

4. A quest for the foundation stones of a system

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What is a system and how can it be studied? In this essay a Learning Management System used in a university distance course is analyzed and described as a system. The different system levels are explained, the components are explored and the fundamental building stones of the system are finally found and defined to be the messages sent by the students in the discussion forum. The method applied is based on Langefors' Systems Analysis Approach and its pros and cons are discussed in the end of the essay. The conclusions indicate that Langefors' theories still are adequate and useful in this context.

4.1 Introduction

Information technology has made it possible to distribute, share and store information independent of time and place. This has led to new alternatives for education and learning; a flexible distance education (Bellanger & Jordan, 2000 and Fähræus, 2003). In this essay the term *distance education* is used to describe education on distance utilized by a computer based Learning Management System (LMS) distributed by the Internet. A LMS makes it possible to communicate with teachers and fellow students on distance. There are several LMS:s used today as “virtual classrooms” or web-based tools for communication and learning in distance education. They provide tools for course production, course administration and communication. One essential tool for communication is an asynchronous discussion forum, independent of time and place. This tool is especially important for collaboration issues (Volery & Lord, 2000). Learning occurs in interaction with others (Meyer, 2004; Schellens & Valcke, 2005; Clark, 2001) and a discussion forum enables learning by offering great opportunities for course participants to collaborate and interact. These activities can facilitate and enhance students' learning processes (Säljö, 2000 and Kemery, 2000).

But what is a Learning Management System more precisely? To be able to fully understand and describe a LMS my intention is to seek for an adequate method which will facilitate my efforts to observe, determine and define the different components of a LMS. I will also try to find a way to describe the different levels of the system and search for and identify the fundamental building stones in the

system. This will be done by applying the perspective of Langefors' (1973) Systems Analysis Approach.

Professor Börje Langefors, born in 1915 in Sweden, was an innovative and influential person in the early days of the *information systems* (IS) research and practice. He spent his early years at Saab Aircraft Company, where he worked as an engineer. In 1965, he was appointed as the first professor in Information Processing at the University of Stockholm. Professor Börje Langefors's major contribution lies in the information systems (IS) theory he developed mainly in the sixties and seventies. His work became the theoretical foundation of the IS discipline. In his monumental work *Theoretical Analysis of Information Systems*, often called by its acronym *THAIS* from 1966, he founded a theoretical development of effective information systems. By his emphasis on the human aspect as well as the theoretical aspects of information systems he has contributed to establish information systems as an academic discipline and also promoted the social science oriented research in the area of IT. (Nationalencyklopedin, 2006 and Langefors, 1993).

Börje Langefors is also recognized as “the father of the Scandinavian School” (see chapter 1, *Information as a Useful Concept* by Péter Révay, in this book) regarding IS research and practise. In this essay I will try to use the Systems Analysis Approach (Langefors, 1973) because I find it interesting to evaluate the relevance and adequacy of a relatively old IS theory. Can it still be useful for a modern system of today? I will do an exercise in Langefors' systems thinking by studying and describing distance students in a distance course at Mälardalen University and their use of a LMS. My object is to seek some of the fundamental building stones deepest down in the system hierarchy. By searching for the building stones I hope this systems analysis method will facilitate my efforts to understand how a LMS is constructed and how it can be studied. My expectations are that this will enable me to describe a LMS in future studies in the research field of web-based learning in general and learning processes and interaction in particular.

4.2 Systems analysis

What is a system? “*A system is a number of related components*”. This is a description of a system defined by Flensburg & Friis (1999). Langefors (1973) argues that almost every phenomenon can be looked upon as a system and the characteristics all systems have in common is their environmental boundaries. The boundaries demarcate the system and Langefors (1973) has developed the *Relativity Principle for Systems* which he describes as: “Every system which is subject to influence from its environment is a subsystem of some larger system and every system part is potentially a system.”

Therefore, when we study a system it is essential to determine where the boundaries are, what the system consists of, what the components look like and how they are related to each other.

Langefors (1973) uses the following terms listed below for analysing and describing a system.

- *The outer boundary* is the border that demarcates the system from the rest of the world.
- *The inner boundary* is the border line that keeps the subsystems together.
- *The subsystems* are sets of building blocks
- *The building blocks* are the parts of the subsystems, the smallest defined parts that the system consists of.
- *The intermediate boundaries* are the boundaries to other subsystems.

The figure below shows a whole system and its different system parts. Focus is on the system and the world outside the system and its possible influence on the system is not taken in account in Langefors' systems analysis theory.

