SIX SIGMA: LEADING THE WAY TO CORPORATE SOCIAL RESPONSIBILITY AND ENVIRONMENT PROTECTION: A MECHANISM DESIGN APPROACH

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ABSTRACT

The aim of this paper is to explore how Six Sigma methodology can act as a foundation and key catalyst for developing corporate social responsibility (hereafter CSR) habits in the blood stream of an organisation. CSR is interlinked with sustainable development, environment protection, social equality and environment growth, but our main focus is on business process performance for the interests of societal groups other than shareholders for the maintenance of long-term sustainability is to be maintained. The critique and innovative case study within this paper shows how the ethical basis of Six Sigma model and methodology can be used to develop CSR in the studied company. The customers delight is reflected in a better rating in the Quality Appraisal Report (QAR) and has yielded a higher Customer Satisfaction Index.

Keywords: Six Sigma, customer, social responsibility, environment protection.

INTRODUCTION

The World Business Council on Sustainable Development (WBCSD) defines CSR as "the commitment of business to contribute to sustainable economic development, working with employees, their families and local community and society at large to improve their quality of life." According to the WBCSD, CSR is the third pillar of sustainable development, along with economic growth and ecological balance. Thus, in last two decades have witnessed more stringent regulation; increase in compliance requirements, increased awareness amongst employees and local community and realization amongst organizations the importance of corporate responsibility. As a result there has been a paradigm shift. Businesses have reinvented themselves as entities delivering value to stakeholders rather than just producers and sellers of commodities/ services. This has brought the global community together on several occasions in international forums and they are also using tools different practices and principles to promote better corporate governance.

The studied company has successfully integrated business benefits through Six Sigma with CSR and environment protection activities. Motorola's Bill Smith initiated Six Sigma almost two and a half decades ago building on the philosophy, principles, and methods of Deming's Total Quality Management (TQM). Six Sigma focuses on establishing world-class business-performance benchmarks by providing an organizational structure and road-map through which these can be realized. Since its initiation at Motorola in the 1980s, many companies including GE, Honeywell, Sony, Caterpillar, and Johnson Controls have adopted Six Sigma and obtained substantial benefits (Pande et al., 2000; Snee and Hoerl, 2003). Two principal facets of the Six Sigma initiative are the statistical model and the continual improvement process. As Six Sigma has been considered a powerful business strategy that employs a well structured continuous improvement methodology to reduce process variability and drive out

waste within the business processes using effective application of statistical tools and techniques.

Although there have been numerous case studies, comprehensive discussions, books and websites addressing Six Sigma (Breyfogle III, et al., 1999), very little research have been done on Six Sigma and its influence on CSR and environmental protection.

Firstly, the definitions of CSR, Environment Protection and Six Sigma are discussed. Secondly we try to establish combined approach of Six Sigma/CSR practice to explain how the Six Sigma methodology is a leading way to corporate social responsibility along with the environmental management program. Finally an exploratory case study with the use of DMAIC (Define–Measure–Analyze–Improve–Control) methodology in a step by step fashion illustrated to increase the tail end availability in POY for customer's benefit to reduce their waste generation and increase productivity without any extra charge.

Theoretical development

The aim of this paper is to explore how Six Sigma can act as a foundation and key catalyst for developing CSR and environment protection within stakeholders. In order to accomplish this research goal, it is necessary to validate the projects of CSR benefits and environment protection increases using Six Sigma methodologies.

Corporate social responsibility

CSR is a term that involves several different concepts and definitions (Carroll, 1979, 1999). The definition provided by the Green Paper (European Commission, 2001) seems to summarize the essential points of the concept, as the integration by companies of:

> Social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis. Being socially responsible means not only fulfilling legal expectations, but also going beyond compliance and investing 'more' into human capital, the environment and the relations with stakeholders.

CSR can be defined as the 'ethical behaviour of a company (or say business) towards society'. It means engaging directly with local communities, identifying their basic needs, and integrating their needs with business goals and strategic intent. The government perceives CSR as the business contribution to the nation's sustainable development goals. Essentially, it is about how business takes into account the economic, social and environmental impact of the way in which it operates. Simply stated, CSR is a concept which suggests that commercial corporations must fulfill their duty of providing care to the society (Agarwal, 2008).

The GRI has developed a set of core metrics intended to be applicable to all business enterprises. There are sets of sector-specific metrics for specific types of enterprises and a uniform format for reporting information integral to a company's sustainability performance.

