On the logic of muddling through
a case study in system design

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Abstract:
The paper describes the development of an internet based 3-D service system for students. Starting as an information service for just one major field of study (business education) the anarchic implementation process enlarged permanently the system boundaries. From the viewpoint of technical rationality the system design of the reported project was badly planned and designed. But this (correct?) approach described in the literature, what we will call the mental model of engineers, failed – lacking support in the faculty – several years ago. In contrast to the traditional technical solution based on literature in organizational theory we will show that there is an inherent logic in the process of muddling through („bricolage“ or what we call the mental model of handcraft).

The Rational of the Project

The project started with the idea to offer all relevant information services for Business Education students via the internet with a 3-D interface (Baumgartner & Wydra 1999). This idea was motivated by four basic cognitive principles:

- *Linking and remembering relevant study information:* Empirical studies in Cognitive Science demonstrated that information embedded in space or linked with spacial structures is easier to remember and learn [Literatur raussuchen!]. It is important for students to follow the hierarchical and procedural structure of the curricula in order to optimize their study organization (eg planning which lectures to visit, which seminar to register etc.) We wanted to implement this complex structure of our curricula in a 3-D representation of our department. Students (but also other visitors) can choose an avatar and move around in the virtual reality environment. They cannot only explore all the relevant information for their study in an interactive way, e.g. knocking at the door of a professor and asking for the outline of her lecture but they can also start the necessary action for the university administration, e.g. booking the lecture, download the literature etc. The prototype of this idea can be explored at: http://iol1.uibk.ac.at.
- *Building up mental models of the study organization procedures:* Moving around in a 3-D virtual representation helps to build up mental models of the correlated and interconnected information which is relevant for mastering the situations in question. From the constructionist point of view it is important to interact with the (virtual) environment in order to the reach viable solution for problems. [Literatur Maturan/Varela, Foerster,

Glasersfeld etc. raussuchen]. Especially in a complete new environment (the complete faculty has moved to a new constructed building in february 1999) or for student beginners this can help tremendously. Instead of passivly looking up study problems like "what do I have to do for register my thesis" in a database of Frequently Asked Questions (FAQs) we could implement a robot avatar which guides the student around and shows her where to pick up the relevant information, forms etc.

- *Building up social virtual communities:* In our faculty we have a lot of students from the north of italy which also speaks german and the far west of Austria (where no university is located) which have to travel many hours to Innsbruck. The problem is not only the distance but also the difficult road condition – expecially in winter time – because of the Alps. We want therefore to provide our students with an online service where they can get relevant information without to come in person to the university. Clearly for faster access we have implemented this information in normal 2-D HTML. But with the possibility of a 3-D multi-user world out students can not only communicate in real-time to exchange their views but this helps also on closer acquaintance with each other. Tools like the avatar studio by blaxxun (http://www.blaxxun.de) can provide the necessary personal information to facilitate the process of building a community of students.

Hier nun irgendeinen charakteristischen screenshot, der einen vielleicht auch einen Avatar an unserem Institut (Sekretariat, Seminarraum etc.) zeigt

The History of the Project:

The following uncommented time-table lists some milestones of the development and of the project. We will provide an idea of the anarchy and chaos of the implentation process. We therefore do not focus on technical but on organizational issues:

- *March 1998:* The new professor (Peter) who is scheduled to get his professorship in business education in the winter term 98/99 launches the idea of a 3-D student information system.
- *September 1998:* Funding is provided for the prototype by the university. The focus is still just to provide study information in a 3-D environment. The connections to other systems (eg. database of lectures) as well as the working flow in the administration which has to follow up the planned interactivity (eg. booking of lectures) is not included in the system design.
- *October 1998:* An external graphic designer (Detlef) [+URL von Deiner Homepage für Werbezwecke!] is contracted.
- *November-December:* Fotos for a realistic 3-D Design of the interior of the – still not opened new faculty building – are made and the connection to the architects are established.
- *Februrar 1999:* The faculty is moving to the new building.
- *March 1999:* An new central database of relevant lecture information developed under national guidelines provided by the responsable ministery of science and transport is implemented by the central EDP-department. This intervening process happend parallel and with no connection to the 3-D environment.
- *24th of June 1999:* According to a new law (Universtiy Act 1993) Innsbruck University "tipped over" to the new regulations. During the transition period of the last few years the power transfer from the old to the new self-governing bodies was prepared. The consequences of this complex organiszational process with are linked with more autonomy for the university could not be foreseen. Alliances and cooperations of individuals, departments and faculties were negotiated and put forward under the

continuously variable conditions of micro politics. In this process our formerly department of business education and human ressource management went together with another department and formed the new "Institute of Organisation and Learning (IOL)".

- *Summer 1999:* The process of merging together the different priorities of the new department results in a complete revised homepage of the new institute. The outsourced contractor has at the beginning no communication with the designer of the study information system.
- *Autumn 1999:* It becomes clear that the different approaches (central databases on university level, databases on department lebev and information services on major field of study level) have to come together. The effect of this new awareness is a different outlook to the daily work of the secretaries and lecturers. The result is an integration of all the different and indepent projects (central databases, homepage of the department, study information system of business education a part of the responsibilites of the department). But now there is to do the design again and a new funding problem arises...

