Architecting for Humans; How to Transfer Experience?

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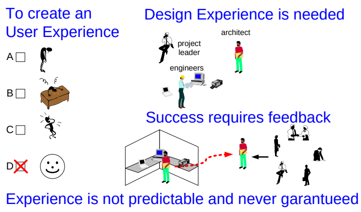

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Abstract

The ultimate goal of Product Creation is to create products which give the user a great experience. User experience is very intangible. Product engineering focuses on tangible requirements. Successfull product require both sound engineering as well as creative design. The question is how to obtain a workforce, which is capable of both activities?
The education of successfull engineers is limited to engineering methods. Additional skills are acquired by experience. Unfortunately experience cannot be transfered from one engineer to the next. Such a transfer is approximated by active personal development.

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1 Introduction

Many modern appliances cause an alienated feeling for (less-technical) consumers. Figure 1 shows a multiple choice set of feelings for programming the well known Video Cassette Recorder (VCR) or its later successor the Personal Video Recorder (PVR). This task of programming the VCR is often delegated to the family member with sufficient technical feeling.

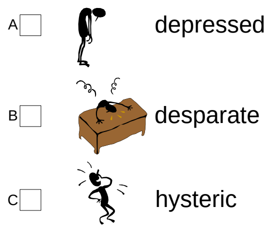

Figure 1: Did you ever program a Video Recorder (VCR or PVR)?

A long lasting process is performed to come from some consumer need to a manufacturable, salable product. This product creation cycle is shown in figure 2. It starts with a product manager, who perceives a product opportunity as a need from the user. The product manager formulates the product requirements, which are used by a development team, consisting of engineers, architect and project leader, to design a product. The final result of the engineering effort is a ”product documentation”, which is used by manufacturing to produce the product and by sales to sell the product. Via the retail channels the product finally arrives at the consumer.

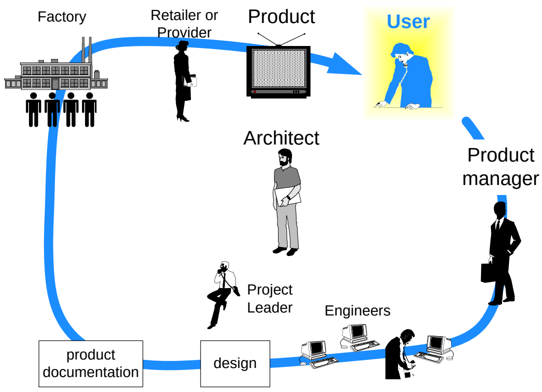

Figure 2: Product Creation Cycle

The word ”experience” in the title of this article is used in a double meaning:

- the feelings and emotions an user experiences when using the system
- the accumulated skills and know-how of working many years in the domain

Both concepts of experience share the difficulty or in fact impossibility of transferring experience from one human to the next. Figure 3 visualizes these 2 forms of experience.

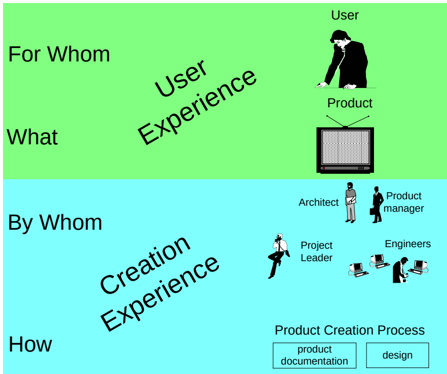

Figure 3: 2 Levels of Experience

The experience of the human using a new product, resulting from an engineering activity, is determined by emotions, feelings, opinions, et cetera. At the other hand engineering a product from available technologies is in many aspects a very SMART activity. See also [2] for a further discussion on the relation between ”fuzzy” user needs and SMART engineering. Figure 4 visualizes the gap between the user experience and the engineering world, which is to bridged by an architecting effort.

