

Large Scale Permanent Education Programme in IT in Belgium.

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Abstract

From 1996 on the Belgian industry urgently claimed the University of Gent to do a special effort for a large scales IT formation programme. This was mainly due to two reasons: firstly there was an acute shortage in IT-professionals (Y2K, Euro, industrial expansion,...), and secondly IT was evolving so fast that many IT professionals were outperformed by the youngsters coming out of the universities (Object-Orientation, Java,...). This demand was bundled by a global Belgian industrial association, acting on the 'client' side. Accompanying signals were sent out that the formation programme should be done by all universities together offering a 'service', and also that the programme should take into account the mobility problem of the participants.

The result was a very large scale modular formation programme, covering more than 500 hours theory and exercises over a 27 month's period, starting in March'98, in a rhythm of 2 evenings of 3 hours per week. Intensive use was made of videoconferencing, since participants were spread out over 12 sites in Belgium and three additional sites abroad. Exercises were given all over the country, and guided by assistants sent out from the universities. There were a large number of accompanying measures, such as Web-support, electronic discussion groups... The efforts are certified by the organising universities based on a regular scheme of examinations.

The model of this IT course has stimulated the organising universities to collaborate even more, and establishing other courses as well.

The presentation will give an overall overview of this course, very unique in different aspects, including the results of the evaluations done so far, and lessons learnt for the future.

Permanent Education: the changing landscape.

In 1993 already, industry in Belgium felt that employers unhooked ever earlier from their jobs. Several causes were identified, such as technology refreshing and running faster and an extremely high job pressure pushing employers into corners leaving them no time to look around and to replenish themselves regularly. At the same time industry experienced that neither private training nor other associations (engineering associations...) would give the answer. Private training companies - how useful they were - provided only direct and concrete training, useful for the specific task at hand, but less interesting in the long run. Some associations / institutes provided seminars on high-end topics, more an introduction to give a flavour, but seldom a full course. The net result was that industry came knocking at the university's door with a very clear demand to organize postacademic 'permanent' educational programs 'on demand', i.e. where in depth and basic engineering courses should be offered in a way to make it attractive and accessible in an optimal way: i.e. with a very low doorstep.

The university itself was confronted with a strongly changing landscape in the field of industry oriented education. In the vortex of offerings, the university had to take a clear and above suspicion position. The univer-

sity should clearly not go into product oriented formation, but also not - which was less obvious - into short programs leading to fast outdated knowledge. On the contrary, the university should provide an well-equilibrated mixture of basic - long lasting - and fresh-from-the-shelve technology knowledge. Clearly, in such a scheme, the load for the participants would be tremendous: it would not suffice to attend the courses; extra efforts by homework, projects and exams would be required, increasing the study load substantially. Combining this with a full time job in an environment where access and mobility of participants to courses due to traffic congestion is severely hindered, poses an immense challenge to the university, used to operate in a more protected atmosphere.

The compensation the university offers is quality, front-end know-how, and also an above suspicion certification. Certification is an element where both the industry management and the participant himself benefit. For the participant it would mean an intrinsic value enhancement in his career, whereas for the management it would be the proof of the high quality level of the education programme.

The Institute for Permanent Education at the University of Gent.

Although full engineering curricula existed in postgraduate form, they did not fit the goal for several reasons: anchored at the academic year, more static, well defined entry conditions, broader scope... Therefore a new educational form had to be initiated. A governmental decree created the legal framework: certification by special diplomas, imbedding into the duty of the academic personnel (professors and assistants), remuneration... After those boundary conditions were fulfilled, the council of the engineering faculty of the University of Gent founded the "Institute for Permanent Education" (abbreviated as 'IVPV'), as an Institute operating entirely within the faculty structure of the University of Gent. To boot the institute some representative industries were prepared to provide an important startup financial donation, with the connotation they eventually would receive part of it back in the form of course attendees.

At the top of the IVPV a steering committee was set up, consisting of 50/50 members from industry and university. The president was said to always come from industry, whereas the operational director should be a professor from the university. The steering committee's task is to lead the institute at the highest level by suggesting educational programs, and by determining all executables and modalities. The steering committee is the real forum where industry and academics meet to match needs and opportunities. A number of successful educational programmes have been done: object-orientation, statistics, polymers, information & management...