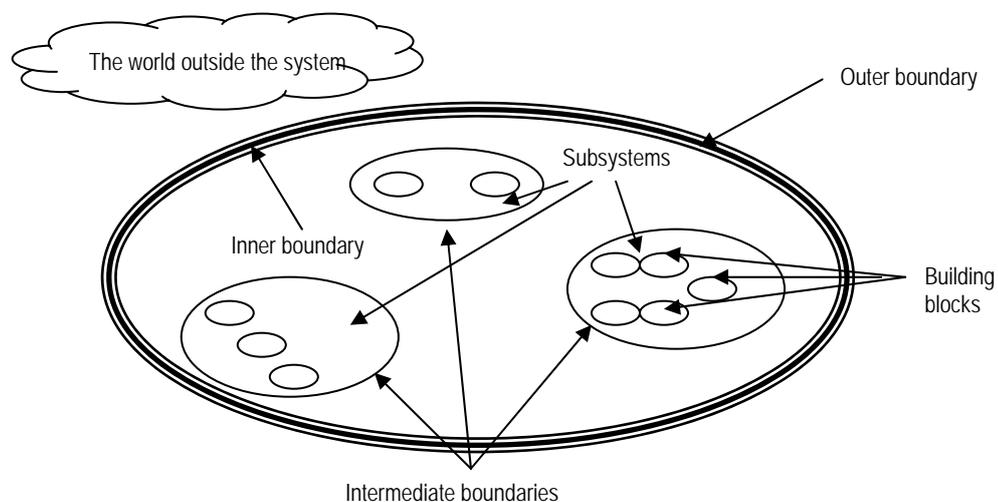


Figure 1 – The whole system with its components according to Langefors (1973)

Langefors (1973) emphasize further that we are not able to grasp a system in one viewing and therefore we should not try to manage more than one piece at a time. This is his reason for developing and using his *Fundamental Principle of Systems Work* which means:

- A *Definition of the systems as a set of parts*
- B *Definition of the system structure*
- C *Definition of the systems parts*

D *Determination of the properties of the system*

Repeat A-D until satisfied.

Inspired by the *Fundamental Principle of Systems Work* I will describe and analyse the LMS.

4.3 The Distance Course

The course in question was a web-based distance course named *Introduction to Academic Studies*. Eleven students began the course and eight students finished it. The objective of the course was to encourage and prepare the students for future academic studies. It was part of a one year college program for students interested in university studies but not fully qualified for studies on an academic level. The program was offered by Mälardalen University which is one of the universities in Sweden. A Learning Management System called WebCT was used in the course. To enable the view of the course as a system I think it is essential to understand the context of the course. In figure 2, below, the different components mentioned above are put into the sketch in the same way as described in figure 1.

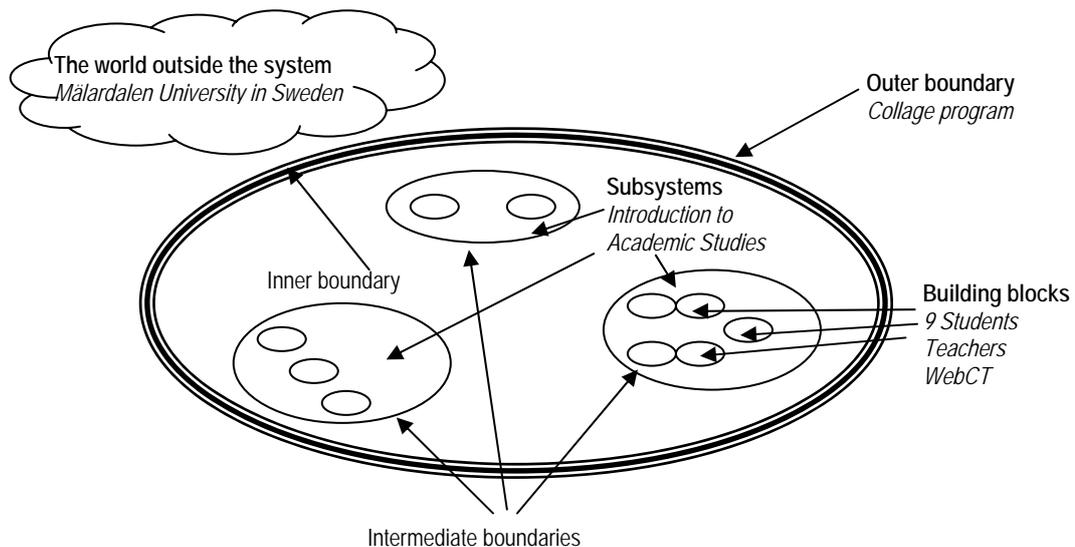


Figure 2 – *The context of the course in Langefors' terms*

4.4 The Learning Management System – WebCT

A Learning Management System defined by Paulsen (2003) is:

[a] broad term that is used for a wide range of systems that organize and provide access to online learning services for students, teachers, and administrators. These services usually include access control, provision of learning content, communication tools, and administration of user groups.

