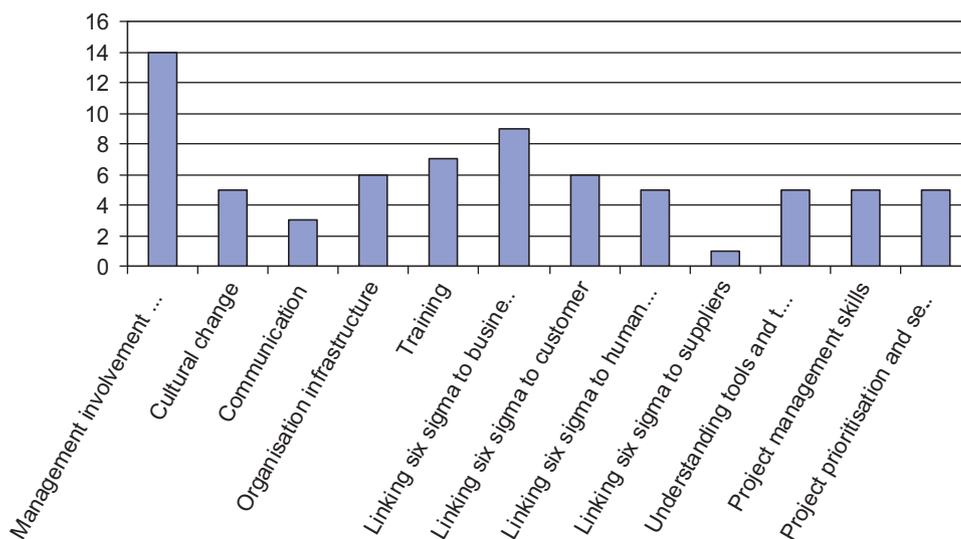


Fig. 1. Frequency of CSF highlighted in a sample of 18 papers.

3. Comparing US and Italian implementations of Six Sigma

The bustling industrial Italian territory encompasses a huge amount of small and medium enterprises, most of which still has the characteristic of a family owned business; hence utterly different from the North-American public company model.

Introducing Six Sigma in such a small organization is not so simple, since HR training can represent a significant burden for the limited budget of such companies, and the management is not so keen to distract employees from the daily business as organizational structures are extremely lean and most of the staff represents key roles and has no substitutes. Moreover any type of change is often perceived as a foe, with management fearing the unknown and preferring sticking to the old habits.

Notwithstanding the great amount of literature written on Six Sigma, the bibliographic analysis showed a significant gap: no contributions were focused on the implementation of Six Sigma in Italian companies. It is not a surprise that also in the national literature, almost no authors are specifically concentrated on the Italian situation. In most cases, books published in Italian are just a translation of an international book. Starting from such considerations, the following research questions arose, regarding the approach of Italian companies towards Six Sigma:

Q1. *are Italian companies implementing Six Sigma exactly as it was originally conceived at Motorola or, rather, is there an Italian way to Six Sigma?*

Q2. *do Italian companies that implemented Six Sigma recognize the same set of critical success factors singled out in the international literature?*

4. Q1—case studies of Six Sigma implementation in Italian companies

4.1. Research methodology

In order to answer to the first research question, the research team planned to carry out a set of case studies of Six Sigma implementation in Italian companies.

We started the research by carrying out a few cases in an informal way, in order to get a first idea about possible areas in which a Six Sigma implementation in a typical Italian contest can differ from an American one. The preliminary analysis indicated four major areas, in which the original Six Sigma approach could undergo major adaptations, namely: sponsorship, number of staff involved in the Six Sigma project, approach towards green belts training, way to measure projects results.

A structured questionnaire has then been developed, which was structured according to the following list:

- company history and general information;
- quality department organization;
- history of Six Sigma implementation in the company, with particular focus on sponsorship and number of staff involved in the project at its various stages;
- details concerning the staff training;
- approach towards projects selection and measurement;
- detailed study of two Six Sigma projects, carried out and concluded in the last six months.

The questionnaire has been used to conduct about one and a half dozen case studies. Case studies were carried out through a face-to-face interview with a Master Black Belt (when available) or with the head of Quality Department. In the following, a selection of the most significant case studies will then be

presented. The General Electric case has been used as a benchmark, and will also be briefly presented.

4.2. Case studies

- **General Electric:** General Electric is one of the first and successful companies after Motorola implementing Six Sigma programs; GE adopted it in a new way, extending Six Sigma to every area of the organization. Although GE's CEO Jack Welch is considered as the "revolution Six Sigma" man, his commitment and enthusiasm matured over time. In fact, he had never been a big fan of quality programs in general, but when he realised the GE's products and processes had not yet attained world-class quality, he admitted his mistake and tried to act timely. At first, Welch was concerned that Six Sigma ran counter to his business strategies for the following reasons:

1. it was centrally managed;
2. with its reports and standard nomenclature, it appeared too bureaucratic; and
3. it required specifically agreed-upon measures.

