11. SYMPOSIUM „DESIGN FOR X“
SCHNAITTACH, 12. UND 13. OKTOBER 2000

INTEGRATING DESIGN METHODOLOGY

Mario Fargnoli, Umberto Pighini.

1 Introduction

The evolution of market requirements in the last years has deeply transformed the designers way of thinking and operating during the product development stages.

In fact, at present, a short time of product development, an high level of quality, a minimum environmental impact, the respect of safety parameters and, on the other hand, the minimum level of cost have become absolutely necessary requisites in order to achieve the product success.

The combination of all such aspects gave rise to a lot of remarkable problems during the product development, particularly during the design stages, and the output of this situation is that very often some of such requisites are neglected or disregarded.

Many Authors [1; 8; 16, 18] in the field of the product development are convinced that a more intensive use of Design Methods is the right way to try to solve the problem underlined.

Nevertheless, at present, only big companies use a limited number of Design Methods, often in an unsatisfactory and incomplete way.

The main reasons for this wrong way to use methods (Design Tactics) into the Design Process (Design Strategy) must be sought in the lack of a deep knowledge of the available methods and the lack of a complete knowledge of their rationale and co-ordinated use in the Design Process.

The aim of this research is to give a contribution to the solution of such important problem, otherwise to answer to this question: “How can the use of Design Methods can improve the Design Process in order to help the designers to reach optimal results in shorter time?”

1. The research approach adopted is based on a continuous improvement and can be subdivided in three main stages:

2. definition of a complete classification and characterization of the available design methods;
3. establishment of the right way to co-ordinate them;

4. development of a general Procedure which allows for a rationale and integrated use of the methods in the design process.

2 Classification and Characterisation

Regarding design methods as rational procedures which allow for the achievement of a specific result in the optimal way, in the first phase of this study among the high number of methods (more than 100), were selected the most diffused and the best known (about 90) and studied the characteristics of each one.

The result of this first step was a generic classification of the methods (**Level I**), very important in order to develop a first subdivision in four classes (**Level II**):

- Class A: methods for data collection
- Class B: methods for searching new ideas;
- Class C: methods for improving existing solutions;
- Class D: methods for evaluation.

In this second step of the work it was possible to add to each method more information about it: effectiveness, cost and need of a group work.

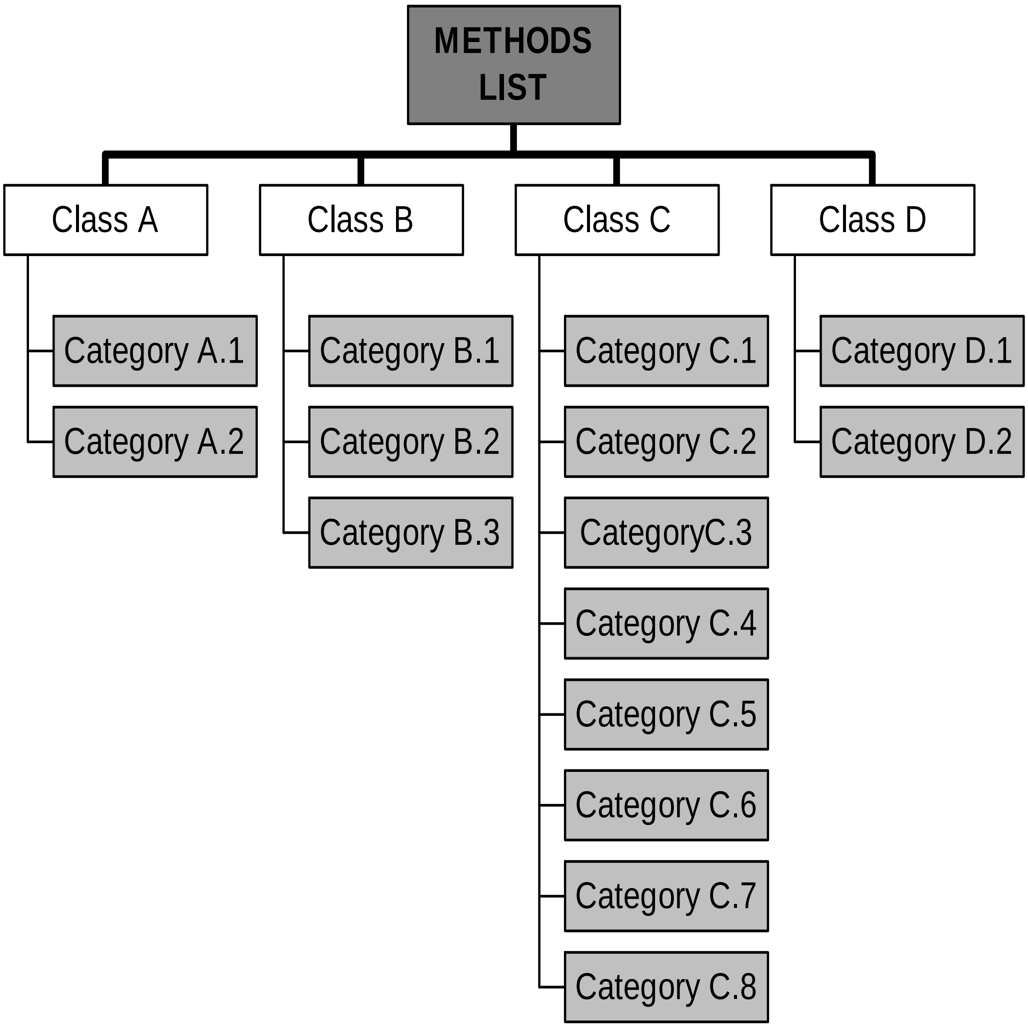
On the basis of this deeper characterisation, we subdivided each class in categories (**Level III**; example1): Developing each class, it was possible to define a complete and accurate characterisation of the methods regarding the specific aim of each method (example 2)

