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Postgraduate Research training in Belgium: the case of engineering

(Draft)

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Some years ago postgraduate education in Flanders has been changed by the University Decree of 12th June 1991. Before this decree, a dissertation, based on independent scientific research, supervised by a professor and defended in public, was the only condition to gain a PhD (= learning by doing model). Since the decree, each university may organise doctoral studies and oblige PhD students to follow a training programme before defending the dissertation (more information in the policy paper).

This case-study was carried out at a Faculty of Engineering in Flanders. This faculty differs from the others in two ways. First a selection of students already occurs before entering the academic training courses at first-cycle level. Engineering is at this moment the only faculty that organises an entrance-examination. Second, the academic training in order to obtain the second-cycle qualification of 'Burgerlijk Ingenieur' takes 5 years which is more than in some other European countries.

We should stress that the selected departments are strongly research-oriented. This means that they deliver more PhD's than other departments of the faculty, as is shown in table 1.

Table 1. The number of PhD's awarded at the Faculty of Engineering in general and in the departments A, B, and C from 1982-1983 till1994-1995

Academic year	Faculty of Engineering	Dep. A	Dep. B	Dep. C
1982-1983	19	8	6	1
1983-1984	25	8	4	2
1984-1985	31	11	6	7
1985-1986	20	8	1	4
1986-1987	27	11	4	5
1987-1988	27	12	3	4
1988-1989	23	9	4	5
1989-1990	42	14	4	8
1990-1991	25	19	1	1
1991-1992	33	16	5	6

1992-1993	52	26	8	6
1993-1994	51	17	9	8
1994-1995	47	29	5	6

Source: Faculty of Engineering

We interviewed four professors and twelve PhD-students to get an image of the concrete organisation of doctoral studies and the experiences of professors and students. Four issues will be discussed: 1) access; 2) the doctoral training programme; 3) the global task-package and completion time and; 4) supervision and evaluation. The data show that the PhD-training is at this moment in a transitional stage. Some students are still working in the old system (older or senior PhD-students) while others in the new system (younger or junior PhD-students).

I. ACCESS

1. Conditions

1.1. Diploma

The first and most important condition of admission is the diploma. Depending on the kind of diploma of the student, s/he will directly or indirectly be admitted. Therefore we can distinguish two tracks: the direct and the indirect track. Students of the second group need to pass a pre-doctoral examination. This however can take a different form depending on the training and on the experience of the candidate.

Table 1. Tracks of entrance

DIPLOMA	**ACCESS**
1. Second cycle qualification of 'Burgerlijk ingenieur' (civil engineer) of a Belgian university	**Direct**
2. Master of Engineering, obtained at the university of our fieldwork	**Direct**
3. Master of Engineering obtained at a foreign university * professional experience * no professional experience	**Indirect**: examination by a commission of professors **Indirect**: Studying a full year Master of Engineering[1]
4. A second cycle qualification of Colleges of higher education * professional experience * no professional experience	**Indirect**: examination of 60/90 study-points **Indirect**: a two or three-years programme[2]

[1] After the Master programme, these students get direct access (cfr. categorie 2)

[2] When these students succeed, they have a diploma of civil engineer and get direct access (cfr. categorie1)

1.2. Other necessary conditions

Entrance to the doctoral programme is only granted to candidates who meet certain standards. All candidates, Belgian civil engineers as well as other candidates (foreign students, industrial engineers,...) should have excellent marks during the undergraduate training and/or during the pre-doctoral tests.

1.3. Informal conditions

When a candidate wants to enter the doctoral programme s/he should at least meet the criteria determined by law (decree 12th June 1991) and by the faculty, i.e. excellent results in the pre-doctoral test and/or the graduation exam for engineer. In addition there are some informal conditions which cross these regulations and have an important impact on the policy of access.

Every candidate, whether Belgian or foreigner, has to find a supervisor who will support him. If no professor wants to join hands with him, he won't be able to obtain a grant or admission to the pre-doctoral examination and is consequently excluded from the third cycle.

The faculty stimulates graduates from Colleges of higher education (e.g. industrial engineers) who have no relevant professional experience to take the two- or three-years programme in order to obtain the degree of civil engineer before starting a PhD. Although the law does not demand this special programme, the faculty took this as a general policy. This has the advantage that candidates from Colleges of higher education not only become a PhD in Engineering, but civil engineer as well.

2. Actual course of admission

2.1. Initiative and motivation

Who takes the initiative to work for a PhD? We can distinguish two groups: on the one hand the students who are invited, during the last year of the second cycle, by a

professor to make a doctorate, and on the other hand those who take the initiative themselves and look for an opportunity to make a doctorate.