In the studied company, though social welfare and community development is at the core of Company's CSR philosophy and continues to be a top priority. It revolves around the company's deeply-held belief in the principle of symbiotic relationship with the local communities, recognizing that business ultimately has a purpose - to serve human needs. Close and continuous interaction with the people and communities in and around the manufacturing

divisions has been the key focus while striving to bring around qualitative changes and supporting the underprivileged. Company's contributions to the community are in the area of health, education, infrastructure development (drinking water, improving village infrastructure, construction of schools etc.), environment (effluent treatment, tree plantation, treatment of hazardous waste), relief and assistance in the event of a natural disaster, and miscellaneous activities such as contribution to other social development organizations etc. The Company's CSR teams at all manufacturing divisions interact with the neighbouring community on regular basis.

In short, definitions of the term CSR may depend on individual perceptions of responsibility/obligation that in turn addresses the broader topic of the role of the organisation in society. In brief, the concept of CSR encompasses many dimensions of business activity ranging from the social (e.g. community programs), to economic (e.g. employment) to the environmental (e.g. waste reduction).

Environment Protection

International efforts towards environment protection have their roots in the United Nations Environment Programme (UNEP), which was established in 1972 after the UN Conference on Human Environment was held. ISO 14001 is the preferred option for the studied company and most companies seeking a recognised environmental management system because it applies to the whole company and environmental data do not need to be disclosed to the public. ISO 14001 requires the monitoring of environmental legislation and the assessment of its risk to a company. In the studied company, environmental protection is considered as an integral part of the planning, design, construction, operation and maintenance of all our projects. As the issue of environment protection has brought the consumers, the industry and the government on a common platform wherein each stakeholder has to play his own role.

Six Sigma

Six Sigma refers to a set of well-established statistical quality control techniques and data analysis methods used to identify and reduce variation in products and processes (Breyfogle III, et al., 1999). Sigma is a letter in the Greek alphabet that represents the standard deviation from a statistical population, so "six sigma" denotes a target level of quality that is six times the standard deviation. This means that defects only occur approximately 3.4 times per million opportunities, representing high quality and minimal process variability (Linderman, et al., 2003, Pavletic, et al., 2004). Six Sigma methods are used to support and guide organizational continual improvement activities. By using Six Sigma statistical tools, companies are able to diagnose the root causes of performance gaps and variability, thereby improving productivity and product quality. Six Sigma borrows martial arts ranking terminology to define practitioner roles. Six Sigma typically involves implementing a five-step process called the DMAIC (Define, Measure, Analyze, Improve, and Control) process (Pande, et al., 2000, Snee, et al., 2003).

Figure 2: The Six Sigma DMAIC project management steps

This process is used to guide implementation of Six Sigma statistical tools and to identify process wastes and variation. It is similar to the Plan-Do-Check-Act business process improvement method.

Integration

The overview and focus area of different practices like Six Sigma, ISO 1400 and CSR are illustrated in Table 1.

To further explore and develop understanding the relation of Six Sigma as a foundation and key catalyst for developing CSR habits in the blood stream of an organisation, an integrated model and innovative case study was considered. It is learned that existing national and international quality models are consistent with the principles of CSR and its objective (McAdam, et al., 2003). We modify Wood's model (Wood, 1991) of CSR for the possible way of incorporating CSR & EMS using Six Sigma with an expanded business excellence model as illustrated in fig 3.

