IMPLEMENTING THE BOLOGNA PROCESS AT LTU
A tool for flexibility

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ABSTRACT
Due to shrinking enrolment in Chemical/Mining Engineering at LTU, several measures have been implemented to add flexibility in time and location of education. In addition, the Bologna model for higher education is already put into action with three Master programmes, which admitted students this educational year. A new School of Natural Resources is suggested to further add flexibility in running of courses, and serve as marketing point for studies at LTU.

1 Background
Over the last 3 – 4 years it has been increasingly clear that educating for small industrial sectors in a world where economic cycles, common opinions, what youngsters fancy, and political steadfastness are changing more rapidly than the lead-time it takes to produce a Chemical/Mining Engineer; it is a challenge. This has lead the Luleå University of Technology (LTU) to do several changes in its structure and educational programmes. The changes have been reported on, to a part, at previous Mineral Processing Conferences (Pålsson, 2002, 2004, 2005).

We realised early that we cannot trust the industry, i.e., their forecasts and willingness to hold on to projected recruitment. It is well known that the industry shows most interest in education at universities and institutes at the end of an economic cycle. In addition, since the average cycle is about five years and the lead-time to produce an Engineer is more or less the same it has lead to a situation where production and demand do not fit. They are, in fact, perfectly out-of-sync, cf. Figures 1 and 2.

Due to bad recruitment a few years back, we predict a shrinking output of fresh engineers over the next two years as can be seen from Figure 2. In the first and second year of studies we have about 15 students of which we expect two thirds realising what is best for them ---. However, they will not be available until 2008 at the earliest – in time for the next down-turn in the economy.

With this background, it was obvious that we could not continue as usual – at least no if we wanted to survive as an engineering department. Instead, the key had to be flexibility – in time, location, and curriculum.
Figure 1. Annual production of Mining Engineering graduates with Mineral Processing-Metallurgy option.

Figure 2. Annual production/prediction of Chemical Engineering graduates with Mineral Processing-Metallurgy option.
2 Flexibility

2.1 Time and location
Starting already in 2001, the department of Chemical and Metallurgical Engineering had begun to use a Learning Management System (LMS) from WebCT. It gave us the possibility to distribute teaching material to students off-campus. At about the same time the computer laboratories at the department got a terminal server, which, in theory, made it possible for us to have off-campus students running proprietary computer programs from home.

Now in 2006, the LMS has been changed to a University wide system, Fronter, and the department renamed and expanded to Chemical Engineering and Geosciences. Of totally 111 course codes at the department, 60 have a course “room” in Fronter. Several of the courses also share a common room, so the uptake is even better.

What we didn’t realise from the beginning was that our on-campus students would very much like the possibility to have all course notes, extra material, and transparency copies at one location, reachable from their dormitories.

The “real” distance and net courses are about five, and they are run with the Fronter LMS for asynchronous communication, i.e., distribution of material, discussion *fora* and chat-sessions. The latter is probably better characterised as a synchronous communication and is supplanted by a more direct communication tool, Marratech (2006), which is a video conferencing system run on personal computers. With this, the teacher may sit in front of his computer and deliver a lecture, conduct a seminar, or have an exam with one or several individual students. With all these tools, we have achieved a considerable flexibility in running courses, and have saved money on copying of hand-outs and travel costs. Figure 3 shows a conceptual picture of the new teaching, where it doesn’t matter if the student is located in Ulan Bator or Mudoslompolo or at home in Luleå.

![Conceptual view of modern teaching](image-url)
2.2 Flexibility in curriculum

The current system for educating Engineers at the Master level in Europe demands that the students start their studies at a University, studies there the whole time, and after at least five years of continuous labouring at the desk are ready for the real world (industry) that has most likely changed considerably since the student went to the University.

One way of added flexibility adopted by LTU and most of Europe is to change higher education according to the Bologna model (Anon, 2000), (EU Commission, 2005). This means that all university studies in Europe will have 3 years of basic studies leading to a Bachelor’s exam, followed by two years of Master’s studies, eventually with additionally three years for a PhD. Sweden has been slow in introducing the Bologna model, a proposition went to the Parliament June 2005 (Government Bill 2004/05:162 New world – new university). It did not pass the Parliament until 23rd February 2006. Despite this, LTU went ahead and started eleven Master programmes already in autumn 2005 cf. Table 1. Tree of them (marked in bold-face) belongs to Chemical Engineering and Geosciences.

Here it should be noted that the current 4.5-year Master of Engineering programmes in Sweden are regarded as profession-oriented, and per se, not included in the Bologna model.

Table 1. Master programmes at LTU.