Students can be invited by a professor to make a PhD, e.g. because they have excellent results. Each professor has, of course, the ambition to recruit brilliant students in his research unit before they are snatched away by the industry.

> To make a PhD, it goes like....they (= faculty) just wait until students come and ask for it themselves. They do not approach students to look whether they are interested in making a PhD. Unless of course ... each year there are some extremely brilliant students and they are of course badly wanted in each research group. (Student 1)

A second and more prevailing reason is the need for researchers within the framework of a project. Sometimes departments have to face a lack of potential researchers, e.g. when they are strongly research-directed but have a rather small number of students in the second cycle.

> (...) because our department is strongly research-oriented, it often happens that companies want to start projects with us (...) we then have to look for people. (..). So we advertise in the Dutch press, the German press, or we contact colleagues abroad. (...) It is not easy to find enough suitable researchers.. For instance next academic year, I think, we supply more research positions at our department than the demand. It is not like that... that all good (undergraduate) students are interested in doing scientific research. A lot of students prefer to go directly to industry. (Professor 4).

When these students were asked for their motives to make a doctorate, the same reasons showed up each time. They can be summarised in three categories: 1) pure interest in scientific research; 2) interest in educational activities, and 3) the pleasant atmosphere in the department. The interest in scientific research and the experience of a pleasant atmosphere mostly arose when working in a research unit on their second-cycle thesis.

2.2. Contract-flexibility[3]

Most PhD students in Flanders are employees of the university and earn a salary. Based on the number of second-cycle students and a staff-student ratio depending on the subject group (humanities, sciences and biomedical sciences), each faculty receives a particular number of assistant positions paid by the university budget. However these assistant positions who last for a maximum of 6 years, can only employ a small part of all doctoral students. Most doctoral students are paid on scholarships or contract-projects. But since most scholarships and contract-projects only last 2 to 4 years, which is far too short to write a doctoral thesis, the faculty worked out an employment strategy by which as many students as possible can proceed to a doctorate during a period of 4 to 6 years.

This strategy works as follows. Each student who gets access to the third cycle, writes a proposal in order to gain a scholarship, even if money is available on a contract-project to pay someone[4]. There are two important State-funded scientific organisations. One organisation is more selective (A) than the other (B). As a principle, students with the highest achievement apply in the most selective one. These scholarships last 4 years. The others, who are also very capable students, apply in the second. In this case, the content of the proposal is important. The student has to defend the proposal in front of a jury[5]. These scholarships take 2 years and can be extended for two more years. If the student fails to gain the scholarship, he will be paid e.g. on a contract-research. Often, the proposal is introduced a second time a year later. If the scholarship or the contract project comes to an end but the PhD is not finished yet, the student will be moved to another contract project. This contract-flexibility is only possible because the Faculty of Engineering has a large number of contract-research with the European Community and the industry.

This situation causes that this Faculty has a variety of contracts and different doctoral students can pass along a totally different pattern of contracts.

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[3] In appendix 1, the way in which doctoral students can be financed in Flanders, is explained.

[4] When money is available to pay a researcher, but this researcher obtains a scholarship, an extra person can be paid on the contract project. In that case, two people instead of one can work at the research unit.

Table2. Contract pattern of the 12 interviewed students[6]

Student	Phase 1	Phase 2	Phase 3
1	Grant B (-)[7]	European project 2 years	Assistant first year
2	Project 1 year	project: 50% Assistant 50% 2nd year	
3	Grant A first year		
4	Grant B (-)	Grant university 1st year	
5	Grant B (-)	Project 1st year	
6	Project 2 years	New project 3rd year	
7.	Grant A (+) 4 years	Project 1st year	
8	Project 1st year		
9	Project 1 year	Assistant 3rd year	
10	Grant B (-)	Project 1 year	Grand B (+) 2nd year
11	Grant B (-)	Assistant 2nd year	
12	Grant A (-)	Grant B (+) 1 year	Grant A (+) 4th year

2.3. Choosing a PhD-subject

There are no legal rules concerning the PhD-subject. The way students choose their subject is a rather informal process. How does it happen? In general the selection of the topic of research is the responsibility of the student, but there are some limitations.

First, there is an important difference between students who win a State-scholarship and students who are paid on a contract-project. State-funded researchers can, in concert with the supervisor, develop a subject requiring fundamental research. Students who are paid on a contract-project are bound by the project. Especially projects in co-operation with industrial partners have a less fundamental and a more applied nature. In case the

[5] This can sometimes cause troubles because the promotor writes the proposal and the student (who has no scientific experience yet) has to defend it. We will pick up this issue later on in the text.

[6] To know the total duration the students are already working at the Faculty, the noted years in each phase have to be added up (e.g. student 1 is in his 3th year).