He was hesitant, "not yet willing to throw his hat into the Six Sigma ring". The turning point came in 1995, when, talking with Larry Bossidy, chairman of Allied Signal, Welch was convinced that Six Sigma was the best solution for GE's problems. In January 1996, Welch announced to his top managers that he was launching a path-breaking program that he hoped would transform the company. When the employees tried to dismiss Six Sigma as the program of the month, Welch changed the business structure at a corporate level to prove his serious intentions about the program. He implemented two relevant strategic changes:

1. a 13-days training for every employee; and
2. promotional consideration dependent on the completion of Green Belt training (Hendericks and Kelbaugh, 1998).

Welch led the company through the implementation of this initiative that could "bring the best opportunity for growth, increased profitability and individual employee satisfaction in the history of the company, and make quality an integral part of our culture".

In the first stages of the program, GE trained more than 100,000 people in Six Sigma. Since the initiative began, the results have exceeded even Welch's ambitious hopes and expectations: in 1999, GE enjoyed cost savings from Six Sigma application of more than 2 billion \$ (from GE Annual Report, 1999); in the same year, at the annual meeting to present the balance sheet, Jack Welch stated that "Six Sigma GE Quality will be the biggest, the most personally rewarding and, in the end, the most profitable undertaking in our history".

- **Fiat services:** Fiat services (formerly called Business Solutions) is the centre of excellence of the Fiat Group for administrative, customs management and administration of human resources services. The Six Sigma program was launched in Fiat Services in the second half of 2005, with the aim of improving internal processes, pursuing quality and efficiency. The Black Belts work under the guidance of Master Black Belts to apply Six Sigma on specific projects, leading the Green Belts. Their work is focused on implementation of projects. The Green Belts are employees who, in addition to their specific roles and responsibilities, devote part of their time to execution of Six

