Trends of Development - Perspectives and Innovations

Part 1: **Progress by Benchmarking**

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TRENDS OF DEVELOPMENT – PERSPECTIVES AND INNOVATIONS

PART 1: PROGRESS BY BENCHMARKING

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ABSTRACT

Innovation comes with new products, improved processes or more efficient and effective organization. Innovation is evident when a noticeable progress is realized by implementing changes. Progress is measured against the actual state-of-the-art. If the state-of-the-art is not yet attained but known, then progress is easily attained by adopting the state-of-the-art. The realization of this goal is measured by quantitative and qualitative benchmarks. Based on the benchmarking process requirements that are not met by existing products, processes or organization are developed. Thus, demands on research and development are established for further progress. Paramount for any progress are open minded people with an up-to-date knowledge of actual methods capable to bridge a knowledge-doing-gap. Therefore, goals in education and training are the content of the second part of the lecture.

Key words: State-of-the-art, innovation, benchmarking

1 INTRODUCTION

Everybody is suffering from the ever increasing information overload, not always considering that there are essential differences between data and generating the necessary knowledge for attaining a defined goal or benchmark. There are some intermediate states, such as information, knowledge, acting, acting the right way and finally reaching a goal which has initially been defined. Shortly:

data ≠ information ≠ knowledge ≠ acting ≠
rightly acting ≠ reaching the goal

The process of reaching goals is cyclical. By travelling towards a goal you will gain new data, new information, new knowledge and new experience, which will eventually change the goal. Goal may be synonymous with target or objective or benchmark. The use of these words is not well defined. Thus, a paper on «Progress by Benchmarking» should be a contribution to reach a better comprehension of today's possibilities in the important field of «knowledge management».

Every entrepreneur (e.g. an applicator of high performance polymers) must survive in our highly competitive global world. Thus, he must strive to be the best in his field of work and to remain it permanently. This concerns the satisfaction of customers and other stake-holders (i.e. shareholders, employees, suppliers, the state for safety, education, …) regarding quality, costs and profitability. Three areas of innovation are relevant to improve competitiveness:

(1) materials – (2) processes – (3) organization.

Whereas normally an applicator has only influence on the innovation of products by choosing and influencing the best supplier, he is able to improve processes and organization on his own initiative. Being capable of doing this, he must be able to measure any progress attained. He must also have the right people to put theoretical considerations into practical action. Since 1911, when F. W. Taylor in "The Principles of Scientific Management" first put forward the idea, benchmarking has become the standard procedure for creating better values from the customer's perspective. Therefore, benchmarking will be the first part of this presentation, preceding the part on "education".

Progress is only possible if the entrepreneur and his team have the openness of mind to put the state-of-the-art into action (e.g. executing fool-proof guidelines exactly and learning from complaints) based on the results of a benchmarking process. Here come education and training as an unavoidable basis of any progressive change. The success of our economy and of the well-being of the people thus depends fully on the efficiency and effectiveness of our state-guaranteed and state-funded educational system. Massive shortcomings of the actual state of our system are well known and have to be healed. The future trends in education – starting with parenting through continuous training of legal experts – will be the second part of the paper[1].

[1] I owe much to the classical work on benchmarking by Carol Jean McNair and Kathleen H. J. Leibfried which is often quoted and followed in my text. The book is available in German and a necessary further reading. It is a "must". The newest state of research is accessible in German in "Competitive Intelligence" by R. Michaeli.

2 WHAT IS THE MEANING OF THE TERM "INNOVATION"?

Any company believing that it has all answers and that it can learn nothing from others has no future. But in spite of this, many companies maintain that they are already the best and they cannot learn anything from other companies.

How can we learn? Learning is time consuming and learning means to be open minded. If we want to spent time for learning we should have a systematic approach. This is "benchmarking". Learning means progress of knowledge. Thus the state of our knowledge or – speaking for the craft – the state-of-the-art is essential.

We are learning to enrich the human life.

There were always innovations and there will be always innovations. Therefore the question is important: What is the meaning of innovation? In searching the Encyclopaedia Britannica from 1960 you find between the two terms "innocent" and "inns" no such term as "innovation". Thus, 50 years ago the concept of innovation was not relevant. This conception has changed. Therefore the definition of the term may be interesting. In the Brockhaus you find:

Scientific and technical, cultural or social elements (e.g. inventions, institutions, ideas, behavior patterns) and the way they are introduced and distributed, which, in their breakthrough function, serve to change a society's social structure. Innovation research investigates the conditions for the creation, implementation (diffusion), management (innovation strategies) and impact (social conflicts, improvement of social relations) of innovation. The term … describes in science the planned and controlled change to a system by means of break-throughs.

