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"Suggested Procedure to Contribute to Sustainable Building and Value Engineering Achievement"

Riham Elshafei [1], Hesham Basiouny[2], Hossam El Din Hosny[3]

1. Civil Department, Faculty of Engineering, Alexandria University, Egypt.
2. Department of Construction and Building Engineering, Arab Academy for Science Technology and Maritime Transport, Alexandria, Egypt.
3. Department of Construction Engineering and Utilities, Zagazig University, Egypt.

الملخص :

غالبا يتخذ اصحاب الاعمال في ادارة المشروعات احدي المنهجين في ادارة مشروعاتهم و هي اما الحد من المصروفات مع الحفاظ علي مستوي الكفاءة الوظيفية للنشاطات المختلفة اللازمة لسير المشروع وهو ما يسمي(Value Engineering) , او تخليق مشروع صديق للبيئة وغالبا يتم اهمال الجانب المادي في هذه الانواع من المشروعات.

ومن هنا يجب التعامل مع المشروعات بمنظومة جديدة تتبع كلا من المنهجين السابقين في نفس الوقت (توفير مصروفات مع الابقاء علي الكفاءة الوظيفية للنشاطات المختلفة و ايضا مشروع اكثر صداقة للبيئة).

تطبيق value Engineering Methodology مع اختيار خامات اكثر صداقة للبيئة سوف يمكننا من تحقيق الغرض من البحث.

Abstract:

Almost Building Owner's take in their project management procedure one of two concepts; Either deliver products meeting three criteria simultaneously, i.e., products of lower cost with improved quality and performance standards (which called Value Engineering) or increasing the efficiency with which buildings and their sites use energy, water, and materials, and reducing building impacts on human health and the environment over the entire life cycle of the building (which called Sustainability) and here Owners can neglect cost from their thoughts.

In our research we can suggest a procedure to combine both of Value Engineering and Sustainability aims to produce a product with low cost, high performance with more sustainability; Exploring of material selection can be considered on Value Engineering Methodology to contribute more sustainable building.

Keywords: Construction Industrial, Value Engineering, Sustainable Building, Material Selection on Value Engineering, Material Selection on Sustainability.

Introduction

The concept of sustainable building incorporates and integrates a variety of strategies during the design, construction and operation of building projects. The use of green building materials and products represents one important strategy in the design of a building.

Building and construction activities worldwide consume 3 billion tons of raw materials each year or 40 percentage of total global use (*Roodman and Lenssen, 1995*). Using green building materials and products promotes conservation of dwindling non-renewable resources internationally. In addition, integrating green building materials into building projects can help reduce the environmental impacts associated with the extraction, transport, processing, fabrication, installation, reuse, recycling, and disposal of this building industry source, Material selection is one of main sustainability

principle and depends on seven criteria in that process to achieve green building benefits and stockholder's requirements (economic, environmental and social).
In the other hand Value, engineering came into existence around World War II as a strategic methodology to be used to deliver products meeting three criteria simultaneously, i.e., products of lower cost with improved quality and performance standards.
Miles (1947) was the original initiator of the value engineering (VE) process and methodology. This technique has been widely applied in various fields including manufacturing, transport, and construction. Special emphasis has been placed on VE by Federal agencies which have proposed and developed procedures that require mandatory use of VE in highway construction over $25 million dollars(*FHWA, 1997*), which may be increased to $50 million dollars (*FHWA, 2013*).Specifically, it is proposed that Title 23 of United States Code of Federal Regulations Part 627 to contain a mandate requiring State Departments of Transportation to conduct a minimum of one (1) VE study for each federally funded project on National Highway Systems (NHS) costing $50 million or more for highway projects and $40 million (originally $20 million under FHWA, 1997)for bridge projects. Further, Section 106 requires State Departments of Transportation to establish a program that reduces cost and improves quality of project, promote innovation, remove design elements that are unreasonably costly and ensure efficient investments by calling for VE studies (*Project Development Procedures Manual Chapter 19, 2013*).
However, Value engineering itself with its techniques can achieve partially Sustainability goals or benefits, and in our thesis we will develop that technique to obtain sustainability goals by take in consideration all criteria can affect material selection and then produce a green building, And whereas VE is highly efficient on design stage from construction phases, also design efficiency is one of sustainability principles, so design method alternatives and material selective criteria for several activities in the project should be considered on integration with each other on value engineering Methodology development .