As mentioned before the LMS used in the course was WebCT (Web Course Tool). In the course *Introduction to Academic Studies* the main communication tool was a forum for discussions. The forum was used by all teachers and students through the whole course. The WebCT was a part of the course and the discussion forum was a part of the WebCT.

The discussions were held in an asynchronous mode. The participants were independent of time in contrast to synchronous communication like chats, which take place in real time. In order to avoid confusion among the students threaded discussions were used in WebCT. Threaded discussions are asynchronous online discussion environments where conversations can occur between two or more people. The threads allow the reader to follow the various contributions to a discussion and respond to specific messages.

The students were obliged to take an active part in the different discussions and their participation was part of the course examination.

4.5 The Course as a System

I have chosen to perceive the distance course *Introduction to Academic Studies* as the whole system. With another approach the whole system could be all the courses offered by...

...a department of a university

...a university

...all universities in Sweden...in Europe...in the whole world.

If I believed in life on other planets I could even have chosen to let the whole system be represented by the courses in the whole universe.

A consequence of adopting the view of Langefors' (1973) *Relativity Principle for Systems* and applying the theory on the course *Introduction to Academic Studies* could be described as the figure below. The different components I have identified are outlined in figure 3.

One of the characteristics of a system is the distinct border, sharply marked off from its surroundings, which serves as a demarcation for the system as a whole. This border, *the outer boundary* in Langefors' terms, is illustrated in figure 3, together with *the inner boundary*.

Looking outside the system (i.e. the course) we can observe the closest environment, which can be described as different entities of all students, teachers, subjects, departments etc. at Mälardalen University. These entities are outside *the outer*

boundary. If we change view and perceive to be inside the system we will find that *the inner boundary* demarcates the system from the environment or the world. Inside the Inner boundary I have defined three entities which I believe are important for the description of the system; the students and teachers in the course and the Learning Management System, WebCT.

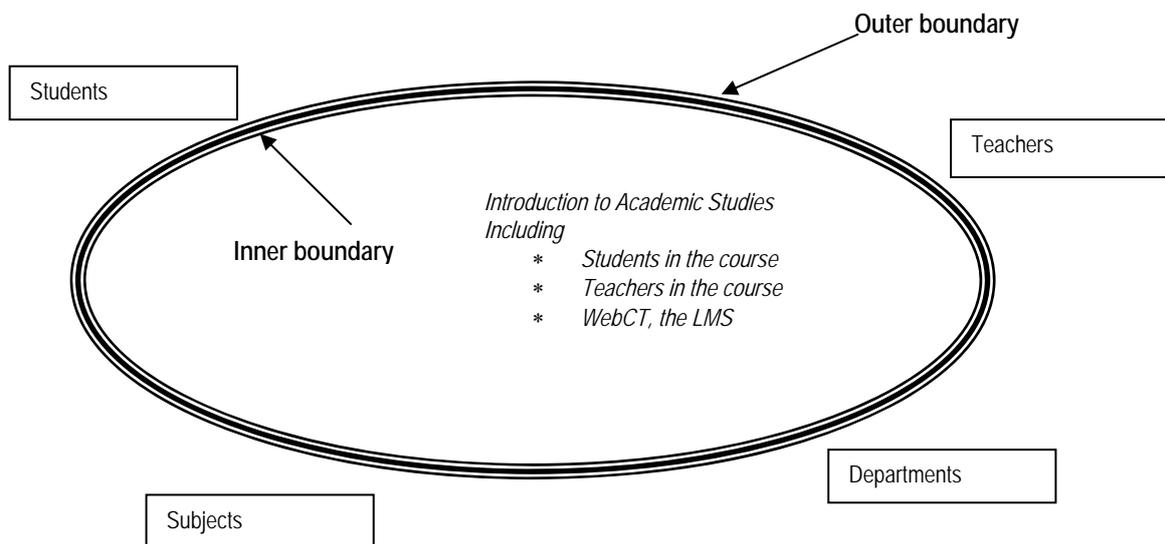


Figure 3 – *The course as a system*

As been explained above the group of teachers, the student group and the Learning management system, WebCT, are constituent parts of the course i.e. the system. In Langefors' (1973) terms these parts are the *subsystems*. The border around each subsystem is *the intermediate boundary* and each subsystem consists of *building blocks*.

