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DEALING THE SUSTAINABILITY CHALLENGES WITH LEAN SIX SIGMA FRAMEWORK

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ABSTRACT

Sustainability has become a very sensitive subject of the 21st century all over the world, especially for the business organizations, as the planet earth is dragged in to the effects of climate change. In the years to come this subject is going to be the top most agenda for all the countries, governments, public and private organizations. Companies will slowly exhaust all low hanging efforts to show the improvements in achieving the sustainability goals and the time will come when companies will have to adopt some structured and disciplined methodologies to achieve the stringent sustainable development targets and demonstrate consistent results to all the stake holders.

The study of sustainability reports of select Indian companies reveals a need for a structured methodology for analysis and improvement actions such that significant improvements are seen and sustained over a long period of time.

Lean Six Sigma is a proven methodology used by several organizations to achieve sustainable improvement results. This research paper suggests use of Lean Six Sigma as a strategic framework for Sustainability. The Sustainability objectives are required to be part of organizational goal tree. Six Sigma tools also help in prioritizing the projects along with other business initiatives with equal weightage to social and environmental initiatives. Lean Six Sigma improves the process efficiency, eliminates waste, making the Sustainability initiatives profitable for the organization.

Keywords: Sustainability, Sustainable Development, Six Sigma, Lean Six Sigma

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1. INTRODUCTION TO SUSTAINABILITY

The word Sustainability is more being used for the human sustenance on the planet earth from 1980s. Even though Sustainability does not have a unique definition as yet, most widely used definition came from the concept of 'Sustainable Development' put forth by the Gro Harlem Brundtland Commission of United Nations on March 20, 1987 (Remigijus Ciegis et al, 2009). The commission defined Sustainable development as 'the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'

Even though Brundtland's definition is widely used, different people with different perspectives have come up with different definition to suit their perspective. One of the major reasons for this disagreement is because there are two prominent points of view viz. Ecologists' view and Economists' view. Ecologists emphasize on the preservation of the status of the ecological system while the economists emphasize on maintaining and improving the standard of living for human beings. There is also confusion in the understanding of quality of life and standard of living. Humans want quality of life and industrialists want standard of living.

It needs to be appreciated that entire world is a single system. Once we understand this, we realize that pollutions caused at one part of the world affects the air quality in other part, or the pesticides sprayed in one country could harm fish stocks off the coast of some other country. Therefore, the actions and decisions taken by earlier generations are going to impact the current and future generations across the globe.

World Bank's report *'Beyond Economic Growth'*, first printed in year 2000, says that the understanding of 'development' is different among countries and individuals. The meaning of development is beyond merely economic growth to include things such as freedom, equity, education, health, safe environment, and much more. However, the economic development takes the precedent over the other important parameters of development.

The report *'Trends in Global CO2 Emissions – 2014 Report'* published by PBL Netherlands Environmental Assessment Agency (2014) points out that the global carbon dioxide emissions from fossil fuel combustion and from industrial processes (cement and metal production) increased to a new high in 2013 of 35.3 billion tonnes. Top 3 emitting regions in 2013 which together accounted to 55% of the total global CO2 emissions were China, United States and European Union. There have been several summits including the recent at Paris in November 2015. However, the developed nations are not ready to retard their economic activity nor they want to take the responsibility to fund the developing nations to adapt to the cleaner methods in their development pursuit.

The environmental or ecological sustainability is greatly impacted by the industrial production and the production practices.

The climate change is the major emphasizing factor in the Sustainability; however, experts have given equal importance to the Social impact of the business organization. Hence Sustainability talks about 3 pillars viz. Social, Environmental and Economic impacts. As the climate change is severely impacting the globe, Corporate Social Responsibility or Responsible Business has taken a prominence at the corporate strategy. The Global Reporting Initiative (GRI) organization released guidelines for publicly disclosing an organization's economic, social and environmental performance. Such reporting is released in the form of 'Sustainability Report'. After GRI 3 and GRI 4, Global Reporting Initiative has recently released Sustainability Standards 2016 along with 17 Sustainable Development Goals (SDG 17) which are more precise and bring in more discipline in the reporting / disclosures. SDG17 also provide for the direction to the organizations on what to improve. Further on, John

Elkington (1997) coined the term "triple bottom line" to describe social, environmental and financial accounting or 'People, Planet and Profit' which implies that corporations not just focus on the economic value that they add, but also the social and environmental value they add or destroy.