In economics … the planning, development and implementation of new products and product qualities, new production processes, new methods for organization and management as well as the penetration of new procurement and sales markets. Although innovation can often follow an invention, its economic exploitation then takes it further.

Until the 18th century, inventions and discoveries were mainly the work of practitioners, e.g. skilled workmen or craftsmen. Since then, however, they have increasingly become an achievement of scientific research, although technical imagination and coordination skills remain important. The research institutes … are striving for greater organization in research.

It can be seen that the definition or the meaning of the word "innovation" is not simple. You must make clear what you are talking about. There is often a dispute about the meaning of words. I like to quote Nobel laureate physicist Percy Williams Bridgman (1892-1961), who said: *For of course the true meaning of a term is to be found by observing what a man does with it, not by what he says about it.* Or the great Scottish moralist of the enlightenment John Locke (1632-1704): *We should have a great many fewer disputes in the world if words were taken for what they are, the sign of our ideas only, and not for things themselves.* Or Ludwig Wittgenstein (1889-1951) quite shortly: *The meaning of a word is its use in the language.* We should avoid these disputes by having a serious dialogue about the meaning of our terms.

For this you must not go to college. Leonardo da Vinci considered himself as a man without book learning, but an disciple of experience. He said: *"All I can rely on is experience"*. This opinion he had in common with Aristotle and Albert Einstein. But if you want to acquire all experiences on your own, you are wasting time and money. There are so many experiences told in publications. Some of them are quoted in "References". Especially the concise books on «How to Produce Effective Operations and Maintenance Manuals» by M. Tidwell (2000) and «Guidelines for Forensic Engineering Practice» by G.L. Lewis (2003) must be mentioned. Both were initiated by the American Society of Civil Engineers (ASCE). The ASTM book on significance of tests and properties may also be mentioned here[1]. The application of well-known principles like simplicity and modularity is very helpful (E. de Bono).

3 THE MARKET SITUATION IS PERMANENTLY CHANGING

There should be an early warning system of impending problems if the market is changing and you have to adopt new products or processes to succeed in the future.

There are two directions: you can (1) invent or (2) imitate and develop. Inventions are mostly expensive. Thus, it is appropriate to learn first from other companies in adapting the procedures for your own system. As T. Barlow explains in "The Australian Miracle – An Innovative Nation Revisited" (2006) imitation is the straight way to success: *Most successful high-tech, high-growth states throughout all ages have succeeded only after their citizens first began copying what people in other countries were already doing. Just look at the US … The history of science and technology is predominantly a history of imitations and improvements.* Another example: The fashion czar Pierre Cardin was first a collaborator of Dior.

Benchmarking is a procedure to standardize internal and external imitations to become the best-in-class. This doesn't exclude generating new ideas for real innovations, eventually creating monopolies. But monopolies are extremely seldom when you have a look at the history of technology.

4 BENCHMARKING TO FIND OUT THE BEST-IN-CLASS

Benchmarking, or the use of externally defined quantitative and qualitative performance measurements, pro-vides the foundation for meeting and exceeding the expectations of stakeholders. Rudyard Kipling may be quoted: *I had six honest serving men; they taught me all I knew. Their names were where and what and when and why and how and who.*

You must understand customer expectations and you must identify the requirements. After fact finding and focussing and armed with a set of measurements, you are able to gather and analyze information. Here is a practical example of wasted time on site needing an analysis:

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[1] Significance of Tests and Properties of Concrete and Concrete-Making Materials, ASTM Special Technical Publication 169B, STP 169B by American Society for Testing and Materials (1987)

Tab. 1: A practical example of use of time paid

Productive time	42 %
Non productive time	58 %
Waiting	*24 %*
Unnecessary breaks	*19 %*
Ework	*6 %*
Bad communication	*5 %*
Coming too late/leaving too early	*4 %*

The final phase is where improvements are put in motion and then the benefits are reaped. Cherry picking improvements gives you quick success, but the implementation phase is often the most difficult part of the process.