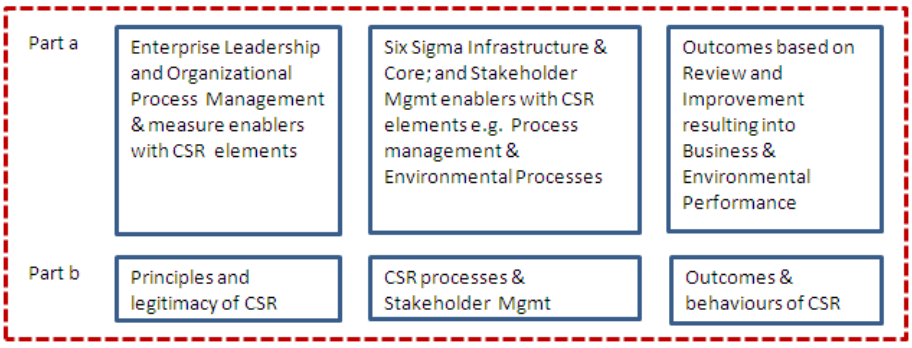


Figure 3: Six Sigma in a CSR context

Practice	Overview	Focus Areas
Six Sigma	Six Sigma is a strategic approach that works across all processes, products, and industries. It is a rigorous and analytical approach to quality and continuous improvement with an objective to improve processes and profits through defect reduction, yield improvement, customer satisfaction, and performance. **Performance (financial) = Efficient, effective processes**	Six Sigma focuses on these success factors that differentiate companies that adopt Six Sigma from those that have TQM. The factors are: • Precise understanding of customers and the products or services they purchase • Emphasis on statistics and measurement • Thorough and structured training
Environmental Management System (ISO 14000)	The objective of the standard is for an organization to establish an EMS that is integrated with the overall business management process. Elements of the EMS include Environmental Policy, Planning, Implementation and Operation, Checking, and Management Review. Integral to the model is the concept of continual improvement of the EMS.	It emphasizes standards, records, audits, and corrective action. Companies document what they do and do what they document; however the processes may not be valuable or efficient to begin with and the company may be institutionalizing wasteful and inefficient practices. Focus areas include compliance, emissions reduction, reduction of hazardous waste generation and reduction of industrial wastewater pollutants.
Corporate Social Responsibility (CSR)	Growing consumer and corporate attention on ethical behavior, especially in light of recent corporate scandals. 82% executives see value 86% consumers see value Socially responsible investing (SRI) > $2 trillion Harris-Fombrum Reputation Quotient (RQ) GRI/ISO 26000 *Business Ethics* "100 Best Corporate Citizens"	Balanced focus on: • Economic impact on ALL stakeholders (society, shareholders, customers, employees) • Environmental performance • Labor practices/workplace quality • Human rights • Impact on society/community

Table 1: Overview and focus area of different practices

Business & Environmental performance

Studied company shoulders a wide range of social responsibilities and community development initiatives. These include environment protection, providing facilities for education and health in rural areas, relief for victims of natural calamities. Some of the initiatives in the area of education are adopting primary education schools, provision of equipments and aids for education, scholarship and sponsorship for the needy and deserving students.

CSR Increases Customer Loyalty and Sales (Agarwal, 2008), though this statement is perhaps the most non-controversial about CSR's business benefits. Consumers not only want good and safe products, but would also like to know that what they buy was produced in a socially and environmentally friendly way, and are sometimes even willing to pay more for products that are produced in a socially and environmentally responsible manner. The customers' delight has reflected in a better rating in the Quality Appraisal Reports (QAR) and has yielded a higher Customer Satisfaction Index for the studied company.

After implementing the integrated model, improved environmental performance was observed with results in fewer defects, lower scrap and rework rates, less waste, and more dependable processes, which lead to lower manufacturing costs, lower warranty and liability costs, higher efficiency and productivity, and increased return on assets and profitability as illustrated in figure 4. Though the above described integrated methodology was introduced in a stepwise fashion to ensure the organization was not overwhelmed. This simple action gave a whole new meaning to waste – handling it like a raw material or finished product.

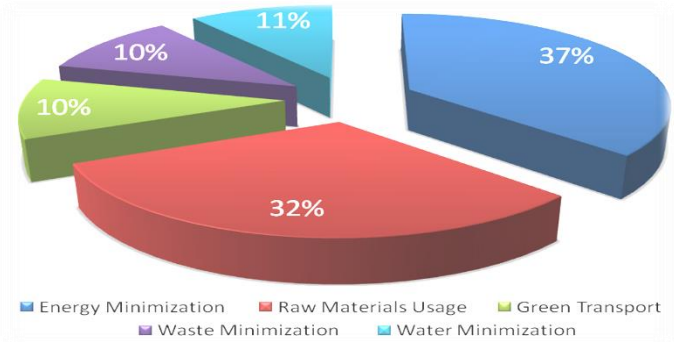


Figure 4: Resource efficiency projects for fiscal 09-10

Case study: Tail availability improvement for customer's benefit

Texturing is one of the intermediate processes between POY spinning and textile weaving that imparts bulkiness and cotton-like feel to the polyester yarn. The texturing industry caters to this step and is the next customer for POY manufacturers in the value-chain.

