

VALUE ANALYSIS - AN APPROACH TO SUSTAINABILITY

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Abstract

Since the birth of Value Analysis (VA), during last century, by L. D. Miles all Value Management (VM) tools aim at increasing the Value of a VA subject, this being defined as the relationship between the satisfaction of needs and the resources used in achieving this satisfaction [1].

VA, which led to VM, was seen, formerly, as a cost reduction tool, even if using a functional approach. Today this is no longer possible and any VM study must take into account the different stakeholders needs and expectations. Technical and economical aspects can no longer be separated from environmental and social ones which means that the three components of Sustainability must be considered.

The authors, coming from different backgrounds and experiences, have been developing, testing and implementing a methodology – Sustainable Value – profiting from the synergies between VA and other methodologies and concepts connected with Sustainability, mainly Cleaner Production and Eco-efficiency ones.

The main difference towards any ordinary VA application is that through all the VA work plan special attention is paid to the three Sustainability vectors: economical, social and environmental - in the gathering of data, in the characterisation of functions during functional analysis, during creativity and in the evaluation of ideas.

This approach has already been tested and implemented in about 20 companies from different areas: metal mechanics, plastic transformation, detergents, automotive components, quarrying and stone processing, etc.

The proposal is to present this approach as well as some results and difficulties in its implementation.

Keywords

Sustainable Value, Value Analysis, Value Management, Sustainability, Cleaner Production, Eco- efficiency

INTRODUCTION

For centuries, throughout the industrial history, in a more or less explicit way, the adequate use of resources has always been an objective. When Miles developed Value Analysis methodology, last century, at the end of the forties, he had also this aim in mind. The evolution of concepts lead to the present Value definition as the relationship between the satisfaction of need and the resources used in achieving that satisfaction [1]. In other words, and because it is a functional approach, the objective is reached by improving functions performance and reducing resources.

Other tools and approaches, in different areas, have been developed with identical objectives. When speaking about Cleaner Production, for example, the aim is to produce more with higher levels of quality using less materials, water and energy. As to eco-efficiency what is meant is the double aspects of economics and ecology, or going further on, into Sustainable Development as a process whose main objective is to satisfy the needs of present generation but leaving opportunities to the future ones. Therefore by Sustainability is meant the result of optimisation of a multi criteria process in a very complex system that takes into account three basic dimensions: economical, ecological and social.

Five years ago, in INETI (a Portuguese state laboratory for engineering, technology and innovation), the authors of this paper joined in a working team – the Sustainable Value (SV) team. The objective was to develop a methodology which profits from those technicians' different experiences in the above mentioned tools and areas and from the existing synergies between those ones.

It is the output of this experience that will be presented in this paper - the methodology and the Manual [2] where it was published. More than 20 companies coming from different sectors: metal mechanics, plastic transformation, detergents, automotive components, quarrying and stone processing, just to name some, have already tested it.

THE METHODOLOGY STEP BY STEP

Starting from the VA work plan, as defined in the EN 12973: 2000 [3] (Table 1), the SV team developed a new work plan (Table 2).

The Manual was elaborated in order to support both the work done by the multidisciplinary team constituted by elements of each company involved in the application of the methodology and the process of decision making within companies. In this Manual, together with some introductory text, are compiled the different sheets used in each phase of the work plan. They can also be used in Excel program.

The greatest amount of work to be done along the process has to do with the gathering and processing of information. Even when the companies have all the needed information available, most of the times it is not worked in order to satisfy the methodology needs. Therefore there is a lot of work to be done by each company working team.

The application in a particular company (case study) will be used to exemplify some of the phases of the methodology, namely those where special attention is paid to the three Sustainability vectors: economical, social and environmental - in the gathering of data, in the characterisation of functions during functional analysis, during creativity and in

the evaluation of ideas. This company manufactures automotive components and its study subject was the manufacturing process with the objective of increasing the Sustainable Value of a certain component.

All the unitary operations were identified (Figure1) as well as the inputs and outputs of materials, energy and water. All the collected information is treated and gathered in the eighteen forms referred to as IG in the third column of Table 2. The detailed costs for each operation related to the components are quantified in what concerns human resources, equipment, energy, materials, water and emissions and waste management. The global repartition of costs is shown in Figure 2.

The study subject is then submitted to functional analysis this being a systematic process to describe completely the study subject's functions and their relationships. They are systematically identified, characterised (Figure 3), classified and evaluated [3].

The level of satisfaction of the user will depend on the performance of those functions, being the user more and more aware of the environmental and social aspects associated to the goods he uses.