Studying the course from Langefors' (1973) systems analysis perspective will enable my intention to examine the system of the course in a methodical and systematic manner. My objective is to define the different parts (*subsystems*) and breaking them down into smaller pieces (*building blocks*). In this way I expect the Learning Management System (WebCT) with its different parts and levels to be explained and elucidated.

It is not possible to define and describe all the different system components and their relations to each other in this essay. Therefore I have limited my study to a "quest for the foundation stones" and I will stop at the lowest level, the foundation stones of the system hierarchy. I have chosen the "quest metaphor" to illustrate how I will navigate through the system. A quest is per se based on several choices and you do not know in beforehand neither what you are going to find at the end of the quest nor the exact way to find it. The quest illustrated in this essay

is not different in that aspect. Each time I will come across a system part I have to evaluate its relevance in relation to my research area and thereafter choose an adequate track through the system. On each level I will choose to explore the subsystem I appreciate as the most important for my future studies regarding distance learning and interaction between students and teachers. These selected subsystems will be placed in the middle of the figure and be marked with bold letters.

Langefors' definitions of boundaries and system parts

The outer boundary = which demarcates the border to the environment outside *the whole system*

The inner boundary = set of subsystems which are to be regarded as parts

The subsystem = set of building blocks

The intermediate boundary = the boundaries to *other subsystems*

The building blocks = the smallest parts in a system

Figure 4 – Langefors' terms used in this chapter

In the following sections I will focus on the system components I find relevant for the purpose of this study. These components are *the whole system*, *the subsystems* and *the building blocks* (figure 4).

4.5.1 The starting-point – level I

Our quest begins on level one. I have identified *the course* as *the whole system*. *The outer boundary* is equivalent with the whole system, in this case the course *Introduction to Academic Studies*. *The subsystems* are students taking part in the course, the LMS, WebCT, used in the course and course teachers. *The building blocks* are in this example parts of the Learning Management System, WebCT. They will be explored and explained later, in this section.

The sketch below present and explain the system (figure 5) as an overview designed to facilitate the orientation and understanding of the following levels.

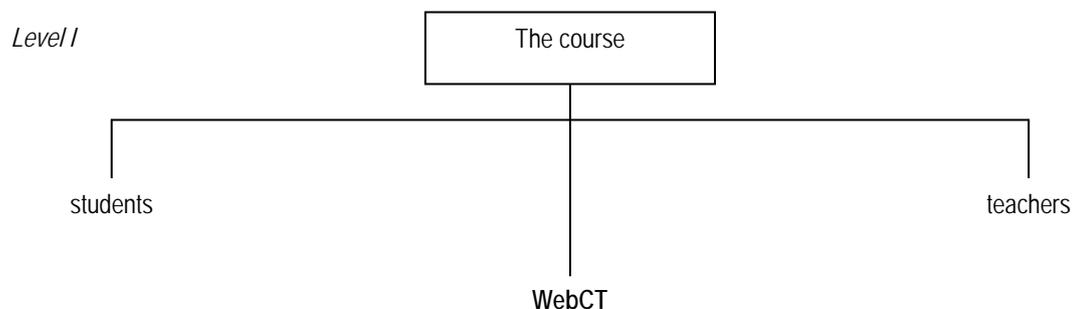


Figure 5 – An overview of the system – level I

For every level we will come across in this study I will highlight three subsystems even if the system consists of several more subsystems. Now we will have a closer look at one of the subsystems – the WebCT.

The learning management system WebCT is a web-based system which enables distance students and teachers to interact and manage a course on distance. The WebCT can be described as a virtual school with features like discussion forums, bulletin boards, course material, mail addresses to all participants etc. When the students in the course received a password and entered the WebCT site of the course *Introduction to Academic Studies* they were met by the course's homepage illustrated below (figure 6). According to the perspective of level I the homepage contained several kinds of *building blocks*. The figure below shows the homepage of the course, in Swedish, where the building blocks are represented by the different *icons*. From the upper right these are *Presentations of each student* (in Swedish; Vilka är vi?), *Course Material* (in Swedish; Kursmaterial) *Weekly Tasks* (in Swedish; Veckouppgift), *Discussions* (in Swedish; Diskussioner) etc.

In the subsequent section we will focus on the encircled icon Discussions (i.e. Diskussioner). The reason for choosing Discussions is that I expect to find some interesting components regarding my research focus – interaction between students and teachers in a web-based course.



Figure 6 – The homepage of the course with icons

The next figure (figure 7) explains the system in terms of Langefors (1973) Systems Analysis Approach.

