VE FOR SELECTION OF SUSTAINABLE CONSTRUCTION PRACTISE

ABOUT AUTHORS

RAJ PILLAI

Raj Pillai, is presently Executive Director at Sobha Ltd, a Bangalore based, and India's leading Real Estate Company.

A graduate in Civil Engineering from Bangalore University with over 25 years of multidisciplinary experiences in the field of construction of buildings, factories and highways in India and abroad with major construction companies, Raj has also undertaken his two year managerial course from Doncaster- UK.

Raj Pillai was also Chairman of 'Indian Concrete Institute –Bangalore Centre' during the year 2008-11 and Vice President {South} Indian Concrete Institute during 2011-13. Raj Pillai is also member of various Committees {Government and Professional} at national and International levels, the most recent one being the member of committee revising National Building Code of India.

Raj has presented various technical papers in national and international seminars, the most notable international ones being 'ICCEX @ BERLIN -2006', 'OWIC @ SINGAPORE-2010, SMART BUILD@ Cape Town - 2014 and 'Affordable housing summit 2014 @ Singapore and Smart Build conference 2015 @ Kuala Lumpur.

For his contribution to Ready Mixed Concrete Industry in India, Raj was awarded 'CHANGE MASTER' award by Tasmac University and Business-Gyan Magazine in the year 2006 Very recently, Raj Pillai has been conferred swith Prestigious 'VISHWAKARMA AWARD 2012' by CIDC- a body of Planning Commission-'Govt of India', for his contribution to the Indian construction industry.

ANITA LUKOSE, CVS®

Anita Lukose is currently Head of the Department of Value Engineering and Technical Purchase Audit at M/s Sobha Developers Ltd., a premier real estate company based in Bangalore, India. She also holds the additional responsibility of heading the Innovation committee that spearheads the Innovation activities in the company.

A Civil Engineer by profession, Anita is also a CVS from SAVE International. She has presented different papers in national and international conferences. She is the recipient of prestigious Soundaram Kannappan medal instituted by INVEST for propagating VE in India during 2013. She was awarded the SAVE paper of the year award during the SAVE International Value Summit 2014. She is the secretary of INVEST South Zone Council and a member of INVEST National Council. She is also a member of the SAVE International Certification Board and E06 Subcommittee of ASTM on Building Economics (E06.81).

ABSTRACT

Since inception, Sobha Limited has always strived for benchmark quality, customer centric approach, robust engineering, in-house research, uncompromising business ethics, timeless values and transparency in all spheres of business conduct, which have contributed in making it a preferred real estate brand in India. As a global leader in the construction industry, Sobha always give importance for perfection and continual improvement. To keep this pace of growth, it is imperative to deliver innovative and competitive products and services. To ensure effectiveness and efficiency, VE is applied in all phases of the product creation process.

A review of the business goal using the function analysis aligning with the sustainability aspect helped Sobha to identify different areas of improvement. One such area where a commonly adopted construction activity was avoided by enhancing the material used is presented as a case study in this paper. Function analysis in different levels and Analytic Hierarchy Process (AHP) helped the team to streamline the procedure to reduce the project duration, reduce wastage, and reduce the carbon emission. All these was possible at a reduced project cost. This case study demonstrates the power of VE in different areas of business operation.

Introduction

Value Engineering helps in the efficient allocation of resources. These resources identified as men, money, machine, materials, methodology are to be judiciously deployed for optimising their usage. Increased use of these resources is a direct cost to the project. Undue decrease in their allocation will affect the project schedule and thus result in the increase of expense in other areas.

The following FAST diagram (Figure 1: FAST Diagram for traditional business) explains this better. As the objective is to sustain business, when 'maximise profit' is identified as the basic function, product sales and project expense are discussed at length. For increasing sales, the product should be of good quality. As a measure of controlling expense, unskilled labour may be considered in the planning phase. The research for better technology may not be considered, as R&D and adopting new technology incur initial cost. Since labour and the technology deployed for the project are not effective to deliver a quality product, there is a big chance of poor quality. To overcome the marketing challenges of a poor quality product, it needs to seek ways to hide the deficiency.