Research problem

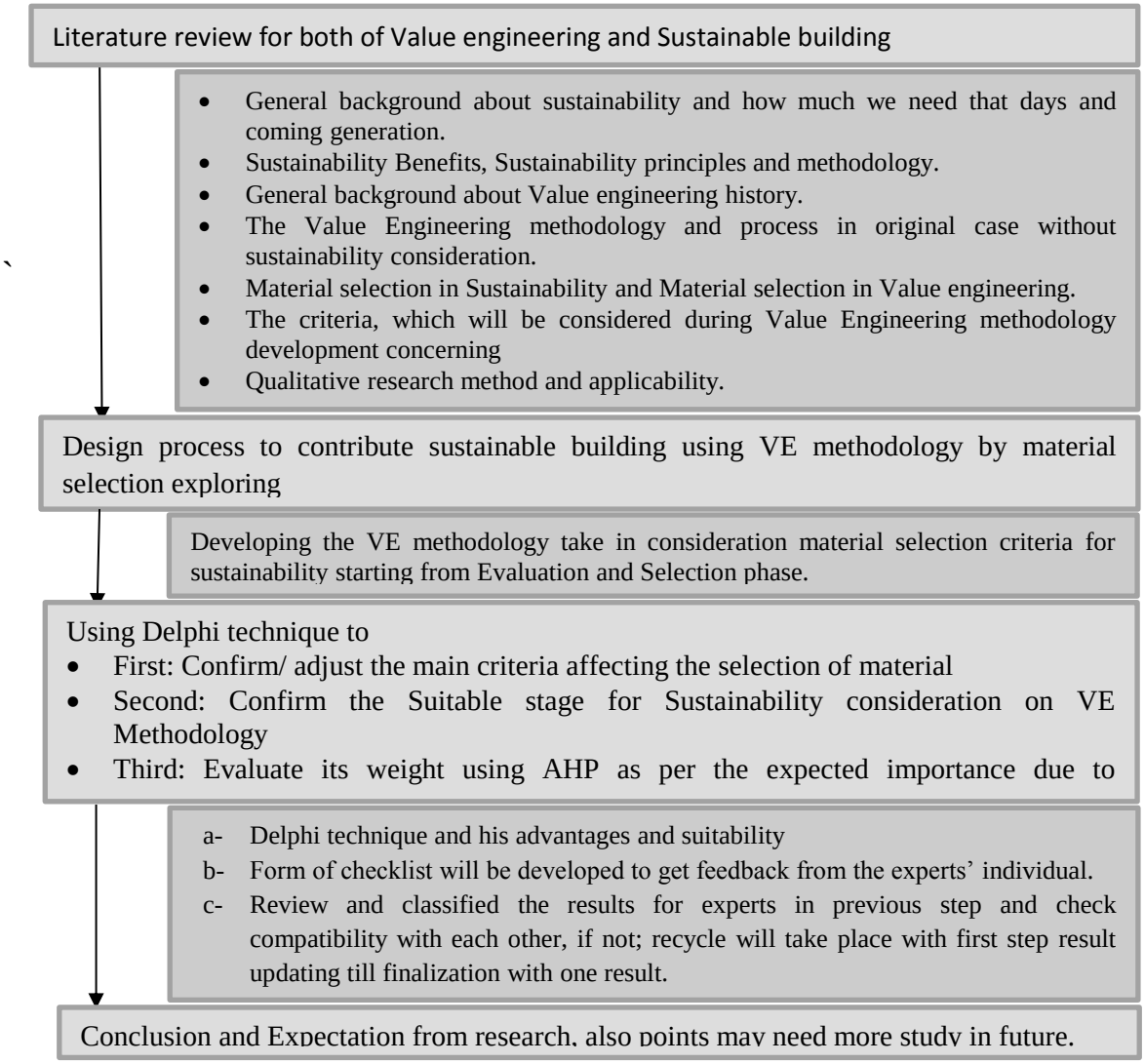
Value Engineering does not express for Sustainability rather relation between Sustainability and VE is not clear; We mostly increase cost to obtain a sustainable building which is walking in opposite with Value engineering main goal.
"Quality, cost and performance are the most important considerations when building owners make decisions (*Jariti &Zergodi, 2008*)"; VE is necessary to obtain that requirements.
And whereas the growth and development of our communities has a large impact on our natural environment. The manufacturing, design, construction, and operation of the buildings in which we live and work are responsible for the consumption of many of our natural resources, So Green building, or sustainable design is necessary to obtain social, economic and Environmental benefits.
The combination between VE, Sustainability is a new area has not enough study; on that thesis; this area will be existed to obtain of both VE and Sustainability benefits with the same procedure.

Objective& Scope

The main objective of this research is how to develop a methodology for combination between VE& Sustainability by Exploring material selection for more sustainable building. Which will be done through:

1- How to develop Value engineering methodology to obtain sustainable building in additional to value engineering goals as these goals (quality, cost and performance) could be considered as a part from sustainability benefits (Social, economic and environmental)
2- Material Selection regarding to the criteria of green material selective will be considered during design phase to obtain the developed methodology and process of Value Engineering.

Research Methodology



Literature Review

Green Building importance and benefits

The growth and development of our communities has a large impact on our natural environment. The manufacturing, design, construction, and operation of the buildings in which we live and work are responsible for the consumption of many of our natural resources.

