

VALUE MANAGEMENT IN BUILDINGS DESIGN***

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1. BACKGROUND

Value Analysis is a methodological group activity applied for Customers by an organized group of multidisciplinary experts and non-experts, under a Coordinator's direction. This activity, naturally exalts and multiplies the ability of each member of the group and consists in singling out the ambit of the major functional influence of the considered entity and the necessary and required functions which are able to satisfy the purchaser's and/or user's explicit or implicit demands.

In Italy, in 1985 was founded the *AIAV, Italian Association of Value Analysis* with a sub-section specifically on 'Civil Construction'. In Europe, the project "Value for Europe" has recently produced a manual on "*Management and Value analysis*", with the aim to promote and diffuse the knowledge of this topic in our continent. Following this, a series of training course will be held to start the certification process, as foreseen by the rule EN45013 (European Union rule).

The project is the fruit of a cooperation between Belgium (AUD), France (AFAV), Germany (VDI), Italy (AIAV), Portugal (APAV), United Kingdom (IVM) and Spain (IAT) on experimentation of Value Analysis. Actually, some of these country

have already fixed standards and systems of certification.

Following this cooperation, there were been European Conferences (inside the European SPRINT project) held in Italy 1989 – France 1992 – Germany 1992 – Spain 1993 – United Kingdom 1994 and Portugal 1995.

Actually in Europe, each nation has an NCO (National Certification Organization) with the aim to introduce and administrate the European system of training and certification in the Nation; the introduced system must consider the culture and the national experience and must be adequate to the minimum standards required by the European manual. Each NCO must have a NCB (NATIONAL CERTIFICATION BOARD) that represents the committee of certification.

With the aim to develop an efficient application of the European system of course on AV and on the Certification system has been created the European Governing Board (EGB) with the scope of preserving the rules, link the national procedure with the European ones, and generally acting as a Supervisor of the whole system.

In the civil construction field, particularly in the buildings one, the increasing action towards the obtaining of a well determinate performance, in

*** The co-contribution of the second Author is limited to paragraphs 1 and 2.

relation to the total cost of the work (the sum of the production cost, of the management in the circle of life and at the end) requires a more and more precise qualification of the project; this is a necessary condition, even if it is not sufficient for the quality of the object.

Consequently, the planners will always be more and more precise in demanding:

a) to the Purchaser-Customer: a well-documented specification of the requirements in relation to the liquid assets both for the realisation and the use of the work ordered by the purchaser;

b) to the builder: operating within the Quality System, referring to the Regulations UNI EN ISO 9000 (European Union rule);

c) to the producer: certified materials and components and specific techniques which could prove the agreement with the condition of environment welfare, of maintenance and durability.

From the foregoing, the design of Public Works, in the regulation act, the article 14 of the new Italian Law on Public Works provides the recourse - during the planning - to the Value Analysis, as a methodological instrument useful to come to the completeness of the design and to the quality of the executive project, as if we dealt with a test in progress; this certainly fill a gap in our public works legislation .

We remember that in USA a Resolution of the Senate made Value Analysis compulsory for the major Public Works projects, because it is verified that this gives a high yield. Indeed, there is a clause which provides that when the firm proposes to the purchasers a solution that, under the same functions, or rather, with a functional improvement, appears to be economically more advantageous in relation to the one presented by purchasers, he obtains the 55% of the savings.

2. DEFINITIONS AND METHOD

Value Management will have more important and meaningful results in the future considering the achievements obtained through the application of Value Analysis, only if a rigorous and univocal definition of "Value" is given.

If in the process of analysis of an entity (project, process, product or service) we do not rigorously identify an index or a parameter which enables us to compare and evaluate in terms of priority the solution proposed by the project team and the possible alternative solutions suggested by the Value Analysts, we run the risk of lapsing into

other better known methods, such as those used by the estimators in the economical-managerial field and those who deal with the Quality System, who do not put in a direct relationship the technical functional proposals which satisfy the needs with the resources and the global costs.

Those who have experimented the potentialities and have appreciated the benefits deriving from the applications of Value Analysis feel the need to outline its characters and give strict definitions and methods of application. This is the reason why, in this document, we pay so much attention to the definition of "Value" through that of "Utility" in relation to the "Global Cost" of the element which carries on the function or the functions needed for the achievement of objectives.