Uninterrupted productivity is a desirable condition for any industrial operation. It is learned that the texturiser - our customer - uninterrupted production on his machine can be obtained with the presence of a visible and pick-able end of the continuous filament yarn at the bottom-most layer of the POY spool wound on the paper-tube core defined as 'transfer tail'. In this technique top-end of spool running into the texturing machine can picked and tied to the bottom-most end of another spool placed in the creel and that would come in continuation with the exhausted earlier spool. This way, the yarn on two different spools are set to run in tandem, thereby avoiding a production interruption, loss of time, waste generation and, of-course,

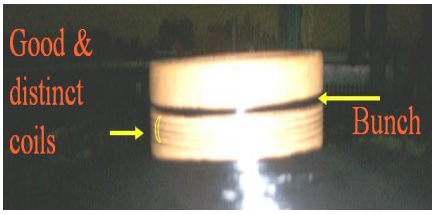
additional cost too at customer end. Thus Six Sigma methodology was used to improve transfer tail availability, through improvisation of POY winder hardware design by in-house innovation.

This led to preferential demand for the studied site's POY vis-à-vis that of competitors. Subsequently, there was significant increase in customer satisfaction reported on the overall performance of the yarn.

An Idea that changed their world

Problem
Low tail end availability in POY

Introduction
It is learnt that efficiency and productivity of Texturising process can be enhanced by a process called splicing. In this process tail of running POY is knotted to a standby bobbin in the creel so as to avoid interruption of the feed yarn. This could be possible only when the POY bobbin is having good quality tail.



The Challenge
We have Barmag SW-06 winders which are 20 yrs old and are the only running machines of its kind in the world. The challenge faced is from state-of-art technology in new generation machine

Strategic Challenges	Threat	Opportunity	Outcome (Strategic Advantages)
Customer expectation of tail transfer above 95%	Possible only in new generation winders	Innovate and improve tail transfer in existing winders without much capital cost.	Innovative design upgradation of the existing winders done. Today, Transfer Tail availability is consistently maintained at >98% (long term plan).

Innovation
The old winder engineering design was upgraded to yield quality of new generation winder. For this studied company undertook the objective to develop an innovative model using Six Sigma methology. This is a breakthrough process, utilizing series of systematic innovations never done before in the World.

Statistical Solution Identification:

Cause 1: Low suction pressure of gun

A pressure gauge developed to measure the suction pressure. All guns were checked for suction pressure and found varying from - 0.4 to - 0.6 bar. Those guns having suction pressure of -0.4 bar were cleaned and refitted with new ceramic tips and -0.6 bar suction pressure achieved. With the available guns maximum suction pressure achieved is -0.6 bar.

Cause 2: Low capacity of Doffing Buggy

Low Capacity of Doffing Buggy resist the flow of waste from the gun after certain no. of positions were doffed, which results on reduction of suction pressure also. Reduction in suction

pressure may affect the threading and tail availability. Capacity of the buggy increased to its maximum by modifying the same. Modified buggy used for doffing full machine along with gun having -0.6 bar suction pressure. Two full doffs each were checked for tail availability with normal and modified buggy as shown in figure 5.

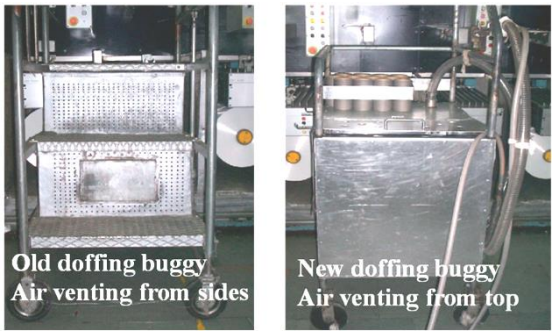


Figure 5: Doffing buggy modified

Cause 3: Transfer Tail Pig tail guide misalignment

There are 368 Barmag winders available. They are supplied in two lots. First Lot contains 263 winder supplied in 1989. Second lot contains 105 winders supplied in 1994. Spare winders from the two lots were compared for pig tail alignment. Those winders supplied in 1994 differs in Cam Profile. Same jig were used for setting the guide distance of both Cams.