The basic mission of the institute is to provide so called 'delta'-learning: i.e. bridge the gap between the knowledge of the employers in industry and the freshmen coming out yearly from the university, this by providing middle to long term courses in a modular way and on demand from industry. Courses should be accompanied by exercises (when possible) and by homework. They should conclude with examinations / projects that would reward the attendee with a university validated certification.

Together with the basic mission of the institute, it was given the task to introduce as much as possible new learning methodologies and technologies, e.g. courses with PC-based exercises. An opportunity was strongly felt when there was a clear interest in a course from industries in the east part of Belgium, whereby it was not feasible to push employers at 4 PM through traffic jams for more than 2 hours, and to send them back home late in the evening at 10 PM. Therefore the course was organized in videoconference, actually given at the university in Gent, and at the same time sent out in real time by 128 Kbps ISDN-lines to two distant locations at industrial partner plants. At the same time an agreement was made those sites would open their doors for 'neighbours' plants and attendees. The videoconference was possible because the University of Gent built at the same period an extremely well equipped multimedia classroom with high performant video and studio accommodations. Clearly all this made the doorstep for the course attendees extremely low, at the same time safeguarding quality and a reasonable interactivity (since the videoconference was in full duplex).

The Information Technology Educational Programme.

Back in 1996 there was a very strong cry in industry (all over Europe) about a dramatic shortage in IT professionals. Not only the exploding IT facilities, but also a number of other factors enhanced the cry: the Internet crescendo, the introduction of the Euro, the emerging Y2K problem, and not to forget the fundamental change in the design of IT applications (Object-Orientation, Java...). This made the industry to re-shape their own IT professionals and at the same time to educate newcomers into the IT profession. It was immediately clear that such a full IT programme could not be supported by one university alone, and that the industrial need was all over the country (and even all over Europe). Both factors enforced the necessity that on the one side industries should bundle themselves as the 'demanding party'; while on the other the (Flemish) universities should cooperate as the 'offering side'. The bundling of industries was done through an existing professional association (FabIT), while the 4 Flemish universities (Gent, Leuven, Brussels, Antwerp) started a 'dean's committee', acting as the de facto organizing committee of a broad and long term IT educational programme. The IVPV of the university of Gent was designated by both parties as the coordinating body for the first issue of the course running from March'98 through June'00.

The IT course content.

To have an idea about the gigantic setup of this educational project, it is worthwhile to summarize its content. The programme is focused around 7 main 'groups' or topics: computer architecture, system software, communication, programming languages, design methodology, databases and graphics. Each group is further divided into *modules*, where a module is the lowest entity to which an attendee can subscribe. 'Labs' or practical exercises accompany some of the modules in 'programming languages' and in 'design methodology'. A module runs somewhere between 12 and 30 hours. All together the programme covers 417 hours of lectures and 87 hours of exercises. The programme started on March 1998, runs until June 2000 and is held twice a week for 3 hours during the evening. Lectures are given (in English) by professors from all Flemish universities and Flemish Technical Highschools at *one* of the 4 organising universities (Gent, Leuven, Brussels, Antwerp) and transmitted by ISDN-videolink to the *other* three, and to some 9 industrial sites (see further). Assistants from the aforementioned institutes give the exercises in PC-rooms at the 4 universities and at the industrial sites themselves, counting approx. for 10 students per assistant. At certain instants more than 30 assistants were being sent out to guide the students. Some industries preferred to give exercises by own IT-specialists in-house. Tests (examinations) are given per module, and a full postacademic certificate is rewarded to each 'student' having followed at least 270 hours of class room lectures plus the accompanying lab projects and who has successfully passed the tests. Special conditions are foreseen for university students (choosing modules as credits for their doctoral education) and for highschool students. Finally there was also a clear interest from affiliates abroad (Germany, France, Spain) of one of the participating companies, which thereby pushed the course onto an international scale.

Breaking the mobility barrier: videoconferencing.