Fig.1 Sustainable Triad for Eco-Village

The main elements of sustainable development, as defined by "DETR" are:

Environmental Benefits by enhance and protect biodiversity and ecosystems, improve air and water quality, reduce waste streams and Conserve and restore natural resources

Economic Benefits by Reduce operating costs, improve occupant productivity, enhance asset value and profits and Optimize life-cycle economic performance

Social Benefits by Enhance occupant health and comfort, improve indoor air quality, minimize strain on local utility infrastructure and Improve overall quality of life.

Green building principles

Six principles for green buildings as Design efficiency, Energy efficiency, Water efficiency, Materials efficiency, Indoor Air Quality and Waste reduction; optimization of one is enough to produce sustainable building.

Material selective criteria on Sustainability

Seven criteria for sustainable material selection.

1. Is the material effective in your conditions?
2. Is the material healthy and safe?
3. Is the material durable and easily maintained?
4. Is the material used efficiently?
5. Is the material available in your area, and can contractors work with it?
6. Is the material cost-effective?
7. Is the material aesthetically satisfying to you?

Value Engineering importance and benefits

Value engineering is a creative, organized approach, whose objective is to optimize cost and/or performance of a facility. in other words, VE is a management.

Value Engineering Methodology and process

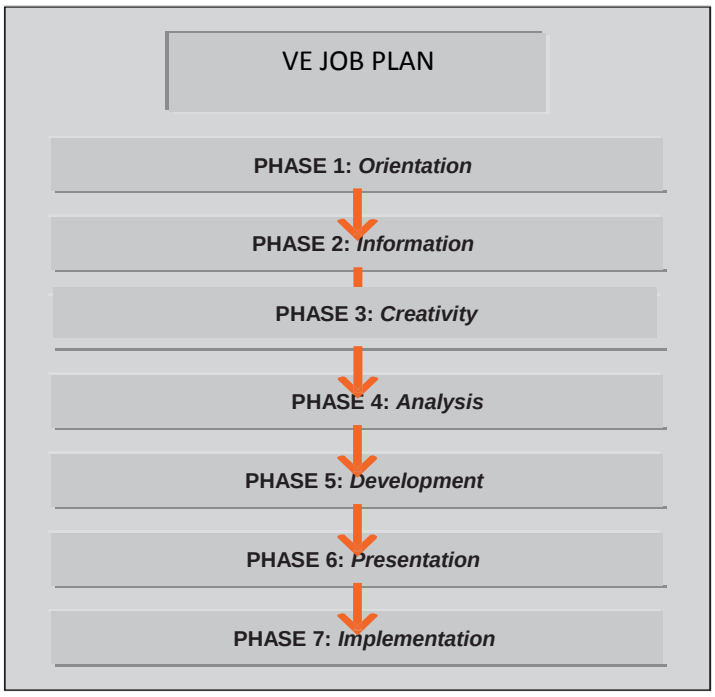


Fig.2 VE methodology

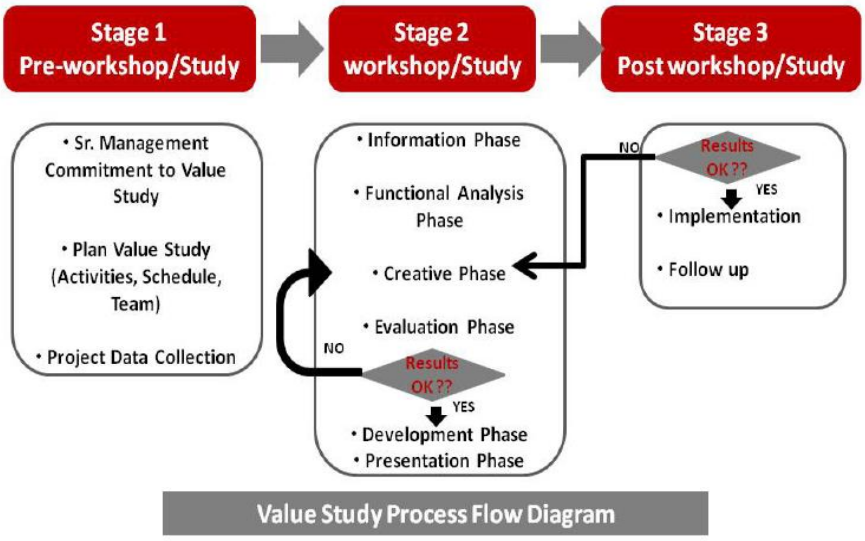


Fig3 work plan study

Design of Suggested Procedure to Contribute to Sustainable Building and Value Engineering Achievement

