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Autor: Knoll, Franz
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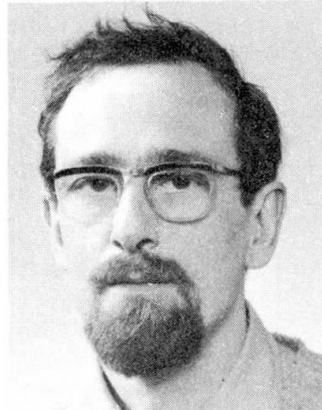
Quality, Whose Job?

Qualité, l'affaire de qui?

Qualität, wessen Aufgabe ist das?

Franz KNOLL

Dr. sc. techn.
Nicolet, Chartrand, Knoll
Montreal, PQ, Canada



Born 1937, in St.Gallen, Switzerland. Civil Engineer Diploma, ETH, Zurich 1960. Research on Principles of Structural Safety, 1963–65. Doctorate 1966, ETH, Zurich. Engineer and Partner with Nicolet, Chartrand, Knoll, Montreal.

SUMMARY

From historical evidence it is concluded that a very powerful agent of «quality assurance» is always at work in the construction industry, eliminating most of the frequent errors committed at the basic level. The question is asked, who that agent is, and how institutionalized and formalized quality assurance will enhance, rather than hamper him in his beneficiary activity.

RÉSUMÉ

La revue du passé permet de conclure que, dans l'industrie de la construction, l'élimination de la plupart des erreurs fréquentes au niveau primaire de l'ouvrage est effectuée par un agent très puissant «d'assurance de la qualité». La question est donc posée: qui est cet agent? comment un système formalisé et institutionnalisé peut-il être conçu de façon à aider, plutôt qu'à nuire à cet agent dans son action bénéfique?

ZUSAMMENFASSUNG

Die Vergangenheit der Bauindustrie lässt den Schluss zu, dass weitaus die meisten der sehr häufigen Fehler, die im ersten Arbeitsgang auftreten, durch einen sehr wirksamen Träger der «Qualitätssicherung» ausgeschaltet werden. Daraus ergibt sich die Frage, wer diese Funktion ausübt, und wie ein vorgeschriebenes und geregeltes System der Qualitätssicherung helfend statt behindernd wirken könnte.



The conscious and systematic study of "quality assurance" is a relatively new endeavour for us engineers. Many of us were educated in the times of the working stress methods when faith in calculations, specifications and drawings was limitless and doubts in the performance and safety of structures so designed and protected by safety margins were not perceived to exist. We have had to overcome a rather substantial psychological block when it came to recognize the meaning and to apply the implications of the probabilistic concept to the structures we were making. They appeared so real and physical that it seemed impossible that the truth about them as established on the desk and drafting table could suffer from defects marring its perfection. Practice however, was a good teacher and the doubts in the work of us engineers, including our own, came to sprout in our minds, robbing us of sleep at night and of the cool and serene air of self-confidence we had thought belonged to an engineer.

So we started adopting the probabilistic concept and adjusting codes and safety margins to this and to other such modern concepts as ultimate strength, limit states, ductility vs brittleness etc. This process of adjustment is hardly finished, and much remains to be done for the sake of a systematic if not uniform application of structural safety criteria, based on probabilistics and accounting for a host of social and physical parameters. While still busy with swallowing and digesting the new concept of expressing and measuring doubt in the form of probabilities, we are already becoming aware that by fully embracing this formalization of doubt and applying it carefully and conscientiously to our everyday work, we shall not "get out of the woods yet". We are like the wanderer in the mountains who, while laboriously climbing to the top of a crest, beholds the next one, higher still, for him to climb:

The next crest will indeed be a hard one for us engineers, as it is made up of a substance very foreign to engineering minds. This substance essentially belongs to those human "sciences" we liked to believe we would be able to do without, limiting our endeavours to the treatment of materials and physical or chemical relationships whose behaviour was entirely predictable, could be "known" or "learned" statistically, or could at least be tamed to serve by some provable empirical methods.

Alas, not so .