The whole system = the course *Introduction to Academic studies*
The subsystems = students, **WebCT**, teachers
The building blocks = icons on WebCT course site

Figure 7 – The course as a system in Langefors terms focusing on the subsystem WebCT

4.5.2 Level II

On the next level (level II) we need to change view and perceive the *icons* to be *subsystems*. Consequently *WebCT* represents *the whole system*. To be able to explore the building blocks of the subsystems I have to select one icon as an example. As earlier emphasized I will now focus on the Discussion Forum called Discussions (i.e. Diskussioner).

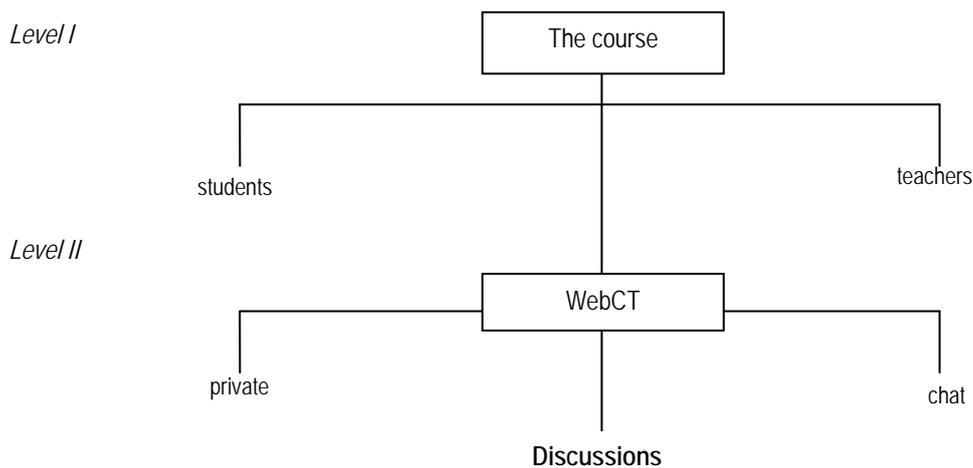


Figure 8 – An overview of the system, level I-II

The next step in the quest of the fundamental building stone in the system is to explore the subsystem Discussions by having a look at the building blocks. A “click” on the icon Discussions will give us the following view.

Discussions

[Compose message](#) ... [Search](#) [Topic settings](#)

Click on a topic name to see its messages.

Topic	Unread	Total	Status
Lärlarlaget	0	12	private, unlocked
Meddelanden från Lärarna	0	83	public, unlocked
Vanliga frågor	0	21	public, unlocked
Öppen diskussion	0	202	public, unlocked
Grupp 1 (Karin)	0	30	private, unlocked
Grupp 1 (Marina & Sara)	233	519	private, locked
Vetenskapligt skrivande	0	7	public, unlocked
Kap 2 med Sven Hamp	0	44	public, unlocked
Diskutera filmen	0	0	public, unlocked
Diskussion med Tommy	0	18	public, unlocked
Naturen, naturvetenskapen och lärandet kap4	3	34	public, unlocked
Naturvetenskap som allmänbildning kap 1	0	48	public, locked
Naturvetenskap som allmänbildning kap 2	7	52	public, locked
Naturvetenskap som allmänbildning kap 3	0	18	public, locked
Naturvetenskap som allmänbildning kap 4	9	38	public, locked
Naturvetenskap som allmänbildning kap 5	12	52	public, locked
Naturvetenskap som allmänbildning kap 6	29	48	public, locked
Naturvetenskap som allmänbildning kap 7	4	22	public, locked
Naturvetenskap som allmänbildning kap 8	18	18	public, locked
Naturvetenskap som allmänbildning kap 9	21	21	public, locked
Naturvetenskap som allmänbildning kap 10	0	13	public, locked
Naturvetenskap som allmänbildning kap 11	0	28	public, unlocked
All	336	1328	---

Figure 9 – Topics, the building blocks on level II

On the figure above we can see how the *subsystem Discussions* is organized. The *building blocks* are represented by different discussions and each *topic* has its own discussion link. A topic could be *Frequently asked questions* (in Swedish; Vanliga frågor), *Open discussion* (in Swedish; Öppen diskussion), a *Film discussion* (in Swedish; Diskutera filmen), a *Book discussion* – in this case one discussion for each chapter etc. If we let the different topics symbolize the building blocks we can notice that they also have their own *properties*. The web page lists the topics or building blocks and provides us with information about them. In Langefors' (1973) terms the information is the *building block's properties*. The information enables us to observe, how many unread discussion contributions there are in each topic, how many there are in total and if a topic is private (for a certain group of people) or public, locked (out of date) or unlocked for a certain user.

The whole system = the WebCT
The subsystems = private, discussions, chat
The building blocks = topics in discussions

Figure 10 – The WebCT as a system in Langefors terms focusing the subsystem Discussions.