In order to contribute for a progressive orientation of companies towards Sustainable Value it is essential that when working on this Functional Analysis phase, the stakeholders' needs (expressed in functions terms) through the life cycle of the study subject take into account not only social and economical worries, but also the environmental aspects.

To estimate Value, or more precisely in this context, Sustainable Value, it is used the definition of Value already mentioned [1]:

Value = Satisfaction of needs/use of resources

The needs are characterised and quantified by the outputs of phase 4 (AF01 – functions listing, AF02 – functions characterisation, AF03 – functions hierarchization, AF04 – cost / function, AF05 – cost / importance, part of AF06 – satisfaction of needs).

As to the resources quantification it comes directly from phase 3 (IG 01 – general manufacturing diagram, IG 02 – specific manufacturing diagram, IG 03 – study subject components, IG 04 – operations description, IG 05- raw materials, IG 06 – auxiliary materials, IG 07 – packages, IG 08 – water, IG 09 – energy, IG 10 – final products, IG 11 – sub products, IG 12 - intermediary products, IG 13 – waste, IG 14 – atmospheric emissions, IG 15 –waste water, IG 16 – noise, IG 17 – mass balance, IG 18 – cost model) where all the inputs and outputs were costed

In all these elements, whenever possible, the three components of Sustainability (economical, social and environmental) are taken into account and therefore the designation of the Value relation as Sustainable Value. This indicator will later be compared to the ones that will be obtained by implementing the proposals generated in phase 6.

The eco inefficiencies of the study subject and its social and environmental impacts detected in phase 3, as well as the non adequate performance of its functions that may have to do either with a non desired level of satisfaction, higher cost than the relative importance of the function, or any other problem are then synthesized in phase 5. The results of this synthesis are good starting points for the creativity process that will follow. Using collective creative methods, of which brainstorming is one commonly used, a lot of ideas can be gathered in a relatively short period of time.

In this case study 66 ideas were generated being the materials costs one of the starting points due to its weight in the costs distribution (Figure2). They were classified according to the time needed for implementation as follows:

- ✓ Short term implementation – 5 ideas
- ✓ Medium term implementation – 27 ideas
- ✓ Long term implementation - 23 ideas
- ✓ Ideas not be considered - 11

Another classification of the generated ideas that can be used is related to Cleaner Production techniques, and for the case study analysed the results were:

- ✓ 25 ideas dealing with good practices
- ✓ 22 ideas to modify the process
- ✓ 6 ideas about materials changes
- ✓ 4 ideas for internal valorisation
- ✓ 3 ideas for product modification

When classified according to eco – efficiency principles the results were:

- ✓ 37 ideas for materials reduction
- ✓ 16 ideas for energy reduction
- ✓ 5 ideas for toxic dispersion reduction
- ✓ 5 ideas for incentive to recyclability
- ✓ 3 ideas for maximization of renewable resources consumption

Then it is analyzed the viability of the selected ideas and here again the Sustainability principles are present, and so there is a technical, an environmental and an economical viability analysis (with its specific sheets, AV01, AV02, AV03) as well as the sustainable value calculation (AV04) for each chosen proposal so that the ones with higher values and in accordance with the objectives and constraints defined in phase 2 will be chosen for further development planning and implementation, thus completing the Sustainable Value work plan.

In a first stage, the implementation in the company that has been used to illustrate this paper had as main results the increase of Sustainable Value in 25% obtained through resources decrease and performance increase. This results from reductions in water consumption (28%), waste water (100%), noise (25%), emissions (90%), and waste generation (20%). The improvement of the company image as well as working conditions must also be referred as well as a better awareness towards the social aspects related with the company activities.

DIFFICULTIES IN THE PROCESS

Even when the needed information is available in the company, it is not processed in the way needed to be worked within the frame of the proposed work plan. So and in order to use the working sheets there is always a lot of work to be done.

The problem is that most of the times the company thinks that it is enough just to

provide the unorganized information and the team leader will do the job. But this methodology implies the effective involvement of the working team. This involvement has to do with two main aspects: the first one is that the ones who better know the organisation and its particularities are those living and working there. Of course that an external look can also bring added value, but for most aspects it is essential the real involvement of the most interested parts in the process, those who know every detail of its inside – the company itself. Besides, the objective of an intervention of this kind is not only to solve a specific problem but above all to introduce and implement in the company a new methodology and a new way of thinking and solving the daily problems. And the only way of learning such methodologies is by doing.