Because the notion of the neat and proper system made up of materials, and scientifically reproduceable facts leaves out one important ingredient: Ourselves. The mind behind the design calculations, specifications, drawings, instructions, as well as the mind driving the shovel or guiding the bulldozer, is a phenomenon which has sofar defied analysis by methods acceptable in the so-called "hard sciences", for reasons we are presently still learning about. It has, however, been studied by scientists of another kind, philosophers, psychologists, sociologists, economists, communications or management specialists etc., all of them fields or people whom we used to eye with some suspicion. And now we seem to need their help, in order to learn about ourselves... ?

DESIGN TRADITION. WHERE DO THE ERRORS GO ?

The intrinsic problem of human involvement in design and construction -as well as in any other field of human activity - has always existed, and it was recognized on various levels of consciousness, as well as in the social groupings and functions which happened to interface with the activity or the product of the construction industry: Law uses laws to encourage good work and discourage bad. Government passes codes of practice prescribing methods and procedures, and the economy as personified by the client or the employer imposes the rules of the day, presumably to their own profit. Other institutions however, such as schools, research or professional organizations, have done nothing at all towards consciously asking the question about the effects of human involvement, let alone the study

of possible answers. Only very recently and rather hesitantly, some engineers have started directing their attention towards the new "crest" coming into view, only to become aware of its sheer magnitude and difficulty.

What then, if this problem has always existed, has brought us this far over the hurdles? Why have we been able to build so successfully, without any formal knowledge about that important ingredient in design and construction, the human mind?

Was it luck, or its sister, prudence, or some kind of awareness of conditions and interrelations which is seated in other regions of the mind than those where school-knowledge is being preserved? Was it "experience" or its abstraction, "routine". Or was it the high degree of our own perfection while performing work?? Or was it, what we are getting used to mean - rather unhappily - with the linguistically atrocious term "quality assurance".

Let us be sure that any of these concepts if enacted to its greatest conceivable extent could not have warranted all by itself the relatively good success we have been enjoying with our building construction.

When one considers the findings about the dreadful insufficiency of human work at the basic level, as for instance reported by Melchers (1,2,3) about surveys performed with the reliability or better "rightness" of design calculations, one begins to wonder how most of these errors do not eventually result in manifest defects, accidents or disasters. The rate of errors committed by the first - which is very often also the last - engineer /technician /draftsman /foreman / worker - to be in contact with a particular element of the work, is found to be several orders of magnitude greater than the effect of errors in the final product, if measured for instance against the number of elementary steps of work (decisions etc.) it took to build something.

What then is happening to the great majority of errors? Why do they seem to disappear or where, by which means and in which form are they being eliminated? A powerful agent must indeed be at work for such a feat to come about, and this, as we very well know, without any noticeable influence of modern science (let us admit that the findings of the few students of human errors and quality assurance in building have not yet penetrated into everyday practice).

Since the time when man first started constructing a roof over his head, he has had to make sure, as a corollary to the main purpose of the construction, namely to provide shelter, that the roof he built would not one day crash onto him as a consequence and with the effects of its weight. And he has been doing just that, advancing rapidly onto larger, more complex, more sophisticated and daring structures, and let us not forget, under the pressure of expectations by society, also onto higher standards of safety from structural failure, along with a relative increase of safety from most other sources of danger.

Again: How can we relate the high if not absolute rate of success with the frightful rate of errors which are being committed at the "grassroots"? If we want to improve "quality" by studying and developing techniques and strategies of "quality assurance", ought we not to look first at the one exercise in the elimination of errors which has been enacted through the times and with such indisputable success.