[7] The signs (-) and (+) indicate whether the grant was obtained or not.

contract research is used as a base for a PhD, the candidate should approach the topic of research from a more fundamental scientific standpoint.

Both parts reflect the dilemma between fundamental and applied research. This, of course, gives rise to the question of the specific purpose of a doctorate. Does it necessarily have to be a fundamental research? Since the university decree of 1991 provides financial support to the universities for each finished doctorate, there is an evolution towards more doctorates. But the question is whether all these doctorates may be devoted to fundamental research, e.g. in Engineering for those students paid on a contract-project there is not always time to elaborate their subject to a project of fundamental research. Second, the individual contribution of a student in the choice of a subject, is relative. No one has ever full autonomy in the choice of a subject, although a doctorate is supposed to be an individual piece of work, one is bound by the project, the supervisor, the research-group,....

> It (= choice of the subject) happened in concert with the supervisor. Well, the general field in which the topic is situated, is .???mechanics. This was determined by the group I choose. But within the broad field, the subject was more chosen by my supervisor than by myself. (Student 10).

Of course, a lot depends on the personal attitude of the student:

> It all depends on your own attitude. I mean, there are here a lot of people who arrive at the department and ask what they can do and there are people who say they would like to do that or that. I really told them what I wanted to do. But, of course, there are advantages and disadvantages because when your PhD doesn't run smoothly from time to time, then you are in trouble.(...) Well that's the way you experience it sometimes. In that case you ask yourself why you choose that topic and why you didn't just choose the topics they presented. (Student 7).

Concerning the content in the three departments, there is a preference for the elaboration of topics the department is interested in. Most research units try to build on former achievements (long-term planning).

2.4. Foreign students

Foreign students come to Flanders through different channels, namely 1) via informal contacts between supervisors in Flanders and abroad; 2) via participation in development projects; 3) when a specific department invites foreign students because of a lack of Flemish researchers; and 4) on their own initiative, i.e. foreign students sometimes write a letter to a professor and ask whether they can make a PhD in Flanders. Mostly they gained a grant from their own country or they finance the training themselves.

Formally, foreign students need to pass a pre-doctoral examination before they get access to the third cycle. This examination can vary from a mere interrogation to a full Master programme. All interviewed professors admit that it is very difficult to get an idea of the real capacities of these foreign students, only on the base of official documents. Sometimes the general standards to proceed to a doctorate, have to be reduced and concessions have to be made to candidates of third-world countries. Again we see that the strict access-rules are sometimes modified and capable of bargaining.

II. THE DOCTORAL TRAINING PROGRAMME

At the Faculty of Engineering a training programme has been established. First, we will describe the formal directives concerning this training programme as embodied in the faculty regulations. Then we will describe the way professors and students deal with the training programme and how they feel about this shift from a learning-by-doing model towards a formal training programme. Again, we stress that the doctoral training programme is only a part of the third cycle; it is only one aspect of what a student has to do to get a PhD.

1. The training programme: formal directives at the Faculty of Engineering

Following a training programme is a necessary condition to obtain the degree of doctor. This programme encloses a whole of educational activities and other scientific study-activities. It contains no less than 1500 and no more than 1800 periods of study. Gaining these credits may be spread over the period necessary for writing the dissertation. At least between 1/5th and maximum 2/5th of the periods of study can be dedicated to educational activities (course components and regularly organised seminars = A-part). These can be PhD-course components, PhD-seminars directed to the widening of knowledge (faculty-level) or to the deepening of knowledge (departmental level), general course components on PhD-level and on second-cycle level. The other part of the training programme (= B-part) exists of other scientific study-activities which are of substantial interest to the PhD-student, e.g., publications, participation in conferences, workshops, supervising second-cycle students etc. 3/5th of the programme should be composed of these activities, which shows that the faculty considers this the most important part. Nevertheless, it should be stressed that, while the training programme is obliged in order to proceed to the doctoral degree, exemption of this obligation can be allowed in certain circumstances. However, this is not further stated explicitly.

2. Assessment of and experiences with the training programme

2.1. Assessment by the professors

How did professors assess this new doctoral programme? We spoke to the chair of the doctoral programme and professors with a long experience in supervising doctoral students. Their opinions are divided whether the introduction of a formal programme was a good or a bad evolution. However, supportive and opponent arguments fall back on one reason: *the introduction of a doctoral training programme has not changed the existing situation: the situation has remained the same.* In this context, it may not be forgotten that we did this fieldwork in three strongly research-oriented departments. They already have a tradition of offering courses to graduate students etc. It is possible

that the introduction of a formal training programme within other, less research-directed departments, may have a broader impact on their way of working.