- Sigma projects. Since 2006, Black and Green Belts training programmes were repeated five times for a total of 46 among Black and Green Belts formed in seven different countries.
- *Dow chemical—equipolymers*: Dow Chemical is one of the most important multinational companies in the chemical sector, present in 37 countries with 156 plants. The management of Dow invested in Six Sigma to reach a state of “constant improvement,” as wanted by its founder. The Six Sigma is now the method that Dow uses to be on target each time, to reach outstanding performances in quality and in service and to have a culture of excellence. In fact, through Six Sigma’s culture and mindset it is possible to achieve profits, being better than the competition in quality and in time. Dow decided to extend Six Sigma implementation from the headquarters to every country, included Italy, where Dow is present through a Joint Venture named Equipolymers. All Six Sigma roles in equipolymers are full time, the only exception being that of Black Belts which after two years of full time work on Six Sigma projects, are then dedicated only partially to Six Sigma. Today, also in Equipolymers, everybody is involved in this philosophy, from the CEO down to the operators in the production facility.
 - *Cameron—Grove Facility*: the Cameron International Corporation is one of the most important producers, at the international level, of equipment and services for oil. Grove was born in 1935 in Oakland, California, and has been recently acquired by Cameron. The production of Grove Italy includes a variety of products for the energy market, and is the leading manufacturer of on-off valves high performance products and flow control systems that meet the most stringent operating conditions required by its customers. Cameron began working with Six Sigma around the year 2000, believing in this philosophy of business management at the point that they refer to it as “the way we run our business”. In Grove Italy, Six Sigma implementation started in February 2006, with a full sponsorship of the American headquarter who decided to invest a large amount of money on improvement activities.
 - *Avio*: Avio, an Italian company founded in 1908, is a world leader in the aerospace industry. The main customer and partner of Avio is GE, which, around the mid-90s, decided to implement the Six Sigma methodology on all production processes. Avio, being attracted by the good results that this methodology brought to GE, began its journey towards the introduction of this new and revolutionary method, not only to improve products quality, but also to improve the attitude of people towards their job. Avio launched, at the beginning of year 2000, an improvement program called “Cartesio Plus,” which introduced the Six Sigma methodology in all business processes. In Avio, Cartesio Plus is not just a plan for improvement, but a real business philosophy. The Cartesio Plus program introduced the habit of data-driven thinking and this, in turn, resulted in a fact-based approach to understand the actions to develop to support the company in the medium and long-term.
 - *ITT—Lowara*: Lowara is an Italian company based in Montecchio Maggiore, close to Vicenza (in the Italian industrial North-East). Established in 1968, Lowara, today controlled by the U.S. group ITT Industries, is the leading manufacturer of hydraulic pumps and pumping systems for industrial applications. Six Sigma was introduced in the company in the late 2000, first in the United States Headquarters and then transferred to European facilities. Lowara is working since 4 years on a program called Value Based Six Sigma (VBSS), in which it was decided to develop especially the statistical part of DMAIC. Black Belts are the main resource for the deployment of Six Sigma. In the initial phase, this program has determined different reactions and significant inertia, as often happened during the implementation of radical changes.
 - *Sony*: Sony is among the most important brands in consumer and professional electronic goods, focusing its activities on innovation and the use of advanced technology tools. In the late 90s, Sony Corporation in Japan has introduced the Six Sigma methodology; the methodology was introduced in Sony Europe in the later years. In 2001, a special office in Berlin was created, that deals with Six Sigma development, implementation and employee training. Sony has developed an adaptation of Six Sigma emphasizing the Define phase. The first Six Sigma projects were related to the manufacturing sector and were directed mainly to cost reduction, increased efficiency and productivity. Today Six Sigma is also applied to transactional processes, and its target is the growth of business.
 - *SKF*: the SKF Group is the world leader in the supply of products, solutions and services in the fields of rolling bearings, seals, mecha-tronics, services and lubrication systems. Six Sigma was developed primarily in the United States around the year 1996, and then spread in Europe starting from year 2000. This methodology is currently present all over the company, so SKF has decided to define some common targets for the group such as the number of Black Belt, which should reach 1% of staff by 2007. Regarding the number of Green Belt, there are no well-defined targets by the group, generally following the ratio 10:1 (ten Green Belts per Black Belt). In SKF, the Black and Green Belt training is outsourced to an external company. A frame agreement has been signed with this company, who is the owner of training activity approved by SKF.
 - *Whirlpool*: Whirlpool Corporation is the leader in the production and marketing of household appliances. The Six Sigma program was introduced initially in America in 1996 and widespread in European locations in the following year. From 2000 to 2003, because of a deep corporate restructuring, this methodology has been abandoned before being resumed following the basis of the model implemented in North America. All over the world we talk about Six Sigma; Whirlpool instead refers to the program “OPEX”—Operational Excellence. Both techniques are based on the same concepts and the same statistical tools, while they are fundamentally different in the improvement strategy.
 - *Axa*: the core business of Axa worldwide is the financial protection. The group is operating in 47 countries. The group is organized in Regional Divisions. AXA assicurazioni is the Italian branch of the group, one of the most important of the Mediterranean area. The company aims to become “the company preferred by clients, collaborators and shareholders”. As a way to deploy this vision, with full top management sponsorship, a Six Sigma program was launched in 2001 named “AXA Way”. The Six Sigma approach is structured in three key areas: process improvement, process management and process design in order to achieve operational excellence in quality of services delivered to customers.

4.3. Findings from case studies

Starting from the evidences of the case studies, it was interesting to analyse the main similarities and the main differences among the formerly analysed cases. The sample of case studied includes companies pertaining to widely different industries, ranging in dimension from family businesses to branches of multinational corporations, so it is not a surprise that some differences emerged.

Table 1

Relevance of CSF (12 respondents) (for a comparison, results in Anthony and Banuelas (2002) are presented in brackets).

Critical success factor	Traditional application		Italian SME	
	Average	Standard deviation	Average	Standard deviation
F1: management involvement and commitment	4.4 (4.3)	0.31	4.5	0.31
F2: cultural change	3.9 (3.6)	0.36	4.0	0.51
F3: communication	4.0 (N.A.)	0.64	3.8	0.77
F4: organizational infrastructure and culture	3.5 (3.9)	0.80	3.4	0.81
F5: education and Training	3.7 (3.4)	0.60	3.6	0.71
F6: linking Six Sigma to business strategy	4.1 (4.2)	0.27	4.0	0.55
F7: linking Six Sigma to customer	3.9 (4.1)	0.45	3.8	0.86
F8: linking Six Sigma to human resources	3.4 (3.1)	0.86	3.4	1.04
F9: linking Six Sigma to suppliers	3.6 (3.5)	0.78	3.3	0.90
F10: understanding tools and techniques within Six Sigma	3.7 (4.2)	0.55	3.7	0.49
F11: project management skills	3.6 (3.6)	0.57	3.7	0.59
F12: project prioritisation and selection	3.8 (3.9)	0.55	3.7	0.43

One interesting aspect to study was the main cause that triggered the start of an implementation project:

- in some cases the implementation in the Italian company has been decided in the corporate headquarters (as in Cameron and Dow cases);
- in other companies, the implementation followed a (warm) suggestion from the main customer or partner (as in Avio and CGT, official Italian distributor of Caterpillar);
- yet another possibility is the hiring of a manager coming from a company with a strong Six Sigma culture (as in the case of AXA).