Considering the need to qualify the planning and the realization of building, Value Analysis is introduced as a valid tool to achieve Quality System objectives in relation to the human and economic resources necessary for the production and the management of buildings during their supposed life cycle.

A significant sample of people, experts or non-experts in the subject which is being discussed, using this method and this operational technique, attributes a Value Index, defined in the next part, to every function of the considered entity (single element, part or complete product).

This brings a close relationship between the concept of Quality, in terms of satisfaction of needs, and that of Value, based on the utility of the examined entity, in relation to the resources and the global cost which have been estimated for the production and running of the entity in its supposed life cycle.

Differently from the already complex situations which can be found in the industrial mass-production field, to obtain the satisfaction of the expressed and implicit customer/user's needs in the field of civil engineering, it is necessary to take a series of different factors into consideration.

These are:

- each product is a prototype;
- the planning and the realization of a work must be in accordance with both performance norms and rules specifically devised for works which are unique and unrepeatabe.
- Keeping to the estimated costs is more and more strictly requested both for production and for management;
- the work must be planned and built in such a way to maintain a high degree of efficiency in time and a high commercial value.

- every condition which is necessary to guarantee a rational use of resources and a sustainable development in relation to the environment, for this and the future generations, must be respected.

The project building team is therefore requested to punctually aim at the project's completeness also asking for multidisciplinary contributions and checking the quality during the project phases.

As regards the determination of the quality of the project and the value of the proposed solution, the reference parameter which we suggest in this document is the *Value Index*. We are therefore introducing some definitions and some considerations about the method, which will be subsequently applied in the case study described in this document:

Entity UNI EN ISO 8402:1995 : what can be described and considered individually: activity, process, product, service, organization or any combination of these.

Function : Activity carried out by the considered entity or the use that can be done of it

quality UNI EN ISO 8402: 1995 : Amount of the properties and of the characteristics which confer to the entity taken into consideration the ability to satisfy expressed or implicit needs.

As regards the Value Analysis method, when the Main Areas of Functional (AMIF) of the considered entity have been identified, the attention is focused on the necessary and requested functions which are aimed at obtaining specified performances (primary) and for each of them a value index *V* is defined, so as to order the solutions proposed by the customer and those proposed by the value analysts according to priority.

Primary functions will be linked with utility and the related incidence of the global cost of the entity updated to the time in which the customer/user will take possession of the property, so as to estimate the value indexes which in this way become real indicators that can be used to influence the customer/user's choices on the decisions to be taken.

A value index related to an entity will be that of the entity itself, in case the entity carries on only one function; if the functions carried on by the entity are more than one, instead, the entity value index will be represented by the weighted mean of the indexes valued for each entity.

If, for example, we consider a panel to be applied to a ceiling, the Value Analyst's team will discuss the following questions:

Which are the functions it carries on? – “it absorbs the noises”, “it creates an air space”, etc.

- How much do the project works performing these functions cost?
- What functions should it carry on?
- What are the alternative solutions that perform the same function?
- How much do the works related to the alternative solutions cost?
- Which is the value index related to each of them?

3. THE CASE STUDY: A BUILDING OF HISTORICAL-ARTISTIC VALUE

The “Case Study” is based on the collaborative contribution requested by a public customer owner of an historical-artistic building to a Value Analysts team in the planning phase of a possible intervention aiming at giving it a destination of use of social importance, since it could bring an economic-managerial profit.

The customer asks the Value Analysts team to solve the following problem: “The team must take into consideration, analyse and evaluate the solution given by the customer, estimate the value indexes of each of them, in relation to the place, to the characteristics of the building, to the possible uses which can bring to economic profit, and give alternative solutions providing a list of value priorities of all the solutions among the possible destinations of use compatible with the finalities of the public institution, owner of the building, and the nature of it.”

The fact that in this kind of problems there are some fixed principles common to all the possible solutions deriving from the intrinsic real estates values requiring the respect of the architectonic and historical-artistic characters, must be taken into consideration.

Our attention is therefore to be focused on those functions which are judged to be compatible with this kind of building, which is to be maintained in its vocation and social value and is therefore to be the object of integrated preservation.