Green and VE team

Name	Title

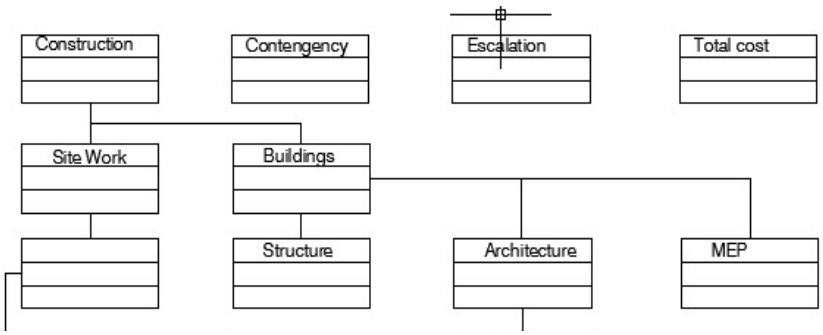
Value Sustainability Job Plan

Information Gathering

Information Sheet

Serial	Person or Company Name	Contact no.	Information
1			
2			

Cost Model

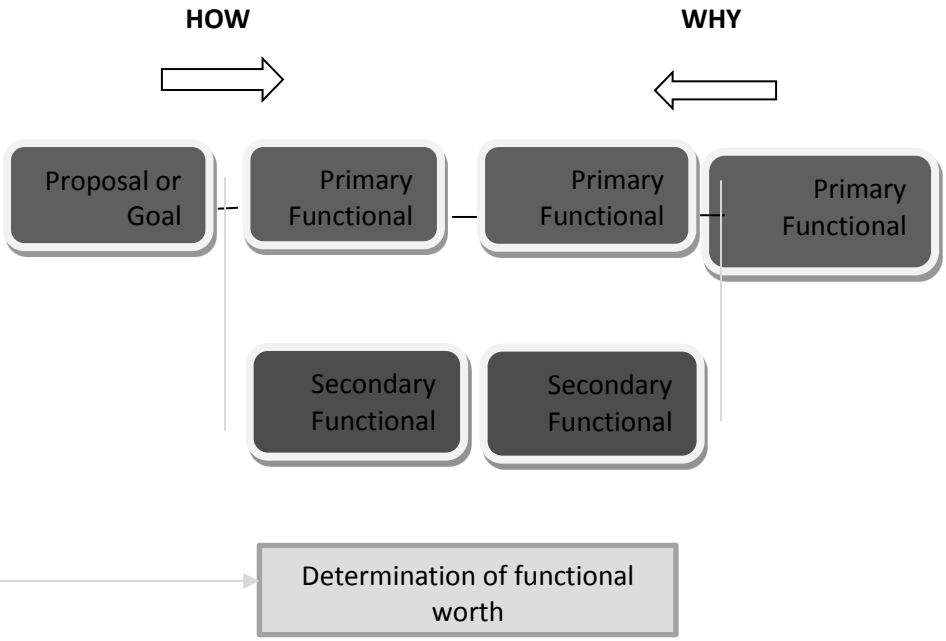


Function Analysis

Function Analysis model

Item	Verb	Noun	Kind	Cost	Worth	Cost/ worth	Action
			Primary/ secondary				

Fundamentals of FAST



Item	Element category	Cost (LE)	Worth (LE)
1	**structural**		
1.1	Division 1		
1.1.2	Subdivisions		
1.2	Division 2		
1.2.2			
1.3	Division 3		
1.3.1	Subdivisions		
2	**Architectural**		
2.1	Division 1		
2.1.1	Subdivisions		
Total		EGP	EGP