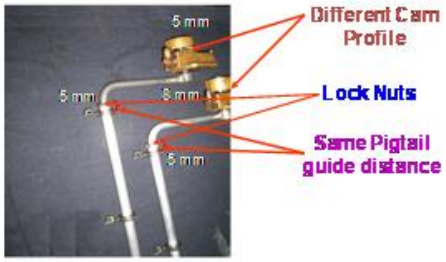


Figure 6: Different Cam profiles with same guide distance

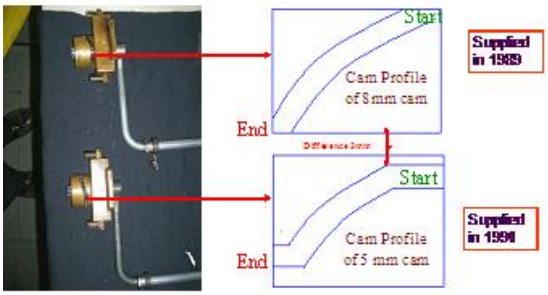


Figure 7: Cam profile 8 mm vis-a-vis 5 mm

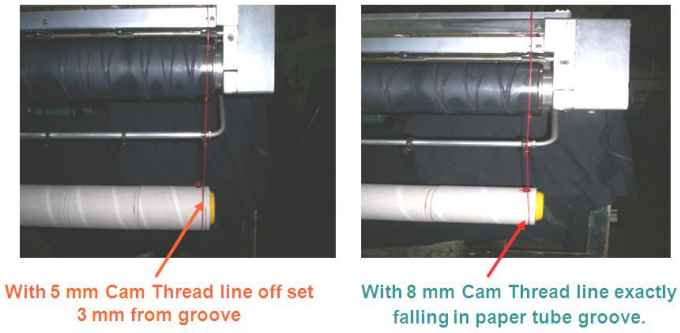


Figure 8: Thread line differs with different Cam profile and same Pig tail guide distance

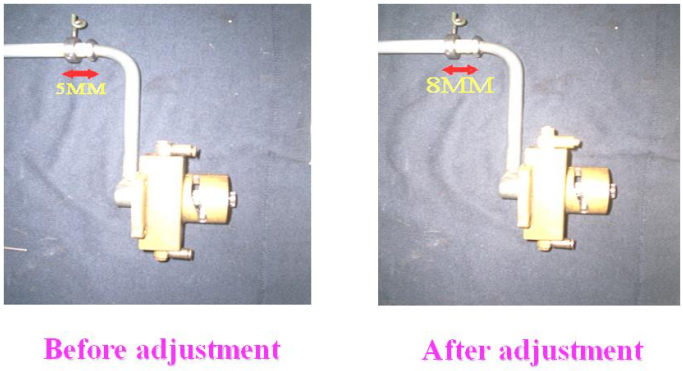


Figure 9: 5mm Cam guide adjustment

Cause 4: Fast Transfer Tail Action

- Instrument air supplied through Logic box is 6.0 bar pressure.
- 6 bar pressure is acting on transfer tail and yarn shifter when both are in action.
- For Yarn shifter air supply through throttle valve is available to adjust/ reduce bunch size.
- There is no provision to reduce the air pressure supplied to Transfer tail to adjust coil.
- Higher the air pressure faster will be the action of transfer tail.
- Faster the action of transfer tail, lesser the chance of having good coil.
- Throttle valves developed and trial taken in few winders with different air pressures.