> The only new thing, as I see it, is that they have to attend more courses and I wonder why. (...) The PhD-student already is fully occupied by publications, attending conferences, project-administration, second-cycle students who have to be guided etc. So I have the feeling that the obligation of attending courses only leads to attend 'empty' courses instead of something else. (professor 3).

> Oh, I think it only has advantages. Everything will become more professional. (professor 2).

> I already said, we are a strongly research-oriented department and the content of the faculty doctoral programme, in fact only formalises some elements which were already applied at our department. (professor 4).

It is important to note that nobody was explicitly in favour or against the formal training programme. Everyone saw the advantages (e.g. reflection of methodology, quicker progress, shorten the time to prepare a PhD,...) and the disadvantages (e.g., growing pains, lack of courses...). However, some had more positive feelings, while others had more doubts about the new system.

2.2. Assessment by the students

To get an adequate picture of the assessment of the doctoral programme by the students, it is important to make a difference between the more experienced and the younger students. The older students have embarked in the old regime (learning-by-doing model) and were not obliged to attend the formal training programme. They started before June 1994. The younger students, who started after June 1994, are obliged to attend the doctoral training programme.

2.2.1 The introduction of a new system

In general, the same arguments we heard from the professors show up. According to the students, the introduction of a doctoral training programme has not changed the former situation; it is only a process of formalising existing practices. Besides this general

statement, opinions are more divided. Some students think it is not useful, others are more moderate minded about the training programme.

> Well, I don't need a calculation system with study-points to figure out my interest and to decide whether or not to attend these courses. (student 4).

> The doctoral training programme doesn't create more possibilities. If one feels the need or has the interest to attend courses, he would have done it of his own accord in the past. (student 1).

> Nothing really changed. The only thing that changed is that you have to carefully fill in records with all your activities. A positive development however is the fact that the faculty will have to organise more courses. They are obliged to organise courses. But whether these courses are useful? (student7).

> I hope the doctoral training programme will make it easier for students to attend courses abroad, that they (= professors) will easier give the permission. At least you have a strong argument there. (student 9).

> I think it doesn't make a difference for our group because it was already used to attend courses and seminars. (...) Everything was there already. (student11).

2.2.2. The content of the doctoral training programme

Especially for the B-part, all respondents agree that each aspect is important (seminars, conferences, publications, workshops, summer-schools,...) and that there is no problem to obtain the needed study-points. There are enough opportunities to attend seminars, conferences etc. More than for the A-part, the formalisation of these aspects in a training programme is artificial, e.g., it is rather normal for a PhD-student to publish results because this is the only output of scientific research.

Concerning the A-part, there were a lot of remarks. We give some examples illustrating the mentioned remarks on the course components. Most remarks can be reduced to the question whether course components should have a general or a specialised character.

> There are the so-called, how do they call it...seminars for doctoral students or something in that style which are organised at the Faculty of Engineering. Well I think, heaven, cover you up and get out of here because...(...) Yes there are professors, giving lectures on topic in their field of study. But I am not interested is the synthesis of, hell I don't know, some chemical substance or the putting of yellow and red bricks one on top of the other...(...) It is just not my cup of tea... I

> mean, I do think permanent education is important, but I prefer it in my specific field of study. (student 5).
>
> Well, I don't know whether it took your attention, but all the courses which are introduced in the doctoral training programme, are all directed towards research. They will not organise a course, dealing with, for instance, learning to work in a team.(...) That's a sign for me to conclude that the university still is a cumbersome and rather old-fashioned enterprise. (student 5).
>
> I have only one concern about the doctoral training programme. I hope it won't be narrowed to an offer of courses specifically directed towards research. That's the most important danger. It can be interpreted as a widening of knowledge but also as a narrow specialisation. (student 8).
>
> Attending infant school classes!!! No, I think it should be specialised courses and all the rest is irrelevant. If you want to learn French, than you should take courses during your free time. (student 9).

It is however remarkable that both groups of students have objections to the actual supply of course components at the Faculty of Engineering. They agree upon the fact that the existing course components are not well worked out, but they disagree on the direction in which they should be worked out: more specialised or more general. This disagreement reflects a more fundamental question about the purposes and the content of a doctoral training programme

3. Conclusion

It is difficult to give general conclusions about the training programme. The third cycle has only recently been changed from a "learning-by-doing" model towards a formal training programme. Consequently, the Faculty of Engineering is in a transitional stage and the system suffers from some growing-pains. Moreover not everyone, professors as well as students, is well informed about the new system. The older students don't feel involved and the younger students do not always have a clear image of the situation while they are still new at the faculty.