work catagories

stru

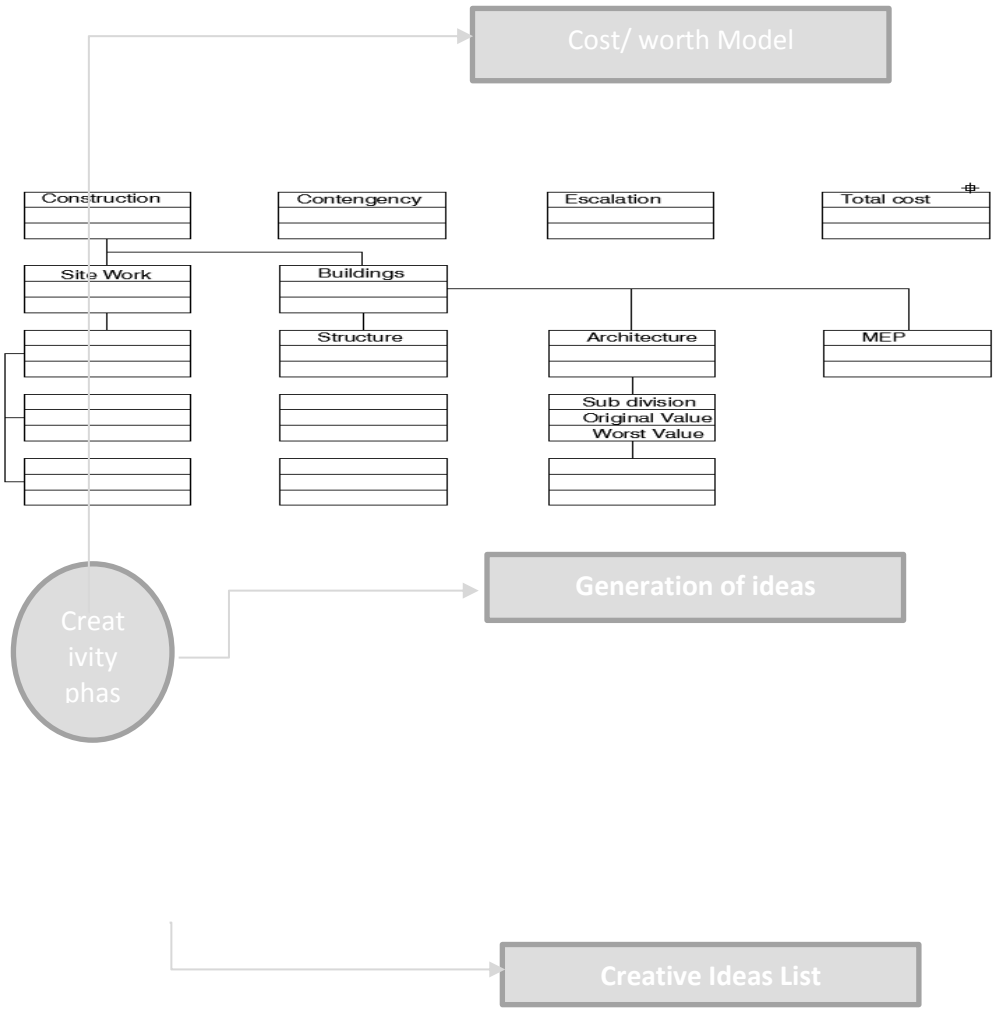
Archite

mechanica

Electrical

special equip

Item no	Category	Creative Idea List
1	**Structural**	
3		



4	**Architectural**	
6		
7	**Electrical**	
9	**Mechanical**	

Judgment

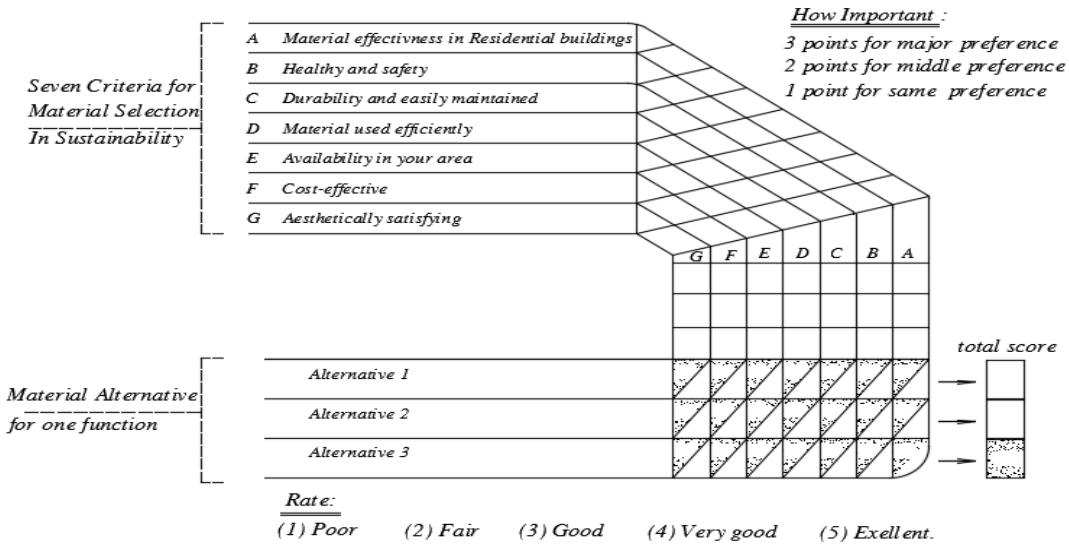
Judgment model

Item no.	Creative Idea List	Judgment		Idea Rank
		Advantages	Disadvantages	
Str. 1		•	•	10
Str. 3		•	•	6

Evaluation and Selection

Weighted Criteria Matrix

Weighted Criteria Matrix Model



Summary of principal recommendation

Recommend

Discipline	Original	Proposed	Social benefits	Economic Benefits	Environmental Benefits
Structural					
Architectural					
Mechanical					
Electrical					
Equipment					
Total					

Delphi Technique

Characteristics of the Delphi Technique

The Delphi technique is well suited as a means and method for consensus-building by using a series of questionnaires to collect data from a panel of selected subjects (*Dalkey & Helmer, 1963; Dalkey, 1969; Linstone & Turoff, 1975; Lindeman, 1981; Martino, 1983; Young & Jamieson, 2001).* Delphi, in contrast to other data gathering and analysis techniques, employs multiple iterations designed to develop a consensus of opinion concerning a specific topic. Ludwig (1994) indicates