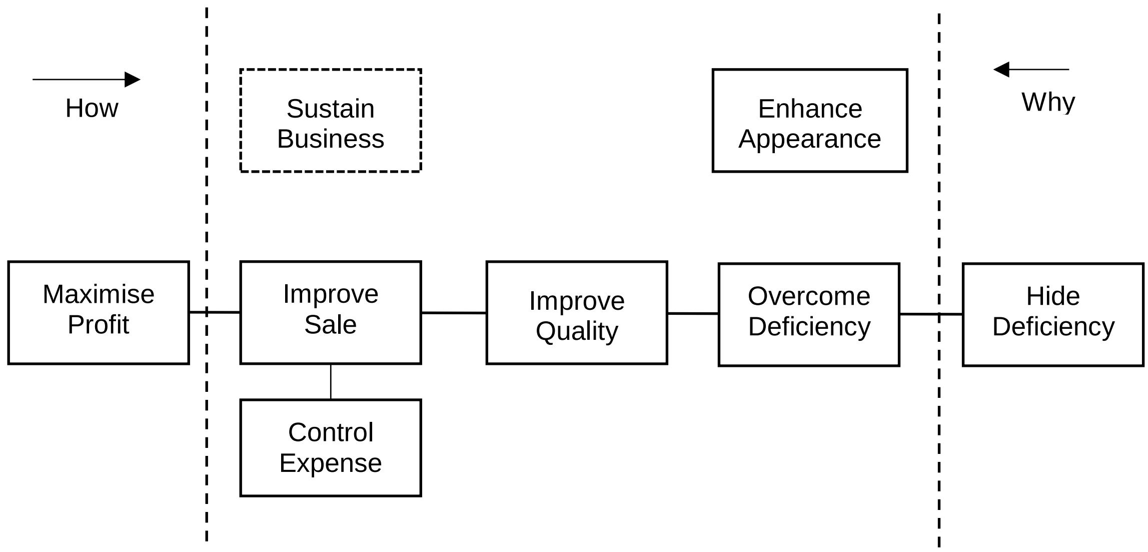


Figure 1: FAST Diagram for traditional business

Function Analysis

The review of the above FAST diagram by aligning the business to the identified sustainability parameters, helped in making the business model more effective and efficient. As the business objective changed, the procedures and processes also changed. Thus the function analysis was helpful in identifying areas of improvement. To incorporate such progresses further, technology innovations and upgraded procedures were implemented.

Rather than the usual practise of getting into the exercise of reducing waste, the analysis of activities helped the team to identify activities consuming time and effort. The function based thinking helped the project team to allocate the resources effectively in various areas of operation such as design, materials used, procedure deployed, and marketing strategy. Reviewing existing procedures helped to retain the required, eliminating unnecessary ones and add new practises.

This change in thought was in the revised FAST diagram given below (Figure 2: FAST Diagram for Sustainable business**)**.

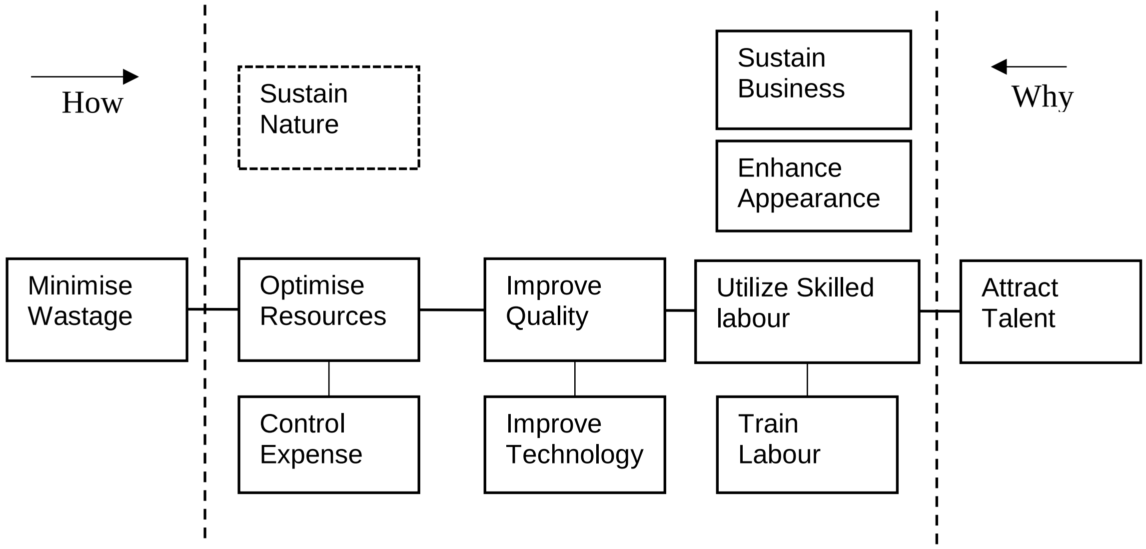


Figure 2: FAST Diagram for Sustainable business

Function based change for a High Raise Building

To explain the formulation of the change and its impact, one of a high raise building is taken as a case study.

