

**DESIGN AND REVIEW OF BACHELOR LEVEL
EDUCATION IN PROSTHETICS AND
ORTHOTICS IN THE NETHERLANDS**

By

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A new young tree is growing out of an older established tree.
Synonym for the new course
(The Three, engraving made by Jan Lievens 1607-1674) .

Abstract

The aim of this study was to gain insight into what kind of forces are acting on the educational design process in the Netherlands. In a specific way, a B.Sc. level course in prosthetics and orthotics with a Dutch curriculum has been compared to programmes at other universities throughout the world offering similar courses.

Starting a new course is not an easy task. Institutions offering education face increased responsibility to government and society. It is necessary to justify why and how programmes and courses are designed, explored, reviewed and adjusted. Designing educational programmes to fulfil a certain need, in this case the need for a prosthetic and orthotic BSc. undergraduate level course is a rather complex matter. All kind of forces such as student numbers and the number of study years, the 'Bologna Statement', credit point system and the nature of academic titles which are now subject to change as well as the new concept of 'competences' affect this process.

In order to carry out this project, a study of the Dutch school system was carried out; including a review of changes taking place in Secondary education. A questionnaire was designed and sent out to 11 universities throughout the world who organise relevant courses. Eight of these questionnaires were received and reviewed to extract information about their curricula.

One of the most obvious conclusions which can be made is that the Dutch curriculum takes four years. The number of study years in at the institutions questioned, varies from 1 to 4 years. Although a little variation exists, a slightly higher percentage of male student are attending p&o curricula. Anatomy, mechanics and biomechanics are indicated as core subjects. Most of the graduates find a job in the orthopaedic work field. Another conclusion is that a large number of study hours are now dedicated to problem based learning.

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Designing and evaluating education is something what can not be done alone, certainly not when this process is used in a research project and a dissertation had to be written down. This is therefore a project where a number of people and institutions contributed in a remarkable way, what was certainly a great help in motivating to finalize this project

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1 Introductory

1.1 History of the graduate course in Prosthetics and Orthotics in the Netherlands.

Since the early 70's in the Netherlands a wish for a four-year full time graduate (BSc.) course in prosthetics and orthotics exists, denoted as a HBO course. The need for a prosthetic and an orthotic course at this level was already mentioned in 1974. At his time an international study week on prosthetic / orthotic education took place (Hughes 1976). HBO stands for "Hogere BeroepsOpleiding", and can be compared with the English equivalent Polytechnic or graduate course. A common translation is also a University study of professional education. It will offer the graduates an ingenieur title (ing.) or from 2004 a BSc title.

Compared to countries like Germany, the United Kingdom and the United States of America, the development of a prosthetic and orthotic course in the Netherlands did not developed until after World War II. The lack of large numbers of amputees as a result of World War I (1914-1918), The Netherlands was in that time a neutral country, is a possible reason. Up and till that time orthotists and prosthetist received their theoretic education in Germany, and learned their skills in practice in the Netherlands, figure 1-1a and 1-1b shows a card tray with a reference to "fachliche vorschriften zur regelung des Lerlingswesens im orthopedie, dated 1938. (in eng. .professional regulations to the vocational training of prosthetist and orthetists, dates 1938.). This card is to be found in the library of the Leipziger University. In Leipzig, Germany. This card tells us that already in 1938 people were engaged into orthopedics in relationship with education.

Despite the lack of training facilities, orthopaedic companies, workplaces did exist already in 1901. Martin Loth founded the Martin Loth Orthopaedic Industry.

After World War II the ministry of War did had that availability of an orthopaedic workshop and an rehabilitation was founded in 1949 by a social insurance provision (Sociale Verzekeringsbank) and a medical doctor with knowledge of prosthetics was appointed. (Klaus, 2003). In 1950 the Sociale Verzekeringsbank founded a new rehabilitation centre and installs the association Orthobanda (Vereniging Orthobanda) with a committee vocational training.



Figure 1-1a
Card tray with literature data,
library of the Leipziger University



Figure 1-1b
Card tray: Fachliche vorschriften zur regelung des
"lehrlingswesens".
library of the Leipziger University

At the date of July the 18th, 1950 the industrial disability assurance board appointed a 'prosthetic committee' to play an advisory role towards this board.

In 1953 the rehabilitation council was formed and came into place of the industrial disability assurance board. This council was also involved in education and January the 8th in 1957 a course was started according a model of modern apprenticeship. In 1961 the first three bandagists and ten prosthesists / orthosists graduated.

After paying a visit to the United States of America, Western-Germany and the United Kingdom, Mr. H. Vlijm (inspector rehabilitation centre social insurance provision) concluded that course only by modern apprenticeship can not be sufficient enough for the near future. Although since 1949 progress have been made, the prosthetic devices do not meet that level of perfection what is required, partly due to amputation levels which are not optimal, and a lack of sufficient trained protesists / orthesists. It is therefore that plans have been made for higher vocational education, which should start the first time in 1964. This step should be considered as the first step to Higher vocational education (HBO).

A number of initiatives have been undertaken in order to establish a prosthetic and an orthotic BSc. level course. In 1977 an advisory committee under responsibility of professor R. Rozendal , started the design of four new course, Primary (prostheses), Secondary (orthoses), Tertiary orthopaedic technician), and the "meister-building". In 1980 the primary and secondary course have been started. The other two did not..

Further going developments, both national as well as international, gave the SOFOB (Stichting opleidingen flebologie, orthopedie, en bandagist) enough leads to do more research in order to investigate if this type of training could be adopted in the Higher Vocational Educational System. After consultation the HBO council, an advice to start in 1990 two separate courses, one in prosthetics, one in orthotics, in cooperation whit the Fontys University, was the result.

This initiative led to a part-time variant, called " orthotics / prosthetics expert course", (Kemenade, 1992). This course was designed as a two-year part-time course and was meant as a continuation of the vocational training which was offered by the Koning Willem I college in Den Bosch. From 1999 this course is runned by the "Stichting Vakopleidingen Gezondheidstechnische Beroepen", SVGB in Nieuwegein.

Every new initiative in starting a new full time four-year education must have been approved by the government, represented by the Minister of Education and Science. A new course or study must therefore be presented to the Minister by a so-called "t" document, (croho stands for centrale registratie opleidingen hoger onderwijs, in English: central register for university studies leading to a BSc. Title). This document consists of all relevant information concerning the new course. In February 2000 a croho document for the "Hogere Beroepsopleiding Orthopedische Technologie" (HBOT), in English: Higher Professional Education in Orthopaedic engineering, is presented to the Minister of Education and Science, (Holtkamp, 2000). This education is to be compared with a graduate (BSc. - level) course in prosthetics and orthotics.

The Fontys University in co-operation with a Belgium University, the Katholieke Hogeschool Kempen, made this course possible. In this co-operations two main goals had to be achieved. Firstly, to make a cost-effective course in prosthetics and orthotics for Dutch students in the Netherlands, bearing in mind that only a limited number of students will attend each year this course. The number of students who start the course will be, in three to four years from now, approximately 18-25 each year. The second main goal is to get into a real co-operation between the two University's because Dutch students will attend an amount of lectures and skills at the Catholic University Kempen (in Dutch KHKempen KHK). Therefore there must be a comparative educational system and student-information system developed.

To be more specific, the Dutch educational model is a four-year full time programme for Dutch students. Belgium students only have to attend three years of education in Belgium. Dutch students will start their education the first year at the Fontys University in Eindhoven. The second year students will go to Belgium to receive together with the Belgian students their education. The Third year is a mixed year. The first half is a follow up from the second year. The second part of the third year is a practical clinical period, a traineeship. Dutch students will fulfil this period within company's or hospital's in The Netherlands. The final year again is a mixed year. Part of it is a final practical period, and part of it is finalisation of the theory.

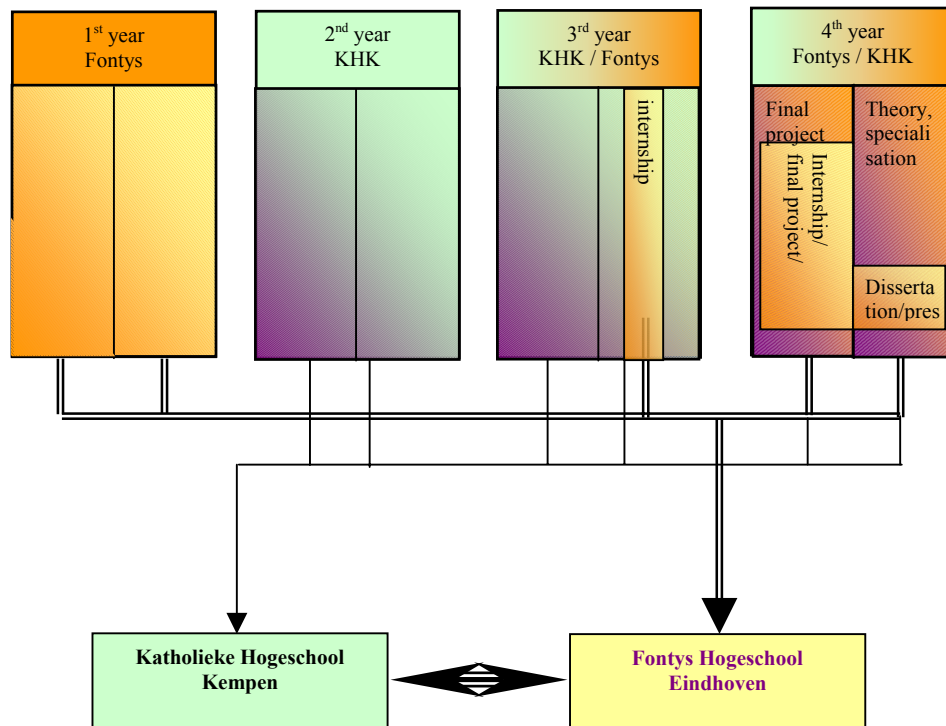


Figure 1-2 Educational model of the BSc course in The Netherlands used by Fontys in co-operation with the KHKkempen

It is these kind of developments that made a prosthetic / orthotic course possible for the Netherlands. Figure 1-2 shows the educational model in a diagram. Although many work still have to be done, the basics or fundamentals are presently available. The primarily designs of this program in prosthetics and orthotics were based on the experience of people from the prosthetics and orthotic work field, consultants, teaching staff, both from Fontys as well from the KHKempen. Then again al the courses, practical training and so on has to fit within a very thigh financial framework.

1.2 Recent developments.

In February 2002, the Dutch government introduced a new system concerning grades and titles of students whom have finished their education. This is called the Bachelor / Master system and the titles BSc and MSc (in the Netherlands known as the BA/Ma system). This system is introduced for a number of reasons. One of them is to make an easier comparable system to those from abroad. This change is one of the results of the “Bologna-statement” (*Bologna, 1999*), made by all the Ministers of Education in Europe at Bologna at June 19th 1999.

(The review of the prosthetics and orthotics education at BSs level, the fine-tuning of the education and the new system of the titles lead to this research project.)

2 Designing education, in general.

2.1 Introduction

Any product which can be purchased in the western society is a result of a process that leads towards this product, whether it is a cd-player or an educational program that leads to a diploma.. Mostly this process starts with an idea of how a product should look like, functions, meets a need of some kind and so on. The same principle goes with education, how it is designed, developed, offered and evaluated, and after evaluation, adjusted. For instance, In case of the cd-player it is not that difficult to evaluate the working and functions of such a device. It is relatively simple to test whether the cd-player is functioning in a right way, after all, the cd-player has to play a cd After solving the possibility to get a hold on optical data registration in the early 70's the main problem for cd-players was caught, namely to be able to store data on an optical disk. Data is read from a CD with a low power laser contained in the drive that bounces light—usually infrared—off of the reflective surface of the disk and back to a photo detector. The pits in the reflective layer of the disk scatter light, while the land portions of the disk reflect the laser light efficiently to the photo detector. The photo detector then converts these light and dark spots to electrical impulses corresponding to 1s and 0s. Electronics and software interpret this data and accurately access the information contained on the CD (Encarta 1999). It is obvious that this whole process can be tested and evaluated in a very digital way. It functions or it functions not.

In case of designing education and evaluate this it is relatively difficult . Mainly because of the fact that a number of forces are acting upon this process. In particular forces from the government society, branch, professional associations. Of course a number of these factors have a political an cultural background. For instance, political choices do have a direct influence in how education is offered and what the possibilities are to look after this.(first of al financial) This is one of the main reasons why education can differ from one political era to another or differs from one country to another. Designing education is one thing. Evaluating it is another. Were a lot of forces present in designing a course, a lot of these same forces, and outcomes are not that easy to evaluate in an objective manner. Mostly it gives a lot of discussion in assessing the results.

To get an idea of what kind of factors are influencing the whole educational system , not only from out of a designing view, but also from out of a exploitation view and an evaluation point of view a “mind map” is drawn containing a large number of these factors. The mind map is showed in appendix 2.1. This mind map visualises; I the design variables, II target groups III evaluations groups IV qualification and quantification and V the exploitation factors. In the following paragraph a number of these factors will be discussed.

2.2 Design principles

The design of education starts out of different lines of approach. (Smid, 2001). In this paragraph two points of view will be discussed. After making a combination of these two the design process, with a number of marked variables can be entered in order to design a course.

Designing out of a “knowledge” perspective.

Creating an educational program or course can start from out of knowledge. Knowledge is a central production factor in our modern society. Knowledge can be seen as the fifth production factor, next to capital, labour, land and entrepreneurship. From the high till the low ranks of society, information and knowledge are playing a more and more important role. The question now is, how to define information and knowledge.

Information is knowledge which is transferred in a tradable product that can be used in a decision process. Knowledge goes thus in front of information. Everybody is used to scientific knowledge or in other words, declarative knowledge., based on a whole of declarations, which can be assumed, on a basis of research, that these are false or true., not related to any context what so ever. That is the reason that this can be used in different contexts

Not all knowledge is free of context (Tennant 1999). A lot of knowledge is linked with respect to the context in which this knowledge has been developed. These forms of knowledge fits more in a point of view of ‘increase of value’. Indeed, also here acts a way of idealism of freedom of context., mainly the development of procedures of “how to reach a certain wisdom” in a certain situation.

Recently a lot of attention is paid for background knowledge, also named as tacit knowledge. This form of knowledge is seldom available in text form. The term tacit knowledge refers to the fact that those who are active in economic industriousness not only uses declarative knowledge. Professionals for instance are using at least as much complementary “known-how’ as they use tacit knowledge, which is knowledge that not available is by a formal form of knowledge transfer. Tacit knowledge is acquired in doing the all-day things, like working, hobby’s or observing an experienced senior. Organising educational programs or courses in which these forms of “situated knowledge” has been made explicit, supplementing and if necessary corrected appeared from this point of view as a very important task.

2.2.1 Designing out of a “target-group” perspective.

A second way of approach in designing secondary education is offered by the professionals themselves. The professionals can be met in different forms or aspects in executing their profession, for instance as an employer, employee, official, service provider or partner. This variety shows that educators can not define the outside world” in a standard way. If this was possible than a design process could be rather simple because a number standard specifications could be used. In designing educational programs.

The different indications for employer, employee, official, service provider or partner points to considerable cultural differences. Someone who is working in a job under supervision of a chef does sometimes have a low intrinsic motivation. An official will be expected to do his job without respect to his private opinions. A specialist or skilled worker mostly has a large amount of professional pride and knows exactly what to do and what not, and can do that without supervision. A professional does not have this at all. A professional is a natural in his job and sometimes a bit possessed of his job and has a large amount of intrinsic motivation. A service provider derives the identity and criteria for the job not from his trade but on what is accomplished at the customer’s side. And last but not least, a partner derives the labour satisfaction and quality of the cooperation process whit his partner.