The Delphi Process

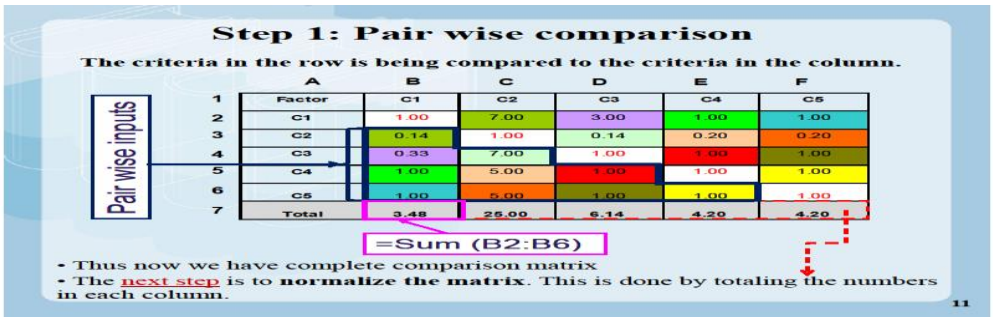
Round 1; In the first round, the Delphi process traditionally begins with an open-ended questionnaire, **Round 2**; In the second round, each Delphi participant receives a second questionnaire and is asked to review the items summarized by the investigators based on the information provided in the first round. Accordingly, **Round 3**; In the third round, each Delphi panelist receives a questionnaire that includes the items and ratings summarized by the investigators in the previous round and are asked to revise his/her judgments or "to specify the reasons for remaining outside the consensus", **Round 4**; In the fourth and often final round, the list of remaining items, their ratings, minority opinions,

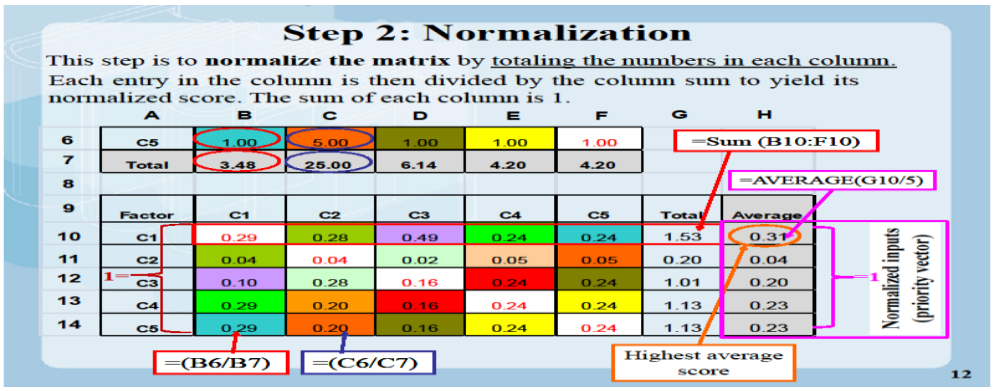
Subject of questions

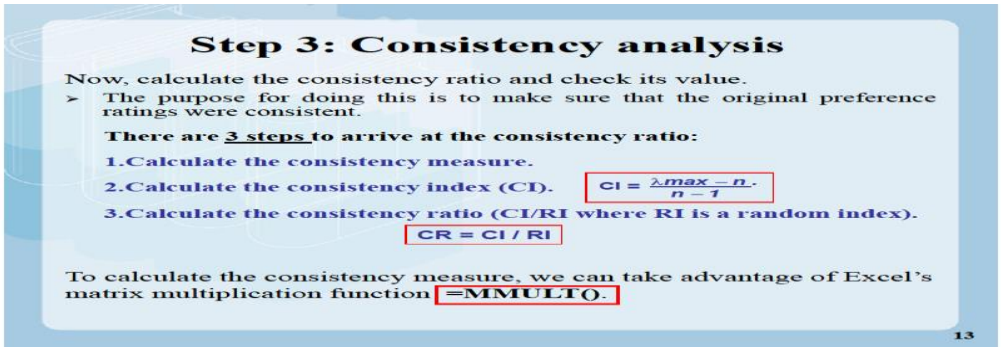
1- Are the seven criteria for material selection mentioned on the research sufficient to contribute sustainable building?
2- Is the stage of material selection suitable on VE process as it is on Evaluation and selective stage?
3- Is The weight of criteria having relation with the nature of project?
4- For residential building, paired weight for criteria is required.

Statistics Analysis for result using AHP

AHP can be used to Decompose the decision-making problem into a hierarchy, make pair wise comparisons and establish priorities among the elements in the hierarchy, synthesize judgments (to obtain the set of overall or weights for achieving your goal) and Evaluate and check the consistency of judgements.