The starting data on which the team based the elaboration related to the methodology follow these steps (see enclosure 1)

1. informative phase
2. creative phase
3. analytic-selective phase

4. implementation of solutions phase
5. showing of the solutions phase

The data are:

- objectives of the customer/promoter of the initiative
- place and global analysis of the studied building
- list of the hypothetical destinations of use

The objectives that the promoters aim to achieve are already clearly specified in the question. The place has been studied in environmental, social and economical terms, verifying the compatibility of the project hypothesis according to the legal town planning instruments. This has been exemplified in some charts (see enclosures 2).

The activities and the functions which satisfy the user's needs in order to carry out those activities have to be listed for each hypothesised destination of use. The requirements and the performances which the building will have to provide must also be expressed (see encl. 4).

When the activities have been defined, those which are compatible with the requisites and the performances can be put together under the definition of "Environmental Units"; each of them can be aggregated, in relation with their compatibility, into "Spatial Units" which can be defined through strict technical requirements.

When the functions have been defined and due notice has been taken of the solutions which have been proposed by the customer and those which have been devised by the AV team, we have proceeded to the analytical-selective phase and to the definition of parameters of assessment.

Value Indexes have then been attributed to each destination of use which has been taken into consideration.

General parameters (also called "complex") have been split into specific parameters (also called "elementary") to make the following estimation of the value indexes easier.

Such indexes represent the capability for the destination of use to absolve the considered parameter or aspect (see enclosure 3)

After that a destination of use has been taken as a reference, its compatibility with what already exists in relation to a particular parameter of assessment is as much higher as the cost to satisfy the technical requisite related to the parameter is lower and as the utility is higher; utility in this case means the minimum cost we are ready to pay in order to obtain the function which is performed by the technical requisite related to the parameter.

When the quantities W_i and C_i ($i= 1,...I$) for each spatial element Es_i and the related totals $W_{jn}= SW_i$ and $C_{jn}= SC_i$ (referred to the destination of use Du_j and to the technical requirement RT_j) have been calculated and properly combined, they define the *elementary value index* of the j-nth destination of use compatibility in relation with to the n-nth particular parameter (see Table 1):

$$\text{Elementary Value Index} = W_{jn}/C_{jn}$$

However it would be better to give a range of standard values, from 1 to 5 in order to attribute value 5 to the element which has the highest elementary value and 1 to that which has the lowest.

Since such an index can tend to an infinite value if the reintegration cost C_{jn} is equal to zero (to which corresponds a compatibility of 100%), to provide the standardisation of elementary value indexes it is better to use in the calculus, instead of the same indexes, their respective reciprocal C_{jn}/W_{jn} .

Organising the elementary value indexes, after they have been standardised, into matrices, it is possible to compile the following matrix:

Table 1.

Spatial Element ES_i		Destination of Use DU_j		Technical Requirement: $RT_n = \text{thermic insulation}$
Parameter B1	Technical Element	W	C	Notes
	E_{i1}	W_{i1}	C_{i1}	
	E_{i2}	W_{i2}	C_{i2}	
	
	E_{im}	W_{im}	C_{im}	
TOTAL	W_j	C_j		

$$Ive = \begin{bmatrix} Ive_{11} & Ive_{12} & \dots & Ive_{1N} \\ Ive_{21} & Ive_{22} & \dots & Ive_{2N} \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ Ive_{J1} & Ive_{J2} & \dots & Ive_{JN} \end{bmatrix}$$

In such a matrix, the elements Ive_{jn} which are form it represent the capacity of the destination of use j ($j=1, \dots, J$) to satisfy the parameter n ($n=1, \dots, N$) and then basically they represent indicators of quality, which in this case means the capacity of an entity (in this case the destination of use) to satisfy needs (both implicit and expressed).

We can also say that, the way in which the elementary value indexes have been defined gives us the possibility to consider them as representative of the compatibility degree of a destination of use of the building, in relation to the considered parameter.

To calculate the Value indexes "Iv" of each hypothesis, which in this case is the destination of use, we have to attribute to the particular parameters and then to the general ones, their respective "weights" so as to be able to make a pondered sum which will provide a final graduation of the studied hypothesis.