View the large geographical and organizational scale, obviously important ICT techniques should be setup to the maximum of its possibilities. The first goal was to bridge time and space efficiently in order to comfort the student's attendance as much as possible. From day one of the project distant learning was chosen as the underlying technology to carry the lectures to the students. As a presentation method either PowerPoint or plain text files have been set forward. Initially, before the start of the project, a number of tests have been carried out with application sharing packages (such as Microsoft's NetMeeting) over ISDN lines. They turned out to be largely unstable when used outside an Intranet. On the other side the tests with videoconferencing over ISDN-lines, even in multipoint, turned out to be really stable. Furthermore many of the participating universities and companies had both equipment installed and experience with the medium. Therefore the decision was made to use ISDN-videoconferencing, and in order to enhance the visual quality, 3 ISDN-lines (i.e. 6 B-channels) with a capacity of 384 Kbps were selected for each communication link. The cost of such high quality links (in view of very considerable communication times) is of course extremely high. Fortunately the national Belgian Telephone Operator (Belgacom) - being also an interested party to bring the course inside its premises - was prepared to largely support the ISDN communication.

Since there were all together 12 Flemish conference sites that should be served, a huge switching facility was necessary. To fulfill this requirement a 'Multi-Conference Unit (MCU)' - commonly called a 'bridge' - was hired at a central location (Imec Leuven) in Belgium. All ISDN-communications were setup as a bi-directional point-to-point link between each conference site and the MCU. Such an MCU is usually voice-operated, i.e. whenever on one of the incoming channels a sound is above a threshold, the MCU switches all other channels to that particular channel. The net effect is that when lecturing, all other sites switch to the lecturer, and when someone in some site asks a question, all other channels (including the lecturer channel) switch to the person asking the question. When afterwards the lecturer starts answering, switching is reversed again. However due to the large number of sites (and the rumour level) experience showed this was a too sensitive way to operate. Since the MCU was human operated anyway, switching on questions was done manually. In practice, regularly (e.g. every hour) the lecturer starts a "Q&A" round, and asks the operator to switch to all sites one by one. It is noteworthy that the MCU was not sufficient to support all sites (especially the ones abroad). At some industrial sites (Antwerp / Brussels) other 'slave' MCUs connected the video signal further to other national and to the international sites.

Setting up a technical infrastructure is one thing. Using it professionally is another. To alleviate this, a number of organizational measures had to be taken. First a continuous training programme for the lecturers was established in cooperation with the organization Europace 2000 at Leuven University. Thereby all lecturers had to follow a limited training to make themselves familiar with the medium. Secondly, a strong policy about the design of slides was followed, which emerged from experience in passing PC-screens through the videoconference medium. Thirdly a professional studio-alike setup was used at the lecturer's side: at least two professional video-cameras (one on the lecturer and one towards the audience), a PC directly coupled to the video system by a converter/encoder and at last a high quality document camera.

Complementary ICT support techniques.

a. WWW Support.

Since it could be expected that the education programme would interest a very large number of people, an efficient information channel was necessary. A huge Web site was setup which contained not only all details of the course, but which serves also as a messaging system (scheduling, examinations, results...) between the organization, the remote sites and the students. To give an idea about its impact on the project, from day one on, the detailed contents, lecturer information, books... for each course hour was made available at the Web (<http://www.ivpv.ftw.rug.ac.be/infotec/>).

b. Information Server.

Another problem to tackle was the communication between the central organization at the IVPV in Gent and the remote sites. This problem raised because of the distribution of course texts and slides was rather complex, since due to the limitations in quality of image and sound, the students (at all sites) should have both the text and a copy of the slides on their desk during the lecture. Each lecturer transmitted his/her text and slides to the central course coordinator at the IVPV in Gent, who in turn should distributed it further to all sites, where local coordinators were appointed. As usually happens in such circumstances, lecturers come up rather late with their texts and presentation-slides. Therefore at the central site a (protected) ftp information server (UNIX) was set up, to store all texts and presentations as pdf-files, from where all local coordinators could download it in order to photocopy it in time. This information server turned out to be handy during the examinations (tests) too: exam-forms could be opened up (made 'readable') at a very precise instant of time to trusted parties abroad (university colleagues) in order to minimize fraudulent interactions between participants.

c. Discussion List.