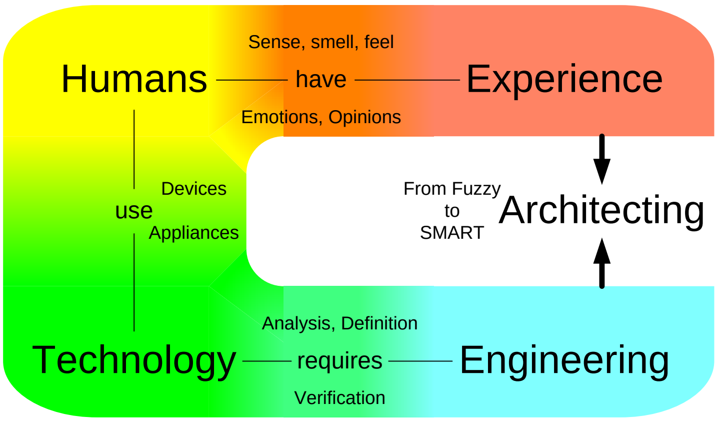

Figure 4: Bridging the gap between Experience and Engineering

2 User Experience

As an example of user experience Time shift recording is used. Figure 5 shows the concurrent activities that occur when straightforward time shifting is used. In this example the user is watching a movie, which is broadcasted via conventional means. After some time he is interrupted by the telephone. In order to be able to resume the viewing of the movie he pauses the viewing, which starts invisible the recording of the remainder of the movie. Sometime later he resumes viewing where he left of, while in the background the recording of the not yet finished movie continues.

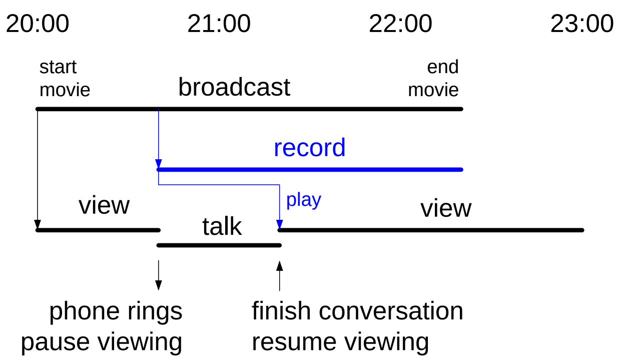

Figure 5: Example Time Shift recording

In this simple form (pause/resume) this function provides freedom of time to the user. This appears to be very attractive in this interaction modus. However when such an appliance is designed limits out of the construction world pop up, which intrude in the user experience. Table 1 shows a number of construction limits, which are relevant for the external behavior of the appliance.

- number of tuners
- number of simultaneous streams (recording and playing)
- amount of available storage
- management strategy of storage space

Table 1: *Construction limits intrude in Experience*

Construction limits, but also more extensive user stories, see figure 6, show how the intrinsic simple model can detoriate into a more complex interaction model. Interference of different user inputs and interference of appliance limitations compromise the simplicity of the interaction model.

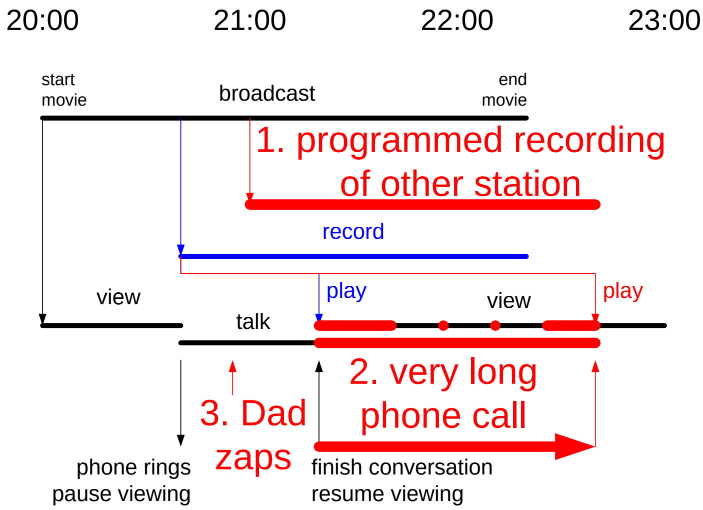

Figure 6: What if?

The story behind figure 6 is that Sharon, mother of 15-year old Brigit, is watching the latest Meryl Streep movie on television. This entertainment is interrupted by a phone call from her sister. Sharon pauses the movie and talks extensively with her sister. Five minutes later dad, Bob, walks in the room and zaps to CNN, to watch the latest developments. At 9 o'clock a recording should start of a soap series, programmed by daughter Brigit. 9:15 Sharon says her sister good bye and presses resume to continue with her Meryl Streep movie.

The big questions in this story is: *What is recorded when?* and *Who is able to watch the desired content later this evening?*. Most Personal Video Recorders have only one tuner and will therefor not support the three persons satisfactory.

In the Post doctoral education for computer science designers at the technical university Eindhoven, the students have to design such a time shift appliance. In the function of "requirement expert" I was involved in this design workshop. The initial effort of the students was heavily focused on creating a requirement specification, full with tables defining requirements. This thick stack of paper did not really help the students to understand the essence of the appliance, nor did it help to identify the critical or difficult issues. After challenging them the students build a functioning prototype on a PC, which immediately surfaced a number of critical issues and enabled discussion and feedback on the user interaction model, see figure 7.