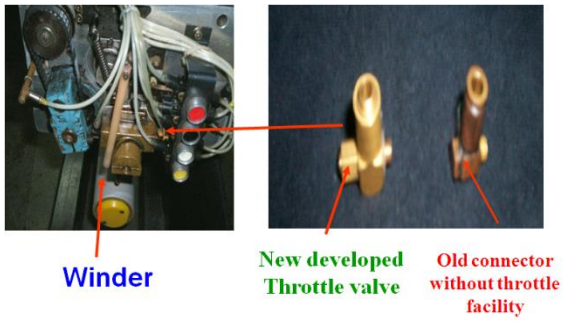


Figure 10: Throttle Valve developed

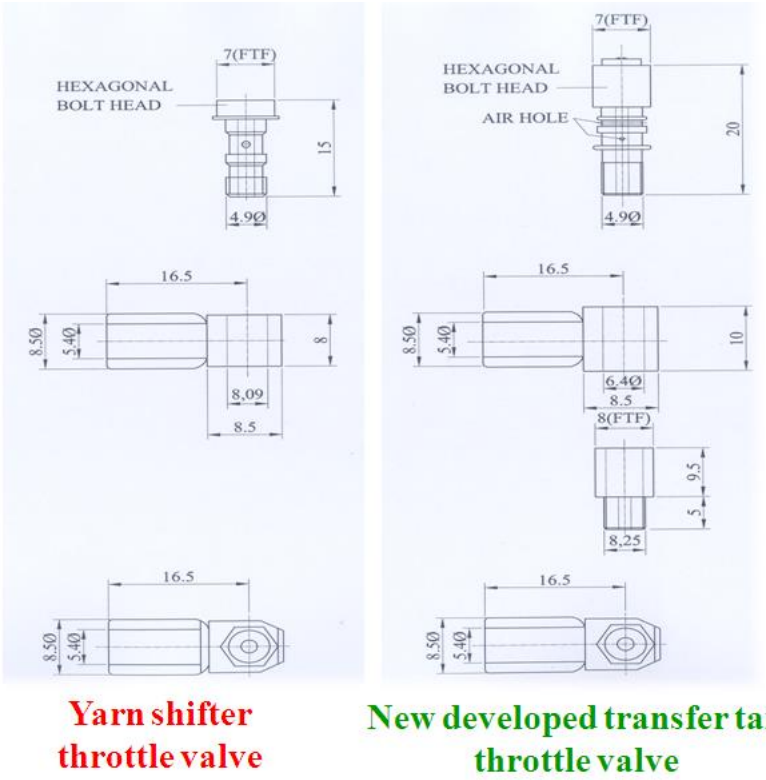


Figure 11: Throttle Valve developed

Evaluation of Results

Higher tail end availability facilitates in continuous package changeover without breaking the yarn and a key attribute to productivity of customers machines

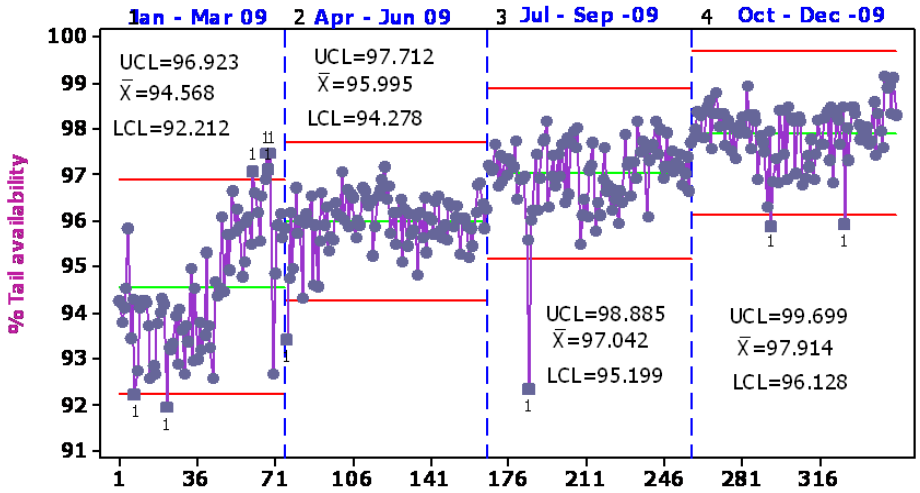


Figure 12: I Chart of % Tail availability from Jan-09 to Dec-09

Benefits:

For Plant

- Coil availability increased from 93.6 to 97.9% during project duration.
- Good & distinct coils available.
- No Threading failure.
- Reduction in threading failure improved yield 98.89 to 99.14 %
- Avg. Package weight improved from 14.45 during project to 14.64 kg after project.
- Reduced Paper tube consumption 69.2 to 68.3 No./MT

For Customers

- Splicing efficiency improved from 82 to 90%
- Higher tail end availability facilitates in continuous package changeover without breaking the yarn and a key attribute to productivity of customers machines.
- Texturising machine efficiency expected to improve

CONCLUSIONS

In fact, the implementation of the Six Sigma organizational structure and methodology in the studied company has significantly improved the performance of CSR activities in all direction, while environmental protection is considered as an integral part of the planning, design, construction, operation and maintenance of all our projects. In this sense, the contribution of this research is to describe the impact of an organizational approach with Six Sigma methodologies to improve the performance of an improvement program in CSR activities. More precisely, this research provides evidence that in an analyzed company the Six Sigma methodology and organizational structure increased both CSR and EMS performance improvement program, ability to reduce the source of variation.

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