To become a really proficient or skilled person is usually a nice but long road which has to be walked. Accompanying an experienced peer as in the old days is nowadays

not in every situation appropriate. Skills, attitudes and competences necessary for a variety of functions, tasks or professions demands a complex knowledge- and competence structure to such an extend, that not just one behaviour model can be distinguished. To become a really good professional takes about 10 years (Diepen, S et al 1993). The best way to gain all the different aspects of a profession is to experience different types of working environments, evaluate your own labour routines, ask for guidance from more experienced colleagues, ask for clear assessments and after finishing the initial education time. (van Delden, 1991). To obtain a habitus specific for a task, in other words, to obtain a specific repertoire ask for an amount of time and attention.

A “profession “ is not just only a form of intern grammar; it is also an embedding into a social structure. The building of a relevant network takes a number of times, but is absolute essential for an adequate professional competence. Social capital is at least as important as human capital (Burt, 1997). This point of view gives a perspective on to a number of other questions than the first spoken point of view.

2.2.2 Designing out of a “form view” perspective.

The third point of view is zooming in into elements as knowledge and the participators, but emphasises other aspects, in particularly the form. Training or education aimed to improve the exercises of the duty's is now appearing as a very cautious piece of work. Lecturers, trainers, coaches have to met specific requirements. Their reputation with respect to the content must be in order, they must have a right to speak, offering a correct model of behaviour show an affection to their profession and they must have the ability to work with younger college's etc.

Training- or educational programs can not exists out of only one lecturer or a simple connection of only a few lecturers. Here also applies, the knowledge- and competences structure necessary for the various professions is to such an extend, that it is almost impossible to implement this by using only one “data-carrier”. Combined arrangements of lecturers, teaching material, practice, internship, possibility's to personal development seems to be necessary (Poell 1998). This point of view set the form central and can be stated that to design and develop the course a specific didactic use is necessary. Out of this point of view, the numerous forms of learning and educating are formulated as an issue. Attentions are then there for the variety of players who takes the initiatives; managers, colleagues, personnel and

students. In mind is kept then of course what the staff, teachers and lecturers, has learned themselves, concerning, experience, skills and insights, in the past. Teaching forms are then developed to utilize this experience in combination with that what is developed elsewhere by importing knowledge and experience. At this moment a choice must be made whether a curriculum is organised intern of extern, by a partnership construction or any other form of network construction.

2.2.3 Choice of point of view.

In the design process in general but in designing education in particular a major issue is to make a choice or combination of choices from out a certain point of view, partly based on philosophy of the institute, objectives, human resources etc. As mentioned in de foregoing paragraphs different point of view are described. Knowledge, target groups, or perspective or culture, are point of view, which can be chosen to work from. In general there are no demanding reasons to choose or avoid a particular point of view in designing educational programmes. Every point of view has its own drawbacks. One of the criteria in choosing a point of view is whether the designer, design team, is able to handle the advantages and disadvantages belonging to a certain point of view. In this particular case, a choice is made for “from”. One main reason war debit to this, the first: use as much of the existing material as possible due to some other reasons (will be discussed later on) The advantage in making this choice is the availability of a lot of existing material which is very efficient. However choosing for a “form” point of view includes also some dangers. A certain risk will be formed by the fact that, unless there is a one hundred percent perfect pedagogic and didactic curriculum, it is not precisely what is wished for by the market i.e. institutions, company’s, hospitals etc, witch is also demonstrated by Kessels (Kessels,1993).In daily practice the disadvantages of this point of view must be decreased or undone by putting a lot of effort in the design of the curriculum so that most of the components, described by the other to views are also paid attention to, as knowledge and target groups.

2.3 Design variables

Before going in to detail of design variables necessary in course design firstly a design process will be illustrated .In essence, designing a course differs not that much from a “material” product. Both an educational course as well as a “material” product

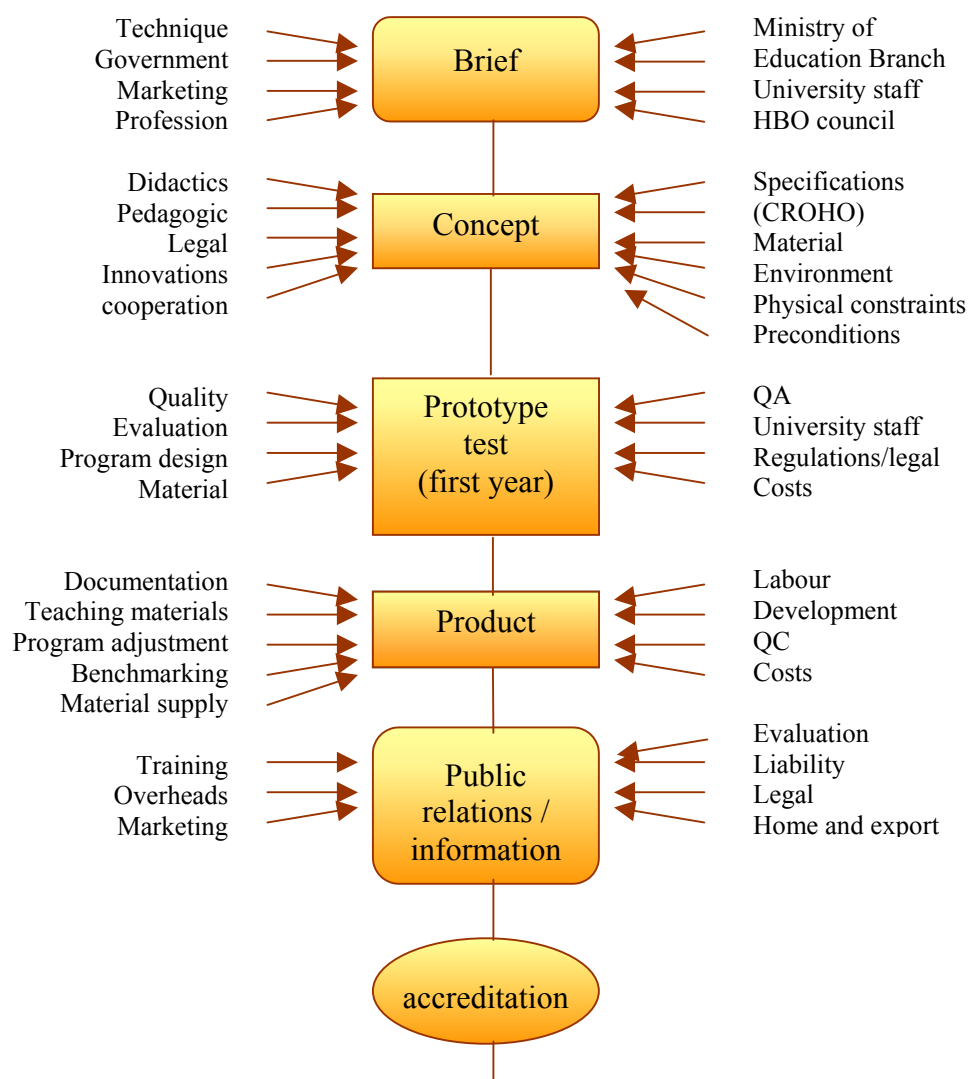


Figure 2.3.-1 Designing education

finds most often their starting point in an idea or a need for it. In other words a product which found their existing, using modern marketing concepts by a market pull or push (Oakland 1998).

In case of designing education, in the same way as working on product development, a choice for a certain design process must be made. In figure 2.3-1 (designing education) is an example of a design process drawn. Using a protocol, visualised in figure 2.3-1 helps to arrange the various steps necessary in a design process. A design process contains out of a number of steps. The first step is a Brief. After a Brief is written down a concept will be developed. This concept will comprehend ideas concerning pedagogic, didactic basic assumptions, like learning styles, etc. This concept will lead to a result, which can be at best described as prototype. This prototype is tested in the real world, because it is almost impossible and certainly not to be financed to run a “test” year. The first time the programme is offered, it is also the test phase. After the prototype phase a fine-tuning can be done. After fine tuning and evaluation an “end state” of the first year programme can be more or less defined. Next to the first year also second, third and fourth year will be developed in this sequence. Although figure 2.3-1 shows a public relation and information block almost at the end of the cycle, it must be said that already before starting the first year of the program a public relation and information action must be realised. After all, you need to have students to run the program with / for.

2.3.1 The Brief

This brief contains an idea of what kind of educational product is wanted. Where does the idea come from? What kind of features and end level is required. This brief is usually supplied by the educational research and development department or by the one of the knowledge centres and obtained from the ministry of education, or the HBO council, or , branch or company's, or a combination of several parties. In other words, from purchasers as students or employers, customer feedback and market awareness. These partners can be described either as users or as customers. In more detail, there are really only three sources of information, which can be used as information for formulating the design brief in education.

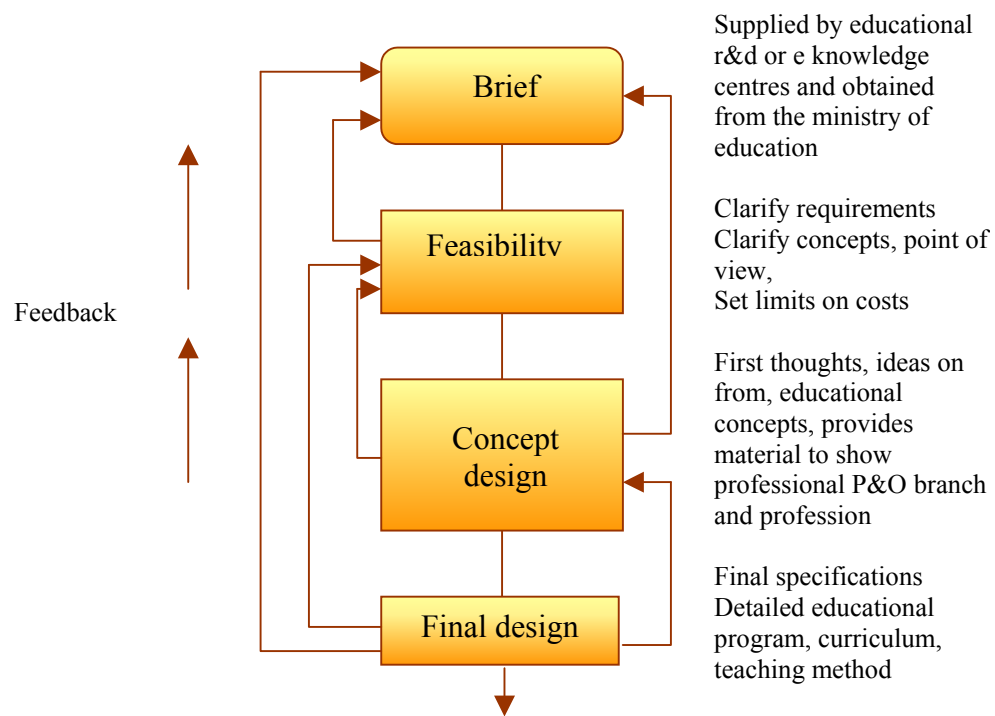


Figure 2.3.1-1 A flow chart of the design process.

- Changes in the school system prescribed by the ministry of education.
- Observations made by educational research and development department staff or knowledge centres, marketing and public relation staff, on visits the industry, schools etc. Their predictions of what new educational programmes or course may be developed and what needs exists or may arise.
- Recommendation of examination committee (from 2004, a examination committee will be follow-up by an accreditation committee)

Once there is a design brief, the process should follow the sequence listed below. It must be said that although the list below assumes a certain chronological sequence, parts of the list are done simultaneously or in a feedback loop with other parts (Figure 2.3.1-1) This figure shows very clearly that the design process is an iterative process, which means that there is a constant feedback and adjustment possible.

- Analyse the brief and identify the main aspects and preconditions
- Make a preliminary design for concept evaluation
- Consider didactics and educational tool options and make a preliminary selection
- Conduct a feasibility assessment
- Develop a concept professional profile, and academic profile (prototype)
- Involve student information an quality assurance procedures
- Produce a fully detailed programme design.
- Justify choice of concepts and methods
- Document everything
- Do a first year run and evaluate
- Asses trial results
- Write specification for finalised design
- Public relations and information
- Prepare for Accreditation

In devising a design there are a number of principles which should be keep in mind and paid attention to in order to arrive with an end product that fulfil the demands

and wishes, stated by the parties concerned. In order to achieve this it is very important to keep the design process transparent, to keep it simple try to use or modify existing designs and if possible existing material. Using existing material in a certain form other relevant courses can help you in designing the specific parts. Another very important variable is of course the work field (company's, institutions, centres etc.) where graduated students find their jobs. In the design process this work field must be involved in the developing of educational programs This can be achieved for instance during the design process to organise frequently round table conference with all parties involved (later in this dissertation will this be in detail disused) .

2.3.2 Concept

After studying and discussing the brief, the a second design phase, the concept phase begins. At the end of the concept phase there must be a clear idea of what the programme should look like, in terms of what kind of training must be developed. for whom and what. It must result into an “croho” application, an application addressed to the Minister of Education in which the necessity of a new curriculum is explained and proved. Also an programme profile (educational programme) and a profession profile, both for the profession, for which the course will be developed must be ready to server as anchor points in further development. The programme profile contains information of what specific or characteristic for this program is. In this document basic assumptions about didactic and pedagogic concepts are made. For instance, what kind of method is there for lecturing, is it in an instructional way, a teaching way or is it in a problem based learning way and is there a need for practical hours or clinical hours. A number of these questions can be answered when the profession profile is known. This document (appendix 2.3.2) describes in a general way how the profession is look like, it also describes a number of specific quality's needed to exercise the profession. It may be obvious that both the programme profile and the profession profile must be in line with the framework and regulation of the law involved education. The most important fact in this is the duration of full time BSc. courses, whit's is four years. Innovations is also a rather important subject in designing education. For insiders, the Dutch school system in general is a rather open society to innovate and the higher vocational education system in particular. For a few years ago the whole educational system was redesigned into modules and students had to work into project groups to deal whit a

number of problems derived from the profession and under guidance of a lecturer. This is now known as problem based learning. Also the internship and supervision of the apprentice was changed. A year ago a start was made with competence based learning. This educational reform was enabled by two different bodies. The first one is the AXIS programme (Dool 2000), which describes and mentions a number of problems in the Dutch situation. The second is made by the Commissie Accreditatie Hoger Onderwijs (committee Accreditation Higher Education, 2001). In their report '*Prikkelen, Preseteren, Profileren*', (*translation: stimulate, achieve and characterize*). This report will be the most important report in the Netherlands the coming decade. This report is describing the way to accreditation of institutions and programmes, it consists of a number of guidelines and regulations of which institutions have to satisfy. If they do not then there will be no accreditation document and hence there will be no more financial from the government and hence there will be no more educational program. So concluding, for now, this report is very demanding and forces institutions to a number of innovative measures. In chapter 4 a number of these innovations in relation to prosthetics and orthotics will be discussed.

In the concept phase also a list with specifications, requirement for the program has to be made as well as a lot of educational material as literature, books, publications, syllabi and demonstration material must be collected of existing material. What is regarded as missing can be developed in concept.