A problem with distant learning and 'virtual classrooms' is that the communication between students themselves is not self-organizing. Although in this IT-project one could expect fruitful discussions between participants from the same company (although...), other discussions and exchange of experience (e.g. on labs and homework) are not evident. This need was particularly felt when the first lab-sessions started, since the lecturers were quickly overwhelmed by e-mails regarding particular topics or problems. Therefore it was decided to start a discussion list at the central server in Gent by using the well-known Majordomo system (on Unix). Students could subscribe / unsubscribe on sublists per course module. This feature immediately became a hit. Students started in depth discussions among themselves, with their professors watching in background, intervening or stimulating when necessary. It became so popular that the professors sometimes had to calm down sheer endless discussions!

Subscription policies.

Distant learning and videoclasses demand also for creativity in subscription policy. As soon as a video signal is transmitted to an industrial site, the marginal cost of a new participant is quasi zero, since even copying texts etc... could be carried out locally by the company itself. Therefore the idea of a 'global subscription' for large companies was accepted: i.e. the company pays one global fee, regardless the number of participants which they put before the videoscreen. Exception to this are the exercises (if they were guided by assistants from the organization) and examinations (which have a cost pro capita). All this resulted in several subscription formulas:

- global subscription for a whole company: all personnel could choose any module;
- full personal subscription: one fee for any choice of modules for 1 person;
- module subscription: choosing modules 'à la carte'.

Course attendance: some figures.

To give a rough idea of the course's wide scope, some figures (as of April'99) may be helpful.

- total number of individuals subscribed: 1 077;
- total number of participants summed up over all 23 modules: 9 284;
- total number of [hours * participants] over all 23 modules: 226 080.

An important point in postacademic courses is whether participants would not drop off at a point during the course track. Any one knows that for people doing a full-time job, sometimes under high pressure, it is not evident to go to a class room twice a week for 3 hours during 2 years, especially when the study material is highly technical and on academic level! After evaluations, we could draw a number of conclusions about student dropouts.

- The internal company culture and follow-up is essential. Companies who didn't put any restriction and didn't follow up attendance and progress on the course showed the quickest drop out in attendance. On the other hand, companies who carefully selected their employers and followed them up regularly maintained a much more stable attendance.
- The pre-knowledge of the participants is also crucial for the success. Especially in informatics, people in industry have the tendency to over-estimate their own skills. Using PC-tools, being able to write programs or to configure a PC is often confused with an in depth knowledge of computer architecture, system software, program design... People don't seem to see the difference between an ad hoc training on a specific package (which only lasts as long the package) and an in depth study of computer science / informatics which lays the base for a much longer survival.

The lesson learnt from this, is that (for the next edition) the companies will be thoroughly informed about the active role they have to fulfill in the educational programme, and that a pre-assessment is necessary to make the participants aware of their own knowledge and shortcomings. The outcome of this assessment may eventually lead to a differentiation in learning path for distinct student groups.

Course Evaluation.

Such a huge and complex project like this IT-project should be evaluated in depth, and from an independent source. Therefore a scientific programme was submitted to a governmental scientific body (IWT) to have the course thoroughly evaluated on a regular base. This evaluation project was lead by a colleague from another department of the Gent University (Prof. Els De Bens, dept. communication sciences), who did fit it into an existing scientific programme (MediaLab). The focus of the evaluation should not only cover the classical elements (contents, lecturer, teaching modalities...), but especially the multimedia facilities (videoconferencing, discussion lists...).

The evaluations were submitted to rather large groups of students, who cooperated gently to the process. Some important results from the last report about the *multimedia facilities* are as follows.

a. *Some statements about videoconferencing (VCF) were submitted to the students (Table 1).*

| Statement | I agree | Neutral | I disagree | Missing | Total |
|---|---------|---------|------------|---------|-------|
| Videoconferencing is static | 43.1% | 42.3% | 13.8% | 0.8% | 100% |
| Videoconferencing is little interactive | 72.3% | 22.3% | 4.6% | 0.8% | 100% |
| Videoconferencing has a bad quality of the image | 11.5% | 44.6% | 42.3% | 1.5% | 100% |
| Videoconferencing has a bad quality of transmission | 9.2% | 46.9% | 43.1% | 0.8% | 100% |
| Videoconferencing is unsuitable for exercises on-line | 56.9% | 28.5% | 11.5% | 3.1% | 100% |
| Videoconferencing is unsuitable for bridging time and distance | 4.6% | 26.2% | 68.5% | 0.8% | 100% |
| The presence of a life teacher is essential | 20.0% | 29.2% | 49.2% | 1.5% | 100% |
| The presence of the course coordinator is essential | 35.4% | 29.2% | 33.1% | 2.3% | 100% |
| Videoconferencing does not promote the interaction and contact with other sites | 74.6% | 19.2% | 4.6% | 1.5% | 100% |
| Videoconferencing does not stimulate a 'classroom feeling' | 34.6% | 44.6% | 19.2% | 1.5% | 100% |
| The teacher is not well trained for using videoconferencing | 13.8% | 62.3% | 21.5% | 2.3% | 100% |