All those problems vanish or at least are significantly reduced when there is a real and effective support from the Decision makers, this being translated not only in the interest on the working progress but and specially in providing the necessary resources (human resources availability, material, financial whenever necessary) for the work to be performed.

RESULTS AND GENERAL CONCLUSIONS

In a general way the application of this methodology, in several SME lead to the following global results:

- ✓ Increase of Sustainable Value;
- ✓ Company eco - efficiency improvement;
- ✓ Development of new products;
- ✓ Expression of user's needs;
- ✓ Diagnosis of manufacturing processes at environmental, economical and social levels;
- ✓ Identification, control and reduction of cost;
- ✓ Optimisation of manufacturing processes;
- ✓ Adoption of environmental best practices;
- ✓ Improvement of the environmental profile of processes and products
- ✓ Reduction of materials, energy and water consumption;
- ✓ Waste preventive approach;

- ✓ Reduction of toxic dispersion;
- ✓ Company competitiveness improvement;
- ✓ Improvement of internal and external communication – with workers, suppliers clients and local community;
- ✓ Attitudes and behaviour change;
- ✓ New competences development in companies namely in what concerns Sustainability;
- ✓ Adoption of more social responsible behaviour by the companies.

The present edition of the *Manual Valor Sustentável* [2] must also be mentioned as an important result of the work developed.

One of the main conclusions to be taken is the applicability of the methodology in companies from different areas and dimensions, with different study subjects and the confirmation of the good results that can be obtained with its application.

The methodology enables the companies, which apply it, to diagnose the main problems concerning their manufacturing processes and products (for those that decide for an integrated study of the product) leading to the quantification of the total costs including the environmental and social ones. It also leads to the improvement of functional performance of the study subjects by improving the satisfaction of the user's needs and by using a pollution preventive approach and by taking into account the eco efficiency principles through the application of the methodology. It also contributes to costs reduction by minimizing resources intensity (materials, energy, water, operation time, ...) of products and services.

The application of the methodology leads to ideas that increase the sustainable value of the study subject of the company and improve communication. It also leads to the adoption of more responsible corporate social behaviour by the companies as well as to the increase of their competitiveness.

The methodology shows a high potential to be used as an operational tool for the development of sustainability at entrepreneurial level.

The success of such an approach depends on the effective support of company's Top Management.

TABLES

Table 1: Responsibility (●) and participation (X) during the phases of the VA work plan ⁽¹⁾

Phase Name	Phase Nr.	Decision maker	Team leader or VA project leader	Working group	Operational departments
Preliminary Phase	0	●			X
Project Definition	1	●	X		X
Planning	2		●		
Gathering data	3		●	X	X
Functional Analysis	4		●	●	X
Gathering ideas	5		●	●	X
Evaluation of solutions	6		X	X	●
Development of proposals	7		●	●	●
Presentation of proposals	8	●	●	●	X
Implementation	9	●	X		●

⁽¹⁾The responsibility and participation will vary from project to project and from organisation to organisation

Table 2: Value Analysis versus Sustainable Value work plan and its working sheets

Value Analysis Phase Name	Sustainable Value Phase Name (Sustainable Approach)	Sheets to be used by the working team (option Excel sheets)
0. Preliminary Phase	1. Company general data	DG 01 – general identification DG 02 – labour conditions DG 03 – staff flowchart DG 04 – relationship with stakeholders
1. Project Definition 2. Planning	2. Project specific data	DE 01 – study subject DE 02 – working team DE 03 – objectives DE 04 – constraints DE 05 – information about the product
3. Gathering data	3. Global inventory	IG01 – general manufacturing diagram IG 02 – specific manufacturing diagram IG 03 – study subject components IG 04 – operations description IG 05- raw materials IG 06 – auxiliary materials IG 07 - packages IG 08 - water IG 09 – energy IG 10 – final products IG 11 – by products IG 12 - intermediary products IG 13 - waste IG 14 – atmospheric emissions IG 15 –waste water IG 16 - noise IG 17 – mass balance IG 18 – cost model
4. Functional Analysis	4. Functional Analysis	AF 01 – functions listing AF 02 – functions characterisation AF03 – functions hierarchization AF 04 – cost / function AF 05 – cost / importance AF 06 – sustainable value
5. Gathering ideas	5. Problems synthesis 6. Previous identification and selection of ideas	SP 01 – problems synthesis II 01 – ideas listing and classification II 02 – ideas description II 03 – definition of groups of ideas
6. Evaluation of solutions	7. Viability analysis	AV 01 – technical viability AV 02 – environmental viability AV 03 –economical viability AV 04 –sustainable value
7. Development of proposals		
8. Presentation of proposals 9. Implementation	8. Action plan	PA 01 – action plan