In this phase also a feasibility study must be carried out. There must be come into being an idea of number of student who want to attend the programme, what the benefits and cost will be. In some particular cases attention has to be paid in ways of cooperation's between university's or branch and university. In any way, there must be an idea of how the programme

2.3.3 Prototype

If the feasibility study concerning macro-appropriateness, student numbers, finance, program content, has a positive result the next step must be set. A prototype of the curriculum can be designed. Anyway it is not just the curriculum by itself what has to be designed. Also plans according to the university staff, quality assurance, ways of evaluation the curriculum and formal adjustment of the legal and regulations must

be made and carried out. Particularly adjustment to and with the intermediate vocational educational program is important. Systems to follow the study progress of student have to be implemented and study guides and examination regulations must be written down. It is then in this phase from the outmost importance that some ideas of how to perform the curriculum. In this case thus, or completely self supporting and independent or in cooperation with another university. Later in the dissertation will be discussed how a number of details were arranged, in chapter 7. For now it is sufficient to mention that in order to build the curriculum and study program it became also necessary to check the legal and regulation concerning educational laws of both country's, since the partner university is located in Belgium. That this made some things somewhat complicated is not surprisingly.

2.3.4 Product

2.3.4.1 General preconditions

After the croho application in relationship to suitability, is approved by the advisory committee education (ACO) as mentioned in section 6.3 paragraph 1 of the Law of in higher and scientific Education (WHW) the end product can be developed. In this product phase a variety of elements have to be draw up. For instance a number of documents, such as teaching materials, syllabi, prognoses for labour, and a number of quality assurance documents have to be produced. The product is the complete curriculum of the course including the textile art, learning styles, study guide, regulations concerning the exams etc.

The product, the curriculum has to fit into the philosophy of the University and must find a support to establish the new course. In this particular case it is from the outmost importance that this new developments fits in the mission statement and ambitions of the University and for this rather unique project also of the partner University. It is therefore useful to explain something's about the mission statement of the Fontys University in brief. The complete mission statement is admitted in appendix 2.3. The three most important statements are, in relation to the study: The Fontys University wants to be an educational institute in which students and employers cooperate with each other in a nice atmosphere and in which both employers as well as students have their own and collective responsibility for where they are accountable for. In relationship to the content, The Fontys University wants to meet the expectations of students, employers and professional branch of a

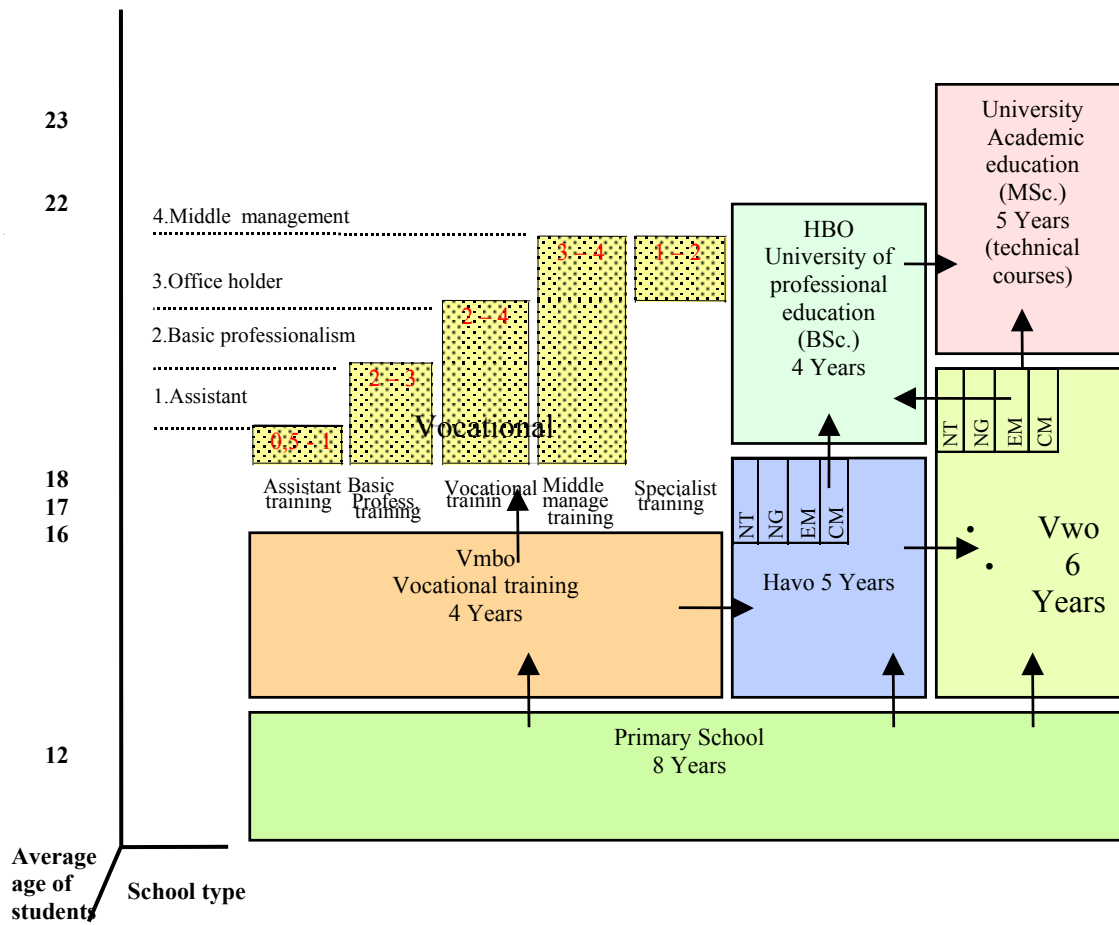


Figure 2.3.4.1-1 Educational organisation in the Netherlands

qualitative high ranked training by offering made to measure top products. In relation to the surroundings: The Fontys University wants to be an open, transparent en reliable partner in her surroundings and professional work field for which the students are trained.

2.3.4.2 Competences

In connection to the mission the vision of the University gives a little insight in how the above-mentioned statements are reached within the individual departments. The Engineering department, The Prosthetics and Orthotic BSc. level course is part of this department, wants to join the educational vision of the Fontys University: learning and educating with an aim on development. (Staff memorandum Educational vision Fontys) This is why professional competences, learning competences and generic competences are at service of the personal and social functioning in further developing. Studying is a social activity in that sense that the competence development aimed at, only can be reached by means of interaction with representatives f the profession, other students and lecturers.

In the product phase a very important element must be implemented, the preconditions that prescribe for a great deal the end result of the product form. In chapter 7 will be go into detail in the preconditions in relationship to the Prosthetic and Orthotic profession. Preconditions for HBO education in general are: a course at HBO level must have a duration of four year, full time study. In practice this will mean that in each year the students must process 1680 study hours, according to the ECTS credit point system. In four years this is a total of 6720 including internship. Other preconditions are that the study must be accessible for students from HAVO an VWO with a study certain study profile or for students with an MBO preliminary education (figure 2.3.4.1-1 Educational organisation in the Netherlands).In order to adjust to program to the preliminary educations asks a lot of consultations with the parties involved. A roundtable conference is a helpful instrument in this process.

Educational reform is also a factor that must be considered in the course design. For approximately fifteen ago, the way of teaching was group teaching. The lecturer did his teaching, was the person who was talking. Ten years ago the courses were reformed into equal modules. Students were then able to follow the necessary modules in order to finalise their study. Approximately five years ago another

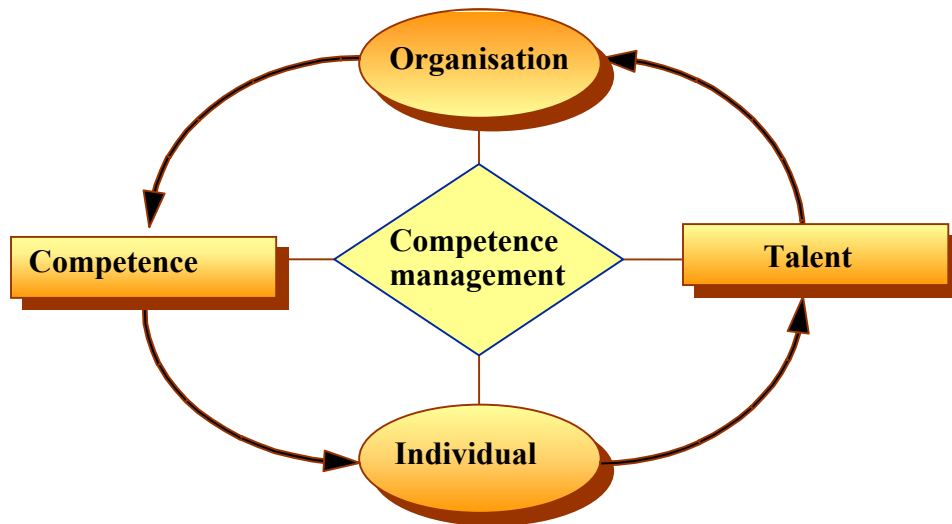


Figure 2.3.4.2-1 Competence management, competencies en talent, (source Fontys Dictionary September. 2002)

educational reform was started, problem based learning in relation to self-activation in relation to students was very much promoted and introduced.

The educational reform factors that at this moment have to be considered are twofold. At first it has everything to do with competence and competence development, secondly it finds its basis in the AXIS report (Dool, 2000), which is leading in the reforming of HBO education. Interesting is that in this report is referred to a large scale research to the professional practice of vocational and higher educated people (Den Boer and Hövels, 1999) is mentioned that there are three striking developments. First: broadening and specialisation are becoming much more coincided. Professionals must have the substantial means over his professional skills and general knowledge and practical skills. Having only one of the two is inadequate. Second: In the professional occupation there must be a matter of or, a further professional development, or available possibilities to develop specific functions in the company. Third: a growing number of professions have to deal with time pressure. These three factors must also have been taken into account in the course design.

To prepare graduate students to meet these kind of demands in daily practice the course program must have defined a great number of objectives which are derived from a number of final attainment level descriptions (also subject benchmark statements). In the Netherlands at this time a transformation from these objectives and final attainment levels to competences takes place. In order to understand what is meant by the term competences it is helpful to give a definition. A competence is a behavioural characteristic that contributes in a distinguish way to a successful performing in realising the goals of an organisation, (Fontys 2002). A competence is work related. A talent is perceptible behaviour, ability, of a person, student, and is therefore a personal characteristic of which an individual can make a contribution to the goals. (Figure 2.3.4.2-1) Every competence exists out of three components:

- a name of a competence
- a general definition
- a description of behaviour in four levels.

A competence is therefore a combination of an objective, a final attainment level and an attitude. Is this combination that tries to give a broader description in order to

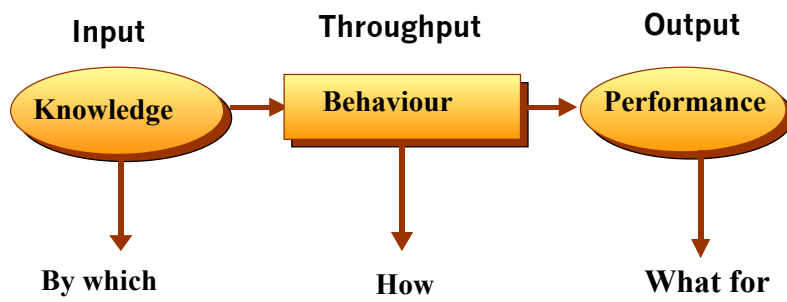


Figure 2.3.4.2-2 Knowledge, competences en performance
(source Fontys Dictionary September. 2002)

meet the modern requests. However, there can be made a difference between knowledge, skills, attitude and performance.

- Knowledge; is the tool, which will be used, and is a basic requirement for good functioning. Knowledge can be described as the necessity to have with respect to the professional skills, expertise, experience, assignments /responsibilities/ qualifications and kind /level of the followed education.
- Performance; Forms the goal to which the activities are being accomplished and whit that it is the resultant of functioning in a successful way. In performance models measurable indicators are being used. A result is then expressed into a percentage, a number or an amount.

Knowledge is a qualitative requirement and performance is a quantitative requirement. What do you need and what is in it for you?

A competence forms a connection between knowledge and performance and describes desired behaviour an attitude, necessary to come, using the required knowledge, to the appropriate performance. By that competences described, recorded into a competence-profile, the process of how knowledge can serve to reach the acquired performance, Figure 2.3.4.2-2.

The reason for the amount of attention to these competences and competence description is caused by the fact that in the years to come, as mentioned before, all the educational institutes are being assessed, by an examination and visitation body, in a way in which the competences, and the derived generic designations will be a central issue.

These generic designations (10), together with a number of specific, profession related designations (1), will be the source of which the new curricula, in the near future will be derived from.

In the description of how to design education, it must be mentioned that although in the models, after a Brief, a conceptual phase a product phase is achieved. This product however is not a status quo product so to speak. There is never a “finalized” product” which can be used year after year. These kinds of products, the course

program, are always subject to changes. It is therefore that in chapter 7 the process in designing the prosthetic and orthotic course is described in two phases. One phase up and till the start of the course and the other from start till this moment, just to show the process.

2.3.5 Public relations / information

At a certain moment in the design process, public relations and information to the “outside world” becomes important. After all, a product, even if it is an educational one, must be brought under the attention of potential students and the professional world of course. No public relations means no students, no income, no more course. So public relations are an essential part of the design process.

Public relations and information can be realised in a number of ways. Informing the professional branch at conferences and board meetings is an important one. Also publications in professional literature is a way of communicating. Student counsellors of the preliminary school can inform potential students of possibilities in studying prosthetics and orthotics. For this purpose brochures (appendix 2.3.5-1) have been made in which the course and way of studying will be explained. The Internet is becoming more and more important in communication. Therefore also a special website www.fontys.nl for the prosthetics and orthotic course have been made. In appendix 2.3.5-2 an example of this website is showed.

Other important ways in the communication is the opportunity to join various kinds of administrations, boards and committees. These direct links can be of importance by adjusting the content of the course, and in evaluating the preliminary results.

2.3.6 Accreditation

This paragraph will try to give some insight in one of the largest educational reform projects in the Netherlands since the introduction of the mammoth law in 1968.(Oosthoek's Encyclopaedia, 1970). This law was responsible for the school system we know now days, although a lot of changes and adjustment have taken and will take place. One of these changes is the introduction of the basic curriculum, the first phase and the second phase structure In chapter 6 will this be covered into

detail. Although accreditation could be worth while a separate dissertation, because of the fact that it is a whole new evaluation system and a lot is to be investigated and developed, it will be dealt with in a summarized way. Attention to this accreditation system is paid because a link between design, evaluation and quality management will become clear.

As mentioned before, since the ratification of the Bologna statement the Bachelor / Master structure must be implemented. Part of this process is the development of an examination framework for the Bachelors and Masters programmes. In the perspective of this dissertation only the examination framework of the Bachelor programme will be illustrated.

The whole of Europe seems to be busy with accreditation. Accreditation seems to become a more and more important instrument. Cooperation's of Universities as the 'Association of European Universities (CRE), University foundations like the HBO-council ,VLORHA VSNU and other parties join the European Network for Quality Assurance (ENGQ), (Kemenade, 2001).

Accreditation has its roots in de United States of America. One of the definitions is;

"The accreditation process is the means whereby formal recognition of competence is given to a certification body (or registrar) by central (normally national) authorities".

The main issue is therefore a formal recognition by testing the quality on the hand of general standards. In the end rapport of the CRE project "Towards accreditation schemes for higher education in Europe?" of February 2001 the following definition is used.

"Accreditation is a formal, published statement regarding the quality of an institution or a programme, following a cyclical evaluation based upon agreed standards".

This definition makes it clear that accreditation has a cyclical form, i.e. al around the world there is a recognizable form of cyclical quality assessment systems, which consists of self-evaluation and peer review assessments. The accreditation process itself however is handled in various ways. There is a lot of difference in who and

whom is accredited. For instance, the United States of America know a system of institutional, regional specialized and professional accreditation agencies. In Eastern Europe the government is accrediting. Next to these differences there are also differences in what is being accredited. Is it a separate course or a complete University? Another question that needs to be answered is, what kind of an object is the be researched. Is it the input, throughput and / or output, or a combination or all three? (Figure 2.3.4.2-2). Is it about management of the organization or about the content of the course, is it about quality improvement or quality assurance Functions of accreditations therefore are there different and accreditation is sometimes free of obligations or compulsory.