2. SUSTAINABILITY CHALLENGE

Since there is no concrete and universally accepted definition of 'Sustainability', there is a variety in the interpretation of the concept worldwide. Remigijus Ciegis et al. (2009) have done an elaborate research on the various definitions used in their research paper and conclude that although the essence of the concept of Sustainability is clear, the exact interpretation and definition of Sustainable Development have caused wide discussions.

David Pearce and Giles Atkinson (1998) have pointed out that the World Commission has clarified that the emphasis only on future generations is a part of the story, whereas, reaching to the poor now is also a priority. David Pearce and Giles Atkinson (1998) have highlighted the concepts of critical natural assets and genuine savings rate. They questioned if the critical natural assets are reducing and genuine savings rate negative. As the natural assets are finite. The regeneration of natural resources is a very long process. Therefore, if we consume the resources beyond a particular rate, it is certain that future generations will not get the resources for their needs.

According to one of the report published by United Nations (2010) the global economy is consuming the natural resources at increasing and unsustainable rates. Even though, the substitution or emergences of alternate technology bring in temporary relief, the scale of consumption of the finite resources continues to rise. The growth in population and their rising dispensable income is expected to exert further pressure on the resource consumption.

With this background of Sustainability challenge, the business organizations appear to be in the dilemma of environmental preservation and social equality versus economic growth. The consumers and the stakeholders are increasingly becoming concerned about the environmental impact the organizations are causing. At the same time Governments are tightening the legislations around the protection of environment, business ethics and social parameters.

Corporate social and environmental responsibility has become a major concern in the recent years for the top management. Various voluntary initiatives such as – Global Compact, Global Reporting Initiative, Carbon Disclosure Project, ISO 14000 certification for Environmental Management System, development of ISO 26000 – are increasingly being incorporated by the business organizations in to their business strategy. As of now, all these are voluntary initiatives. These initiatives require the organizations either to disclose their environmental and social impact or to comply to the requirement of the specific standard. However, how to achieve and sustain certain improvement in the process is left the organization.

As far as Environmental impacts are concerned, the areas such as energy conservation, water conservation or resource conservation are vast areas and would require continuous efforts and these improvement efforts would continue for years. The programs may run in three parts

- Adopting a totally different technology – for example, use of solar or wind power instead of conventional power from state electricity boards, change of non-biodegradable material to bio-degradable material etc. This requires a planned investment and migration.

- Use of improved technology – this may involve benchmarking, better equipment or machinery investment etc. for example, use of LED lights in place of normal CFL. Power efficient motors and switches etc.
- Continuous improvement of the processes which may include – reduction, reuse and recycle of resources.

3. PROCESS IMPROVEMENT METHODOLOGIES

As we look at the efforts taken by the global bodies in raising the awareness of Sustainable development, those are more on the impacts and advise on disclosures and not on the methodologies or frameworks to be used for identifying the improvement opportunities, identifying root causes and actions for their elimination. In the absence of such guidelines, organizations are seen as following various practices as suitable to them. In most of the cases ad hoc actions and initiatives are taken to show or achieve improvements. Since the actions are ad hoc in nature, those cannot guarantee the sustenance. Sometimes these actions are those low hanging fruits; however, real sustainable development challenges are beyond these quick gains. So, beyond these you need proven improvement methodologies such as Lean or Six Sigma. These are systematic methods to identify the improvement opportunities and improvement actions.

Various management techniques are in use by the business organizations in order to improve their performance, processes and results. Some of the most common being the TQM (Total Quality Management), ISO 9000 series standards, Lean, Six Sigma, Theory of Constraints (TOC), Kaizen, Environment Management System (EMS) or ISO 14000 etc. These methodologies provide a structured approach to improve efficiency and effectiveness. Each of these techniques are used in appropriate situations depending on what needs to be improved and where it is being applied.

M. Asif et al. (2011) in their research titled '*Sustainability in Business Excellence Models*' studied various business excellence models and if those can adequately support Sustainable Development. M. Asif et al. claimed that both BCPE (Baldrige Criteria for Performance Excellence) and EFQM (European Foundation for Quality Management) do not adequately address requirements of Sustainability. The research paper identifies some of the short comings of GRI guidelines and claims that some of the important internal efficiency or productivity related performance measures are not adequately covered.

However, this paper differs with above argument in the light of the recent Sustainable Development Goals (SDG17), this gap has been bridged.