The parameter's weights are decided by the comparisons between couples of them, first of all attributing a (qualitative) score representing the sum of the preferences of that parameter in relation to the others and then, finally standardising the obtained scores in a range from 1 to 10. In the comparison between couples, the scores related to each parameter are attributed on the base of the degree of their relative importance, referring to this ordered list:

- 1: minimum preference
- 2: low preference
- 3: medium preference
- 4: high preference
- 5: maximum preference
- letter/letter: no preference (parity)

From the matrix **Ive**, it is possible to extract "m" matrices **Ive_m** (blocks or cells), in which "m" is the number of the general evaluation parameters we have considered. Each of this sub matrices contains the elements Ive_{jn} corresponding to the level of satisfaction related to the j-nth solution ($j = 1, \dots, J$) which have been esteemed in relation with the particular parameter n-nth ($n = 1, \dots, N_m$) taken into consideration, where N_m is referred to the number of particular parameters belonging to the m-nth general parameter. Obviously $\sum_m N_m = N$ (total number of particular parameters).

Ive_m can be defined as the matrix of each hypothesis elementary value indexes in relation to the m-nth parameter.

Multiplying **Ive_m** by the matrix of weights related to the particular parameters which belong to the general parameter m-nth and dividing by the weights sum, we reach the score of the esteemed solutions in relation to the parameter m-nth

For example:

Parameter: A – feasibility in relation to the technological sub-system (Table 2).

The Du_j Hypothesis' score in relation to the parameter A, can be obtained using this equation:

$$\frac{((Ive_{j1} \times w_{11} + Ive_{j2} \times w_{21} + Ive_{j3} \times w_{31} + Ive_{j4} \times w_{41}) / (w_{11} + w_{21} + w_{31} + w_{41})) = Iv_{j1}}$$

In some way the other coefficients of the Du_j hypothesis in relation to the rest of the parameters (B, C, ..., G) will be obtained. Such coefficients, after they have been ordered into a matrix, represent the scores of every alternative in relation to the general parameter considered each time.

Multiplying the matrix constituted by each hypothesis Value index in relation to the general parameters fixed by their weights matrix, we get the **Iv** matrix, whose elements Iv_j represent the pondered sum of the j-nth solution scores, or in other words each hypothesis Value indexes being finally able to compile the final graduation of the esteemed solutions, putting in the highest position the solution related to Iv_{max} .

Table 2. Parameter: A – feasibility in relation to the technological sub-system

	Parameter: A1 Weight = w ₁₁		Parameter: A2 Weight = w ₂₁		Parameter: A3 Weight = w ₃₁		Parameter: A4 Weight = w ₄₁	
Du ₁	Ive ₁₁	Ive ₁₁ xw ₁₁	Ive ₁₂	Ive ₁₂ xw ₂₁	Ive ₁₃	Ive ₁₃ xw ₃₁	Ive ₁₄	Ive ₁₄ xw ₄₁
Du ₂	Ive ₂₁	Ive ₁₁ xw ₁₁	Ive ₂₂	Ive ₂₂ xw ₂₁	Ive ₂₃	Ive ₂₃ xw ₃₁	Ive ₂₄	Ive ₂₄ xw ₄₁
Du ₃	Ive ₃₁	Ive ₁₁ xw ₁₁	Ive ₃₂	Ive ₃₂ xw ₂₁	Ive ₃₃	Ive ₃₃ xw ₃₁	Ive ₃₄	Ive ₃₄ xw ₄₁
Du ₄	Ive ₄₁	Ive ₁₁ xw ₁₁	Ive ₄₂	Ive ₄₂ xw ₂₁	Ive ₄₃	Ive ₄₃ xw ₃₁	Ive ₄₄	Ive ₄₄ xw ₄₁

$$Iv = \begin{bmatrix} Iv_{11} & Iv_{12} & \dots & Iv_{1m} \\ Iv_{21} & Iv_{22} & \dots & Iv_{2m} \\ \dots & \dots & \dots & \dots \\ Iv_{j1} & Iv_{j2} & \dots & Iv_{jm} \end{bmatrix} \times \begin{bmatrix} w_1 \\ w_2 \\ \dots \\ \dots \\ \dots \\ w_m \end{bmatrix} = \begin{bmatrix} Iv_1 \\ Iv_2 \\ \dots \\ \dots \\ \dots \\ Iv_j \end{bmatrix}$$

The VA method, intervening before and during the planning of a project, allows both possible checks of the solutions proposed in the project regarding the prescriptions related to needs and performances included in the contract of performance and creativity moments. Taking into consideration the functions which have to be satisfied by the studied entity to meet the customer/user's explicit and implicit needs, it gives the possibility to "measure" the degree of satisfaction.