Sobha is known for its quality products. Moreover, as the project consists of a high end apartment, quality finish is a primary requirement. By providing good quality plastering, the product aesthetics is enhanced tremendously. With the improved technical input, VE team studied the plastering activity, its function 'hide deficiency' and the activity cost. This was substituted by enhancing the properties of the concrete used.

The cost effectiveness of concrete has been worked out using ASTM E1699 as a guideline "to perform VE/VA during preliminary design to analyze the relevance of each requirement and the specifications derived from it. Critically examine the cost consequences of requirements and specification to determine whether the resultant cost is comparable to worth gained. Further analyze high cost low performance or high risk function and the identification of alternative way of improving value "

Situated in Bangalore, 'Sobha Indraprastha' is a building of 37 floors for which the tunnel form construction was adopted for fast construction. Conventional concrete was suggested for wall construction. The quality parameters set for the product demanded plastering of the walls. A function analysis gave clarity to the team about the requirements of the concrete to be used. The suggestion from the creative phase was to improve the traditional concrete used, as self-compacting concrete, so as to avoid plastering. This also helped in using less cement, thus reducing the cost while making it more environmental friendly.

Enhance Surface finish

Concrete has following functions in a building

- Provide compressive strength
- Facilitate durability
- Resist corrosion (due to the attack from atmospheric sulphate & chloride)
- Improve life cycle (of building)

Plastering to the surface has the following functions:

- Hide undulations
- Enhance aesthetics

When Plastering is done on the concrete walls, hacking has to be done to ensure bonding between the two materials. So the plastering and the related activities increase the duration of the project which has a direct impact on the costing.

The constructability also had to be improved due to the difficulty to achieve proper compaction of concrete using vibrators in the congested reinforcement.

During the creative phase, team developed the idea of enhancing the surface finish of the concrete with admixtures which will help to avoid plastering and improve constructability.

Enhance Concrete properties

The team analyzed the concrete properties and identified areas of improvement which will help to avoid plastering. The feasibility of the using self-compacting concrete (SCC) instead of traditional concrete was explored.

Different Cementitious materials were considered as a replacement of cement and extensive test were carried out.

The options were evaluated and finalized using the Analytic Hierarchy Process (AHP).

The logistics involved in producing SCC is quite significant – vigilance in quality control at plant and pouring point, extra storage bins / silos Hence it was decided to have a captive RMC plant at site. SCC requires higher fines content and this adds to the concrete production costs apart from the minimum cementitious content of (approx. 450 kg/cum), which is significantly high compared to Conventional Concrete.

"Smart Dynamic Concrete (Low Fines SCC)" was proposed and the objective was to achieve all fresh and hardened properties of SCC by reduction of total cementitious and /or fines content which would lead to an economical SCC.

SCC is generally recommended for high grades of Concrete (M40 and above) due higher Fines content of above 450 Kgs/ Cum. Sufficient lab trials were conducted at the site to develop SDC (Low fines SCC) with addition of 30-50% of GGBS to develop different grades of Concrete such M25- M50.

The following were taken into consideration:

- To maintain homogeneity of the mix (stable SDC), a Viscosity Modifying Admixture (VMA) was used and, at the same time, to increase its robustness, without affecting the flows significantly (low yield value) and enhancing the plastic viscosity.
- Based on the grade of concrete, type of exposure and the durability factors, the cement content of the SDC (low fines) was chosen.

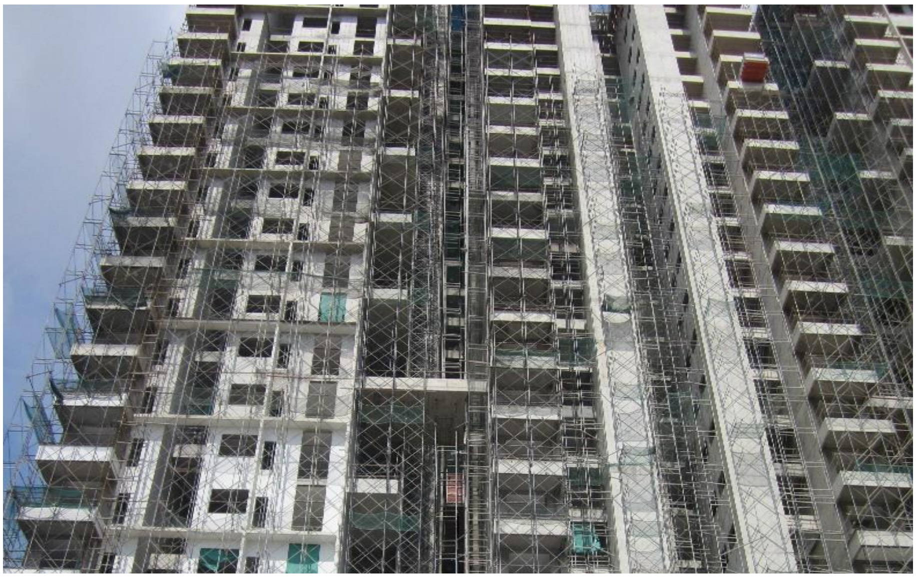
Smart dynamic concrete (SDC)

