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Quality Assurance – Professional Ethics, Management or Common Sense?

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1. OUR PROFESSIONAL CHALLENGE AND REPUTATION

The contribution to the introductory report for this symposium by Walter Bosshard, Jörg Schneider and myself on this subject was considered rather provocative by some colleagues. In this second attempt I will take up a more positive attitude and start with a fairly subtle question:

What is our Professional Challenge? Obviously, we all wish to design and build exciting structures, manifesting engineering art and skill, arousing public esteem.

There are many examples for exciting structures, but only a few per generation. The majority of us is only concerned with very common structures: Warehouses, industrial buildings, office buildings or even only with the rehabilitation of existing structures. But as concerns these moderate projects, we may at least attempt to design and build *excellent structures*.

What is excellent? We may say that structures should function adequately at reasonable costs - but there is more to it: Maybe structures should also be simple, optimal, beautiful, perfect, The best description in this respect was coined by Walter Bosshard referring to structures having '*Gestalt*'. Originally, this is a German word, but according to Webster's Collegiate Dictionary, '*Gestalt*' is *a structure so integrated as to constitute a functional unit with properties not derivable from its parts in summation*.

It is difficult to give examples for excellent structures and even more difficult to give example slides. The reason may be that '*Gestalt*' simply cannot be reflected by photographs.

Presuming that the audience has at least some perception of excellency or '*Gestalt*' in relation to structures and that all of us would like to sign responsible for many excellent projects, we may return to reality. Reality is truly reflected by *our professional reputation*.

If we are honest, we are actually considered to be more or less specialized technicians for limited tasks. Of course, there are exceptions, but the majority of us obviously has precisely the reputation we deserve.

We could accept this reputation in view of the general trend towards an increasing degree of specialization in all engineering faculties. However, recent accidents - not necessarily referring to the structural field - urgently suggest that engineers extend their scope of professional concern. With regard to accidents with world-wide consequences, the issue of professional reputation is less than marginal, but a certain relationship between professional conduct, tasks and reputation nevertheless exists.



For more moderate building projects consequences of inadequacies of the project are generally less disastrous. But as is generally acknowledged, inadequacies may often be traced back to the allocation of only limited task and, correspondingly, only to a limited scope of professional concern.

2. RELATION TO QUALITY ASSURANCE

The foregoing reflections may be considered as rather self-evident and the audience may be wondering whether this contribution will miss the topic, i.e.

Quality Assurance? This relation is clarified if we consider *how to achieve excellent structures* or in semi-scientific terms: What is the probability for realizing excellent structures? Referring to the individual operations of the building process, realizing excellent structures requires that

- specifications
- investigations
- design
- construction documents
- construction
- maintenance

are excellent. If the individual operations were independent of each other, we may obtain a rather low probability for obtaining excellent structures, simply corresponding to the product of the probabilities for the excellent individual operation.

Considering the individual operations in more detail, however, it can be recognized that e.g.

- the probability for an excellent construction may depend on the degree to which construction documents, design detailing, structural design, etc. are excellent, or
- the probability that construction documents are excellent may depend on the degree to which design detailing, structural design, architectural design, etc. are excellent, or
- the probability for an excellent structural design may depend on the degree to which the architectural design, investigations and specifications are excellent.

Vice versa it may be concluded (from probability theory or common sense) that e.g.

- the probability for an excellent construction is only increased by an excellent design, if design considers construction constraints, or
- the probability for an excellent structural design is only increased by an excellent architectural design, if the architectural design considers structural rules,

thus introducing additional criteria for assessing the excellency of the individual operation.

For the purpose of giving a definition - which these introductory lectures are expected to do - the following definition is offered: *Quality Assurance implies increasing the probability for obtaining excellent structures by increasing the probability for an excellent individual operation for given preceding operations and simultaneously increasing the probability for excellent successive operations.*



For obtaining structures performing adequately at minimum costs this involves

- sound technical solutions as the "conditio sine qua non"
- technical means for control, referring to sensible, cost-effective and timely methods
- more or less formalized control procedures to an extent which is appropriate to the job

supplemented by an organization of the building process ensuring

- cooperation among parties
 - information flow
 - clear responsibilities
- and - most important - a management, or better, leadership supporting
- motivation
 - education
 - efficiency.

3. DECISION MAKING

Where procedures are too complex to be comprehensively appraised by engineering judgement, aids for decision making are available. These aids or tools generally involve analytical methods, often referred to as "system analysis".

System analysis may be performed at various levels of sophistication, ranging from a pure qualitative assessment or a subjective allocation of quantities up to the application of reliability methods in conjunction with a detailed analysis of data. System analysis may be pursued for various purposes, e.g.

- writing specifications
- hazard identification
- deciding on investigations
- optimizing design
- weak point identification
- specifying control plans
- planning maintenance.

4. PATHFINDING

These methods and provisions obviously are of support for achieving an adequate performance of structures. But what about excellency or 'Gestalt'? Will this remain *a reservat for the grand engineers*? Clearly, aids for decision making alone do not render 'Gestalt'. If decision making involves the left part of our brain, 'Gestalt' strongly requests the right part of it. The Stanford business professor Harold Leavitt considers the managing process as an interactive flow of three variables: Pathfinding, decision making and implementation - as quoted in "The Search of Excellence" by Peters and Waterman. This may also apply to the managing of the building process and 'Gestalt' is strongly related to pathfinding. It follows that pathfinding should be supported by

- *improving working conditions*
 - *educating engineers in the art of design*
 - *promoting design aids*
- to make 'Gestalt' possible.



5. THE WAY TO GO

Threats to the inherent possibilities of Quality Assurance are imposed by

- a retreat to the soft sciences on the one hand and an over-emphasis of the purely analytical approach and formalized procedures on the other hand
- an overstressing of conceptual matters including verbal exercises on common sense generalities (therefore, this contribution comes to its end)

hence, this is not the way to go. I would suggest

- 1 - *Definition of the implications of QA;*
 - QA is more than*
 - . material control*
 - . design checking*
 - . organization charts*
 - . check-lists*
- 2 - *Missionary/persuasive stage*
 - explaining the ideas,*
 - general concepts,*
 - inherent possibilities for*
 - convincing the profession*
- 3 - *Gradual implementation of the concepts into*
 - everyday practice supported by ...*
- 4 - *Education:*
 - . engineering students*
 - and professionals*
 - . clients*
 - . authorities*
- 5 - *Critical appraisal of the regulatory background*
 - for engineering activity*
 - . codes*
 - . standards*
 - . contracts*
- 6 - *Development of aids/tools/methods*
 - . technical*
 - . decision making*

Concluding I should like to state that Quality Assurance should not be considered as a new discipline or a research subject on its own. It is only a framework for reflection supporting our professional conduct and challenge.