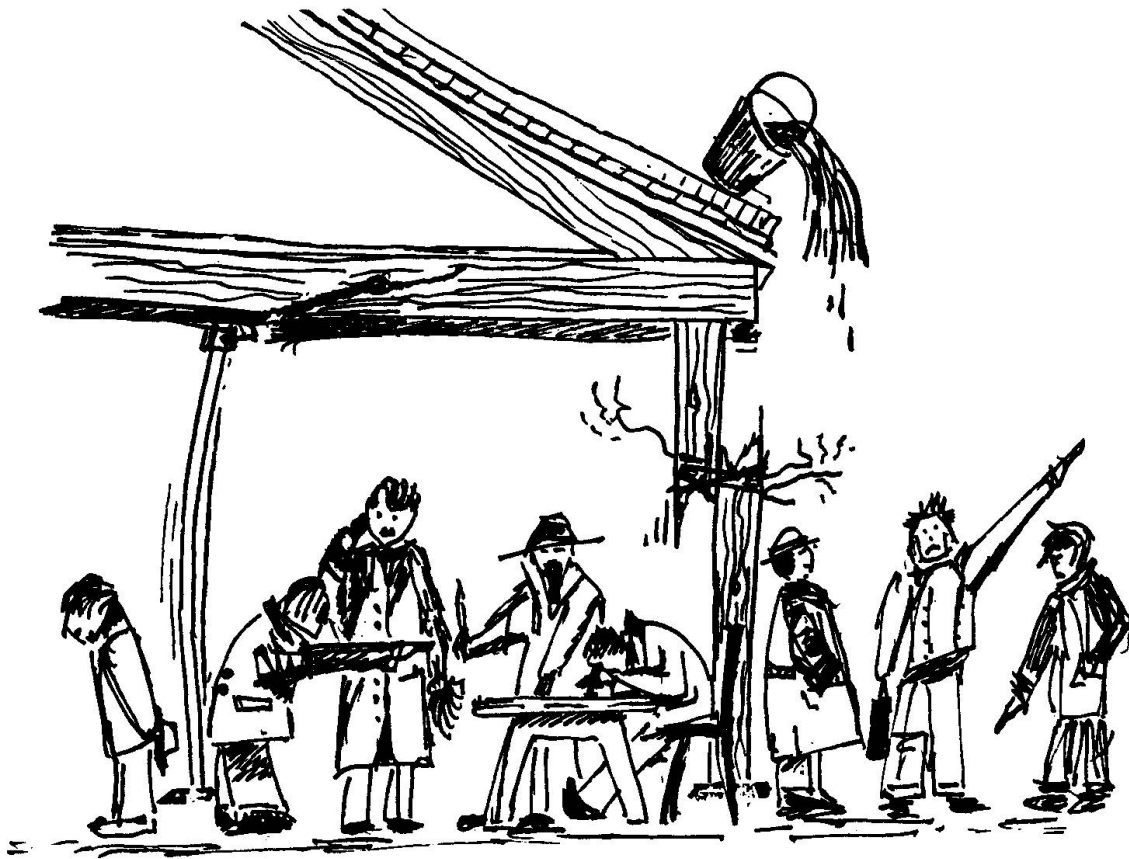
SPECIALISTS AS BUILDERS ?

It is perhaps a sign of the times that the quest for formalized quality assurance in a systematic way should come about just now. Whether it is in order to improve, or to counteract failing success of the informal system used so far in practice, reasons do exist which would explain why informal methods of quality assurance might be losing ground to



the perpetuation of errors. These have to do with the increasing sophistication and fine-tuning of design and construction techniques, where ever sharper pencils are wielded by an increasing number of different specialists, each of them commanding a field of vision that becomes narrower and narrower, allowing for ever less circumspection among the participants of the construction game.

It remains to be seen if formalized quality assurance can replace the "builder", a man who has died out centuries ago but who, in one person and mind, possessed the totality of knowledge it took to design and build something. I would like to contend that, although the descendants of that man have become very much less universal, it is still them, rather than the specialists, or any institutionalized or formalized QA-procedures, who are principally responsible for the success in construction. Whichever assigned function they carry by name, be it "engineer", "superintendent", "architect", "project manager" etc., it will be them who discover when things start going wrong, by spotting errors anywhere in any form, before they can do harm. Without them a Babel of specialists will set in, with the well known consequences.



SPECIALISTS'
BAZAAR

Their principal strength is in their motivation, in their general knowledge and comprehension of structural behaviour, in their ability to direct attention where it matters, and their circumspection. If they are to act out their vital function, the elimination of errors, they must have access to all or as many as possible of the relevant elements of the building process, in time as well as all other dimensions. They should be there when conceptual design decisions are made, when contracts are set-up, when the drawings leave the design office, when the structure is being fabricated and erected, and when it is being OK'ed for use. They should even be there while it is being used, in order to detect defects that show up only after some time, or in the course of abuse, etc..