The user experience is influenced by many factors, ranging from environmental factors, such as social status, location and time to personal factors, such

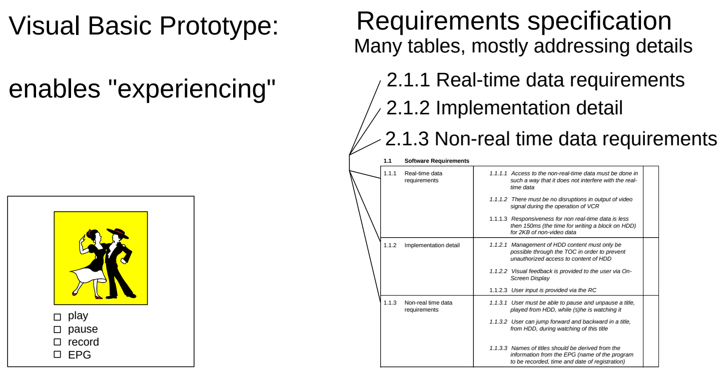

Figure 7: OOTI workshop 2001

as education, preferences and physical status. This wide variation of influencing factors is shown in figure 8.

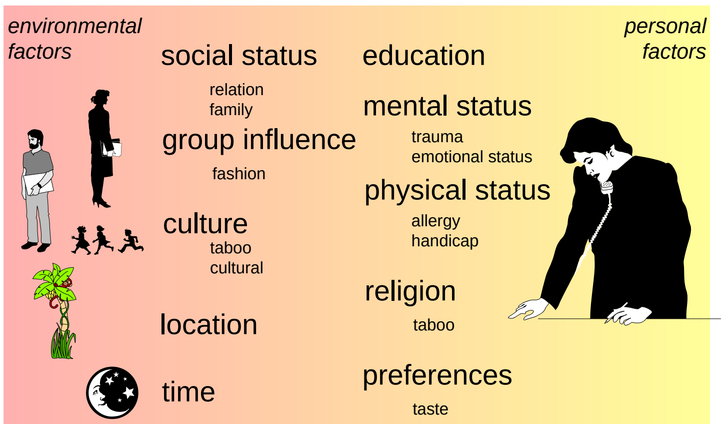

Figure 8: Factors influencing the User Experience

The challenge is to make the user experience more tangible, for instance by ”SMART”ening the experience. Table 2 indicates what we would like to do with a ”SMART”ened experience.

A consequence of all factors which determine the user experience is that the experience space is in practice infinitely large. The size of this experience space is the product of all users and all values that every influencing factor can have. Figure 9 shows for only a few influence factor the size explosion of this experience space.

Although the infinite size of the experience space might suggest the impossibility to design good products, it is not that bad:

- define
- measure
- predict
- verify

Table 2: *How to "SMART"en Experience?*

People	Number of People on earth	$O(10^9)$
		*
Time	Human lifespan in seconds	$O(10^9)$
		*
Location	Square meters of planet earth	$O(10^{14})$
		*
...	...	...
Size of experience space		∞

Figure 9: Infinite Experience Space

It is not that bad :-)

Many nice and successful products exist!

One of the important means to achieve successfully products is the abundant use of feedback. Figure 10 shows some important aspects of obtaining feedback; get architects and designers out of the development laboratory; use short development cycles and observe and listen to users.

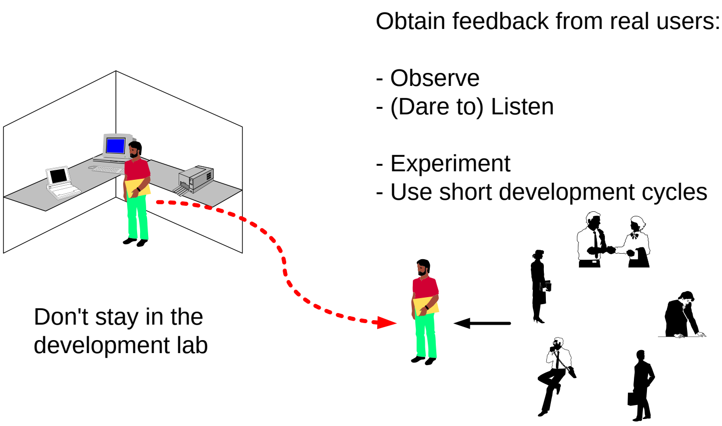

Figure 10: Key Success Factor: Feedback

3 Engineering

The world of engineering and construction is full of tcechnologies and tools. Figure 11 shows some commonly used elements of this world.