SDC is the concrete that has properties of self-compacting concrete (SCC) using a lower amount of cementitious material without detrimental effects. The production of SDC is made possible by combining an innovative VMA with a Super plasticizer.

VMA also enables us to achieve self-compacting properties with lower fines and paste contents without the risk of excessive bleeding and tendency to segregate. The VMA plays a vital role in maintaining the homogeneity of the SDC and increase its robustness, without affecting the consistency significantly. VMA also enhances plastic viscosity. Interest in the use of SDC is rapidly growing because it has the potential to deliver considerable savings to all stakeholders. Moreover, these savings are achieved without compromising the plastic and other ultimate properties of concrete, thus making SDC an attractive proposition.

Additional Benefits achieved due to SDC

- Reduction in construction time by 50%.
- Excellent surface finish with no honeycombing and voids is can be achieved with SDC. Hence, the repair costs can be maintained at a low level and plastering of exposed faces which is common practice in most parts of the country, prior to painting, can be eliminated.
- Reduction in cost due to repairs.
- Good surface finish so that plastering could be avoided.
- SDC requires minimal to no vibration due to its self -compacting properties, thereby resulting in easy work, lower energy and reduced manpower & machine utilization.
- Overall reduction in cost of the structure
- Enhanced durability and service life of structure.
- SDC reduces the carbon footprint of concrete and the construction processes because of the lower cementitious content and with addition of ground granulated blast furnace slag (GGBS) up to 50%, less energy, lower in-place costs, better finish and enhanced durability



External plastering work is eliminated at sobha indraprastha due the implementation of SDC

Total Area of External Plastering at Sobha Indraprastha is around 45000 SqM. This helped in the reduction of project cost by about 2,100,000 INR (33,000 USD)

On an average 300 Kgs of cement is used to produce 1 Cum of concrete and manufacturing of 1 MT of cement results into 1 MT of Carbon dioxide into the atmosphere. The study also helped to mitigate the amount of carbon dioxide into atmosphere by using lesser content of cement in every cubic meter of concrete

Co2 emission into atmosphere by burning fuel.

- 1 Litre of Petrol releases approximate about 2.33 Kgs of CO2 into Atmosphere.
- 1 Litre of Diesel releases approximate about 2.77 Kgs of CO2 into Atmosphere.
- SDC Eliminates the use of Petrol/ Diesel needle vibrators thereby reduces about average 2.5 Kgs of CO2 emission into atmosphere for every liter of petrol/ Diesel usage.

Conclusion:

Value Engineering is powerful as a basis for organizational decisions and to structure data in a way that is transparent and easy to understand for cross functional teams.
It is helpful in the following areas:

- Complexity reduction
- Formulating the organisational requirements
- Understanding of cost contribution vs. functional contribution
- Improving the effectiveness in building construction

In order to have reliable results, it is necessary to have agreement across the different functional areas of the organization on the required functions. A FAST diagram makes it

clear to all in a very simple way. Identifying the right design objective is imperative for the success of the project.
A major portion of the waste and raw materials use is generated by the built environment. Material cost of construction is 60 % and one of the major cost in material is concrete. The VE study was able to achieve remarkable improvements in constructing a greener product more efficiently. Reviewing the project as whole helped the team to achieve improvements in specific areas. Considering activities in parts limits the outcome and impact of the study.

Every 1MT of Cement produces 1 MT of $C0_2$, hence on an average about 9179 MT of CO2 emission into atmosphere is reduced due to replacement of Cement with GGBS. One ton of CO2 mitigation requires planting of 50 trees and this VE exercise also resulted in an environmental impact equal to that of planting 500000 trees!