If they are prevented from looking because we bury them under too much paper, or enclose them in physical, procedural or legal walls, they will fail to be effective and we might as well set the lawyers to work right away, to start sorting out the mess. This is exactly what is being done to an increasing degree and with increasing frequency, where contract documents are no longer concentrating on the quality and specifics of the work but are indulging in shrewd and ingenious manoeuvres with the purpose of shifting responsibility away from everyone's yard onto somebody else's. This is a sorry state of affairs which becomes possible only because everyone's confidence in the work, including his own, has become so low that he finds it more expedient to spend time and energy to cover himself, rather than on the work, obviously with the tacit and pessimistic assumption in (the back of ?) his mind that things will go wrong in any case. Reality bears this out all too often, of course; how could it be otherwise with everyone getting ready for the "fun", and lawsuits becoming so frequent that lawyers seem to make more money on the construction than the real participants.

Here we see also the origin and reason for the clamour for quality assurance, especially of the procedural, institutionalized and formalized type: It will give everybody the illusion that responsibility for good work has been shifted away from him, onto someone else, e.g. the people attending to the QA-procedures, or eventually to nobody human at all, but to the "procedure" itself, as embodied for instance by the documentation produced in its course.

It is here that the most dangerous illusion is lurking: If we delegate the responsibility for quality work away from real human participants onto some faceless institution and the paperwork of clerks, we have effectively and successfully eliminated it, i.e. it no longer exists as a function. The results of this are just now starting to become known, with spectacular accidents or cost overruns, with ecological or economical disasters which seem to be nobody's fault because everyone was looking the other way, namely onto and exclusively onto his special narrow field. Little it matters that in the course of the legal follow-up the social system usually succeeds in tagging the fault for the wrong onto some minor participants who are too weak to fight back successfully and who, unfortunately for themselves, but fortunately for everybody else, were caught not looking the other way. They are subsequently made to pay for the mishap by being ruined financially, morally and professionally, although their authority and means of influence onto the process were quite often in no proportion with the responsibility which is now being assigned to them, retroactively.

This is not a complaint about the lawyers and jurisdiction - after all they are being installed by the system representing society and the wishes and interests of all, according to the weight with which each one can bring them to bear.

But it is a sad statement about us engineers and builders who are giving away the responsibility for our own work, in exchange for the illusion of security; who are trying to delegate the function of attending to the quality of our own job onto institutions or mechanisms called such high sounding names as "quality assurance", "quality control", "verification", "laboratory testing", "authorities having jurisdiction", etc. These will not fail to disappoint us because they are basically empty frames without human content and substance. Everyone is trying to become a bystander, letting things happen while he is performing his limited act of specialized work which consists entirely of matters he has not yet been able to delegate away, and which in many cases turn out to be irrelevant exercises in selfsatisfaction.

This does not only happen to the engineers and builders of course but rather commonly in all realms of society, e.g. including medicine where the patient turns the care for his wellbeing over to the medical services and doctors who in turn delegate it to proceduralized testing, or to the next specialist. It also includes the family where we see parents effectively trying to divest themselves of the responsibility for their own children,



choosing to direct their attention and energy onto more "rewarding" pursuits. At its base is the old illusion that one can get something for nothing, if only the necessary machinations are thought out cleverly enough.

What it means to us engineers is that if we are no longer ready to answer personally for our own work, we have indeed failed in our creative endeavour, we have become functionaries, or in effect, slaves of the system even though we may be wearing the cloak of a fancy expert. If we do not consider the success of the entire building project our job, we are clerks in a bureaucracy. And when has something of value ever been produced in a bureaucray.

Coming back to the design practice and what we can learn from the traditional and mostly successful if informal performance of this work:

In essence it is being done by people and not by institutions or machines, or by procedures and paper documents. The mistakes that people make - and I believe we now recognize beyond any reasonable doubt that they are numerous indeed at their origin - are again being caught and eliminated by people, not by rule-books or documents. But it will take somebody who is ready and able to look and see what is happening, somebody who does not narrow his field of vision and above all, somebody who cares.

"There is no safety device known
that is better than a careful man".

(Found inscribed in a vehicle for railroad track
inspectors).

Would not the conclusion from this then be, that strategies for the pursuit of quality ought to concentrate on ways to help that "careful man", to make him more effective and circumspect, through whatever humane means, rather than by degrading him to a clerk whose job it is to produce paper for somebody's satisfaction, or satisfiction...

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