Obviously, at this moment the faculty is in a transitional stage and nobody is totally satisfied. Especially the students are not happy with the obligation to attend classes.

Most respondents however hope this is only a temporary stage which will improve in the future. At this moment the formal situation very much resembles the old situation of a learning-by-doing model.

On the other hand, whereas students were less in favour of the new programme, in general the interviews show that professors are more favourable to the system.

III. THE GLOBAL TASK-PACKAGE AND COMPLETION TIME

1. What has to be done and by whom?

Formally, students with a State-scholarship should only work on their PhD and students paid on contract research, should only work on that specific project. Students having an assistant position, have, besides working for a PhD, to do some teaching (e.g. exercises, supervising students working on their thesis).

Often, additional tasks besides the PhD are divided among all PhD-students. This is the consequence of what was called the contract-flexibility. PhD-students may have several different contracts during their career as a PhD student. If the formal rule would be followed, contract researchers would not be able to proceed to the doctor's degree. In order to give as much students as possible the opportunity for a doctorate, the formal rule is replaced by an informal one putting all Dutch-speaking students[8] in the same situation. These additional tasks enclose teaching, responsibility for labs (software, machines, maintenance) and project management (administration, presentations, writing proposals).

Legally, these additional tasks may not exceed 50% of the total work-time. Indeed, according to the law, a PhD-student who is also assistant, should have the right to spend at least 50% of the available time on his PhD.

[8] For reasons of language-barriers, foreign students are not often involved in teaching.

2. How do professors and students experience this situation?

Opinions of professors and students do not totally correspond on this issue. They agree that these tasks should fairly be divided amongst all students. The availability of financing sources are accidental and may not influence the opportunities to write a dissertation. Everyone should work under equal conditions. Opinions are divided concerning the fact whether these conditions are really equal or not.

Professors believe that all students are treated equally and that their tasks have positive consequences.

> Every PhD-student gives exercises and the reason is simple: they can still talk to second-cycle students. Explaining something to second-cycle students is a challenge to everyone. Giving lessons and explaining things are difficult matters in the beginning and they can learn it by giving exercises. It is part of their doctoral training I think. (professor 3).

Some students however think they have many, sometimes too many, of these additional tasks. This appreciation differs between departments, the period of the academic year, and the individuals.

> Well, didactic task, that is not much nor is it little work. I don't complain about this, it's just that these tasks have fixed dates. So all your other work is postponed or you just drop it. (student 1).

> If you really want to do it good, it takes a lot of your time, but that's a personal choice you make. Can you permit yourself to make yourself look silly? I think it's more a matter of honour. (student 2).

> Well there is always a lot of sighing about these additional tasks. Personally I think it is a welcome distraction, you can widen your horizon. Often it also offers the opportunity to refresh some knowledge. (student 12).

> I: How much of your time is spent on additional tasks? S: At this moment too much. Officially I think it should be something of one third of your time. But, from now till the end of April, it will be more for me. Of course during the Summer, you have no educational tasks at all. But now there are weeks I can't do anything else (student 9).

Nevertheless, in spite of these complaints, most PhD-students agree that they learn a lot while doing these extra tasks. It often makes their work diversified and especially the contact with students is stimulating.

3. Completion time

Besides the proportion of time available to work on the PhD, there is a global time limit wherein the PhD should be finished (although this is not legally regulated). A guide-line could be the duration of a contract, e.g. a grant provides a salary for a period of four years and an assistant position is normally granted for six years. But, because of the contract-flexibility which is typical for the Faculty of Engineering, in principle, the time can be much longer since the PhD-student can be moved from one contract to another.

Nevertheless, there are some informal rules concerning the global duration. Whereas in the past it usually took about 5-6 years to complete a PhD, there is at the moment a clear tendency among professors to reduce this period to 4 years. The most important reason is that students who stay at the university for 6 or more years are no interesting candidates anymore for the industry. Also within the academic world, opportunities for PhD-students to obtain postdoctoral posts or to start an academic career are small.

Students from their side, have another opinion about time limits. There is a remarkable difference between the senior and the junior PhD-students about the time they foresee to complete the PhD. Whereas senior students foresee about 5,5 - 6 years, junior students foresee 4 - 5 years. Most students think that there are always reasons to continue working on their PhD, but it is important to compromise between quality of the dissertation and labour market opportunities.

> I'm in my 5th year now. I think that's enough. But it depends on the demands you make upon yourself. I can easily proceed with my PhD for two more years but at a certain moment, you should end it. The tendency now is to shorten the time to make a PhD. (student 12).

> You can defend your PhD after three years and after five years. I think the quality of the work will be different. I think it must be possible to write the Phd in four years. If I have to leave within four years, I'll write it within four years, that's no problem. (student 8).