I like to refer to our publication at the 5th International Colloquium "Industrial Floors '01", in which we developed within the frame of an Eureka project a matrix of 55 properties. First we had to classify the available sources of knowledge according to increasing reliability:

Tab. 2 Sources of Knowledge

Gossip (e.g. from applicators)
Publicity, direct marketing, Internet
Publications, scientific and commercial
Conferences with/without discussions
Prospects, CD-ROMs, DVDs
Samples
Practical experiences with objects
Undocumented applications
Documented applications by
Calculation
Object report
(Repeated) orders of applicators
Invoices
Prices
Size of Packaging
Statistical purchase data
Labels
Safety data sheet
References with object reports
Scientific field analysis

Then we collected 55 different data according to 8 different categories in order to compare different products:

Tab. 3 Categories of Basic Data

1 Identification	4 data
2 Main characteristics	11 data
3 Other technical data	9 data
4 Health and ecology	5 data
5 Application	9 data
6 Sources of knowledge	5 data
7 Samples and references	4 data
8 Costs	8 data

In the final report we stated: *The project has shown how important, but also how difficult it is to reach our goals. We have come closer to finding a model for industrial floors. However, unfortunately the "Trial and Error" method still plays a large part. It has simply not been possible to get a grasp on the multi-parameter system of "industrial floors" by measuring just a few properties. A study by the US Army has also shown the importance of a comparison between laboratory tests and field analysis. Our work towards finding a reliable analysis of values must continue.* Here comes the logical straw-man-model.

5 THE CONCEPT OF A LOGICAL STRAW-MAN-MODEL

If you meet a group of managers responsible for the same tasks in different subsidiaries of the same company, e.g. floor laying works, starting with acquisition via estimation to acceptance and accounting, they will accumulate a lot of numbers. But very few valid comparisons between the subsidiaries can be made. Actual practice is mostly quite varied across the subsidiaries, making it difficult to isolate which subsidiary represents really “best practice”. According to McNair and Lei-brand a logical straw man can be developed which is representing the best practice for a defined series of tasks. Measurements were devised to capture the essence of the “best” performer. The straw man was not based on any one subsidiary but rather consisted of pieces of each: each branch excelled at a different set of tasks. The benefit of this approach, beyond the development of an ideal subsidiary unit for everyone to work toward, was that it depersonalized the change process. This opened new opportunities for each subsidiary to improve; no one location was privileged or ignored.
With the straw man in place and agreed upon, the benchmarking exercise could begin to focus on measuring each subsidiary against this ideal. Measurements now had a purpose: they could be used to identify performance gaps at each subsidiary as well as to support the standardization of the service system from publicity to complete customer satisfaction. This straw man also served as the basis from which to choose among available alternatives for enhancing the service. Finally, in the process of developing the straw-man-model, areas were identified, where standardized information communication technology solutions could be effectively utilized.

The manager then tracked all productivity measures on an ongoing basis. These measurements provided the first wave of change for the organization. Measurements are powerful tools in the change process for any organization. In this case they were

clearly

identified areas where each subsidiary was meeting expectations and where improvement needed to occur. These measurements removed the ambiguity from the change process, providing each manager with the tools necessary to meet the corporate service standardization objectives and led to rapid improvements in meeting customer expectations.

In the construction industry you can compare one site with another site for internal benchmarking, thus creating an ideal building site. Then, you have to adapt your marketing approach to acquire only jobs of this ideal site if this is possible to fill your capacities.

6 FIVE STAGES AFTER THE BENCHMARKING REPORT

In construction there are three possibilities ordered according to increasing complexity:

Benchmarking from one site to another
Benchmarking of different working groups
Know your competitors by talking to them

After collecting all the data you will get a report about the present situation. This report normally will not please everybody. McNair and Leibfried are thinking that the harsh realities revealed by a benchmarking study may be compared to the death of the belief in one's superiority, i.e. to "mourning" for lost innocence and the securities of the past. This can create denial, anger, rejection, and depression before accepting the facts. The authors are quoted as following:

1 Denial: When reality isn't acceptable
Seldom do the results of a benchmarking study proclaim the company "best-in-class" across the board. This may trigger the response: "This can't be true." Swallowing the bitter pill of reality is the worst part of benchmarking. Having continuously worked to beat the competition, the only initial response is denial.

2 Anger: Stage two unfolds
Most generals shoot the messenger who bears bad tidings from the field of battle. In anger, management can refuse to accept the data, perhaps even suggesting that the study was poorly done. It is not a happy event to move several mountains to get to the top, only to find there are mountains yet ahead. What is done after the anger passes, spells the difference between growth and decline.