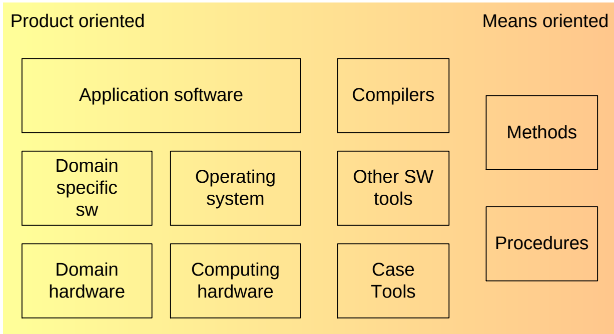

Figure 11: The world of the construction

The engineers are educated in construction disciplines: how to apply technologies to realize a solution which fits the specified requirements. Table 3 shows some of the disciplines in the education of an engineer.

- Programming languages
- Operating systems
- Algorithms
- Data structures
- Formal specification and verification techniques
- Analysis, simulation techniques

Table 3: *Engineers are educated in construction disciplines*

Product Creation is much more than engineering only. Engineering is an important part of product creation, which enables the engineers to re-use methods, tools et cetera (see figure 12 for more detail). However on top of engineering also creativity is needed, where creativity is based on diverse sources as intuition, lateral thinking, trial and error et cetera. The engineering know-how can be teached in courses, while the creativity is developed (and should be latent available) mostly by experience.

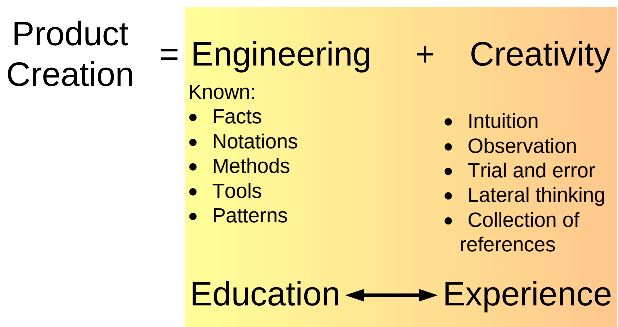

Figure 12: Product Creation is much more than Engineering

4 Education

The understanding that product creation is a combination of engineering and creativity helps to formulate an educational curriculum for architects and designers.

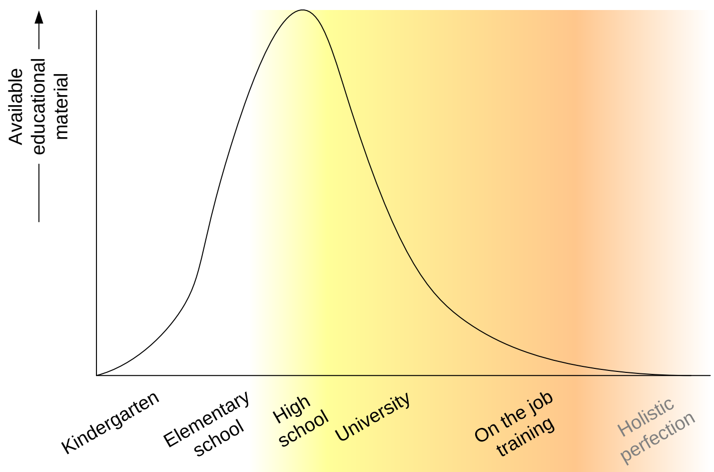

Figure 13: Educational Material per education stage

Figure 13 shows that for education at schools and universities quite a lot of educational material is available. However the more advanced education becomes the less material is available.

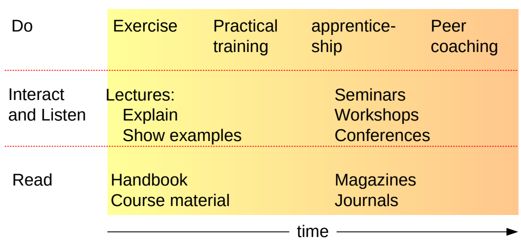

Figure 14: Changing Education model in time

The education can be decomposed in 3 types of learning: *doing, reading* and *interacting and listening*, see figure 14. This figure also shows that the contents for these categories changes over time.

The *doing* during school and university is mostly practising by making exercises, this evolves into practical training, then into apprenticeship and finally it becomes peer coaching.