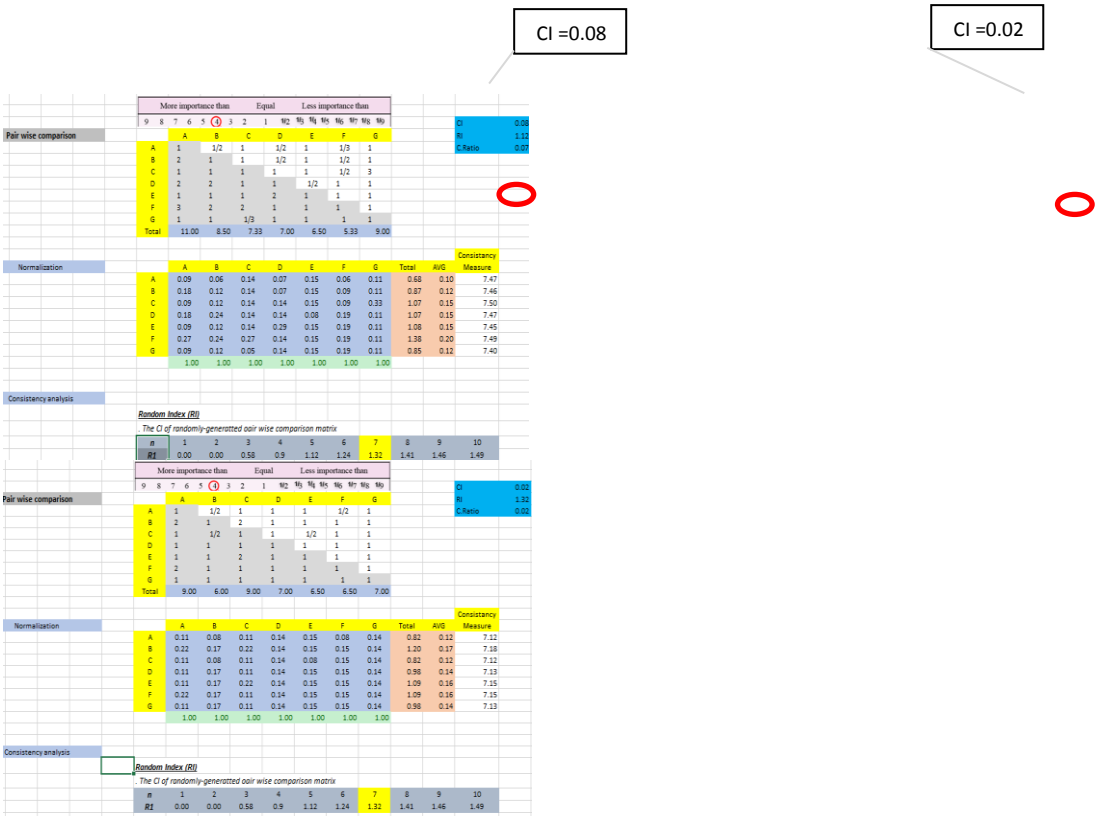


Application AHP on our Responses

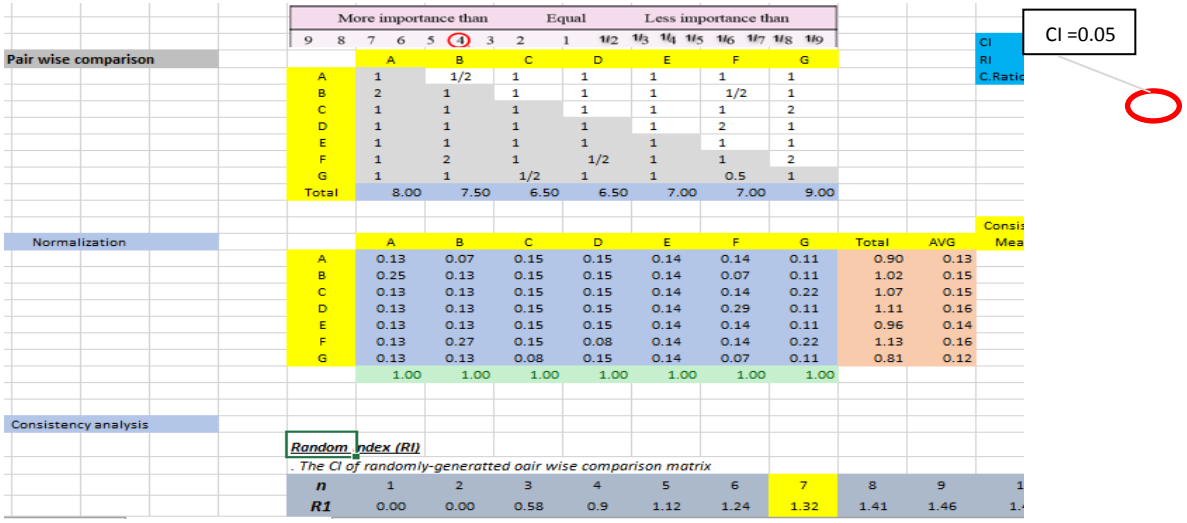
Round 1

- Contact with fifteen participants to get their answer/ opening regarding to the four required subjects.
- AHP statistics analysis by Excel sheet used to Evaluate and check the consistency of judgements *Khwanruthai BUNRUAMKAEW (D3) Division of Spatial Information Science*

  Graduate School of Life and Environmental Sciences
  University of Tsukuba, (March 1st, 2012)
- All participant questionnaires are perfectly consistent, as the consistency index almost < 0.1 (range from 0.02 up to 0.09), so we didn't need for another round.