3 Bargaining: Let's make a deal with the devil
Bargaining is the process of rationalizing what has occurred, of setting boundaries around a problem in order to fit it into one's existing world view instead of learning the lessons being taught. If an error in the study can be uncovered, then business can continue on as usual. If not, bargaining and rationalization gives way to depression.

4 Depression: We're as bad as the report says
A general feeling of inadequacy overwhelms the managers charged with searching for solutions. Simple tasks may take on monumental size; they become unsolvable mazes

of impossible complexity. But as unpleasant as the truth may be, it can only be faced, not avoided.

5 Acceptance: Turning defeat into victory

Learning comes from accepting reality and taking actions to change it. It starts with asking the right questions: with accepting that the benchmarking results are probably correct and lessons can be learnt from other sites, groups or from competition. How is the process managed elsewhere? Is it better to have centralized or decentralized structures? What role does measurement play? Is a team-oriented approach better then individual decisions to make change? Can process changes made to get rid of non-value-added activities and costs? What insights do we get from other experiences?

With acceptance of the benchmarking results, a performance gap can be closed. As workable alternatives are developed, enthusiasm is rekindled. The final objective, continuous improvement, is identified and pursued: perseverance ensures that it is reached. A learning organization has been created. For fine tuning of the results the following Eight-Step-Method according to H. Geiselhart may be used:

Tab. 4 The Eight-Step-Method

1 Definition of a problem or an opportunity
2 Deeper understanding of the problem or opportunity
3 Developing alternative solutions
4 Critical evaluations of proposals and decisions
5 Planning of implementation
6 Discussion with the involved persons
7 Put the decision into action
8 Evaluation of the results (if necessary continue with 1)

7 POSSIBLE HUGE INCREASES OF PRODUCTIVITY

An excellent example of gains of productivity not to be believed before is the case of the wine industry. The productivity increased from 1880 to 2000 by a factor of 10 (!). One century before as much as 2.176 h of work were needed for 1 hectare (10.000 m2). During 50 years till 1930 this value decreased only about 16 % to 1.822 h. 30 years were needed to decrease the value a further 1/3 to 1.229 h, then further 20 years to half it und 20 more years to have only 1/3 of the value of 1980. This is less than 10 % of the value of 1880, 120 years before. Thus, wine became affordable for many people.

Tab. 5 Increase in productivity in the German wine industry from 1880 to 2000 (SLFA)

1880	2.176 h	100 %
1930	1.822 h	84 %
1960	1.229 h	56 %
1980	614 h	28 %
2000	212 h	10 %

The increase in productivity for harvesting grain is the reason that less than 2 % of the population is making a living from agriculture today. Fourastié is giving the following values for harvesting 100 m² of land[1]:

Tab. 6 Increase in productivity in grain harvest from 1880 to 1945 for an area of 100 m^2

1880	1 hour	Sickle
1850	15 minutes	Scythe
1900	2 minutes	Reaper
1920	40 seconds	Motorized reaper
1945	35 seconds	Harvester

In a recent calculation K. Hermann reports that 1.000 kg of grain is now processed in only 1 minute by a Claas Lexion 600 compared to 140 hours manually before[2].
Similar increases of productivity should be possible in the field of construction and floor laying taking into account the great progress in robots during the last three decades.

8 CONCLUSION

If we need progress by innovation – and an entrepreneur is needing change in order to avoid bankruptcy by competition – we need a starting point which is generally a state-of-the-art report defining the benchmarks for further possible improvements. We need to know that innovation is not limited to new products but concerns also improved processes and optimized organization.

Benchmarks are incorporated in the process to establish a logical straw-man-model – e.g. for an applicator specialized in laying very resistant floors on the basis of high performance polymers. In such a model you have to describe the past practice. Best practice is found by quantitative evaluation of all the components of a business.

It should be adequate to discuss practical and academic education and training stressing the importance of knowledge and application of the newest developments. There should be an obligation for continual education, also for professors at universities and other experts, as it is established in the most modern industries and private services.
There is also the important question: Are there limits of engineers and skilled workers doing a job of high responsibility? Is all the training done to avoid costly supervision, replacing supervision by self discipline? Are there difficulties? If yes, is there any solution? Think of nuclear reactors, of air traffic accidents such as the Airbus disaster at Mount Odile in Alsace (France), the Concorde crash near Paris or the collision of two aircrafts near Constance or the recent Transrapid accident in Germany.