4. LEAN SIX SIGMA – A PERFECT FIT FOR SUSTAINABLE DEVELOPMENT PROJECTS

While various management and strategic tools / methodologies are available, Six Sigma fits most appropriately with the need for Sustainable Development projects. A large amount of opportunity lies in the 3'R's for the scarce resources – Reduce, Reuse and Recycle. 3R i.e Reduce, Reuse and Recycle – is the mantra often being talked about by the industries who are concerned about the global sustainability. Even though these key words are conflicting the economic or growth aspirations of the company, it is a challenge to the Marketing, Research & Development and manufacturing organizations that we

- Create the products which consume less of the natural resources
- Reduce the unnecessary consumption of resources
- Reuse the resources to the fullest extent
- Increase recycled content in the products

- Improve the lifecycle of the products

Each of these objectives is a challenge to the process engineering and reengineering. Lean Six Sigma – which combines best of the Lean and Six Sigma methodologies (Jagadeesh Rajashekharaiah and Mark Gershon, 2011) – would be an ideal framework to systematically achieve improvements in the areas as stated above. Lean Six Sigma helps in identifying waste or defects, reducing or eliminating them and making the process variation to the minimum.

Six Sigma methodology was developed at Motorola by Bill Smith in 1986. His other colleague Michel Harry developed the methodology further and propagated the program to other corporations. Within a span of a decade the Six Sigma methodology was getting adopted by several organizations. Jack Welch, CEO of General Electric and Larry Bossidy the CEO of Allied Signal both promoted Six Sigma within their organizations for improving processes and reducing variation and thereby improved the company performances. Jack Welch praised Six Sigma as "the most important initiative GE has ever undertaken." (**George Michael**, **2002**, p. ix)

GE defines Six Sigma methodology as a highly disciplined process that helps in focusing the development and delivery of near-perfect products and services. The central idea behind Six Sigma is that if you can measure how many "defects" you have in your process, you can systematically figure out how to eliminate them.

The concept of defect in Six Sigma philosophy is the characteristics of your product or service or its delivery process, which does not meet customer specifications.

According to Kimberly Eve Furphy, (2010), Six Sigma methodology is a set of tools, strategies and methods that help organizational transformation through significant improvement in bottom line, product quality and manufacturing processes.

Comly Wilson (2013) highlights how Lean Six Sigma can help in achieving Sustainability goals. She says Lean Six Sigma is a proven methodology for defining problems, reducing waste, systematically improving outputs and tracking results. With the same prioritization, measurement and problem-solving tools, Lean Six Sigma could prove to be very suitable for corporate sustainability programs.

The sigma level denotes the percentage defect free products. 1 sigma process denotes 30.9% defect free products, 2 sigma level denotes 69.1% defect free products, 3 sigma level denotes 93.3% without defects, 4 sigma level denotes 99.4% without defects, 5 sigma level denotes 99.98% without defects and 6 sigma levels denotes 99.9997% without defects which means 3.4 defects in one million opportunities. In a way, defect-free product ensures low or no waste, or rework. Therefore, addressing a zero waste in the processes can become a significant achievement for Sustainable Development. Zero energy waste, zero water waste, zero material waste would add to significant saving for the organization as well as for the planet earth. By just eliminating the waste, organizations can significantly add to their profitability. And hence, Six Sigma can help achieve dual objectives of sustainable development as well as addition to the bottom line.

When we talk of Sustainability, the organizations identify the material impact areas and decide a target for the reduction or improvement. This target is to be considered as customer specification in terms of Six Sigma. The top management who are the closest stakeholders for sustainable development is the actual customers of the process.

5. LEAN SIX SIGMA SUATAINABILITY ORGANIZATION

Several organizations are practicing Lean and Six Sigma for improving processes, operational efficiency and eliminating the wastes. Organizations have built an organization in the form of Quality Champions, Master Black Belts, Black Belts and Green Belts to continually and

systematically making improvements and generating the savings for the organization. The organizations need to understand that the Six Sigma resources are company resources and they are not divided in to departments or functions. They are pulled in to the projects which are of importance to the organization and based on their ability to contribute in the specific area of their expertise.

The Quality Champion or the Master Black Belt positions must directly report to the CEO of the organization. The organizations who have a dedicated Chief Sustainability Officer (CSO) or a similar position, will benefit from such arrangement because the CSO will have the Six Sigma resources at his or her disposal for any strategic projects under Sustainable Development.