From out of the perspective of this dissertation the Dutch situation will be described and if necessary compared with the English system

2.3.6.1 Accreditation and organisation

Due to the ratification of the Bologna statement in 2002 a reformation of quality, quality assurance and quality management will take place. A leading model in arranging higher education is the Anglo-Saxon model, in the Netherlands known as the Ba/Ma, Bachelor Master structure, a model that is based on two main cycles. For the Netherlands this is a rather new point of view, in Belgium it is a confirmation of their system. The United Kingdom is up and till now the only country that consequently utilized the accreditation system, which is organized by the Quality Assurance Agency (QAA). An important tool is the academic review, since 2000-2001 an official method.

In the Netherlands the accreditation process is now being tested in a pilot form. After studying the outcome and comments on this process, together with the design and development of the necessary instruments a more definite form will come out. A number of official bodies are now founded. The Netherlands Quality Agency (NQA), will have an international orientation. The Netherlands Accreditation Organisation (NAO) and Visiting and Judging Institutes (VBI)

2.3.6.1.1 The Netherlands Accreditation Organization (NAO)

The Netherlands Accreditation Organization (NAO) was formed by the Dutch Government with the objective to establish an accreditation system for all existing and new degree courses in higher education. In view of the internationalisation of courses and the labour market, accreditation seeks to safeguard (comparable) standards of quality for degree courses in higher education, with the objective to:

- Create transparency in the education system;
- Ensure independent quality assessment;
- Enable international comparison between degree programmes;
- Enable foreign course providers to access the Dutch market;
- Continue to increase the quality of Dutch degree courses.

The Netherlands has decided to implement a system of accreditation of degree courses as a final step in the process of quality assurance.

In addition, the NAO, on the basis of information concerning the degree courses, seeks to be pro-active by initiating a dialogue with institutes, students, and the labour market.

The framework within which the NAO carries out its tasks was laid down in the Higher Education and Research Act (Wet Hoger onderwijs en Wetenschappelijk onderzoek, (WHW) and briefly comprises: accreditation of existing degree courses and assessment of new degrees in higher education, as well as advice on possible extensions of Master's degree programmes in university education.

In establishing its accreditation framework, the NAO seeks to make use of existing judging and visitation protocols that are functioning successfully. The NAO considers quality and experience of VBI's (in eng. Visitation and Judging Institutes) necessary conditions for entry in the register. For a number of years Dutch degree courses have been accredited and visited by organizations like the Dutch Visitation Council (DVC, HBO-raad, VSNU) and organizations abroad; these include the Accreditation Board for Engineering and Technology (AEBT), European Quality Improvement System (EQUIS)) and the Association to Advance Collegiate Schools of Business (AACSB)

2.3.6.1.2 Quality requirements of a BSc. level course.

In the judging protocol (a quality care system), which is in draft form, 12 aspects of quality and policy are being appointed.

- Ten generic designations, these generic designations are mentioned separately in paragraph 7.5.3.
- Quality of the mission statement and subject benchmark statements.
- Quality assurance of the curriculum content, with the emphasis on coherence of the curriculum.
- Quality of the educational process: aspects that will be investigated are: application and selection, entry-level requirements of the course, didactic concept, assessment and examination counselling, and study load.
- Relationship between the educational process and research (if applicable).
- Quality of supporting of the educational process: planning, organisation, data-system, public-relations,
- Quality management and quality policy.
- Quality assurance of the staff.
- Organisation and leadership.
- Student involvement in the educational process and quality assurance.
- Embedding of international relationships.
- Precondition, like staff numbers, availability of staff, material conditions, and financial basis.

2.3.6.1.3 Elaboration of the requirement

Each Bachelor level course has to meet these 12 requirements. These requirements are the result mentioned in the end-rapport of the Committee Accreditation Higher Education (Commissie Accreditatie Hoger Onderwijs 2001).

In the visitation and judging process, each of these requirements will be assessed in the following way.

- Who are responsible for meeting the requirement?
- In which way is this being covered?
- Who is responsible?
- Is there a connection between the requirements?
- What is the planning?
- What are the financial requirements?
- In which way will be worked out, to what extent the requirements have met.

2.3.6.1.4 Implementation of the PDA cycle.

Assessing the earlier mentioned requirements must be carried out in a structured way. A quality assessment tool is an appropriate way to perform this process. In chapter 9 this process will be covered in depth. For now it is sufficient enough mentioning that the tool which is and will be used is the “PDCA – cycle tool.

2.3.6.2 Accreditation and education

As described the whole process of accreditation is now becoming more and more leading. Important issues in this process, in relationship to the course program, are the ten generic designations (qualification) together with a number of specific designations, which determine very much the broadness and level of what in the Netherlands HBO-level should be about. In designing educational programmes it is therefore very important to be aware of these designations, although they are of course not all new, but they must be more visible than perhaps before.

The ten generic designations (qualifications) are defined quality demands, which must be an integral part of the university policy and will be assessed in the accreditation process and therefore an integral part of future benchmarking. The ten generic designations are described as stated below:

A broad professionalism: this means that a student will be equipped with state of the art knowledge related to scientific research, knowledge, insights concepts and

research results, as well as (international) developments connected to the in the professional profile specified, in order to qualify themselves to: -execute independently the tasks of a starting professional; - participate within a professional body; -engage in self-directed learning professional development.

Multi-disciplinary integration: integration of knowledge, insights, attitudes and skills (of the different kinds of professional disciplines), by virtue of one's profession act perspective.

Applications, -(Scientific): the application of available relevant (scientific) insights, theories, concepts and research results in cases where graduates are confronted with in their profession.

Broad availability and transfer: application of knowledge, insights and skills in a diversity of different professional situations.

Creative and complexity in acting: questions formed from out of the profession, in which in advance the problem is not clear defined and where standard procedures are not appropriate.

Problem based working: define and analyse complex problems and problem situations independently based on relevant knowledge and (theoretic) insights, developing and application of significant (new) solutions and their strategies and judge the effectiveness of it.

Methodical and reflective thinking and acting, aiming of realistic goals, planning and methodical dealing of activities and the reflecting on the (professional) acting based on collecting and analysing relevant data.

Social and communicative competence: communicate and cooperate with other people in a multi-cultural, international and / or multidisciplinary setting, and in these meeting the requirements set by a professional body.

Basic qualifications for management functions: execute simple management tasks.

Consciousness of social responsibilities: understanding and involvement are developed in relationship to ethics, moral standards, and social questions in relation to the (future) profession.

Besides these ten generic designations a number of specific, profession depended designations are defined, in draft form. In chapter 4 this will be covered.

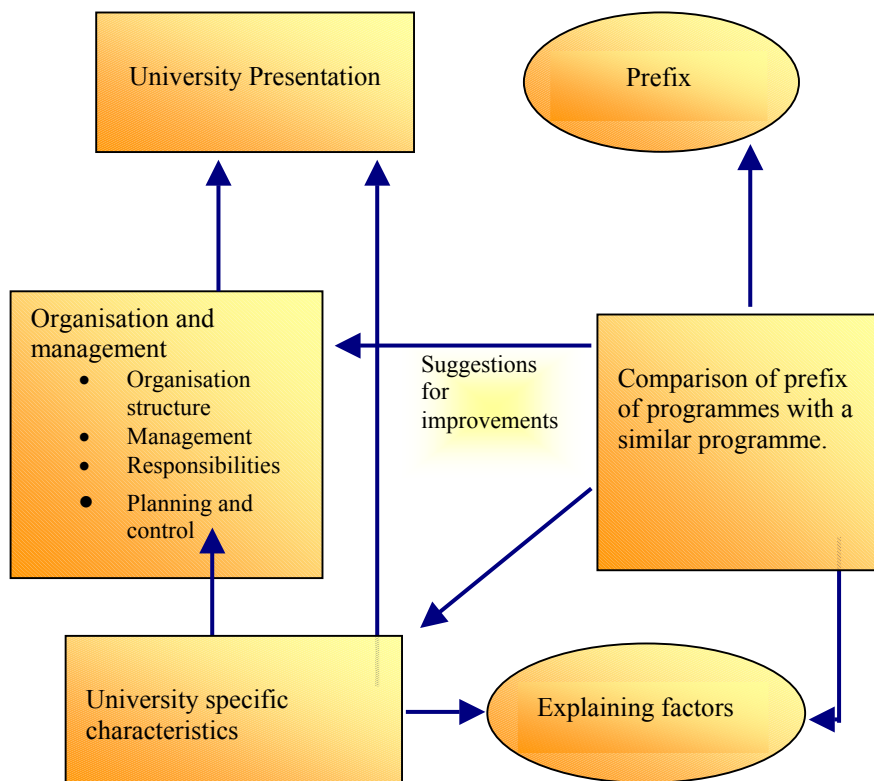


Figure 2.3.6.2-1 A model of the benchmarking process. Edited by FCH.
(Source: het management modellen boek)

Benchmarking is next to the designations an issue that also will be assessed. Benchmarking means a systematic comparison of the programmes and achievements of institutes of programmes between a variety of different institutions. (Berenschot, 1999) Due to benchmarking insight can be provided into standards and comparisons based on where improvements can be realised. It is of course of importance that educational programmes of the same kind will be compared and is therefore a major component in modern education (see also appendix 2.1) Although benchmarking in the Netherlands is a rather new phenomenon in educational institutes, in the industry it is already a well-proven and experienced method. A method which perhaps can be of use is the BETT® - benchmark and analysing model. Due to benchmarking the opportunity will be offered to a weighing and judgement of programmes and result of these programmes. Besides these results examples can be made of other universities by comparison monitoring and copying and can be an important advantage of benchmarking, (see also Figure 2.3.6.2-1). Practicing benchmarking in the right way the following results can be obtained:

- An analysis of strong and weak elements in the organisation also known as a SWOT. Analyses;
- A survey of points for improvements;
- Objectivated standards and insights in potential improvement points of the organisation;
- Examples and ideas.

These results can be of help in improving the educational program and the organisation who supply these programmes. If benchmarking is performed make sure that if comparisons are made, they are made of the same elements and conditions. Otherwise a non-comparable set of issues will be the result. Something that is also of importance is openness. If organisations, can get rid off “ the not invented here syndrome” a large amount of profit can be offered.

The Health care programmes – Prosthetics and Orthotics, show an example of benchmarking in practice. The result of this kind of benchmarking are subject benchmark statements. (The Quality Assurance Agency, 2002).

These subject benchmark statements describes a number of issues in which an agreement:

- Expectations of prosthetics and orthotics in providing patient client services;
- The application of practice in securing, maintaining and improving health and well being in prosthetics and orthotics;
- Subject knowledge, understanding and associated skills;
- Teaching learning and assessment;
- Academic and practitioners statements;
- Work as a professional;
- Application of practice and
- Subject knowledge and understanding.

It is this kind of statement in which a certain agreement is important in developing the content into the right direction. It also has been a tool that has been used in the cooperation between Fontys University and the KHKempen.

3 An overview of the school system in the Netherlands

3.1 Different types of educational school- and university systems.

In order to have a better understanding of the design process of education especially in prosthetics and orthotics, in this chapter the school system in the Netherlands will be explained. In figure 2.3.4.1-1 this school system is visualised.

In the Netherlands after finishing primary education children have to make a choice for one of the forms of a secondary school-systems. A variety of programmes, courses and school-types are available. Depending on capabilities and wishes of young students from the age of 12, choices can be made out of very practical courses till very theoretical courses. The compulsory education of pupils is from the age of 4 till the age of 16. From the age of 16 till the age of 18 there is a kind of partial compulsory education (*OC&W*).

Choices can be made out of VMBO, HAVO or VWO. VMBO stands for Voorbereidend Middelbaar Onderwijs in eng. Pre-intermediate vocational education, HAVO stands for Hoger Algemeen Vormend Onderwijs in eng. These three kinds of educational systems are meant for pupils from the age of 12. They all start with the basic (secondary school) curriculum, (the first phase). This basic curriculum usually takes three school years and consists out of a very broad set of course options, which is in principle for all pupils the same, (paragraph 3.2 XXX will deal with the basic curriculum). After finishing the basic curriculum students will enter the second phase. This phase is a more in depth study. This second phase is not for every student the same. Depending on choices of profile and school type variations in study load can be recognized of a study load of 3200 hours in case of a HAVO student and 4800 hours for VWO students.

3.2 XXX The Basic curriculum.

All schools start the first year with the basic curriculum. During this period all pupils will deal with a broad composed set of course options, which does not differ a lot per school system. A lot of time is spent on dealing with practical everyday situations.

Pupils have to do a lot of things by their selves and they have to questions their self's: what can I do with what I've learned. The length of the basics curriculum can varies from school to school, in principle it will take three years. But a period of two or four years is also possible. In a way, the exact length of the basic curriculum is not defined; the programme will gradually convert into that from the higher school years.

Most schools for secondary education with more than one education types know a first class of secondary school of one or two years.. This transitional year is amongst other things mend for postponing the choice for VMBO, HAVO or VWO. Therefore students will have some extra time to make up their mind and find out where they want to go, depending on their capabilities.

3.3 Course programme in the basic curriculum.

The basic curriculum contains at least the following subjects: Dutch, English, German or French, History and Civics, Geography, Economics, Gym, Mathematics, Physics and Chemistry, Biology, Care (maintenance) Informatics, Technology, and Arts. Schools have to show in the basic curriculum how the various subjects are related to each other.

Schools have to point out in their curriculum how the diversity of the different subjects are linked together. This can be realised in several ways. One of the possibilities is to deal with the different subjects in a variety of course programmes. Another possibility is to cluster the subjects in large projects. For example, an item can be "nature". This item will combines subjects like physics, biology and chemistry. After finishing the basic curriculum a definitive choice must have been made concerning the follow up in their Secondary education school programme. This is a choice as mentioned before between VMBO, HAVO or VWO.

3.4 Description of different types of educational systems.

3.4.1 VMBO, Pre-intermediate vocational education

Pre-intermediate vocational education is a new school type introduced at the 1st of August 1999. This pre-intermediate vocational education consists out of "so-called"

educational roads, coming into place of the VBO and MAVO. This change of education must improve the connection to the (MBO). The pre-intermediate vocational education knows four sectors with a determined chosen set of course options. The final sector choice must be made at the end of the second school year. An educational road is the study route students have to follow starting with the basic-curriculum and finishing with the connecting secondary education. All four educational roads lead to the level of intermediate vocational education. The four educational roads are:

- a theoretical educational road;
- a mixed educational road;
- a profession aimed educational road;
- a cadre profession aimed educational road.

The first possibility, (theoretical educational road) offers an access to the vocational training (level 3) and middle management training (level 4) of the intermediate vocational education plus an access to HAVO, the school of higher general secondary education. Subjects like mathematics and French language or German language are compelled.

Every educational road can be chosen out of four sectors. The four sectors are; technology, healthcare and welfare, economy, agriculture.

A special form of Pre-intermediate vocational education is modern apprenticeship. In this kind of education a large amount of time is spent at the company or institution where the student is working for three or four days a week. The one day that is left is used to follow classes at the school.

3.4.2 MBO, Intermediate vocational education

After finishing pre-intermediate vocational education students have the ability to access intermediate vocational education. This education type is aimed directly at the profession. Of course there also are four levels to distinguish, assistant (1), basic professionalist (2), office-holder (3), middle management (4). Succeeding in a positive way gives then access to school of higher general secondary education HAVO, or HBO, school of higher vocational education.