<table>
<thead>
<tr>
<th>Information Systems Sciences</th>
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<tbody>
<tr>
<td>Electronic Commerce</td>
</tr>
<tr>
<td>Wood Technology</td>
</tr>
<tr>
<td><strong>Chemical and Biochemical Engineering</strong></td>
</tr>
<tr>
<td><strong>Minerals and Metallurgical Engineering</strong></td>
</tr>
<tr>
<td><strong>Exploration and Environmental Geosciences</strong></td>
</tr>
<tr>
<td>Computer Science and Engineering</td>
</tr>
<tr>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>Hydropower Engineering</td>
</tr>
<tr>
<td>Civil Engineering with specialisation in rock and soil engineering</td>
</tr>
<tr>
<td>Environmental Engineering</td>
</tr>
</tbody>
</table>

The first two of “our Masters” are nearly identical to the last years for the options in the Chemical Engineering programme currently run by the department. The major differences are that courses are run in a different order, and the Master programmes have more electives. In this way, we will get additional students taking the specialisation courses.

The third Master has for the time being no basic education at LTU, although such will start in autumn 2007.
Recruitment for our three Master programmes started late, but we managed to get a fair number of applicants, cf. Table 2. However, the immigration authorities became overloaded with residency permits, and caused a slow turnaround of the permits. This meant that only about 20% of those finally admitted made it to LTU.

Table 2. Applications and finally admitted to three Master programmes in 2005.

<table>
<thead>
<tr>
<th>Master programme</th>
<th>Applicants</th>
<th>Registered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical and Biochemical Engineering</td>
<td>86</td>
<td>7</td>
</tr>
<tr>
<td>Minerals and Metallurgical Engineering</td>
<td>62</td>
<td>2</td>
</tr>
<tr>
<td>Exploration and Environmental Geosciences</td>
<td>62</td>
<td>3</td>
</tr>
</tbody>
</table>

The bad results were of course disappointing, but we believe that with better planning and information it will be possible to increase the number of final registrants. Already, the number of Web-applications (Table 3) is larger than last year, and we have noticed a higher interest among European students for our programmes.

Table 3. Number of Web-applicants to three Master programmes in 2006 (as of 21 December 2005).

<table>
<thead>
<tr>
<th>Master programme</th>
<th>Web-applicants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical and Biochemical Engineering</td>
<td>32</td>
</tr>
<tr>
<td>Minerals and Metallurgical Engineering</td>
<td>74</td>
</tr>
<tr>
<td>Exploration and Environmental Geosciences</td>
<td>104</td>
</tr>
</tbody>
</table>

The final added flexibility is when the Master of Engineering programme becomes a five-year programme. This became a reality after the Parliament changed the aforementioned Government Bill to add a 10th semester to all “civilingenjör” and architect programmes (Riksdagen, 2006). We will then in the future have a situation with:

- A five-year Engineering programme,
- A possibility to leave for another programme/university within Europe after three years of study,
- A way to recruit additional students to our specialisations.

3 Proposed new Engineering structure at LTU

One weakness with the current lay-out of options and programmes is that there is no basic three-year education in Engineering Geology or similar. Therefore, the Board of the Faculty of Engineering initiated a study (Anon., 2006a), lead by Professor Pär Weihed of Ore Geology, which has proposed a re-structuring of Engineering, Bachelor and Master Programmes with the aim to increase the
flexibility among them, cf. Figure 4. The first admissions are planned for the autumn semester 2007.

The new structure is characterised by a first year, which is nearly identical for the Bachelor level programmes. These are mainly taught in Swedish, but often with English textbooks. The Master programmes are in English.

![Figure 4. Proposed new curriculum structure at LTU – School of Natural Resources. Note! Mining and Environment are now parts of Civil Eng.](image)

In Figure 4, the Bachelor levels in Chemistry and Mining do exist within current Engineering programmes. Also, to a part, the Bachelor in Environment. For the Master level, our three programmes exist, as well as most of Mining and Environmental Engineering.
A major idea with this structure is to create a flexible system of related programmes with courses that may have students from most programmes. It will also give students from abroad a wider scope of courses.

The Board of the Faculty of Engineering decided (Anon., 2006b,c) to implement a School of Natural Resources. It will incorporate, in addition to earlier mentioned programmes, the Gemstone technician programme, and the arena Resources of the Earth. The Board also gave permission to proceed for planning of the Bachelor programme in Natural Resources Engineering.

Another important benefit of the coming structure is that we now have a “smörgåsbord” of programmes and short courses all related to the sustainable use of natural resources. This makes us an interesting partner in future discussions on European cooperation within this field. At present, we are participating in talks on a joint Swedish-Finnish Master of Engineering programme in Metallurgy. Also, in the early planning stage is the participation in an Expert Centre for Mining and Extractive Industry in northern Finland that may be located at the University of Oulu.

4 Conclusions
We believe that our strong emphasis on flexibility in education will pay off in the future. In addition, it means that we will find it easier to have active professional engineers taking courses in our School of Natural Resources.

In addition, we believe that a School of Natural Resources will be a unique marketing point in our communication with prospective students.

Furthermore, a School of Natural Resources is probably very P.C.

5 References
EU Commision, 2005.
http://www.regeringen.se/sb/d/5232/a/47437
Marratech, 2006. Internet video conferencing, e-meeting and web conferencing for effective collaboration tele working with remote staff, customers and clients.
http://www.marratech.com/