In the final step of the characterisation (**Level IV**) each method was described, pointing out the "*moment of use*", i.e. in which phase or sub-phase of the Methodical Design Process it would be better to use it.

3 Co-ordination and Integration

Once methods characterisation has been achieved, it is possible to study their coordinated uSe, analysing their inter-relationships (example 3).
On the basis of these results, was developed a general procedure including the right methods in each phase, sub-phase and step of the Design Process (example 4).
The aim of this work is to supply an easy and appropriate tool for the designers: they can use the right methods at the right time, optimising the design work.

Prof. Ing. Umberto Pighini
Chair of Machine Elements and Methodical Design
Dept. of Mechanical and Aeronautical Engineering
University of Rome "La Sapienza"
via Eudossiana, 18 – I – 00184 – Rome - Italy
Telephone no. 003906-44585236
FAX no. 003906-4881759
E-mail: u.pighini@dma.ing.uniroma.1.it
Ing. Mario Fargnoli
Chair of Machine Elements and Methodical Design
Dept. of Mechanical and Aeronautical Engineering
University of Rome "La Sapienza"
E-mail mario.fargnoli@libero.it



Subsequent levels of characterisation:

Level I

Level II

Level III

Fig. 1 – General Classification of Design Methods (“Methods Tree”)

- **Example 1- Methods Classification: Classes and Categories.**

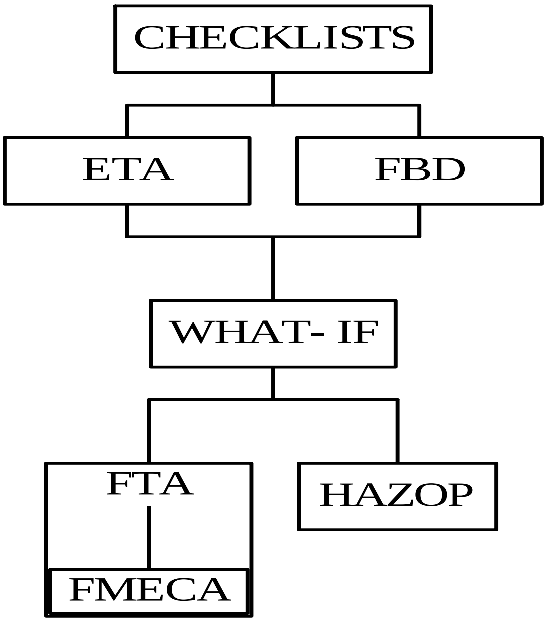
CLASS A	
4 Category A.1	Data Research Methods “IN”
Category A.2	Data Research Methods “OUT”
CLASS B	
5 Category B.1	Associative Methods
Category B.2	Creative Confrontation Methods
6 Category B.3	Analytic-Systematic Methods
CLASS C	
7 Category C.1	Methods for Quality
Category C.2	Methods for Reliability
8 Category C.3	Methods for Safety
9 Category C.4	Methods for Ergonomics
10 Category C.5	Methods for Assembly
Category C.6	Methods for Environmental Impact
11 Category C.7	Methods for Recycling
12 Category C.8	Methods for General Improvement
CLASS D	
13 Category D.1	Methods for General Evaluation
Category D.2	Methods for Cost Evaluation