Up and till the year 2000 the only possibility to study prosthetics and orthotics was to a level of intermediate vocational education in a regular way. The basic training of orthopaedic technicians started in 1960 (Hughes ,1976). In a broad variety of study routes students were trained into this work field. In the early days at the Koning Willem 1 college, Den Bosch and later on, from 1998 at the Stichting Vakopleidingen Gezondheidstechnische Beroepen. In Nieuwegein.

3.4.3 HAVO and WO, Higher general secondary education, resp. Pre University education

The school for higher general education takes five years of study and is indented for preparation to higher vocational education.

Pre University education takes six years and is mainly intend for preparation to scientific university education. Pre-university education also known as Grammar school consists out of two school variant; Athenaeum and Gymnasium. At the Gymnasium all pupils are teached in Greek and Latin language, At the Athenaeum it or Greek or Latin.

Just as in case to Pre-intermediate vocational education and Lower general secondary education there is also a educational reform process going on at this moment at the higher general education and Pre University education. The renewal is based in the disappearance of free choice in subjects to examination. In stead there is now a choice out of four study-profiles:

- Nature and Technology;
- Nature and Healthcare;
- Economics and Society;
- Culture and Society.

Each profile has a common part, which is equal to all study-profiles. There is also a part that is specific for each study-profile. At last there is also a free study part. In this free part student will be able to join certain subjects from other profiles, which will enlarge the possibilities for students to enter University education.

Also a part of the educational reformation in this part is the introduction of what is called “study-house” This is obviously not a new building but a concept in guidance or counselling the students, which is aimed at self-activation and an independent way of studying.

As mentioned earlier to succeed the five years of study at higher general education a study load of in total 8000 hours must have been set aside, (the first phase: three years times 1600 hours plus, the second phase: 2 years times 1600 hours).

In case of pre-university education a study load of 9600 hours must have been set aside.

3.4.4 Higher vocational education, University of professional education and University education

Contrary to the Anglo-Saxon countries where there is only one type of University offering a Bachelor, Master and PhD courses, in the Netherlands two kinds of University exists.

The first type of University is one, which offers four-year course (6720 hours of study load, 1680 hours each year) of higher vocational education. It is best described as a University of professional education and it offers Bachelor level courses leading to a BSc. or ing. title. Next to this there are a number of Universities of professional education who are offering also a Masters degree up and till now mostly in cooperation with an English University, but in the near future also independent of foreign University.

The second type is the academic University. This University offers a Master course leading to a MSc or ir. title. This is a five-year course with a study load of 8100 hours. Also research to obtain a doctoral degree PhD or Dr. at this type of University is possible.

The level of Masters degree is described as an academic master, while a MSc degree obtained at a University of professional education is described as a practical master.

Of course, the future will tell if this distinction is appropriate especially in relation to the new Bachelor / Master structure.

Higher vocational education knows a variety of specialisations. There are possibilities for instance in a number of directions possible.

Technological course: engineering, informatics (known as HTS technical college),

Healthcare: nursing, physiotherapy,

Economics: school/institute for business administration and economics

Social: psychology.

3.4.4.1 University of professional education

In order to get access to a school of higher vocational education, a university of professional education, a least intermediate vocational education or higher secondary education or, pre-university education, both also known as grammar school is required. Important in acceptance a student in new course is the study-profile choice, which has been made. To join a technical study at the university the study-profile also must have been technical, otherwise the differences are too large in order to guarantee a successful study in the coming years. The same applies for studies in healthcare etc. However there are always exceptions to this kind of rules. The prosthetics and orthotic BSc. course is therefore an example. Both a technologic as well as a healthcare profile is allowed for this study.

As mentioned a university of professional education course has a duration of four study year. Year one is a general introduction to the chosen study. Year two is going into dept in a theoretical way and offers in a number of cases the opportunity to visit the work field during practical and or clinical hours. The third year is again going more into dept and a full-scale clinical period is implemented. The forth year is the completion of the course. A large period of internship including a project in completion of one's study and final exams are part of it.

This type of education nowadays is next to formal lectures and classes, based on the principle of problem-based learning. Chapter 7 will discuss this type of education, based on the initial objective, how to design education.

3.4.4.2 University education.

University education leading to a Master degree is a five-year course. The Master course distinguishes from the Bachelor course by dealing with more abstract theory. Utilization of applications is somewhat lesser as in professional education.

In this kind of study also a large amount of practical and if appropriate clinical internship is implemented.

3.5 Changes in secondary and higher vocational and university education.

In the preceding paragraphs the school system is described. Also is a few times referred to an educational reform process. Within the scope of designing education it is necessary to have some understanding of why things are changing in order to be able to adjust or fine-tune the new designed course.

3.5.1 Professional column.

A major change in the coming years concerning the vocational education in each professional level is that all education trajectories must be geared to another, in order to get a better functioning professional column. A demand for higher practically-orientated educated people is increasing as published in “Van Binnen naar Buiten, (Boekhoud, 2001) and (Den Dool, 2000). The growing need for information and communication technologists (ict) is an important cause. Due to this reason a lack of people with a secondary or higher vocational training in other work fields has developed. Research shows that the number of students changing from secondary general education and pre- university education to higher vocational education are stabilising, therefore no growing numbers from this trajectory.

Growth can be established by a better move on from Pre-intermediate vocational education to intermediate vocational education and from there to secondary vocational education. Growth must therefore be established from within the professional column.

However too many students drop out by non-connecting programmes, different “worlds”, other subjects, atmosphere, different didactic approaches etc.

Therefore, transparency and made to measure education must be improved. It is of importance that this is noticed, because although the profession and therefore the education for prosthetics and orthotics in pre-intermediate and intermediate vocational are small, the same kinds of problems are identified. Especially the fact that both study routes are operating in a way of modern apprenticeship modern in contrast with higher vocational education, which is four year full-time education.

3.5.2 European interests.

Besides national, also international interests are important. The European council of Ministers has in 2000 the ambition declared to make out of Europe one of the most dynamic and competitive region of the world. A well-educated population is therefore very important. Another agreement is made to decrease the number of dropouts in 2010 till 50%.

3.5.3 What can be done to improve?

The ministry of education (OC en W) and the field of professional education have made a number of initiatives in order to improve the results of the professional column. Documents as "Doorstroomagenda-Beroepsonderwijs,(Boekhoud, 2001) (in Eng. Agenda vocational education) and Naar een stevig fudament van de kennissamenleving (in Eng. Towards a firm fundament of the knowledge society) and Middellange termijn verkenning Beroepsonderwijs (in Eng. medium term exploration of vocational education) have been produced both published by SIBS, (2001), steering committee impulse vocational education and training. The most important recommendations are:

To improve the move of students within the professional column more cooperation is necessary between the organisations involved in education. For instance: a cooperative use of locations and / or machinery between pre-vocational, vocational and perhaps higher vocational education.

Attractive and up to date study facilities; Variation between conventional lectures and problem based learning. Helpful will be up to date computer facilities and expert teachers

Students must have a central position. This means that institutions must taken into account individual needs, for instance a theoretical surrounding for the one and a combination of learning and working for an other.

Making accessible of moving up from pre-vocational to intermediate vocational and even higher vocational education, by connecting curricula. Students will be more motivated to keep on studying.

More and more people will keep on studying during their career, life-long learning. Within the vocational educations combination of learning and working is rather common.

Last, but not least; the ministry of Education does have a task in making the profession of teachers and lecturer more attractive. Better career possibilities and training facilities for teachers must help attract new staff members.

Concluding: the ultimate goal for the next coming years is to realising a complete professional column, starting from lower vocational education up and till higher vocational education / university education, whit the possibility for students from higher general secondary or pre-university education to attend courses within a certain professional column. The largest advantage introducing the professional column is a more transparent educational system for the student and the profession.

Changes in secondary and higher vocational and university education are next to the introduction of the Bachelor /Master structure together with a new form of accreditation quite a lot targets to get focussed on.



Figure 4.1-1, geographic data of the two universities

4 Designing the Prosthetic and Orthotics BSc. level course (HBOT) in the Netherlands.

4.1 The design process, introduction to the Brief.

Considering history, the above-mentioned facts, methods preconditions and developments, it was quite an opportunity and a challenge to design a Prosthetic and Orthotic course on the level of higher professional education.

This chapter is explaining the design, work method and the results that have been accomplished in the last few years.

As mentioned earlier, an initiative that has led to a part-time variant, called "orthotic / prosthetic expert course", (Kemenade, 1992) had the original purpose to grow out to a full-time four year study. Due to the limited number of students how should attend this course, it was not possible to exploit this in a financial health way. At that moment also possibilities to join this course to other course like Physiotherapy of Engineering was no option for reasons like respectively "numerous fixes" (a maximum number of students) and to much difference from the original curriculum.

Although earlier efforts no results produced, to establish a four year full time course, in 1998 another attempt was carried out.

In 1998 the Knowledge Centre Medical Engineering of the Fontys University was invited to research the possibility in developing a for year full time BSc.-level course in cooperation with a foreign institute, The Katholieke Hogeschool Kempen (KHKempen) in Geel Belgium. It should be noted that the KHKemen already offered a prosthetic and orthotic at the level of Higher Vocational Education since 1994 . This research study has been made possible by TRIS. Trans Regionale Institutionele Samenwerking (Trans Regional Institutional Cooperation, in border regions). The Fontys University in Eindhoven (the Netherlands) and the Katholieke Hogeschool Kempen in Geel are at a geographical distance of each other of 45 kilometres (Figure 4.1-1). (Belgium TRIS offered the financial possibility to investigate the possibilities in cooperation, between the two Universities.

The design brief therefore became very clear and concrete. Investigate the possibilities in cooperation and if there are possibilities developed a croho document and design the course as a whole.

In this formulation three phases can be determined. An investigation phase or a feasibility study, a concept design described in a croho document (central register for university studies leading to a BSc. Title), and after a formal approval, a final course design.

March 8th 1999 a general meeting of SOTO Orthobanda in Bunnik has taken place. This general meeting formed by members out of the profession had approved unanimously to support the development of a collective HBO course in prosthetics and orthotics for the Dutch-speaking countries, this means, Belgium and the Netherlands.(minutes Orthobanda meeting 03-08-1999) In the development of education this is a major step, because the support of the profession is in cases like this an absolute necessity.

At first in the beginning of the feasibility study and later on during the whole design process a round table conference was organised every two months. This roundtable conference was formed by members of the profession such as Orthobanda (Nederlandse Vereniging van Orthopaedisten en Bandagisten), BBOB (Belgische Beroepsvereniging van Orthopedisten en Bandagisten), and ISPO (International Society of Prosthetics and Orthotics, dept. Netherlands and Belgium), ministry of health, assurance companies, the KHKempen and of course the Fontys University. This two monthly roundtable conference has been very helpful during the whole process, on the one hand because it was a very effective communication channel thru to all the section, so people knew what was going on, on the other hand it was very helpful in putting the minds together finding all kind of solutions for problems which were faced on a regular bases, as in every design process will happen.

4.2 Feasibility study to a prosthetics and Orthotics course at BSc. level

Why a need for a Higher Vocational Education in prosthetics and Orthotics?

Although it seems a bit strange to answer a question like this, but this question had to be answered in order to get at the very end an official approval by the government at all.

In order to find this answer, research had to be done towards questions like:

- needs for society for this type of graduates;
- numbers of graduates are needed for the profession both in short term as well as in the long term;
- appropriate expending government funds;
- content frame of reference of the course;
- institution profile.

These questions are answered in the croho document “Hogere Beroepsopleiding Orthopedische Technologie, a necessary application document for new courses needed for the ministry of Education.

This document is the result of the round table conference with its participants and consultation of the ministry of public Health (Volksgezondheid Welzijn en Sport in eng. Public health, Social welfare and Sport), in particular with the management CZS (chronisch zieken en gehandicapten raad, in eng. Council for chronic diseases and disabled), department of profession and education, and with the ministry of Education (OC&W Onderwijs, cultuur en Wetenschap, in eng. Education, Culture and Science).

4.2.1 Needs for society for this type of graduates.

Changes in society as changes in law and regulations, enlarging responsibilities of University level educated employees, a changing environment round the orthopaedic technician, nowadays most often a University level working conditions, continuous changing and complexity of technology, point out the need for University level trained employees in prosthetics and orthotics. Graduates will find their activities in the area of prosthetics, orthotics, bandages and rehabilitation aids, with the patient or client as central figure, using techniques and technology, in keeping or

returning the mobility of people. Next to preservation or recovery of mobility much more attention to prevention of mobility lost is spent nowadays as in the past.

Graduates will find their activities in orthopaedic workshops, rehabilitation centres, healthcare institutes and research centres. It must be noted that a lot of the activities are a result of authority prescriptions

Activities in society of graduates are on the one hand a result of changing law and regulations, return to work and reintegration of disabled and developments in healthcare as product liability, on the other hand a result of changing organisations, mature and emancipated patients, complex technology and international developments. Last mentioned must be placed into relationship of technological developments and professional practice as in relationship to law and regulations. As an example the ADA, the American with Disabilities Act of 1990 (public law 101-336), which mandates access to employment, transportation and communication systems to persons with disabilities via reasonable and appropriate accommodation in public and private sectors and the rehabilitation Act amendments of 1996 (public law 99-506), sections 503 and 504, which mandate reasonable accommodation in federal funded work sites and educational settings, can be mentioned.

Disabled demand full entrance towards society and therefore also a returning to the labour market and maintaining labour. Technological aids are necessary to reduce or remove immobility.

The reintegration law strengthens the above described, by demanding the return of handicapped employees. By means of technological aids such as prosthesis and orthoses, mobility aids, modern communication devices or adjusting the working environment this can be achieved.

International developments show arrears in this respect in the Netherlands. In the USA the ADA is active, which demands a full accessible society for everybody with a main purpose to participating the labour market, personal solutions and mobility solutions for handicapped. In the Netherlands these kinds of developments are now announced by changes of insights and economic as well as changes of image of society.

The current profession not only is affected by changing law and regulation of the national government, but also by regulations of international as ISPO. Four levels of practice the profession are defined by ISPO, (at this moment in draft). A consequence of this is the directives for recognition of Orthobanda. At this moment (during the feasibility study) the Netherlands do not meet the highest level (1) defined by ISPO, caused by a lack of University education. The Netherlands does have level 2 and 3 trained employees. The educational programmes are determined in "Uitleg, (1996)" (in Eng. Explanation). Not offering education on all levels, and therefore not meeting national and international standards will effect the profession and the provisions made in the long term.

As a result of law and regulations, also a change is visible within the companies and institutions itself, more specific in scale and organisation form. For a few years a large amount of small (in number of personal, 1 to 10) orthopaedic workshops exists. Due to scale-up, not specific caused by fusion of companies, but also by efficient handling of knowledge and means, a lot of larger companies did exist. That this does not only appeal the craftsmanship of the professional but also requires knowledge in modern technologies, management and communicative skills may be non surprisingly. To meet the competencies in this sentence in-depth knowledge and a broader domain of work field must be offered, not only from a national but also from an international point of view. The professional not only need to have knowledge of his own profession, but also of the professions of others. The multidisciplinary and interdisciplinary professional functions as an intermediary between the various disciplines.

Concluding: a need for a University level education in prosthetics and orthotics from a society point of view is therefore founded.

4.2.2 Numbers of graduates needed for the profession both in short term as well as in the long term.

The quantity of higher educated orthopaedic professionals in the Netherlands is estimated at 18 to 20 graduates per year. This is based on the figures by the branch organisation Orthobanda. Assumed are 0.8 graduates per 1 million inhabitants. For the Netherlands with approximately 16 million inhabitants this means 13 graduates.