6. STRATEGIC FRAMEWORK FOR SUSTAINABILITY

6.1. Sustainability Goal Tree

One of the most fundamental tool used in Six Sigma for prioritizing the initiatives is the use of Goal Tree. Goal tree links the organizational strategic objectives with actionable goals. While many leading organizations use goal trees, not all have Sustainability objectives and goals included. If an organization has to seriously address sustainability challenges, those must get included in the organization's strategic objectives. Rather Sustainability Objectives are also business objectives. When the organizational goal tree does not include sustainability related objectives and goals, they remain as only the activities to satisfy stake holders' expectations that the organization also works of sustainability initiative. Organization will not have focus on such initiatives.

A Goal Tree is a graphical representation of the reduction of problems (goals) in to sub-problems (sub-goals). Such a drill-down helps in breaking down the larger objectives in to smaller actionable projects or initiatives. At the high-level organization may have 5 – 6 strategic objectives? Each of these objectives are broken down to tangible goals. These tangible goals can also be drilled down to time bound initiatives or sub-goals. Such drilled down approach also helps in assigning the clear responsibilities to people / departments.

In an Organizational Goal Tree, the organization has goals in three distinct categories

1. Economic Goals (Profit)
2. Environmental Goals (Planet)
3. Social / People related goals (People)

Each of these goals is drilled down, like a tree, in to related projects with measurable targets.

As per the joint study by GIZ India, GRI, Thought Arbitrage and Governments of India and Germany (2012), Involvement and ownership of top management that formulates strategies and runs the operations of the company was a critical part of the sustainability process. Most of the companies do not disclose their targets and related investments for their most material aspects of the business operations and policies. And if there are no clear targets, the efforts and the tracking become difficult.

Many of the leading organizations use Balanced Scorecard while formulating their strategic objectives and goals for a short or a long-term plan. The balanced scorecard emphasizes on having the organizational objectives equally spread in four important perspectives

1. Financial Perspective
2. Customer Perspective

3. Internal
4. Learning and Growth

However, with the recent times, it is necessary to include **"Social and Environment"** as an additional perspective in the Balanced Scorecard.

Once the 'Social and Environmental' perspective is added in the Balanced Scorecard, organization is able to provide an equal weightage to the social and environmental issues and related improvements. This approach is useful for the companies who adopt Balanced Scorecard approach for their goal setting and preparing Business Operating Plans.

Usually in the Balanced Scorecard approach, approximately 25% weightage is assigned to each of the four perspectives. Instead, this paper recommends 20% weightage to the five perspectives which includes 'Environment' as the additional perspective.

Figure 1 Balanced Scorecard perspectives with addition of Social & Environment perspective

These perspectives are further drilled down to strategic objectives and goals which forms a Goal Tree. If the goals are significantly large areas to work upon, those are further broken down to time bound projects.

It is necessary to have defined priorities and their targets as a part of an Organizational Goal Tree. This paper suggests use of one of the very popularly used tool of Six Sigma named Cause and Effect Matrix to be used for project prioritization.

6.2. Prioritization of Projects

Sustainability Goal Tree is created by setting up organization-level objectives which are further drilled down to the department / function level goals and objectives. The GRI assessment can be a very good basis for creating the goal tree. All critical areas for improvement from the assessment can be included in the goal tree which can be planned for improvisation and implementation over an annual or a long-range plan.

Table 1 Project Prioritization Template derived from Cause & Effect Matrix template.

	Strategy Linkage			**Ease of Completion**					
Project Name	**Supports Company Strategy**	**Customer Impact**	**Sustainability Impact**	**Investment required**	**Time to completion**	**Are the process stakeholders supportive**	**Data availability**	**Weighted Value by Project Sum of product of rating and Importance**	**Weighted Value by Project %**
Importance of Each Criteria -->>	10	10	10	5	5	3	3		
Project 1								XX	
Project 2								XX	
Project 3								XX	
Project 4								XX	
Project 5								XX	
Project 6								XX	
Project 7								XX	
Weighted Effect on Each Criteria	0	0	0	0	0	0	0		

A template shown above is useful in prioritization of projects across organization. The first column lists all the projects. The top row lists prioritization criteria. Those should be limited in numbers. Above template shows some of those just for example and could be different for different organizations. It is essential that when you are identifying the priorities of the projects which also has sustainability related projects, the organization has sustainability related objectives / goals in priority. In absence of such sustainability objectives the related projects may not get the priority. Sustainability Impact is given equally high (rather highest) weightage equal to other two important parameters such as 'Supports Company Strategy' and 'Customer Satisfaction'. Organizations may choose to specify company strategies individually instead of simply writing 'Supports Company Strategy'. A row below the strategic objectives ranks the objectives / criteria on a scale of 1 to 10. Now each project is weighed on a scale of 0 – 1 – 3 – 9 where

- 0 means project has no impact on the objective / criterion
- 1 means project has insignificant impact on the objective / criterion
- 3 means project has marginal impact on the objective / criterion
- 9 means project has significant impact on the objective / criterion

The column 'weighted value of project' is obtained by summing up the product of 'project rating' and the 'importance ranking of the objectives' and 'ease of implementation'. 'Weighted value' which once put in descending order will provide the prioritized list of projects.