They do not agree with the tendency to shorten the duration of a PhD.

> PhD-students here reason that all professors at our department spent six years or more on their PhD. In that case they cannot criticise us if we tell them after 4,5 years 'I'm sorry but I'm still writing'. Moreover they are not going to sack you because they absolutely want your PhD finished. (student 9).

> I see some problems to end in a period of 4 years. At this moment you have the training programme which already takes time. I search for my subject for about 1 year. If the time will be shortened, I think the quality of the final product will suffer. And last but not least, the end-procedure is very long. I'm already writing very hard for 6 months now and I still have to wait 6 months to defend my PhD, that's already one year of the four years foreseen. (student 12).

IV. SUPERVISING AND EVALUATING THE DOCTORAL WORK

The issues of supervision and evaluation will be discussed within the same paragraph because both phenomena are strongly related. Both processes include a relationship between two persons (sometimes more than two persons are involved), namely the PhD-student and the professor. On the other hand, there are some important differences between both issues. Supervising is a much more general process constantly present during the preparation of a PhD while the evaluation is only relevant at particular moments.

We will first describe the different types of the supervision as well as the problems experienced by professors and students. Second, we will elaborate the problem of evaluation.

1. Supervision

1.1. Two supervising bodies

Each doctoral student has a supervisor. Mostly this supervisor is chosen because of his specialisation in the field concerning which the student wants to write a thesis. This relationship has always been very important in Flanders: the supervisor supervises the PhD-student on an individual basis during the whole time needed to make the PhD. In some cases, there may be two supervisors for one student, e.g., when two staff-members with a different specialisation are needed in order to supervise properly the student. Depending on the professor and on the research group, the contact between the PhD-student and the professor is more formally or informally organised.

Since June 1994, when the doctoral training programme was implemented, each doctoral student is supported by a supervising committee. This committee is composed of the supervisor and two other members of the academic staff, called 'assessor'. They have to control the progress made by the PhD-student. Both assessors should supervise the student but they are less involved than the supervisor.

1.2. Evaluation of and experiences with the supervising bodies

Professors as well as PhD-students at this moment agree upon some advantages and disadvantages of the two supervising authorities. The future will answer the question whether and how the supervising committee plays an important role in the development of the thesis. At this moment, it is too early to give a definitive answer.

In general, we met three problems concerning the supervision by the supervisor, namely 1) the lack of time, 2) initial hesitation to contact the supervisor, and 3) the problem of specialisation.

Lack of time

A lot of students complained, and the professors admitted, that some supervisors often have no time to support the students. This is due to the work load of the professors, like

teaching, administrative tasks, attending international conferences, having to support too many PhD-students etc. Professors are more and more overburdened. However, we should immediately add that not all students experience this as a problem. Some students prefer to work independently without too much interference. This depends on the phase in which the doctoral student is working as well as personal characteristics of the student and the supervisor.

> I have to admit that we ... some of our colleagues have in fact too much PhD students. This means an enormous dedication for the whole group of staff members. They have, I should admit not always enough time to properly supervise young PhD-students. (professor 4).
>
> Yes, I would appreciate it if I could once a month see my supervisor and explain to him what I'm doing. Than he can say... I have an article here that might interest you, or something like that. Sometimes I miss that kind of input. When I started here, I had to look for all on my own, where to search for articles in my scientific field etc..(student 5).
>
> I had a lot of freedom... this was due to the fact that my supervisor did not have much time and leaves his PhD-students very free in their work. A lot of people here work within the same context as I do, but are much more guided. Some of the students prefer to be guided strictly. Maybe in the beginning I would have preferred a stricter guidance, but now certainly not. (student 9).

Initial hesitation

A second problem, felt by some students, is initial hesitation to contact the professor. These students will only contact the supervisor when they have severe problems and nobody else is available to help. This attitude reflects the hierarchical relationship between the student and the professor. Some students still experience status differences which might have a negative influence on the doctoral work.

> Normally I never go directly to my supervisor. First I always check someone else of the group whether my questions are not too stupid. (student 11).

Specialisation

Finally, there is the problem of specialisation. Mainly senior PhD-students have the impression that the supervisor cannot help them anymore while they are already more specialised in their field. Moreover the supervisor has too many other tasks and too

many PhD-students to supervise. Consequently it is impossible for him to know the subject of each PhD-student in detail.

> He (supervisor) knows what I'm doing, that for sure. If I have problems, than he realises that I have problems.... However he can barely help me because after two or three years, you know, you already know much more about the topic than he does. That's logic, I mean, these people supervise about 20 research projects at the same time, .. they cannot know the details of each project. (student 1).