If also adjoining and aging is taken into account, a number of 20 to 25 graduates per year are then appropriate. Considering that a number of students will drop out for various reasons, a number of 30 students each year is well considered., In Belgium, to be more precise, the Dutch speaking part: Flanders with 6 million inhabitants, each year 13 to 15 students graduate.

At this moment, the number of students is now known. This is now an advantage in designing the curriculum but a disadvantage also. If a curriculum now is designed just for 30 students, a large problem will arise. A perfect fitted curriculum will be offered for this number of students; after all it is a small group. But it will be a very cost inefficient curriculum, from a point of view of governmental founding, because it is a small group of students, and therefore no authorisation will be given and thus no croho approval will be awarded.

Concluding: a “stand alone” curriculum in prosthetics and orthotics at University level for the Netherlands will not be possible, only for cost efficient reasons. Therefore cooperation with other institutes will and must be investigated. In this case the most obvious conclusion is to investigate cooperation with the KHKempen.

4.2.3 Appropriate expending government founds.

The prosthetic and orthotic course at the Fontys University of Professional Education will be the one and only course at university level in The Netherlands. Besides the Fontys University no other institute will offer a similar program. This is important because of the fact that there is than no danger of thinning.

A prosthetic and orthotic program will strengthen the medical engineering training cluster, which the Fontys University already available to students and business. A use of existing parts of engineering medical engineering and podiatric t program and infra structure, will be made.

Due to the cooperation with the KHKempen a large part of the existing curriculum over there will be used. Tuning the educational programmes of both universities is necessary, partly due to cultural and society differences, partly due to the length of University education in years. In the Netherlands University education at the level of higher vocational education must take four years. In Belgium it must take three

years. In the four-year program sufficient attention to clinical experience must be build in. The prosthetic and orthotic program will be place in Eindhoven. Both in the Netherlands at the Fontys University as in Belgium at the KHKempen parts of the curriculum will be offered.

For the realisation, a cooperation treaty between the two Universities must be formulated. This cooperation treaty describes amongst a number of other items, when and how students are attending the curricula and in what way. Using existing curricula a large amount of efficiency, of manpower, financial means and knowledge will be accomplished.

Concluding: to satisfy the need for higher educated prosthetic and orthotic professionals (orthopaedic technology) more disabled people will have the opportunity to participate the production process and offer a significant contribution to the society. In the long end, less people will appeal the industrial disability assurance, and therefore this initiative will be in line with the government policy concerning reintegration.

4.2.4 Content frame of reference of the course.

In the paragraph “Needs for society for this type of graduates” developments in society in which graduates have to perform are pointed out. To offer this whole range of possibilities of requirements and skills the university, must from the beginning, take into account in designing the curriculum, the necessary competences which are asked for in practising their profession and were society asks for. From out of the competences, product like a professional profile and subject benchmark statements and a complete curriculum will be derivated.

To be more precise, the major competence for the “Hogere Beroepsopleiding Orthopedische Technolgie”, (prosthetics and orthotics program), concludes the following; be able to interpret and apply knowledge, professional skills, and experiences changes and innovations necessary to offer services in order to provide handicapped people of the necessary aids so the handicapped will able to function as optimal as possible. Of great importance is the on gowing development of technology, applications, working in a social and communicative demanding surrounding in which the graduate has to perform. The student must be familiarised to the process of dynamic context related and changing technological and society

developments. Therefore the student has to develop a attitude of “long life learning”. A basic assumption will be however the existing curriculum recently developed at the KHKempen, adjusted to the national and international demands and didactic concepts.

Concluding: Realisation of a forth year, the curriculum will meet the requirements of Dutch law of higher and scientific education (WHW) concerning the duration of HBO education and fulfil 168 credit points (from 2004 this must be 240 ECTS credit points). Students who will attend this curriculum must have one of the following preliminary training: School for higher secondary education, school for pre-university education (grammar school) or school for vocational secondary education or intermediate technical school.

4.2.5 Educational institution profile.

A major point in the design process is the fit in a number of already existing courses. Although it may seem easier to develop a “stand alone” course” the opposite is true. If a new course can use curriculum parts of existing courses, or necessary know-how is available to the University, it will be easier to obtain permission to and implement the new course in the University program. In the design of the Bachelor course in prosthetics and Orthotics, the existing of Medical Engineering, Podiatry, Physiotherapy, Mechanical Engineering, must be taken in to consideration. Implementation of appropriate specific parts of each course will intensify the Medial cluster of curricula in the Fontys University. A curriculum whit’s finds its fundament both in Eindhoven and Geel (KHKempen) in combination with the Technical University (biomedical engineering) and TNO (human performance)a large research institute, both within a circle of one kilometer of the Fontys University forms a perfect platform.

Concluding: The feasibility study have led to the croho document which has been submitted by the Minster of Education in February 2000. A continuation of the cooperation with the KHKempen in order to further course design, is of course obvious. The formal declaration by the Minister was received in May 2000, to start the Bachelor course in Prosthetics and Orthotics in August 2001. The course was

therefore official acknowledged (in the technical cluster, therefore graduates are allowed to carry the title ing. Ingenieur), financial support for the University guaranteed (directly related to the number of registered students) and students who would attend the course in the future were able to receive a scholarship or grant.

4.3 The preconditions

A number of preconditions have been mentioned already in the preceding paragraphs. Summarised these are the following: finance, macro suitability, expediency, efficiency, student numbers.

Two other preconditions not mentioned before which are of great importance in succeeding the realisation of the curriculum are the following:

- two countries, two school systems.
- organizational conditions

Starting with the first. As mentioned, the curriculum will be offered in two different places, both in the Netherlands as well as in Belgium. A major difference between both Universities is the way of teaching. In Belgium, more specific at the KHKempen, a rather conservative way of teaching is used in transferring knowledge from lecturers towards the students. This means in daily practice a lot of formal lectures and classes, laboratory skills etc. In the Netherlands there is a tendency towards the concept of problem based learning. The use of formal lecturers is minimized in order to give space for problem based learning activities, and the compounding of a personal learning and training activities. Also the duration of both curricula are different from each other. A Belgium curriculum of higher vocational education has a duration of three years, in the Netherlands this is four years. In the design process these preconditions had to be considered. It turned out that the minimum age to admittance Belgium University education is 18 years and a minimum level of pre-university education. In the Netherlands there are only requirements in levels of preliminary education. Preliminary education can be: intermediate technical school (preferably within the professional column), school of higher general secondary education and pre-university education (both in the required profile, Nature and Technology or Nature and Healthcare). To meet this

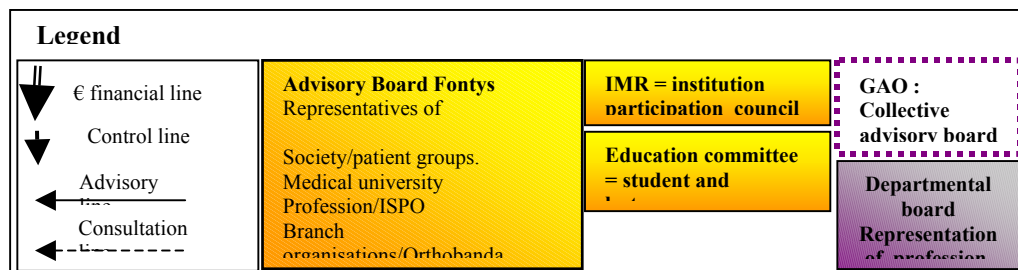
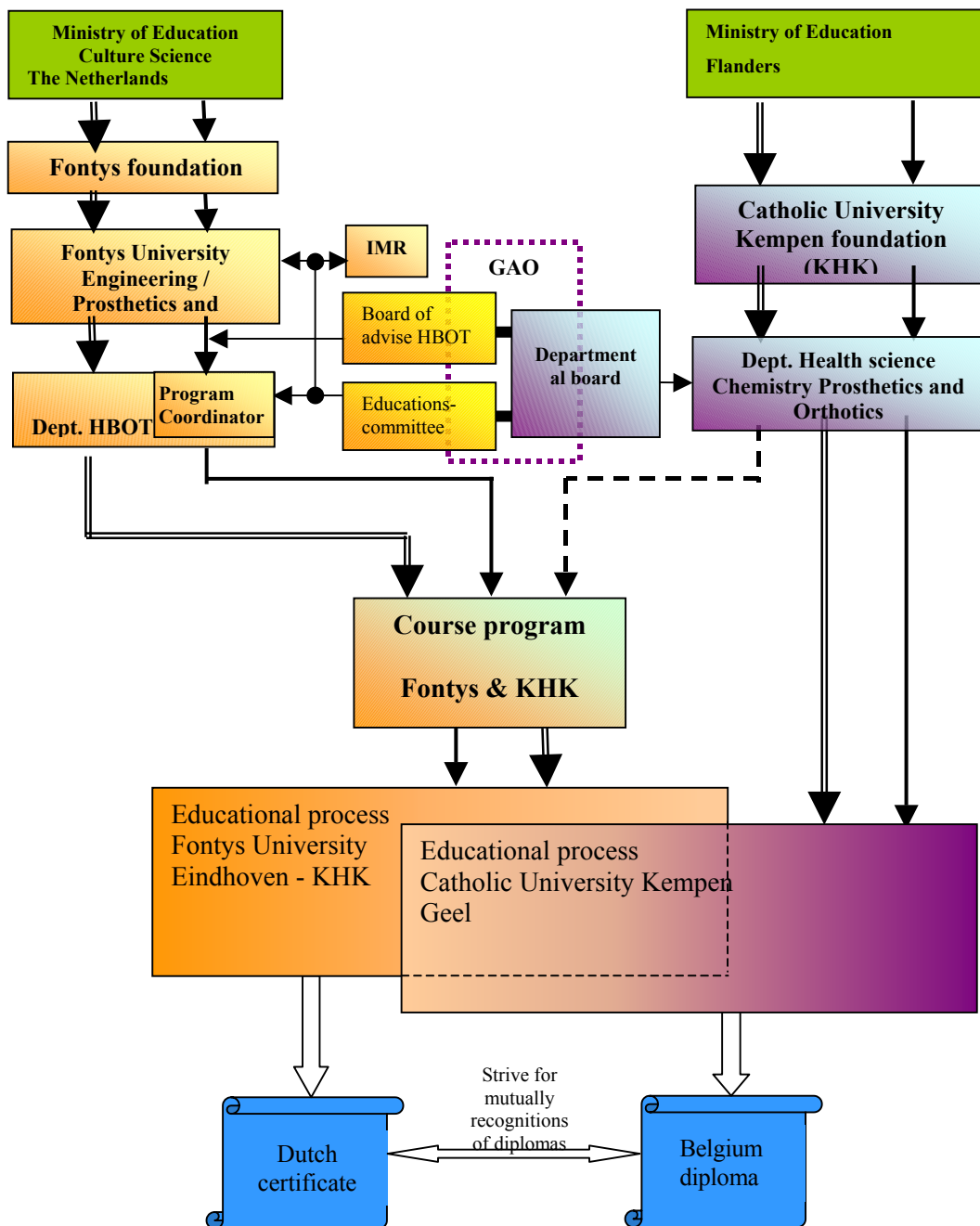


Figure 4.3-1, The model of the organization

requirements students have reached the age of minimal 17 years, must students are older.

A second precondition is a grasp of all the things that are necessary to be able to offer a curriculum, such as the advisory board, board of examiners, examinations regulatory, student facilities such as student organs, tutoring, etc. Together with issues of diplomas or certificates of both universities and how justify this are two major issues that must be solved before cooperation is possible.

The solution towards all these problems was the design of a cooperation model in which both universities will be able to account for their own responsible parts and also will be able to cooperate together in the establishment of the common parts of the curriculum. This cooperation model or organizational model is showed in Figure 4.3-1. This model shows clearly the connection of the two Universities with their departments of education. Also the connection of both individual Universities with all the organs round the curriculum is showed as well as the connecting parts, e.g. the GAO (Gemeenschappelijk Advies Orgaan, in eng. common advisory council). Clearly showed is the result after graduation, the Dutch certificate and the Belgium Diploma. The certificate is reserved for Dutch students and the Belgium diploma for Belgium students, both according to the national law. In the coming years however effort will be put in to harmonisation of both diploma's, i.e. one common diploma.

Concluding: A major issue has been solved introducing the organizational model as mentioned. This model shows precisely who is responsible for what part of the organisation. Also a solution for the difference in curriculum duration has been found. The differences in preliminary training and age differences have been made visible. Paragraph "Design principle" will go into the detail of the educational model, (also showed in figure 1-2).

4.4 Design principle, designing out of a form .perspective

A central issue in designing the prosthetics and orthotics BSc. Curriculum though it is never made explicit is the choice of perspective from where out the design process will take place. At first sight is

Higher educated employees developing, in practice in a methodological way a lot of new knowledge. Acknowledged is the fact that outside universities and research centers a lot of knowledge production take place. In this connection the common production of knowledge inside universities and laboratories is indicated as a “mode I”- knowledge practice (Gibbons, 1994). In the “mode II”-practice it is context related knowledge production characterized among other things by trans disciplinarily, heterogeneity, and context- and application alignment. It is this growth of knowledge which can be interpreted as a major driving force behind the design of new curricula, a lot of latent knowledge is already there. It only needs to be processed to make it available. In the curriculum design of the P&O course, this is exactly what was the case. A lot of knowledge was and is available, also new developed knowledge, that now had to be converted into the format of a four year curriculum.

Because of the fact that a lot of knowledge, skills, facilities and regulations are known and available, the only problem was how to implement all this, in order to make a feasible, high quality curriculum that can be studied by students in two different Universities. It are these reasons why the design process took place from out a form-perspective point of view. Lecturers, counselors, had to meet specific requirements. Their reputation must be in order and having “a right of speech”, must be a role model, love of the profession, etc.

At the Fontys University a process about quality, quality assurance and studyability (to make it possible for students to graduate in 4 years time, without delay) has been going on, aimed at the Educational paradigm “Higher Educating”. A number of examples are given below:

- Interdisciplinary and multidisciplinary learning is becoming instead of knowledge transfer in a conventional way.
- Education is becoming more and more aimed at independent and self activation activities of the students, with competence as basic assumptions. From out these competences, objectives and final attainment levels can be formulated.

- The content of the curriculum is becoming more and more determined by the dynamic of professional profiles and rapidly changing professional demands.
- Learning is even more aimed at the professional practice.
- Higher educating demands modern study facilities connected to national and international communication networks.

These innovative changes together with the basic assumptions and the facilities offered by the partner university, combined with the fact that the curriculum is offered at two Universities justify this choice.

4.5 Concept and prototype

Taking all the above mentioned considerations into account there is more than enough material to design the curriculum according to the Dutch law and to accommodate the profession of prosthetics and orthotics.

4.5.1 Educational model

Out of a number of alternatives decided is to start the curriculum at the Fontys University in cooperation with the mechanical engineering⁽¹⁾ department (figure 1-2). This department was willingly to adopt this new curriculum. Although in Belgium this profession is defined as a paramedic one and in the Netherlands a technological profession, no reasons were found not to join these two curricula together.

(1)N.B. In Belgium “gegradueerde in de orthopedie” in eng. Orthopaedic graduates are paramedic. Due to some pragmatic reasons for the Netherlands is chosen for a technical profession. Partly due for reasons out of the “BIG-law”, beroepen individuele gezondheidszorg, in eng. Individual healthcare professions, which is a register in which a number of healthcare professionals do have to register before exercising their profession. Because of the fact that the orthopaedic engineer is a new profession, it was not recommended by the health care department to run at the same time this very time consuming procedures. If it is in the future necessary to have a registration as mentioned above, a request can always be done.