Two different logics: engineer vs. bricolage aaproach

In the beginning students should just get the relevant information for their study in a 3-D environment. After some intervening organiszations processes at different levels the system original designed has to be revised. The focus turns one's attention not only on students but also to the lecturers and secretaries. The difference between 'outside' (info for the students) and 'inside' (the administration at department and at lecturer level) vanished.

So what? In every text book (eg. Scheer 1998) we will find the recommendation that we have to analyse "systematically and on a gestalt level" all the different flows of information and processes. We have in advance to identify the different responsibilities and interconnected relations as well as the necessary functions and performances the system has to have. We should develop – so the standard literature – a general model of the process independend of the actual humans and incidental characteristics of the processes. If these tasks are finished the system engineer can generate a respository of models (data, functions, processes, organizational units etc.). For the purpose of analysis we will call this approach of system engineers the mental model of technical rationality.

But we did it in a complete different way: Our approach was not "rational" in the sense of technical means-end analysis. There were improvisations, change of the system levels, micro politics and intervening of formerly indepentend processes. We will call this approach follow a notion of the anthropologist Levi-Strauss (1981, Achtung engl. Version aus dem Internet raussuchen und hier zitieren) the mental model of *bricolage* or as is it called in the organizationl theory "muddling through approach". (Literatur?)

At the first sight it might be clear that the model technical rationality is the efficient and correct one. But note that this approach in our faculty already shipwrecked: Three years ago the initiative of the department of business computer science to provide an common interface for the whole faculty was not accepted. Could it be that there are some characteristics in the real world interaction that the model of technical rationality can`t capture?

To explore this hypotheses we have to investigate the different models in more detail:

In the beginning of our approach (bricolage) was not the word (theory) as the bible says but the vision of a solution (Schön 1983 and 1987): The perspective of an interactive 3-D virtual multiuser world. The hands-on practice of this approach motivated a lot of people and

attracted like a maelstrom very different people: The student association, “non-techy” staff of the department, academics curiously what will happen etc. Not to see the huge problems was almost a condition to start.

Instead of a clean analysis of a problem indepent of the acting humans there was “life in organized anarchy” (Cohen/March/Olsen 1972 and March/Olsen 1976). By way of implementig the solution different problems emerged. Again: These problems weren´t treated with means-end analysis but negotiated in many different conversations (with the secretaries, with the contractors of the different intervening projects, with the academic staff, with the EDP-people etc.).

The implementation of a system is not only a technical process but has also his social characteristics. In the model of technical rationality this is only another problem (“to raise the level of acceptance”, “to reduce the resistance”) to be solved by participation and information. In the model of “muddling through” it is a way to generate new solutions by negotiating in micro politics (Ortmann 1992).

Originally planned just as an information system the consequences on the organiszational level are tremendous. The new “game of innovation” (Ortmann 1992, 465; 1995, xx) challenges the routines and traditional practices. Hierarchy and organization structures have to undergo radical change with the effect that a lot of new people draw the intention to the formerly unnoticed process. One can`t foresee the results exactly because of the interchange and struggle in micro politics (Salzgerber 1998, 155).

The engineer tries to reach his ends with different methods. Ideally this methods should be neutral to the goals. A chance of the purpose is characterized as an incomplet underspecified or incorrect analysis of problems. One can say the engineer questions the world out there (Ortmann 1992, 32) and tries to get all the necessary tools for the intended solution. Muddling through looks a the actual situation and tries to find a solution with the tool box available.

In the mental model of the engineer one has to follow a certain procedure to get to the solution. The goal is optimization of different variables for the purpose of efficient functionality (Neuberger 1997, 118). The “know how” of these procedures provides the professional knowledge of the specialist. In the mental model of bricolage knowing how is replaced by “to be able to” the usable skill in a actual situation. To know how to change a spare tire is not the same as to be able to do it. If someone confuses knowing how with to be able to do then there is the intrinsic fundamental risc of failure (Baumgartner 1993, 76) as demonstrated by our experience of the formerly not implemented technical solution.

But it is to keep in mind that the mental model of bricolage is not a guarantee for success. Because it provides a procedure for a inherent social dynamic it has some advantages in the real social world in contrast to the model of technical rationality. But imagine a siutation where two actors with contradictionary models of “muddling through” compete with each other. In that case technical rationality could provide an emergengy exit for both actors without loosing face.

Dimensions	Technical Rationality (“engineer”)	Muddling Through (“bircolage”)
focus	the whole system and the purpose of the system	the tool box available, the system and the purpose
orientation	the “objective” reality, the world out there	the tool box, the actors, the situation
result	generated by the analysis of the problem; should not be changed	is not fixed established, is undergoing a continuous change depending of actors, their

		influence, power and strategies
means-end relation	the goal is the priority and provide; the solution is subordinated and has to fulfill the purpose	solution and problems are co-existent; solution generate new problems
organization of the design process	paradigm of technical rationality; social proces is just one of the marginal conditions	social and technical process can`t divided, the actual actors and decision makers are important
social process	only a question of resistance and acceptance, actual social practices are not important	social practices, the situation of power, hierarchy and negotiation are important
failure	if pre-established ends can`t reached	goals can be adapted, compromises are allowed
organisation is	a set of fixed relation and their formal connections	a set of social practices which have to be negotiated all the time
direction	form the formal function to the real application (deduction)	from the (possible) solution to the formal functions (induction)
evaluation	if the goal is achieved	one has the goal itself also to reexamine

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