Table 1. Statements about 'videoconferencing'.

Although videoconferencing does not score very well in many aspects (too static, little interaction...), the students are convinced that it bridges distance and time, which was the primary incentive to use it. Also the quality of the image and the transmission does not seem to be really a problem for most students.

b. *Comparing videoconferencing with narrowcasting (Table 2).*

| Future alternatives | Yes | No | Missing | Total |
|---|-------|-------|---------|-------|
| Computerconferencing in combination with exercises off-line | 73.8% | 21.5% | 4.6% | 100% |
| Narrowcasting in combination with exercises off-line | 56.9% | 33.8% | 9.2% | 100% |

Table 2. Videoconferencing cf. Narrowcasting.

Although probably not that many students have experience with narrowcasting, they clearly have a preference for videoconferencing (in classrooms).

c. *About using a mailing (discussion) list (Majordomo) (Table 3).*

| Does the mailinglist promote ... | Yes | No | Missing | Total |
|------------------------------------|-------|-------|---------|-------|
| the communication between students | 70.0% | 24.6% | 5.4% | 100% |

| | | | | |
|--|-------|-------|------|------|
| the communication between teacher and students | 78.5% | 18.5% | 3.1% | 100% |
|--|-------|-------|------|------|

Table 3. Communication via Mailinglists.

It clearly shows the high need of a mailinglist as a discussion medium in distant learning.

d. *The quality of the Majordomo list regarding questions / answers (Table 4 / 5).*

| The possibility to ask questions about theory and exercises via the mailinglist majordomo | % |
|--|----------|
| Very low | 2.3% |
| Low | 9.2% |
| Ideal | 25.4% |
| High | 24.6% |
| Very high | 26.2% |
| Not applicable | 5.4% |
| Missing | 6.9% |
| Total | 100% |

Table 4. Quality of Majordomo (questions).

| The quality of the answers you receive from the mailinglist majordomo | % |
|--|----------|
| Very low | 0.8% |
| Low | 8.5% |
| Ideal | 39.2% |
| High | 23.8% |
| Very high | 6.9% |
| Not applicable | 5.4% |
| Missing | 15.4% |
| Total | 100% |

Table 5. Quality of Majordomo (answers).

The students really seem to appreciate the capabilities of the electronic discussion groups.

e. *An overall idea of the enthusiasm for the IT-course can be seen in the following (Table 6.).*

| Would you advice your colleagues to follow this IT-course | % |
|--|----------|
| Yes | 70.8% |
| No | 19.2% |
| Missing | 10.0% |
| Total | 100% |

Table 6. Overall evaluation.

Conclusion.

Clearly, the model of this IT course is far from perfect. Videoconferencing has severe drawbacks: less stimulating for interaction, less 'live' lectures (no body language, the lecturer freezed in his seat,...) and technically lack of bandwidth, lack of image resolution,... On the other hand, breaking the gap of time and dis-

tance is a clear benefit. Also working inside a 'charter' where universities are acting as one group on the offering side, and the industry as one group on the demanding side, was a new and fruitful experience. Currently several new programmes in Belgium will follow this group-cooperating model.

On the technological side, new developments are urgently necessary, offering higher (and guaranteed) bandwidth and higher image resolution. Current GroupWare products are far from mature and stable inside a large-scale environment, although it is from that corner the blessing should probably come. Computers and PC's becoming ever faster will offer in future more flexible software solutions to currently hardware-wise solved technology (e.g. codecs). A (hopefully) passing problem is that most industries are currently not hooked up to high bandwidth networks, making IP-transmission still unfeasible.

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