If students pass their first-year exam (propedeutic certificate) the second year will be executed at the KH Kempen in Belgium. The third year also, except the internship period. Internship will be performed in the Netherlands or internationally, except Belgium, because the Belgium students have their clinical internship also. The fourth year is started with the clinical internship period for at least 5 months. The last semester is then spent on closing down a number of theoretical subjects and finishing the dissertation and preparing the presentation, which must be held before an examination jury. Passing this last phase successfully will result in graduation as an orthopaedic engineer carrying the BSc. and ing. title.

4.5.2 Designation of graduates

In order to distinguish this new curriculum from the existing secondary education a new name was thought of for the prosthetics and orthotic Bachelor curriculum. In full it is called: Hogere Beroepsopleiding Orthopedische Technologie, in eng.: Higher vocational orthopaedic engineering, leading towards a Bachelor degree. Students are allowed to carry the BSc title and the ing. title. Ing. because the curriculum is adapted in a technical cluster and therefore the title of ing. ingenieur is allowed. Graduates may call themselves orthopaedic engineers.

4.5.3 Curriculum content

The content of the curriculum is of course the main issue in the process of designing education. What makes an orthopaedic engineer an orthopaedic engineer and not somebody else. This is the most distinguishing element in curriculum design.

Of course, due to the cooperation of two universities and the availability of supporting disciplines a lot of material is already available and can be used. A number of preconditions are therefore rather modifying for the course. Assumed at forehand, subjects like medicine, anatomy, pathology engineering, mathematics, materials, orthopedic technology, electronics, gait analysis laboratory skills, clinical internship etc. will or must be part of the curriculum. Based on experience of branch

members, teaching staff, and experts in the field of didactics and educational theory, the content of the course in combination with the preconditions the curriculum of the first curriculum year is newly composed. Curriculum year two, three and four already existed in its basic form; the curriculum at the KHKempen. Only parts of this curriculum had to be adjusted to fit into the curriculum of the Fontys university. Subjects which had to be adjusted are cultural social and law specific subjects. As a basic assumption one can imagine that due to the experience of professionals with their personal experience, gained in the past or still from out their present practice the content of the course is to a great extend defined. All the above mentioned subjects are therefore recorded into the curriculum, In appendix CP the four course years are resumed in credit point tables according to the ECTS system (valid from 2004).

Two questions remained:

- 1) How to determine the amount of hours spent on a certain subject.
- 2) How to deal with new insights in education, especially the matter about competences.

4.5.3.1 Curriculum content

The answers are of course not easy to give. Based again on experience, an idea of how many hours must be spend in order to master a certain skill is direct related to the number of laboratory hours. This is according to the personal experience of Belgium and Dutch professionals and related to the amount of means that is available. As will be mentioned in chapter 8, the amount of time spend to a diversity of educational subjects, skills and even clinical periods differs quite a bit when a number of educational institutes are compared to each other. therefore It looks like that no unambiguous dimension for training skills and exercising subject is available. Educational-, and cultural backgrounds looks to be valid arguments for these difference.

For this curriculum in particular it means (partly) fitting into the first year engineering curriculum, combined with fitting into the Belgium curriculum. In this way a efficient use of available means is achieved.

4.5.3.2 Competences

What makes an Orthopaedic engineer an orthopaedic engineer. In other words what kind of (distinguish) competences must have an orthopaedic engineer.

An idea of what in general competences means is explained in paragraph 5.3.4.2 Competences in general, and, paragraph 5.3.6.1.2. Quality requirements of a BSc. level course, Besides these competences and qualifications specific competence must be defined and implemented in the orthopaedic engineering curriculum. This process started two years ago and is still in progress, in fact it is a never stopping process due to new insights and knowledge.

First of all a definition:

A competence is a, due to the collective learning process obtained ability which is available for the group to realise a specific common objective, (Weggeman 1997)

Within the developments in designing of the orthopaedic engineering curriculum the group mentioned above can be seen as a compilation of orthopaedic workshops, institutions, rehabilitation centres and industry who have a need for orthopaedic engineering staff educated at university level. The common objectives that needs to be realised will be reviewed so that this professional group can formulate a realistic strategy to cope with the future. Underneath, an explanation is given how to come from out of these company objectives via general esteemed competences of the orthopaedic engineers, which will be further explored towards final attainment levels and learning objectives. By means of an example will be indicated how to go thru this process.

One of the main objectives of a business, namely; generation of profit and continuity is initially taken as a basic assumption. Generation of profit, continuity and a cost-effective process is a major rule in surviving the business, even if this business a part of the healthcare sector. From out of these business objectives, in designing lectures, lessons, laboratory sessions , these items will be further explored.

An example will follow, in analysing a number of learning objectives which has to be set up to be able to educate a orthopaedic engineer whom has the knowledge to

realise the mentioned business objectives. Of importance esteemed, in order to realise continuity of the orthopaedic workshop, is to be able to be working on product development, to introduce new products.

This new product needs an innovative design trajectory. Therefore students need to know how to innovate. This is seen as an essential competence.

Out of this competence one can ask, which field of knowledge is a necessity for a student to master an innovation process. Examples of field of knowledge are:

Medicine, knowledge of materials, biomechanics, life science etc.

Out of these field of knowledge, final attainment levels or, subject benchmark statements can be defined. Biomechanics is taken as example. To come to a biomechanical design process, a student needs to be familiarized to statics, stress and strain, designing, anatomy and physiology,.. From these final attainment levels lesson with learning objectives can be arranged.

The above-mentioned indicates, how in the research of designing education problems and questions will be handled. This is a continue process and open for new insights and ideas.

4.5.3.3 Perception of determining competences for HBOT.

According to Weggeman, A competence is a, due to the collective learning process obtained ability which is available for the group to realise a specific common objective. Skills and knowledge, with a causal relation to a successful realisation of desired company objectives help to determine the competences which are asked for.

Competences are a cluster of

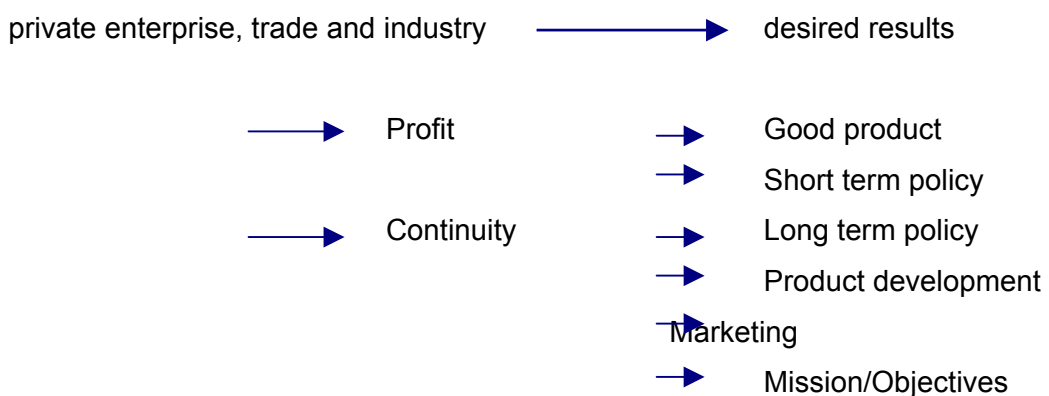
- “broad” skills,
- attitude, and
- knowledge “behind the skills”.

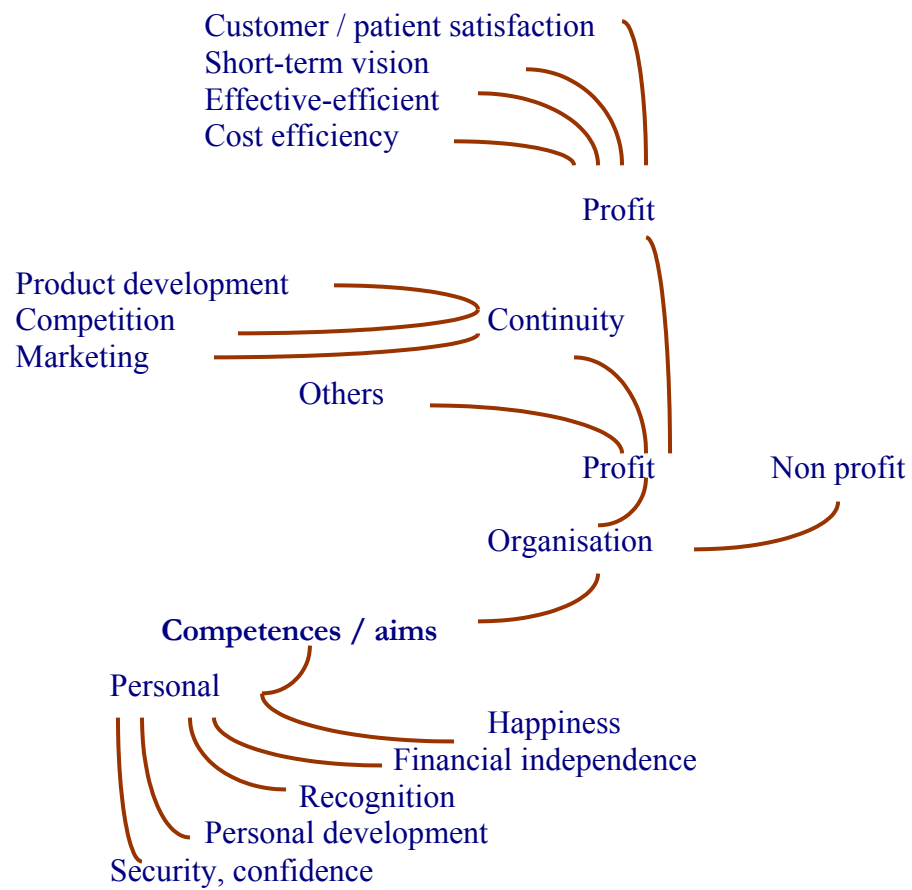
Examples of competences

Entrepreneurship	International
Strategic thinking	Ability to abstraction
Making plans	Vision of future
Knows the organisation	Responsibility
Leadership	Process monitoring
Communicative skills	Learn to learn
Corporate values	Research, data...
Innovative thinking	Publish
Interdisciplinary work	(self)reflecting, assessment, evaluation

Competences can be successfully introduced if the university is able to create an attractive learning and study climate.

As a graduate of the higher vocational education of prosthetics and orthotics, an orthopaedic technological ingenieur is a person with perception of transformation of the material world in the field of rehabilitation and rehabilitation engineering. To meet these goals a general vision of competences of private enterprises, trade and industry must be developed.





Figure, 4.5.3.3-1 Competences and aims

At this time the question can be asked, How can an university educated staff member meet all this? Therefore the University of professional education HBO competences had to be characterized:

- Knowledge of the existing organisation. (What and how to organise?)
- Knowledge of technological capability. (What can be realised?)
- Agreement of a goal. (Is there consensus?)
- Knowledge of state of the art/development / innovations. (How to get the most out of it?)
- Vision for the future (Where to go?)
- Knowledge of project realisation (How to get there?)

Figure 4.5.3.3-1 shows a number of parts and divisions of general elements which forms the competences. Summarised, the general necessary competences to start as a graduate within the occupation are:

1. Is able to function in a dynamic, multidisciplinary and international environment, A variety of activities (more in broadness).
2. Is able to generate innovative ideas and is able to take initiatives, combinative and think of complex procedures..
3. Is able to maintain the skills up to date, expand and transfer.
4. Is able to weigh by virtue of the profession and ethic dilemma's, based on social accepted standards and can make a decision.
5. Is able to communicate effectively in a diversity of manors at every level.
6. Is able to work independently as well as cooperate in a multidisciplinary team in a structured way to achieve the necessary results, and if appropriate based on specific methods.
7. Is able to function effectively in a variety of conditions.
8. Is able to perform management tasks., development and execute company / institution policy
9. Is able to reflect their own behaviour and attitude, give and receive feedback.
10. Is able to contribute in an active way to the developing of the profession.

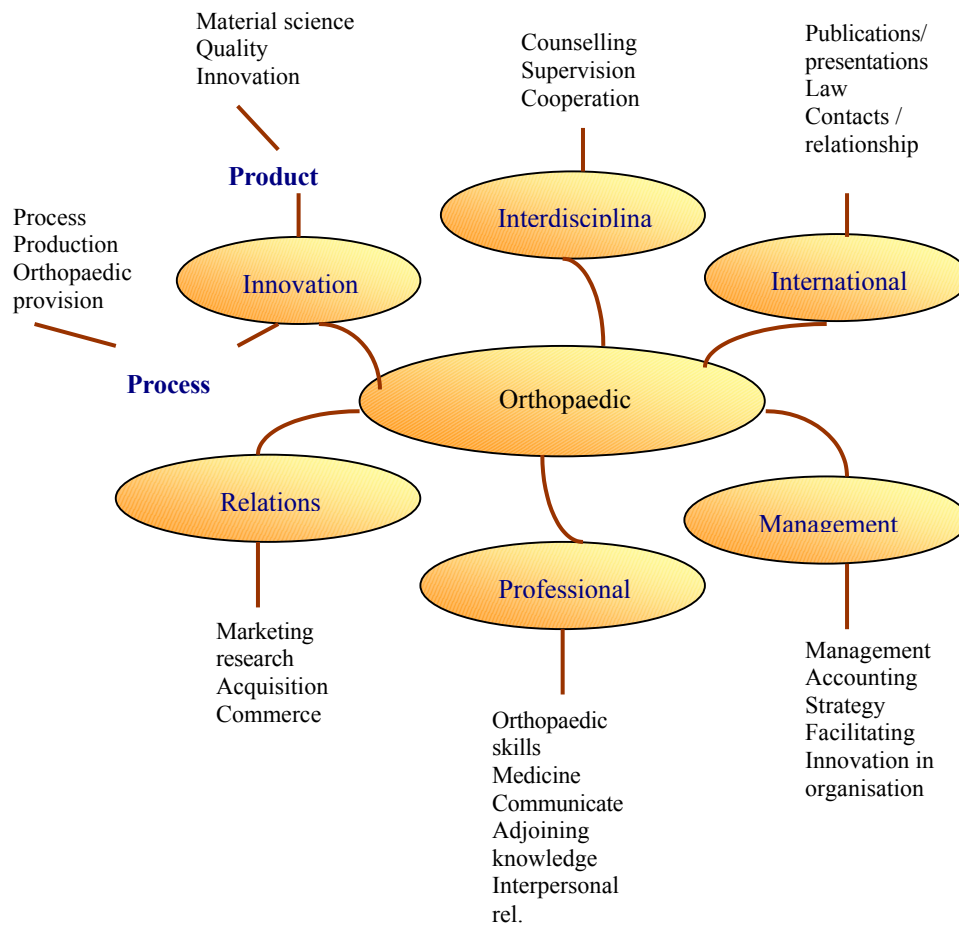


Figure 4.5.3.4-1 Separate requirements

Defining general competences is not enough to describe the entire profession. Therefore also a number of specific competences has to be defined, the so-called professional competences. These professional competences are just like the general competences subject to change and fine tuning.

4.5.3.4 Professional competences, what is specific for P&O.

Professional competences distinguish the profession of an Orthopaedic engineer with other professions and must be therefore rather specific in what is required for the profession. In Figure 4.5.3.4-1 is showed how separate requirements are linked in a way for competences. Prosthetists and Orthotists in combination with rehabilitation and mobility expertise, forms the profession of orthopaedic technological engineering, or rehabilitation engineering. A central issue in this profession is acquiring, collecting, and recording of data and measurements, fitting, producing of supporting- or replacement parts (exo) for the human body.

Graduates of the professional education in prosthetics and orthotics will meet the competences stated below in order to perform the occurring duties as a starting professional.