The *interacting and listening* and *reading* evolve from a preprogrammed fashion at school and university into a selection of seminars, workshops, magazines et cetera.

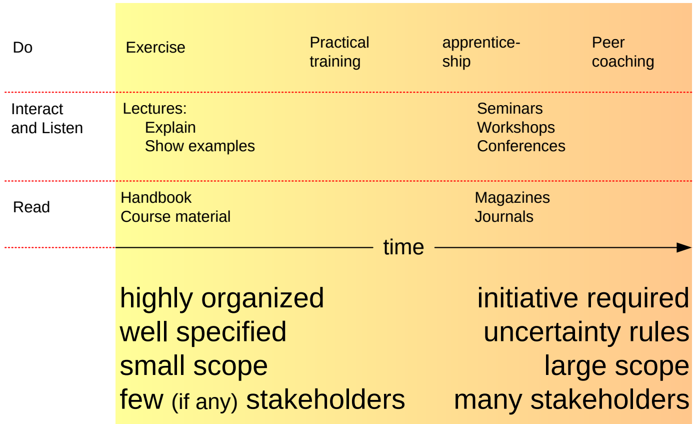

Figure 15: Increasing Initiative required

Figure 15 annotates the education lifecycle with the characteristics. The early lifecycle is characterized by a limited scope, well organized, well specified subjects and involvement of a few (if any at all) stakeholders. At the later stages the characteristics are more or less the opposite: a large scope full of uncertainty and with many stakeholders. In the later stages the initiative for further education should come from the employee itself, no well organized curriculum exists anymore.

- Awareness of engineers of human aspects
- Active personal development drive of engineers
- Awareness of managers of education models
- Active motivation by managers

Table 4: *Prerequisites for continuous successfull product creation*

Table 4 shows the prerequisites to be successfull in product creation on a continuous basis. Both the manager as well as the employee should be aware of the need for further personal development, where the manager should stimulate and the engineer should have a personal drive.

5 Conclusion

Figures 16 and 17 summarize the article.

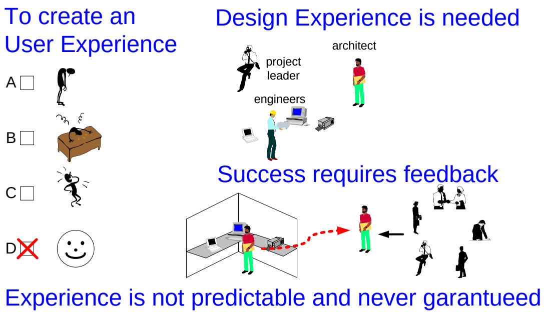

Figure 16: Architecting for Humans

User experience is never predictable, nor is it possible to guarantee an experience. Using methods derived from design experience and applying lots of feedback increases the chance on success.

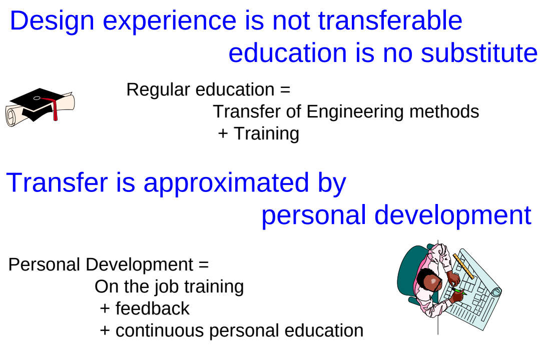

Figure 17: Experience Transfer

Design experience itself is not tranferable, education is a means which can enable in potential good engineers to build up experience faster. This requires a lot of practical training. Later on this engineer must continue his personal development, by means of on the job training, feedback and peer coaching.

6 Acknowledgements

Daniel Malacarne provided feedback on a number of figures.

References

[1] Gerrit Muller. The system architecture homepage. `http://www.gaudisite.nl/index.html`, 1999.

[2] Gerrit Muller. From the soft and fuzzy context to SMART engineering. `http://www.gaudisite.nl/FromFuzzyToSmartPaper.pdf`, 2001.

History

Version: 1.3, date: 21 April 2006 changed by: Gerrit Muller

- updated Figure 1
- added section acknowledgements
- added a textual evrsion of the story behind Figure 6

Version: 1.2, date: 12 February 2002 changed by: Gerrit Muller

- Solved printing problem

Version: 1.1, date: 28 January 2002 changed by: Gerrit Muller

- Article version created

Version: 1.0, date: September 2001 changed by: Gerrit Muller

- Created, no changelog yet