Some solutions

All research units had solutions for these problems, e.g., assigning two supervisors or moving the main point of supervision from the supervisor towards a postdoctoral researcher of the group. In that case, the actual supervision of PhD-students has been commissioned to a postdoctoral researcher, while the supervisor keeps the final responsibility.

> I never see my supervisor and he is never there when problems arise, but we have a solution for that. Within our group there is a postdoctoral researcher who is responsible for us, to make sure all the working-conditions are there etc. (student 8).
>
> He is just too busy doing administrative work and educational tasks. (...) We are his research unit and when we publish an article or something, than of course he is interested but we don't see him that much. He is all right, that's not the point, he is just too busy... but, well, this problem kind is solved by... in our group, there is a person who already obtained his PhD. He is a postdoctoral researcher and he is occupied with the current projects. (student 5).

Not only the postdoctoral researcher, but also the research unit (the group) can play an important role in the supervision of doctoral work by, e.g. reading papers, discussing problems, etc. Only some respondents admit, that when they are making a PhD on a completely new field, the role of the group is rather limited while they can not discuss issues they do not know at all.

2. Evaluation

2.1. Different evaluation-moments

At different moments during the preparation of a PhD, the student is evaluated. First, during the formal training programme, the teaching of the doctoral student is assessed and other scientific activities as well. Course components attended by the student are evaluated by the professor providing the course component. For the other study-activities, the student is evaluated by the supervising committee. This committee thus has a double task, namely supervising and evaluating. It should be stressed that the evaluation system, according to some professors, has not been developed sufficiently. The way the evaluation is described here, is the way it should be/become in the future.

Second, the student has to register carefully all his/her activities as well as the evaluation of it in a diary which is signed each time by the professor of a course component or the supervising committee. When the 1500-1800 hours of study are reached, the student submits the diary to the faculty doctoral committee. This committee decides, based on the diary, whether or not to award the certificate of the training programme.

Third, before the thesis is defended in public, a committee decides whether the thesis can be defended or not. For those students who started after June 1994 (new system), this committee de facto is the supervising committee. Again we see the supervising committee has an important evaluating role as well.

Fourth, if the thesis is approved by the committee, the student has to defend his work in public before a jury. This jury is, as far as students who started after June 1994 are concerned, composed of the supervising committee and at least three other members. Three members of the jury should be a member of the academic staff of the local Faculty of Engineering and at least one member of the jury should come from another university. Other members may be experts from a research lab (without being an academic staff member). However they have no right to vote but only to give advise. The voting still is an exclusively academic matter. Once the thesis is approved by the

committee, this jury awards a degree of success, e.g., cum laude, magna cum

laude, maxima cum laude, and maxima cum laude with congratulations of the jury.

The procedure for foreign students and graduates from colleges of higher education is the same except that before entering the programme, they have to pass a pre-doctoral examination.

2.2. Problems

The supervising committee and the jury are proposed by the supervisor after consultation of the student. No interviewee experienced any problems with this system. Again we stress the fact that the formal training programme only operates since June 1994 and experiences are rather limited. Problems may show up within a few years.

As far as the awarding of degrees is concerned, all professors stress that it is necessary to award degrees because even at the third-cycle level there are differences between students.

> There still is an important difference between PhD-students, although they all reached a certain level. But according to me, we should make the difference between the good students and the brilliant students. (professor 2).

Nevertheless, professors doubt whether students always gain the honours they deserve. Each supervisor wants for his PhD-students the highest honours.

> Yes, there is a permanent impulse among professors to quote with higher marks to their own students. Supervisors are often personally attached to their students' PhD. (...) Still it is a very difficult matter to determine one's degree. You should compare each time several PhD's. Principally this is impossible because each work in a sense is unique and incomparable. But however, our faculty decided that the chair of the doctoral programme should be the president of each doctoral jury in order to make the PhD's more or less comparable and to use the same standards each time(professor 1).

To prevent that all candidates have 'maxima cum laude and congratulations of the jury' or 'maxima cum laude', a quota system has been worked out at faculty level: each year one or two students can earn the highest honours; 30% of the students maxima cum laude; 70% magna cum laude; and 10% cum laude. The grade 'satisfactory' (lowest

degree) is not granted anymore because it is a negative appreciation at the doctoral level, while a student already has to pass at least twice cum laude during the second cycle in order to get access to the third cycle.

On the other hand, the PhD-students are not unanimous concerning the system of degrees.