FIGURES

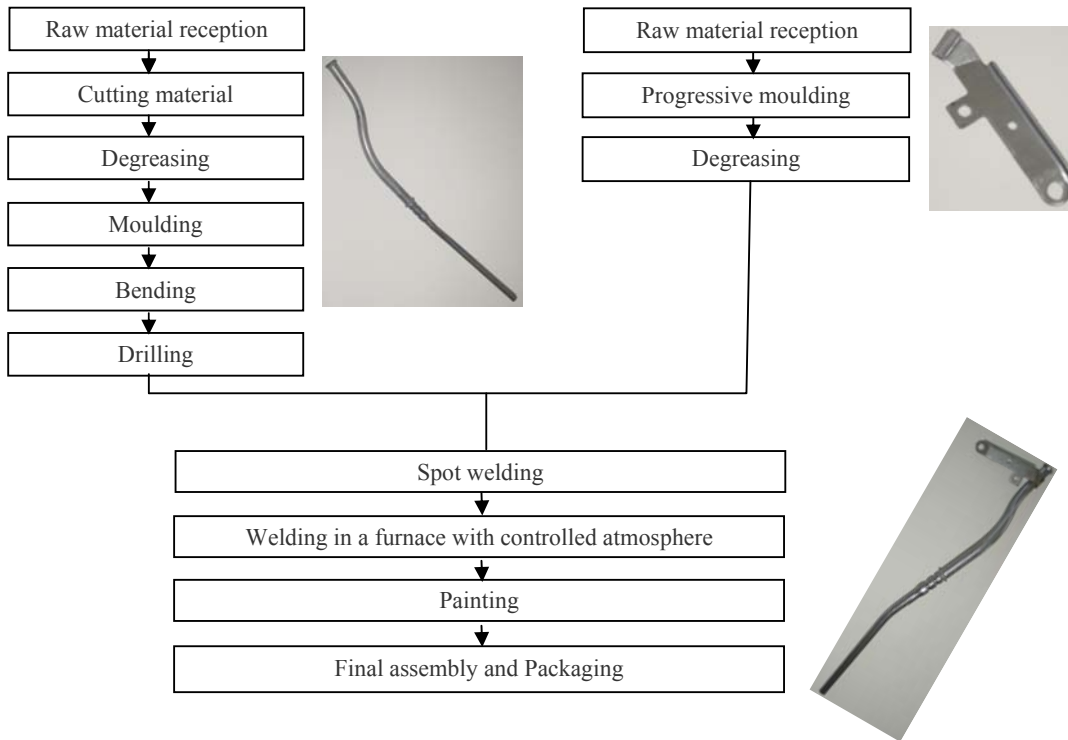


Figure 1: Example of a general manufacturing diagram (IG 01)

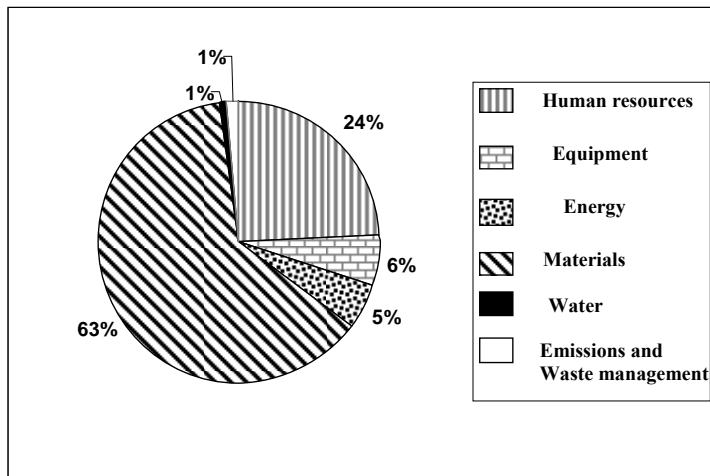


Figure 2: Costs Distribution - example

Function	Criteria	Desired level	Existing level	Comments
Mould component	Technical			
	% internal iron scrap	0%	30%	
	Tools Setup	30 min.	45 min.	
	Environmental			
	Legal conformity of noise level at working post	90 dB	94,9 dB	Press 160 t
Social				
	Legal conformity of noise level at working post	90 dB	94,9 dB	Press 160 t

Figure 3: Example of Function characterisation (Technical, environmental and social criteria)

REFERENCES

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- [3] European Standard Value Management EN12973