**Title :** *"A new original Scheme for Preventing nowadays modern Machine Design Failures*

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**Abstract :**

Traditional classical design methodologies consider (or do not consider at all) the question of the "delivery" at the latest stages of the overall machine design project. Most of the machine design projects are nowadays highly time-dependent, volatile and uncertain. Due to the nature of the design process itself (Inverse iterative problem with a large number of constraints to be satisfied) a new form of "design failure" occurs : the come up with a given satisfactory design iteration that is not available within the requested delivery time interval~~s~~ of the overall *project*.
The current article intends to present a design methodology in 8 steps that organizes the overall machine design process in a way to avoid this problem.

**Keywords :**

Machine design process, detail design, machine elements, design methodologies, delivery constraints, generalized safety ratios ;

**Introduction :**

In nature, the design process is usually considered as one of the most complex processes as it requires very often the satisfaction of (a large number of) antagonist constraints. This inverse problem is only solvable by iterative approaches, each of the realized iteration tending to refine the design a step ahead and thus the largest the amount of iteration is done, the finest the design will be as it tends to satisfy the best way the specification in their wholes. Many authors ([0], [1], [4], [6], [7], [8], [21], [22]) deeply analyzed and tried to summarize this tricky problem of "design" with the aim of facilitating and systematizing the designer's tasks. Anyway, most of them approached the machine design project only on the technical point of view trying to canalize these different iterations into a general *"step by step"* methodology ([21] .. [26]). Additionally, some works completed these technical approaches with cost considerations but only for potential product design comparison purposes ([24], [25], [26]). Never, at the machine design level, in all of these approaches the question of *"the design time"* was taken into account, thus being fully considered as a secondary problem that is not related to the machine design process : this is treated afterwards by other specialized teams of the supply chain and the responsibility *"of delivering the right design at the right time at the right cost"* is not accounted within the machine design process itself. Proceeding that way is considering that the time variable does not exist, what is, in nowadays highly challenging economy and fast developing/changing markets an unfortunate far too simplified assumption ! Many modern variables at the market and the manufacturing levels show that this factor has nowadays absolutely to be taken into account at the first early stages of the design methodology. Internal surveys showed that, over the last 15 years, per period of ~3 to 5 years, the requested *"times to market"* (machine design projects) have been divided per an average of a factor ~2 [-], while the *"decision times to invest"* have been multiplied by the same order of magnitude ! [16], [17] reports a first approach of this time constrains integration.

Factors explaining these trends are, f.e, the market versatility, the "mode effects", the uncertainty (also in the identification of the exact needs) and nowadays drastic *"lack of resources to do"*, make that a given design has to be launched quickly to be *"market's effective"*. On other sides, the nowadays productions, and thus the supply chain of mechanical components, need to be high and on a regular basis planned, reviewed and *"finely tuned"* to be able to reach the cheapest possible costs. Thus said,

one will easily understand that within a given machine design timeframe, the designer should thus directly avoid some given designs that would not satisfy the delivery times requested. Ignoring this new machine design project's "*intrinsic property*" will inexorably lead to "*machine design process failures*" : getting a design that is not available in the imparting requested time and thus needing to urgently re-design a new solution, expecting that this new one will satisfy the overall specification (thus, also the delivery constraints) is, in a sequential classical approach, not at all guaranteed ! Based on industrial practice of the machine design project analyzed over the last 7 years and not fewer than 101 industrial projects, Figure n°1 illustrates this new modern failure risk by comparing the *"Effective Design Time"* for 1st full design iteration with respect to the requested *"Time to Market"* : clearly there is no space for any second iteration !

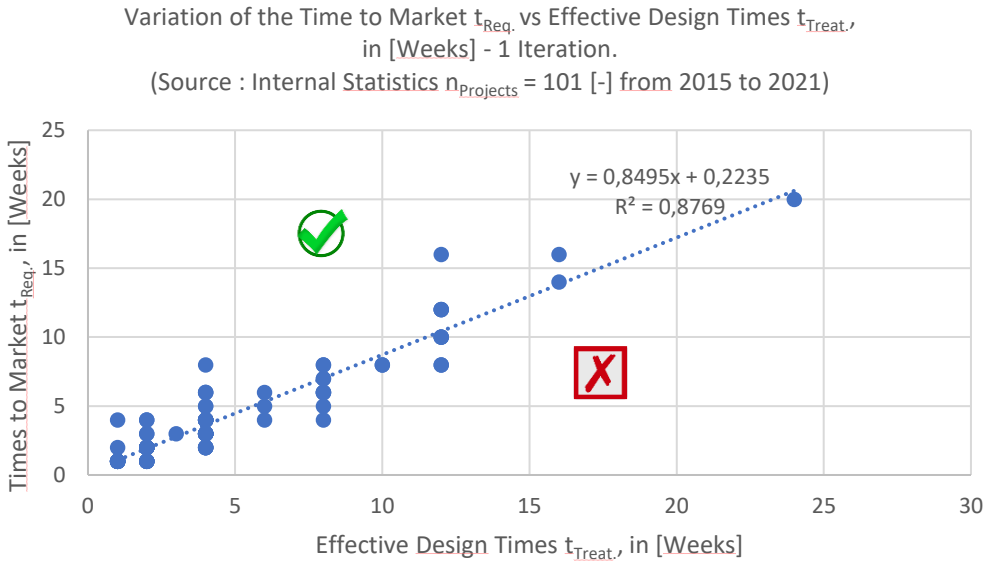


Figure n°1 the time paradox of the *"Time to Market"* vs the *"Effective Design Times"* (and more the *"Time to Invest"* !)

This analysis shows that design time is critical and that the designer should focus on the selection of available components, as the rejection of a design satisfying the specifications but not the delivery constraints results in a significant loss of time and money.

Also, for standard manufacturing programs, an additional observation was made : the numerous amount of potential marketed (but not necessarily available *"at time t"*) components makes the problem much more complex as it loses the designer into a (too) large domain of potential solutions.

Faced with this observation, this led us to the identification of a "8 steps design procedure" explained hereunder, as a further improvement of the previously published paper on the *"generalized safety ratio/alarms methodology"* ([16], [17]).

On the economic level, this original proposal draws also new "strategic perspectives" because it allows making use "at a given time t" of "low runner components" which are on stock but not necessarily called by the market. This way of doing improves the stock rotation by permanently rearranging the *"ABC Analyses"* and migrating "C" products to "B" or "A" category ([4], [10], [12]), reducing in such a way the risk of any wastage of goods.

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