The prioritization of variety of projects becomes extremely difficult if the subjects and the benefits are diverse and incomparable. Above matrix answers some of the questions such as -

- How is a project that costs money but improves the environmental footprint weighed against one that does little for the environment but cuts costs?

- And once environmental responsibility is accepted within the company, which sustainability project deserves to be pursued first?

It is usually difficult to prioritize environment related projects at the cost of any business critical / impacting projects. Therefore, it is necessary to have an objective methodology to assess the impact of all the projects on a similar scale so that even the Sustainability projects get the importance in the business planning process.

7. LEAN SIX SIGMA METHODOLOGY

The methodology is divided in to five phases, which usually are referred by the acronym DMAIC which stands for Define-Measure-Analyze-Improve-Control.
Michael George (2002) defines the DMAIC phases as explained below

1. **Define Phase**: Confirm the opportunity and define the boundaries and goals of the project. Voice of customer and their requirements.
2. **Measure**: Gather the data to establish the baseline or current state of the process as it works today.
3. **Analyze**: Interpret the data by analysis to establish cause & effect relationships.
4. **Improve**: Develop solutions targeted at the confirmed causes.
5. **Control**: Monitor and sustain the results.

Michael George (2002) summarizes the DMAIC road map as under

Table 2 DMAIC Road Map adapted from the book *Lean Six Sigma* by Michael George (2002)

Define	Measure	Analyze	Improve	Control
Establish Improvement project charter	Decide the Improvement goal	Create a focused problem statement	Generate Ideas	Develop control plan
Identify Sponsor and team members	Measure current state (Baseline) data on defects	Measure the process capability and speed of process	Conduct Experiments	Monitor performance
Project Pre-work	Collect and display the data	Determine sources of variation and time bottlenecks	Create straw models	Mistake-proof the process
Map the process	Create detailed process map	Use statistical methods to quantify cause & effect relationship	Pilot Plans	Develop and document standard practices
Understand customer needs	Calculate starting sigma level		Develop action plans	Training
			Measure and evaluate results	Recommend future plans
			Implement actions	

There is enough literature available on Lean Six Sigma hence the DMAIC phases and the tools are not elaborated in this paper.

7.1. Advantages in Using Six Sigma Framework

GRI Guidelines or GRI Standards or even the SDG17 are the good tools to assess performance of the organization and disclose where the organization is and heading to. However, it leaves the action plan for improvement to the liberty of the organization. There are several areas where organizations have to improve their processes. Make the operations more efficient. Lean Six Sigma framework would provide a very strong platform for the organizations for dealing with this challenge.

The biggest benefit of using Lean Six Sigma framework is it positively improves the bottom line for the organization. Use of Six Sigma can make the sustainability initiative profitable, which otherwise is perceived as cost or investment heavy initiative.
Following are the main advantages for using Lean Six Sigma

1. Elimination of waste leading to improved profits.
2. Improved internal efficiency / productivity making the organization more competitive.
3. Stake holder confidence – which is a prime intention of Sustainability Reporting.
4. Sustained improvements.
5. Structured approach for improvements.

8. CONCLUSIONS

The sustainable development is a mammoth challenge for the companies. It has become tough because the companies are caught up between the economic ambitions and the environmental compulsions. Most of the environmental or social initiatives are expensive and cannot be just undertaken. Climate change, ecological erosion, deforestation, excavation and landfills, limited stock of fossil fuels, Green House Gas emission, inequality, poverty etc. are now global problems and no one is singularly ready to take the responsibility. Whatever the efforts that are being taken are too miniscule to compensate the depletion.

Under such circumstances, an aggressive plan for reducing, reusing and recycling the scarce resources is an immediate way for the companies. Lean Six Sigma methodology can be useful for addressing the complex sustainability problems. Six Sigma is aimed at improving efficiency and effectiveness of the processes and thereby it can improve competitiveness of the business organizations and the same times save from the elimination of waste from the system. It's a win-win for the industry as well as global initiative towards sustainability.

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