> I think degrees are good if they make sense. It can't be like that, that they just give you one degree more than at the second-cycle level. That's meaningless. (student 6).
>
> It does make sense... I think... otherwise there is nothing to do anymore and the defence of the thesis becomes a pure formality. (...) Otherwise is leads to a levelling down, in that case you standardise all PhD's. (student 7).
>
> I'm totally against it.(...) You know, it is all bases on politics. You get the impression that what you are going to obtain... it is already determined before-hand. There is that one guy who really maid a terrific PhD .. he obtained the highest honour. Well in fact, the next five PhD-students already know that they won't obtain the highest degree, no matter how good they are. (student 9).

CONCLUSION

This Faculty of Engineering, influenced by the law, has chosen for a doctoral training programme in order to improve the research capacities of their PhD's. The function of a civil engineer is seen as something special, not the equivalent of a researcher. Making a PhD should show that the candidates are not only good civil engineers, but researchers as well who are able to answer fundamental scientific questions. Additional information and training during the doctoral programme should contribute to this purpose. The access to the programme is not easy; the admission of the students is very selective, though this faculty can find, in comparison with, e.g. faculties of the humanities, a lot of resources. Because of the long research tradition of this faculty, and good research management, it is even possible to create more opportunities for PhD's relying to a certain extent on contract research. Although the candidates have some freedom to

select the topic of the research, it always fit the general programme of the department in which they work.

The doctoral programme is rather new, which makes that students are working in different systems. Some students are still working in the old system, a learning by doing model, whereas others have to follow the rules of the formal doctoral programme. At the moment several aspects of this programme give rise to discussion and doubts about the advantages of the new programme in comparison with the old model. Both, students and professors give reasons to give more chances to develop the new structure, but at the same time they doubt whether it should be kept like it is now. Several among them contend that the new system did not really change very much the old structure. Some students already attended courses in the old system, wrote papers, went to conferences, etc. They believe that the new structure only formalised what already was practised. Of course, this attitude may be influenced by the research-oriented tradition of the three departments of this fieldwork. It might be different in other departments. Anyway, the development of a doctoral programme is seen by the Faculty of Engineering as an instrument to strengthen the theoretical and research capacities of the doctoral students. Whether this system will develop into the direction of a graduate school as in the American system is not clear. It might be expected that if the programme is not better financed than it is now, it will be hard to found a real graduate school. Moreover, it is obvious that not all interviewees do consider this graduate school structure as the best answer for training PhD-students.

Appendix 1: Financial resources for PhD-students

Appointment as a university assistant:

Each university/faculty has a fixed amount of positions for assistants, depending on the number of undergraduate students and a staff/student ratio depending on the subject group (humanities, exact sciences, biomedical sciences). An assistant is appointed for two years and the contract will almost always be extended twice (total duration: six years). This PhD student is thus directly paid by the university.

A grant from intermediary organisations:

Some scientific organisations outside the university are funding agencies for doctoral students. These organisations are:

N.F.W.O.= Nationaal Fonds voor het Wetenschappelijk Onderzoek (National Scientific Research Fund)

I.W.O.N.L.= Instituut voor Wetenschappelijk Onderzoek in Nijverheid en Landbouw (Institute for the Encouragement of Scientific Research in Industry and Agriculture). This institute supports only students of the Engineering and the sciences.

I.W.T.= Vlaams Instituut voor de bevordering van het wetenschappelijk-technologisch onderzoek in industrie (Flemish institute for the Encouragement of Scientific-Technological research in Industry).

From 1994 on, specialising grants from I.W.O.N.L. were transmitted to I.W.T.

Every student who wants to make a PhD, can apply for a grant at the N.F.W.O. if he/she is less than 30 years old and if his/her seniority does not exceed 2 years. However, there are severe selection criteria (e.g., an excellent study career and an outstanding proposal) and the number of positions is small. Criteria at the I.W.T. are less severe. We have to make a distinction between an I.W.T.-grant, and an I.W.T.-project.

The I.W.T. also finances projects in co-operation with industrial partners.

Though they get paid by these organisations, these students are located in the universities.

Contract research:

Students can be paid by intermediary organisations but also as contract researchers. These contracts are made directly with the industry (via R&D). But there are also contracts with e.g. the E.U., ABOS, the Flemish Community, etc. Mostly these projects take 2 or 3 years.

Self-financing:

All graduates, on the condition that they find a supervisor for their project and if they had an excellent undergraduate career, are allowed to the PhD programme. In this case, the PhD student is not paid for making his/her doctorate. Students with a job outside the university sometimes choose this track.

PhD students at a beginning level cost about 1,750,000 BEF. each year and are legally employed (no statute of students). Those financing their PhD training themselves are a minority.

In the future at some universities, it will also be possible to get a grant from the university itself with money, granted by the Research Fund, self-financing by the university, E.U.-Projects, etc. This option started in October 1995.