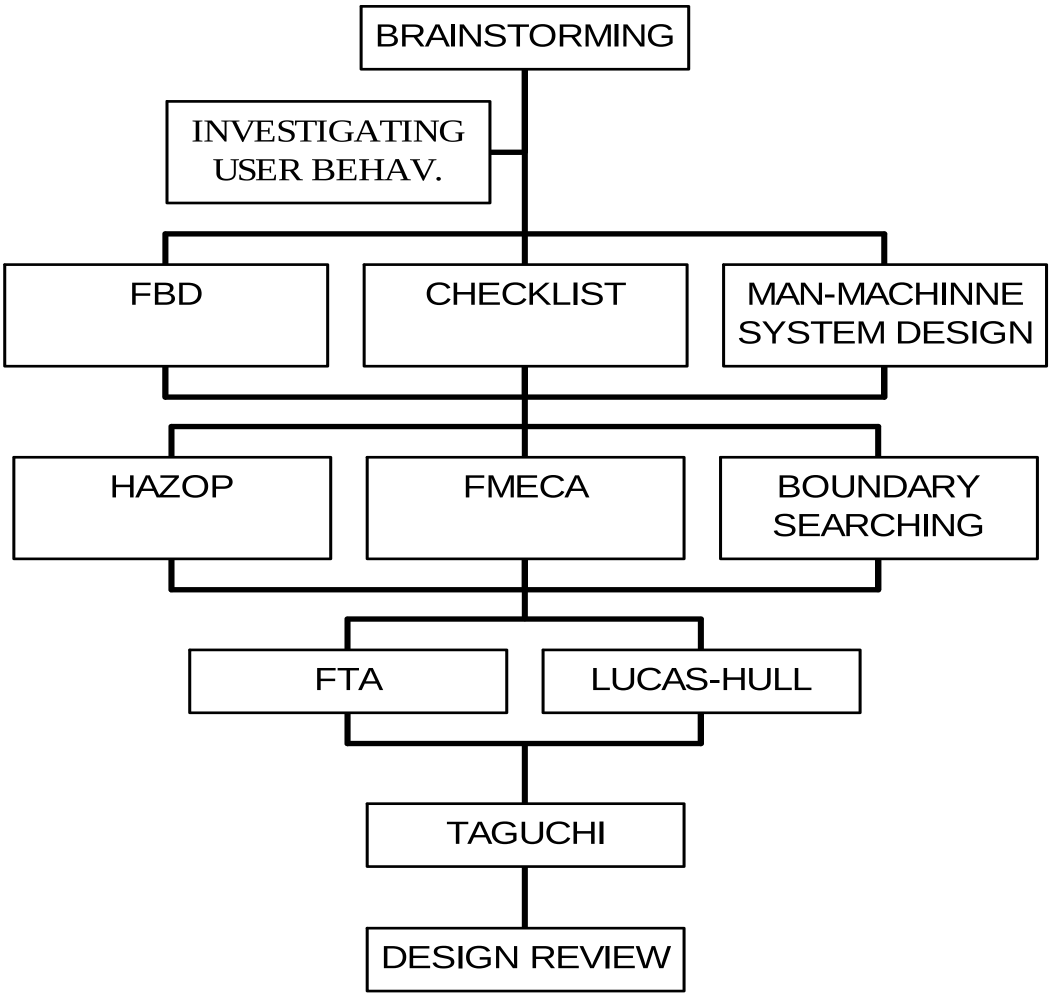
- **Example 2: Class C Methods Classification at Level III.**

CLASS [C]: *Methods to improvement existing MS.*

13.1.1 METHODS		OBJECTIVES
CATEGORY [C.1]: Methods for Quality		
C.1.1	**14 Benchmarking**	To analyse and compare different products, strategies and functions in order to achieve the optimisation of the MS..
C.1.2	Design Review	To evaluate the design requirements and the capability of the design to meet these requirements.
C.1.3	**15 Pareto Method**	Singling out of the more important parameters which characterize the MS.
C.1.4	**16 Quality Loops**	To study the interacting activities that influence the quality of a product, process or service.
C.1.5	**17 QFD**	To translate the user requirements in proper specifications for each stage of development of the product.
C.1.6	Taguchi Method	To find robust solutions that withstand the disturbances.
17.1.1 CATEGORY [C.2]: Methods for Reliability		
C.2.1	FMECA	To study the potential failures that might occur in any part of a MS and the probable effects of each failure.
C.2.2	FTA	To identify the undesirable events of a system.
C.2.3	Quirk's Index	To enable inexperienced designers to identify unreliable components without testing
17.1.2 CATEGORY [C.3]: Methods for Safety		
C.3.1	Change Analysis	To increase safety level of a MS changing its characteristics.

- **Example 3: Methods Coordination**





❑ **Example 4: Integrated Design Process (Phase I of Methodical Design Process)**

*17.1.3 **Phase I**: TO CLARIFY ASSIGNED TASK*

I.1 : DATA COLLECTION	
	17.2 METHODS
I.1.a: Existing MS characteristics.	*A.1.2* 17.3 *B.3.4* *17.4* B.3.6 *C.8.2*
I.1.b: State of the art (theories, patents…)	
I.1.c: Marketing investigations.	*A.1.1* *A.2.2* *C.4.3* *C.5.1*
I.1.d: Available resources.	
I.1.e: Other information	*B.3.4*
I.2 : FEASIBILITY STUDY	
	17.5 METHODS
I.2.a: Data elaboration.	*A.2.2* 17.6 B.3.6 *17.7* *C.4.2* *C.7.1*
I.2.b: Problem analysis (parameters, constraints ..)	*C.1.3* *C.3.2* *C.3.7* *C.4.4* *C.8.1*

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