We will now leave level two and perceive Discussions as the whole system.

4.5.3 Level III

On the system’s level three we change our view once again and *Discussions* will represent *the whole system*. Consequently *the subsystem* will be characterized by *topics* and I choose *Open Discussion* (i.e. Öppen discussion) to be the subsystem to explore.

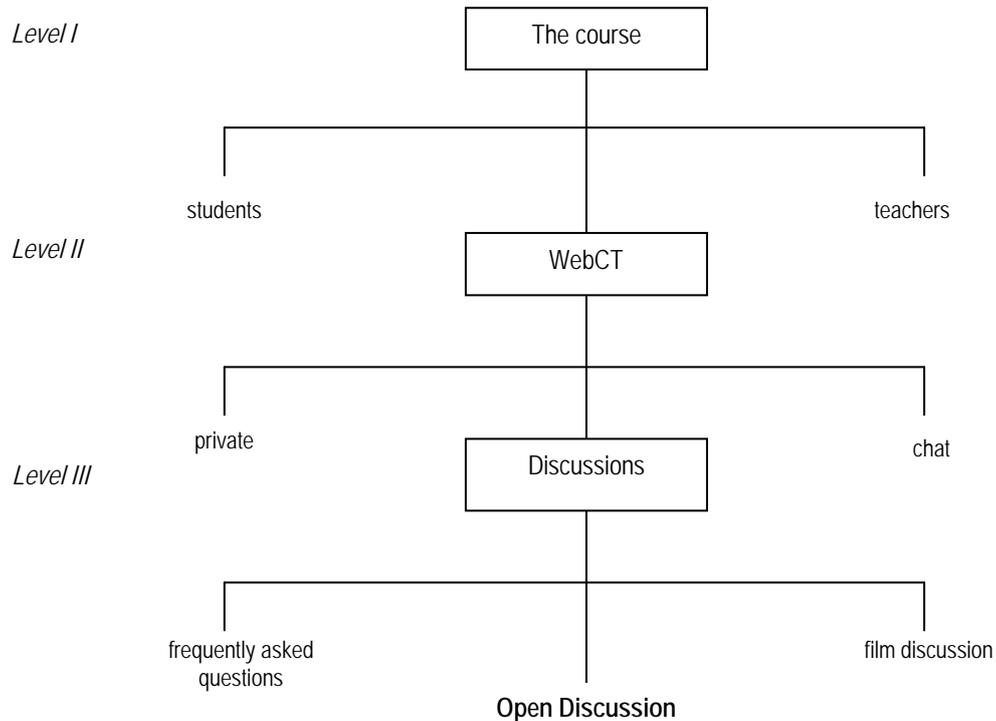


Figure 11 – An overview of the system, level I-III

The building blocks will appear when entering Open Discussion by “clicking” on the topic. Several discussion subjects will become visible (see figure below).

Control Panel Akademisk introduktion, 10 poäng, distans
View Designer Options
- Course Menu - Homepage > Diskussioner > Öppen diskussion
Discussion Messages: Öppen diskussion
Compose message Update listing Search Mark all as read Message options

Display: All Unread Threaded Unthreaded Select topic: Öppen diskussion

Status	Subject	Author	Date
0/7	cumming		
0/3	Cummings		
0/48	Cumming		
0/2	JISSES CUMMING		
0/1	cummings!!		
0/20	cummings?		
0/3	cummings fakta?		
0/9	cummings!!		
0/2	högskola vs kan inget		
0/5	tråkigt!!		
0/7	Ang tråkigt...		
0/5	Examinationsuppg. 1		
0/5	förvirrad		
0/2	seminariepasset vecka 13		
0/18	Byta ansikte?		
0/15	Big bang/Adam o Eva		
0/4	Uppgifter?		
0/12	Va tycker ni???		
0/2	Chat		
0/5	Solarie		
0/16	förnuft och solarie		
0/1	Chat		
0/1	textövningen med Karin		
0/1	Öl En fråga till C...		

Figure 12 – Subjects as building blocks - level III

The *subjects* will now represent *the building blocks*. Each student is able to start a new subject (i.e. thread) or respond on a fellow student's contribution to the discussion. The threaded discussions make it possible to organize and maintain the structure, avoiding parallel discussions on the same subject. The notations to the left of each subject for example 0/18 shows how many contributions in one thread that are unread by the user at a certain time and also the total amount of contributions there are in one subject (i.e. thread). In the present example 0 contributions are unread and there are 18 contributions in all in the subject (i.e. thread). Some subjects have the same name for example *Cummings*. This indicates that the students have not fully understood the importance of labelling a subject in an adequate way in order to avoid confusions in the discussions. The figure below (figure 13) gives an outline of the system on level III in the terms of Langefors.