Among the other findings, it is worth highlighting the following:

- use of an original name (such as “Cartesio”, “OPEX”, or “Axa way”) to better identify the initiative with the company;
- emphasis on just some aspects (the define phase, the statistical tools, pursuing cost savings/efficiency rather than customer satisfaction, ...);
- training outsourced to an external consultant;
- training 100% of the employees is often not a target;
- scarce or no interest to transfer the Six Sigma approach to suppliers.

5. Q2—workshop with experts

The second question has been discussed with Six Sigma experts during a workshop at Politecnico di Milano.

First of all, we went through the list of 12 CSF presented in Section 2.3, briefly discussing each of them with the audience, with a twofold aim:

- ensuring a homogeneous interpretation of the meaning of each CSF; and
- making sure that we did not overlook some important factors, to include in the analysis.

We then moved on, by submitting a brief questionnaire, where we asked to each of the experts to rate the relevance of each of the 12 CSF, in two different situations:

- in case of a “traditional” application (i.e. a big multinational company like Motorola or GE), and
- in case of an application of Six Sigma in an Italian SME.

The experts expressed their judgement in a scale 0 to 10, which allowed a better trimming of indications. Nonetheless, data have been reorganized in a scale 1–5, in order to render them comparable with results presented in Anthony and Banuelas (2002). Results are presented in Table 1 (results presented in Anthony and Banuelas (2002) are reported in brackets in the column “traditional application”).

One important finding is that the following hypothesis:

H0. *the level of relevance of a CSF does not change if we refer to the case of an application of Six Sigma in an Italian SME with respect to a traditional application.*

cannot be rejected at any level of confidence, for any of the analysed CSF.

The comparison of results presented in Table 1 with the outcome of Anthony and Banuelas’ research in Anthony and Banuelas (2002) shows only one significant difference: in our survey, F10 “understanding tools and techniques within Six Sigma” got an average score of 3.6 (3.5 for an Italian SME), while the corresponding factor “Understanding of Six Sigma methodology” was ranked second with an average score of 4.2 in Anthony and Banuelas (2002) (difference is significant at 5% confidence level).

In our analysis, as well as in Anthony and Banuelas (2002), “Management involvement and commitment” is without doubt the most important aspect. F6 “Linking Six Sigma to business strategy” is also very relevant in our research (ranked third in Anthony and Banuelas (2002)), but for SMEs also F2 “Cultural change” gets an average score of 4.0.

Numerical results have then been discussed with the experts. Some of the most interesting comments are presented in the following:

- In the Italian situation, it is not always so easy to get people on board and have their commitment. Like in the case of an Italian subsidiary of an important US multinational corporation, which selected five managers for every European country to launch a first wave of BB training. During their trip to Paris, one of the five selected Italian managers said to the others: “this is my plan: we first listen what they have to tell us, and then we will tell them that we just would not do anything” (we can say that the story had a happy ending because, right after the training, this manager completely changed his mind!). Top management should find out a way to involve the employees: a clear vision and an incentive systems are paramount.

- Diffusion of new roles like Yellow Belts or White Belts might result a double edged sword, because this new role might be conflicting with the strong Top-Down, hierarchical orientation of the organizational infrastructure of the methodology. Higher level roles should not lose their credibility and influence on the lower levels.
- In an SME, availability of financial resources could limit the scope of the application of Six Sigma; therefore some companies decided to focus only on some aspects of the methodology, or to limit its application only to manufacturing instead of extending it to transactional processes also;
- it is not a surprise, then, that in case of a SME, the less relevant factor is F9 “linking Six Sigma to suppliers”: one company should master the methodology before attempting to transfer it to suppliers;
- some companies are relying on external consultants to carry out their BB/MBB training, but organizing an inter-company training course is not always so easy;
- some other companies introduced part-time roles (e.g. a part-time Black Belt spending only 20–30% of his time to improvement projects); this, according to some experts, will not hinder the advantages of the problem solving approach carried out by Six Sigma.

6. Conclusions

In the present paper, results of a research project going on at the Politecnico di Milano are presented. The analysis showed a lack of literature concerning Six Sigma implementation in Italian companies; the present work wants to be a positioning paper on this topic, arising a long list of issues. It is the authors' intention to drive the attention of the scientific community towards such issues, so that some of the issues will be further explored in future researches.

In particular, the authors argue that the insights coming from the analysed case studies and discusses with industry experts – if further explored, validated and reorganized – could constitute a Road Map for Six Sigma implementation in Italian companies; the

validation and re-organization process is still on-going and its completion could constitute a further research objective.

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