- The final weighted comparison matrix concluded from questionnaire result is perfectly consistent; as the consistency index = 0.05 where < 0.1

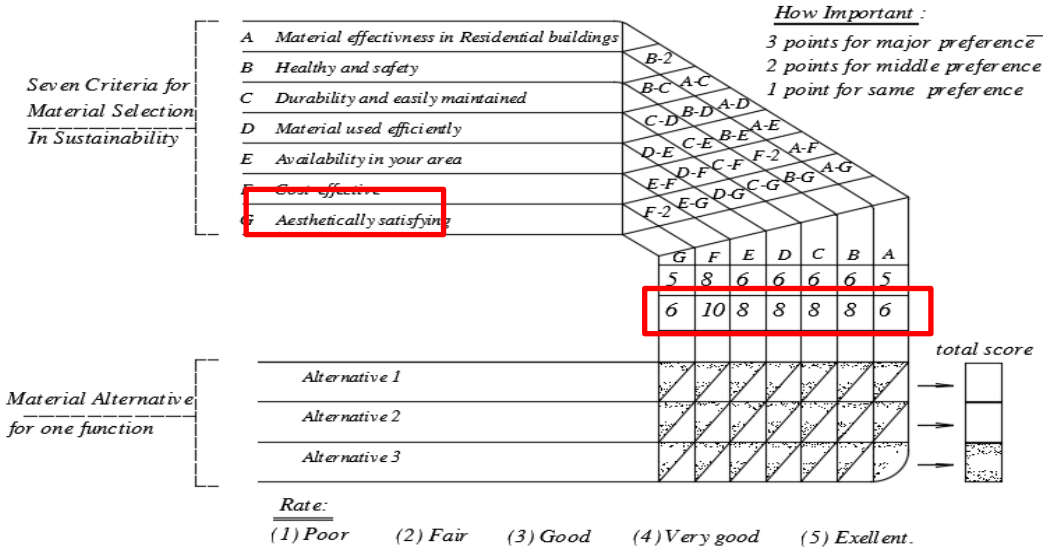


Result

1. The seven criteria for material are sufficient for material selection
    A. Is the material effective in your conditions
    B. Is the material healthy and safe
    C. Is the material durable and easily maintained
    D. Is the material used efficiently
    E. Is the material available in your area, and can contractors work with it
    F. Is the material cost-effective

G. Is the material aesthetically satisfying to you

2. Evaluation and selection phase on VE procedure is the suitable stage to start sustainable phase by material selection process
3. The weight of criteria has relation with the nature of project
4. Final criteria weight matrix is as below



Conclusion

1- We can proceed on one procedure to achieve VE goals & contribute more sustainable building by Exploring material selection.
2- Evaluation& Selection stage on value Engineering Methodology is the most efficient stage to explore sustainable material selection as we are ensuring from cost saving on previous stage.
3- The Seven criteria for sustainable material selection are the base on weighted criteria matrix on Evaluation phase for available alternatives VE process to contribute sustainable building.
4- That seven criteria for material selection can completely fulfill sustainability benefits and can partially fulfill VE benefits…. Figure 4

	Material selection criteria	Sustainability Benefits compliance	Value engineering Goals compliance
1	Is the material effective in your conditions	Social Benefit	Performance development
2	Is the material healthy and safe	Environmental Benefit	
3	Is the material durable and easily maintained	Economic Benefit	Cost reduction
4	Is the material used efficiently	Economic and social Benefits	Cost reduction, increase quality
5	Is the material available in your area, and can contractors work with it	Economic and social Benefits	Cost reduction
6	Is the material cost-effective	Economic Benefit	Cost reduction
7	Is the material aesthetically satisfying to you	Social Benefit	

Figure 4. Compliance sheet between for Sustainability benefits and Value Engineering Goals with material selection criteria

5- Value Engineering Goals are included on Sustainability benefits but the verse is not applicable
6- Nature of project has effect on weight paired matrix for criteria.
7- Cost has the highest score and weight compared with other six criteria

References:

Roodman and Lenssen, 1995

FHWA, 1997, 2013

Project Development Procedures Manual Chapter 19,

Jariti &Zergodi, 2008

Sustainable construction BRIEF 2014

Green building materials MedLab Green Buildings Living Lab

Importance Of Green Building.mht

Institute For Sustainable Infrastructure (ISI) Welcome.mht

Khwanruthai BUNRUAMKAEW (D3) Division of Spatial Information Science

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