The whole system = discussions
 The subsystems = film discussion, open discussion, book discussion
 The building blocks = subjects or threads

Figure 13 – The WebCT as a system in Langefors terms focusing the subsystem Open Discussion.

In the next section we change perspective once more and perceive subjects as subsystems.

4.5.4 Level IV

Next step in our quest for the building stones in the system hierarchy will be to have a thorough look at a *subject*. We change view once more and determine the subjects to be *subsystems*. The *whole system* is now characterized by *Open discussion* but what do the *building blocks* look like? Let us move on to one of the subsystems or subjects and look what is hidden behind it. We choose the subject *Change face* (in Swedish; Byta ansikte). A “click” on the subject will give us the following view:

Subject: **Byta ansikte?**

Message no. 1062
 Author: [redacted]
 Date: Thursday, January 27, 2005 22:29
 Tittade på TV4 ikväll och såg en Brittisk dokumentär som handlade om att forskare och kirurger undersöker om människor är beredda att ta risken att få en annans (en död människas) ansikte. Det var människor som hade fått sina ansikten missbildade efter olyckor. En forskare vid namn John Baker (inte 100 på namnet) tror att man "snart kan ha en vetenskaplig lösning på det. Tycker det verkar helt överkligt! Man frågade sig även om anhöriga till avlidna kunde tänka sig att donera deras ansikten till detta syfte. Kommentarer? Självt blev jag helt ställd.

Message no. 1063
 Author: [redacted]
 Date: Thursday, January 27, 2005 22:37
 Min första tanke är: Fy så vidrigt! Visst jag kan förstå om man har ett deformerat ansikte att man vill göra om det. Men då vill jag väl ändå se ut som mig, och inte ha någon annans ansikte?!

Message no. 1064
 Author: [redacted]
 Date: Friday, January 28, 2005 07:26
 jag funderade mest på, hur skulle jag reagera om en okänd individ kom med min makes ansikte.

Message no. 1074
 Author: [redacted]
 Date: Friday, January 28, 2005 11:35
 Ja men varför inte? Med all plastikkirurgi som finns o folk som ser alltmer underliga ut efter diverse ingrepp så tycker jag att det här är ju åtminstone en någorlunda vettig ide. Tanken är ju kanske inte så tilltalande, som tex Tania sa, hur kul är det att se sin anhöriges ansikte på någon helt annan, men för de som tex har blivit svårt brännskadade o förlorat sina ansikten kan det nog vara en räddning. Finns definitivt etiska frågetecken men grundtanken är ändå bra tycker jag.

Figure 14 – Messages as building blocks - level IV

The exploration of the *building blocks* is revealed and we find several *messages*. These messages are equivalent with the discussion contributions the students were oblig-

ed to make as part of the course examination. The excerpt above shows the first messages of the discussion which proceeded during the 27th of January 2005 to the 28th of February 2005 in the course *Introduction to Academic Studies*.

This is what I have been looking for! The messages between students and teachers represent in my view the foundation stones of the communication on distance. I make the decision to stop here even if it is possible to define further levels. Like Langefors argues "...every system part is potentially a system" and it is possible to go further.

Messages are made of sentences...

...sentences are made of words and figures...

...words are made of letters ...

It seems to be a never ending story.

One reason for ending the quest is that the *messages* (i.e. *building blocks*) in a discussion are especially important for my future research projects. I am interested in how and why interaction between people is important for the learning processes and my intention is to study student interaction in association with learning in distance education.

At the end of the track we have found our smallest pieces, the building blocks of a discussion forum in WebCT. Our quest for the fundamental building stones, at the bottom of the system hierarchy with the approach of Langefors' systems analysis method has now reached its end. My findings regarding the system hierarchy are graphically shown in the following sketch.