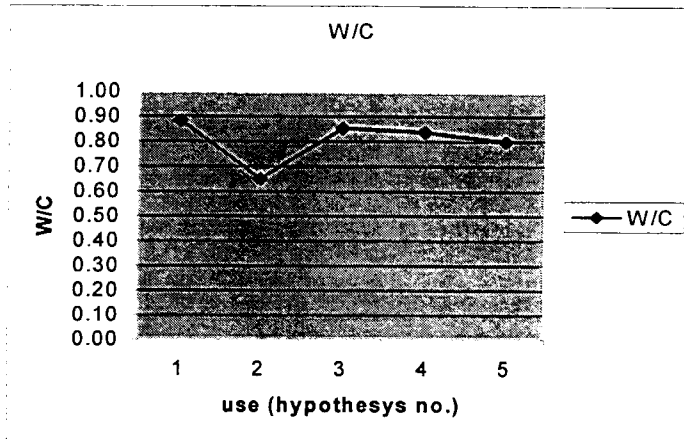
The case study shows how a rigorous methodology can lead the Public Purchaser to better satisfy the community needs. The introduction of the Value index sintetizza in a clear manner the results of a specific application of Value Analysis. Among the different uses of the "Ospedale degli Innocenti" in Pisa, the comparison has been done considering 5 hypothesis, calculating for each the utility W and the global cost C.

hypothesis n°	Use	Utility W	Global cost C
1	Museum	1,5	1,7
2	Youth hostel	1,3	2
3	Cultural center	1,45	1,7
4	Center for media	1,55	1,85
5	Offices	2	2,5

Fig.1 shows how Value Analysis can quantify the value indexes of the different solutions.

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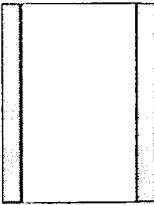
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graph 1

1	2	3	4	5
INFORMATION	CREATIVITY	ANALYSIS	DEVELOPMENT	PRESENTATION
OBJECTIVES - Appraising the building's qualitative consistence- - Performing the meta-projectual phase for every destination of use. Hypothesised - individualisation of great functional interest's areas - classification of the functions	OBJECTIVES - Producing ideas - Looking for alternative solutions to carry out the project. - Identification of evaluation criteria	OBJECTIVES - Appraising the hypothesised solutions - choice of the best alternatives - classification of the best alternatives	OBJECTIVES - Developing the best solutions, Proving its feasibility - Pointing out advantages and disadvantages - Defining technical economic characteristics for the carrying into effect - Setting procedures for proclamation of planning	OBJECTIVES - Introducing the result of the study -Showing the feasibility of the solutions - stating the reasons for the choice - Giving the customers the possibility to make a choice on the proposals
TOOLS - historical investigation - survey of the building's geometric, environmental mechanical characteristics - diagram FAST	TOOLS - techniques of creativity - brainstorming - check-list	TOOLS - multi-criteria analysis - costs/benefits analysis	TOOLS - Suggestions for the customers/users - techniques of work planning	TOOLS - reports and illustrative graphics-

Enclosure1. Starting data on which the team bases the elaboration.

informative phase on the building - chart for technological unit - present state				
technological unit	description	graphics and reports	Indication of possible checks	notes
1.2.1 vertical closing				
Amount of the vertical technical elements of the building system with the function to separate its inside spaces from the outside				
informative phase on the building – chart of classes of technical elements – present state				
technological units	description	Survey of deterioration	possible interventions	notes
1.2.1 vertical closing				
Class of technical elements 1.2.1.1 boundary walls				
informative phase on the building – chart of technical elements –present state				
technical element	functions	provided performance	synthetic assessment on the quality of the provided performance	notes
1.2.1.1.1 boundary wall PPV3				
 schematic section	it withstands the actions			
	it protects from noises			
	it reduces thermic dispersions			
	it facilitates the maintenance			
	it withstands the fire			
	it withstands the cold			
	It avoids condensation			
.....				

Enclosure 2. Informative phase about the building