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1 J. Fourastié: „Le Grand Espoir du XXe Siècle" Paris 1963

2 FAZ 28.11.06

Let me conclude quoting the former German Chancellor Otto von Bismarck (1815-1898). He said: *Only an idiot believes to learn from his own experiences. I prefer to learn from the experiences [i.e. 'best practices'] of others to avoid failures of my own from the start.* This is also very important for education and training.

Everybody knows that progress is slow in our field of work. Compared to the agricultural sector – 150 years ago still a very backward domain – , which is now very efficient because of the fierce global competition with about 1 % of the population producing everything that is eaten, there is a lot to do in our sector. Let's start in our field of work and learn from the experiences of our own sites, our competitors and from other more fortunate sectors.

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QUIZ: **«REPARATURMÖRTEL»**

Question 1
How is a durable industrial floor produced in a new building?
- ☐ Advice from a local building contractor
- ☐ Defining precisely the requirements by a checklist
- ☐ Laying of a monolithic concrete floor
- ☐ Inspecting reference floors laid by the tenderer

Question 2
How do you look after an industrial floor properly?
- ☐ By regular sealing with a topcoat
- ☐ By using wax chips
- ☐ No loads for which the floor was not planned
- ☐ Not using water for cleaning
- ☐ Following the manufacturer's maintenance instructions

Question 3
When does a defect have to be repaired?
- ☐ After accidents have happened
- ☐ When you manage to get hold of a suitable specialist firm
- ☐ As soon as a defect becomes apparent: rutted joints, ...
- ☐ After careful investigation of the causes
- ☐ After obtaining an independent expert's assessment

Question 4
What requirements for a repair mortar do you know?
- ☐ Must be able to taper off to «zero» layer thickness
- ☐ Must be the same colour as the old floor
- ☐ Must be non-skid in wet areas
- ☐ Must not be impervious to water vapour
- ☐ Adhesive pull-off strength must be at least 1.5 N/mm2

Question 5
When is it more economical to completely replace the floor?
- ☐ When you can't find a suitable specialist firm
- ☐ When your own staff cannot repair it
- ☐ When a new floor is cheaper than a repair
- ☐ When workflow must not be interrupted
- ☐ When accidents may occur if the floor is not repaired

Question 6
What firms are allowed to apply reaction polymers?
- ☐ Overlay contractors
- ☐ Painters and decorators
- ☐ Building contractors
- ☐ Firms certified to ISO 9001
- ☐ Specialist firms with long term credentials

Question 7
What specimens/properties are tested in the laboratory?
- ☐ Resistance to chemicals
- ☐ Core drillings
- ☐ Non-skid properties
- ☐ Chiselled-out slabs (400 mm x 400 mm)

Question 8
Why is a test area laid?
- ☐ For an exact pre-calculation of the tender
- ☐ To show the user what the floor is capable of
- ☐ To be able to judge the durability
- ☐ Because it is required by the corrosion protection standard
- ☐ So that the floor-laying contractors can earn money

Question 9
When is a warranty on repairs agreed?
- ☐ Every time a tender is given
- ☐ Every time the site is inspected
- ☐ Every time a diagnosis is made
- ☐ Every time a test area is tested
- ☐ Only in exceptional cases where it is justified

Question 10
What has to be borne in mind during sub-floor preparation?
- ☐ Any material dislodged from the floor must be visible
- ☐ The floor must be wetted: no formation of droplets
- ☐ A water droplet must penetrate into the floor
- ☐ Only milling, followed by sanding, is permitted
- ☐ Adhesive strength must be at least 1.5 N/mm2

Question 11
When is the layer thickness taken down to «nothing»?
- ☐ It is not technically possible to do so
- ☐ The max. grain size must not exceed 1/3 of the thickness
- ☐ Coarse grains must not be added
- ☐ Only fine «powder grain» is permitted in the mixture
- ☐ Adhesive pull-off strength must be > 1.5 N/mm2

Question 12
How do you maintain the repaired floor?
- ☐ Like a new industrial floor, as per maintenance instructions
- ☐ Any new defect must be repaired immediately
- ☐ Entire surface should be sealed with a coloured topcoat
- ☐ No special maintenance is necessary

Remark
Put a cross against the answers that seem correct to you. There is at least one correct answer to each question. All the answers may be correct. Bear in mind that the scientific discussion on this skilled area of work is always only in the early stages. For this reason, some questions will give rise to differing answers, and even disagreements, depending on personal experience. These different opinions should cause a deeper investigation.