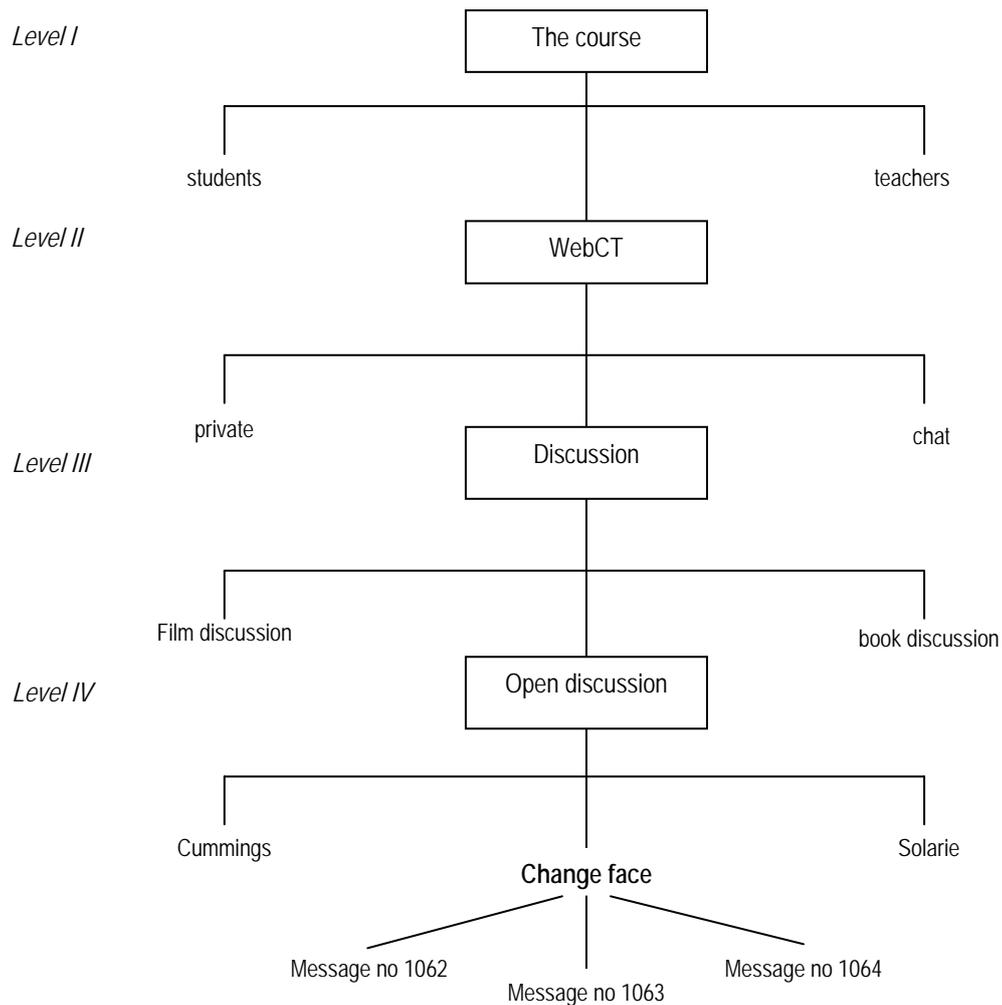


Figure 15 – An overview of the system, level I–IV, with the building blocks on level IV

The whole system = Open discussion
 The subsystems = cummings, **change face**, solarie
 The building blocks = message no 1062, 1063, 1064

Figure 16 – The WebCT as a system (Langefors 1973) focusing the subsystem Change face.

My object is fulfilled; the system’s different levels are unveiled and the quest for the fundamental building stones on the lowest level in the system hierarchy terminates with the different *messages*.

Stopping the quest here seems relevant, also according to Langefors’ (1973) view. He has invented the expression *elementary messages* or *e-messages* for information elements which he argues are the knowledge of something elementary about an object (Langefors 1993). He explains further that an e-message can be an elementary

property, a relationship or the participation in an event (see also Péter Révay's chapter 1 in this book). I have defined the smallest component to be a message, which could be called e-message because of its characteristics of being an electronic message. In my point of view the e-messages in the discussion forum undoubtedly is the smallest information carrier in the information system WebCT. It can also be labelled an e-message in Langefors' terms. The reason for this is that the *e-message* could be looked upon as a participant in an event (where the event is the discussion). The knowledge of something elementary about an object is consequently the meaning of the message, and the message is a contribution to the discussion in the course.

5.6 Discussion and conclusion

I have found that using the Systems Analysis Approach (Langefors, 1973) serves its purpose in this study. Adopting a systems analysis approach has facilitated my efforts to describe the course as a system and to explore and locate the smallest building block of the course. The boundaries, components and relations have become explicit. By using this method I have identified the fundamental building blocks to be the different discussion contributions (i.e. e-messages) from students and teachers, called messages in WebCT. I have found a method to systemize, describe and analyze the different components in a web-based course.

It is interesting to notice that a relatively old systems theory still is relevant for analyzing systems of today. My opinion is that Langefors' Systems Analysis Approach is very general and do not take any notice of the possible influence of the environment outside the outer boundary. If I had evaluated the environment as important I would probably had turned to another systems theory. In this case the need of analyzing the environment outside the system was not relevant and that could be an explanation to why the part of Langefors' *Systems Analysis Theory* used in this essay was easy to adopt.

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