1. Acting as a professional in the field of healthcare and technology with the client / patient as centre, in a high developed ethical consciousness based on respect and equality, combined with an ability for empathy and care and able to see the orthopaedic profession from the users point of view.
2. Analysing questions and problems in rehabilitation, centred around the muscular / skeletal system and define these in an intermediary role between, medicine, technology and society, with the intention to implement and produce these provisions on an orthopaedic technical basis, in order to preserve or improve quality of life and mobility.
3. Advising of clients/ patients and employers with regard to liability, and responsibility of products and working conditions and able to co-operate and communicate in order to document and quality assure the whole process. Is, from out of the design process, able to make considerations regarding,

4. management, market, environment, quality manufacturing and maintaining in relationship to the total lifecycle of the product.
 - a. Insight knowledge of anatomy, physiology and pathology, structure function and dysfunction of the human body.
 - b. Insight and knowledge of possibilities to prevention and reintegration.
 - c. Insight into structure and tasks of health service, law, regulations and standards.
5. Measuring and producing of orthopaedic provisions (prostheses, orthoses and bandages, rehabilitation and walking aids),
 - a. Insight into biomechanics, mechanics, material science, measurement systems in combination with anatomy, physiology and pathology, structure function and dysfunction of the human body.
 - b. Insight, knowledge and skills to manufacture orthopaedic provisions.
 - c. Insight into all technical equipment which is being used in an orthopaedic workshop.
6. Analyse, convert and formulate specifications (wishes) of the patient / client into functional medical and technological specifications for the benefit of the design and development of orthopaedic provisions (prostheses, orthoses, bandages rehabilitation and walking aids). Innovation plays a large role, not only in treatment and product development but also in knowledge transfer, therefore knowledge about other relevant professions both in healthcare and social sectors as well a technical is necessary.
7. Managing of a private enterprise, trade or company, institute or organisation which is acting in the orthopaedic work field, document quality assure and evaluate the technical process and provisions.
 - a. Guide employees in a design process to production and manufacturing of orthopaedic provisions.
 - b. Coordinating labour employers and other sectors of service, necessary for the benefit of manufacturing of orthopaedic provisions.
 - c. Taking care in performing to meet the directives, law and standards of the professional requirements, and the resulting responsibilities and certification of orthopaedic provisions.

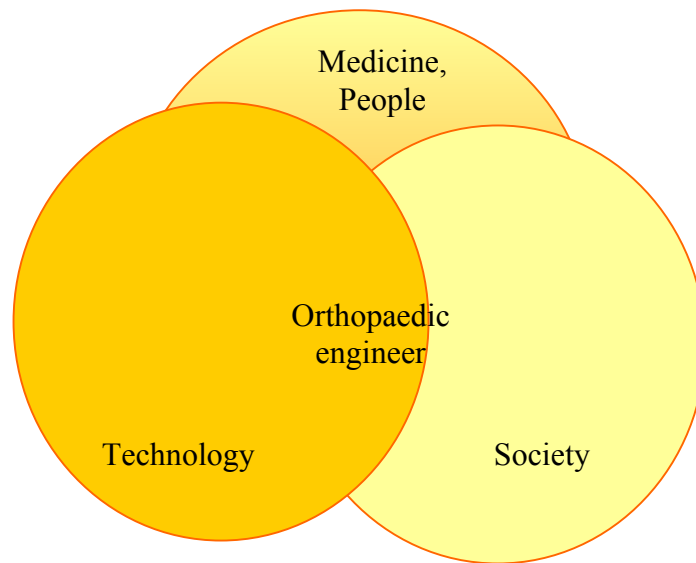


Figure 4.5.3.4-2, The three main pillars.

- d. Taking care of an adequate financial settlement or completion of the orthopaedic provisions in relation to assurance companies and clients / patients.

A graduate needs to have next to the above mentioned competences, also the skills to anticipate in changing insights of insurers, changing law, maturity of patients, higher requirements and faster delivery periods demanded by prescribers (physicians), competitors, international developments and supply management, for the benefit of an efficient management, protocolisation of product choice and standardisation of procedures are also items which becoming more and more important. In the professional practice, the graduate is acting as the speaking person in relation towards physicians, patients and orthopaedic employers who are taking care for the manufacturing of orthopaedic provisions. It is therefore that the graduate must have the knowledge and the skills to manufacture a diversity of orthopaedic provisions.

Concluding: the orthopaedic engineer is a person with an attitude, qualifications, skills and motivation, for the benefit to solve quality of life questions in relation to rehabilitation and mobility, based upon three pillars or areas.

Pillars are:	People:	Involvement, (patients, clients) Medicine, (physicians, prescribers) Multi-disciplinarity
	Technology:	Knowledge Skills, Techniques Attitude
	Society	Law Quality assurance Regulations

These main factors are also visualised in figure 4.5.3.4-2.

The above defined competences, combined with the general professional competences, are the factors which distinguish the orthopaedic engineer from other

professionals and makes the therefore in a way unique. These complete set of competences is the fundament to derivate the more specific final attainment levels and objectives, such as the subject benchmark statements made by the quality assurance agency for higher education (2001) for the United Kingdom. In the scope of this dissertation it goes to far to deal in detail with each of the separate defined objectives, since in this dissertation the design process and the evaluation of this design compared to other universities is the central issue.

4.5.4 Learning styles.

Having available a competence set, final attainment levels, and objectives, gives enough ingredients to arrange the programme which student can attend to. Learning styles is the a central issue. A number of possibilities are available to transfer knowledge and skills. Classes and lectures as well as laboratory practice is used and a lot of experience is available. Also clinical practice is a must for students to practice and get experienced. Beside these forms of teaching also a use of problem and project based learning is introduced, just to practise a lot of skills, (professional, social, technical, attitude) based on the formulated competences. Also a portfolio for students is introduced. The students must keep a portfolio of themselves to a record and survey their achieved results. Both the problem based learning method as well as the portfolio which appeal a lot of the engagement in self directed learning of the student and for as far is possible, it simulates the real world and helps the student in the process of problem solving. (Dool, 2000). This curriculum is therefore a mix of conventional learning methods and skills trainings and a more modern way in counselling and supporting a student in their way becoming a skilled professional , using problem based learning and portfolio.

This curriculum (product) came into being during the design process in cooperation with the already earlier mentioned partners. It is however due to the educational reform and in relation with the forthcoming accreditation, interesting to know how other universities have designed their curriculum and deal with questions like, how many hours should be spend on technical subjects or laboratory hours for example and are other university also working with problem based learning methods. In chapter 8 this will be discussed.

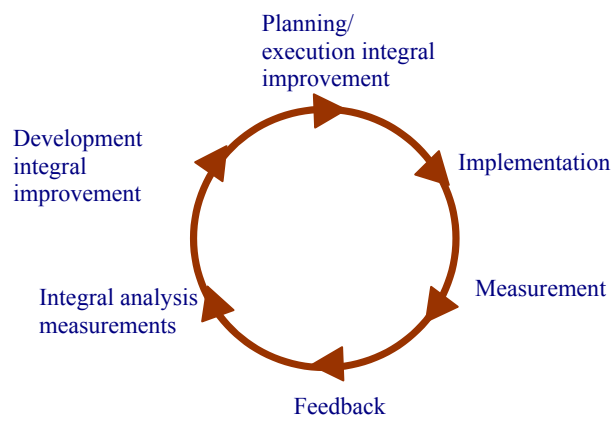


Figure . 4.6-1, PDCA circle
(source: kwaliteitszorgsysteem bachelor opleiding β version)

4.6 Accreditation

In the near future the curriculum will be assessed by a VBI, a visitation judging institute in commission of the NAO. (the Netherlands accreditation organization). Six subjects are major issues which will be assessed, (Nederlandse Accreditatie Organisatie, 2003).

These subjects are:

- Aim of the curriculum
- Programme
- Effort of personal
- Facilities
- Internal quality assurance
- Results.

The general and specific competences forms the fundament of the curriculum which is designed and developed and helps to specify in detail what factors of influence are important. In this way the competences are of major importance in assessing the aim of the curriculum and the programme by the NAO.

Looking at the mind-map figure (appendix 2.1) the matter of I :design variables, II :target groups, III :evaluation group and V : exploitation is discussed, in relation to curriculum design and competence developing.

Part IV : qualification and quantification, is a part which, if handled in a correct way, gives feedback to the curriculum design and offers valuable information about new developments in education. Part IV can be split into two parts related to quality evaluation.

One is a form of quality evaluation directed by the government. This is a compulsory evaluation process performed by the NAO.

The other evaluation process is an integral part of a continue design and adjustment process, showed in Figure 2.3.6.2-1, a model of the benchmarking process, in Figure 2.3.1-1, a flow chart of the design process and in FIGURE 2.3-1 Design of education, Figure 4.6-1,. PDCA circle.

In chapter 8, the information gained by a questionnaire will be discussed and reflected to the curriculum design of this course.

5 Data acquisition, analysing

5.1 Why data acquisition of other curricula in relation to the designed course

In the previous chapters the design process has been described, starting from the beginning up and till the curriculum content related to the defined competences which distinguished the orthopaedic engineer from other professions. Since the orthopaedic technology curriculum, in cooperation with the KH Kempen, for the Fontys University is rather new it can be very helpful to compare this curriculum with other curricula which is offered in a number of other universities. Since there is only one university in the Netherlands (and will be) offering an orthopaedic technology curriculum a comparison had to be made with universities abroad. Comparing curricula helps to improve the curriculum at the Fontys University of help to make more explicit earlier made choices.

Interesting items to compare with longer existing orthopaedic technology curricula are for instance, the curricula itself, amount of study hours, clinical hours, how is the final project work arranged etc. To gather this kind of information different methods of data-acquisition could be used. Interviews, internet, and questionnaires are appropriate methods. In this research study a choice has been made to work with questionnaires. Also information obtained from websites using the internet is used. The advantage for using questionnaires is that the person whom is answering this questionnaire can do this at a convenient time. How this questionnaire is build will be explained in the paragraph below.

5.2 Subject selection and characteristics

The first step in retrieving information is setting up inclusion and exclusion criteria. As mentioned earlier, in the Netherlands there is only one programme offered to students, therefore in order to gather the information looked for, the information must come from abroad. There are a number of prosthetics and orthotic schools trough out the world. Although not an exact number can be given, at least 23 schools which are offering a prosthetic and orthotic curriculum are known.

One of the most important inclusion criteria is that curricula must be comparable to those of the Fontys University, which means that the curricula must in a form of higher (vocational) education following on secondary education or following on an other form of higher education. After applying this criterion 15 institutions remained, including the Fontys University. Institutions offering lower vocational or secondary curricula are excluded. No other criteria are used in defining the population for this inquiry.

5.3 Questionnaire design

Decided was to use a questionnaire which would be send to the institutions which are offering a higher educational training in prosthetics and orthotics.

The aim of this study is to compare the designed curriculum with existing curricula. In order to determine which items should be covered known curricula were examined. For building the questionnaire guidelines from “enqueteren”, (Bartelds, 1989) were used (appendix 5.3). The danger in designing questionnaires is that as a result of too much questions it takes too much time of the respondent so that the chance of returning the questionnaire is decreased. Another danger in designing questionnaires is to go too far in detail. If this is the case, then comparing the answers can become rather difficult. The challenge therefore is just asking enough questions, which can be answered in a relative easy way.

The questionnaire will be introduced by an accompanying letter which is explaining the aim of this questionnaire and how the completed questionnaire could be sent back.

The questionnaire should contain questions concerning:

- general information,
- curriculum (programme)
- work field, traineeship
- progression of students

It was therefore that the questionnaire is split up into 4 main areas with questions concerning curricula etc. and a 5th area to make it possible to write down additional comments (see appendix Q the questionnaire).

5.3.1 The questionnaire and questions of interest.

The questionnaire used contained 4 main areas of interest as already mentioned above in order to get information of other university programmes and curricula. This paragraph will explain the design of this questionnaire.

First part.

This part is use to get general information about the type of programme, awards and student ages.

1 General information

- | | |
|--|--|
| 1.1 Name of the university | To identify the answers (is anonymised) |
| 1.2 Jurisdiction | Is a university private or state |
| 1.3 Type of programme | Is it a full-time or part-time course. |
| 1.4 Final award | Is the final award a BSc, BSc.
(honour)
or a MSc or otherwise. |
| 1.5 What is the average age | In order to get an idea of the age of first
year students |
| 1.6 Gender | Are more or less females or males
interested in is P & O? |
| 1.7 What are entry level requirements. | Is secondary education sufficient or is
another form of education required. |

Second part.

This part is covering the duration and structure of the curriculum. Also questions to retrieve information about contact hours, it-skills hours etc. are asked.

2. Curriculum

- | | |
|-----------------------|------------------------------------|
| 2.1 Duration of study | How long in years takes the study. |
|-----------------------|------------------------------------|

- 2.2 Study hours of program How many hours must be spend in total to study (activities in and outside the university)
- 2.3 Total contact hours How many hours must be spend by lessons, skills etc. (lecturer vs. student) per year.
- 2.4 Total clinical hours The amount of hours spend in laboratories to practice various skills, per year.
- 2.5 Total academic hours Is the total of lecture, problem based learning, practical tutorial and it-skills hours, per year.
- 2.5.1 Total lecture hours the pure lecturing hours, per year.
- 2.5.2 Total Pbl hours Is a curriculum consists out of problem based learning hours, the amount of hours can be filled out per year.
- 2.5.3. Total practical hours How many hours are spend into technical laboratories
- 2.5.4. Total tutorial hours How many hours are spend on tutoring students in an , instructional way.
- 2.6 Total traineeship hrs. the amount of time spent outside the university in work placement, per year.
- 2.7 Total final project hours The amount of hours spent at a final project (last year)
- 2.8 A question concerning, using problem based learning methods is taken in.
At the Fontys University rather new, and therefore curious to other experiences.
- 2.9 A question about what is experienced as core subject(s) is also part of the questionnaire.
This question is to compare experiences from various universities

Third part.

This third part is looking for arrangements in supervising and assessments of students in their traineeship and freedom of work placement choices.

3. Workfield traineeship and / or final project

3.1.1. Who is supervising the student during clinical periods?

Is this the university or clinic or both?

3.1.2. Who is supervising the student during traineeship?

Is this the university or clinic or both?

3.2 Where are students normally placed?

Is this in the private sector, national health service or both?

3.3.1 Freedom of choice for placement during traineeship

Do students have a free choice or chooses the university for them.

3.3.2 Freedom of choice for final project work placement

Do students have a free choice or chooses the university for them.

3.4 Do students have to write a report on their period of practical training?

3.5 Do students have to write a report on their period of final project?

Fourth part.

The last part of the questionnaire consists out of a number of questions in relation to study progression. These questions are introduced to get an idea of size of student population and progression of students.

4. Study progression.

4.1 On average how many students progress annually from year 1→2.

4.2 On average how many students progress annually from year 2→3

- 4.3 On average how many students progress annually from year 3→4
- 4.4 On average how many students progress annually from year 4→5
- 4.5 On average how many students progress annually from year 5→to graduation

These questions can be answered by filling out student numbers.

- 4.6 What is (are) experienced as difficult part(s) in the study.

An open question which can be answered freely.

- 4.7 Where find graduates employment.

An open question which can be answered freely.

The last question of this questionnaire is a question about comments of this questionnaire or information that the respondent wants to share.

- 5.1 Comments.

Do you have any comments on this questionnaire or want to share any other kind of information concerning this questionnaire.

Also an open question which can be answered freely.

5.4 Collected data.

The questionnaire was send out to the 15th known institutions of higher and university education. In order to get a large enough response rate a reminder was sent or a telephone call was made to those universities who had not responded. Ten institutions (this includes also the new designed course) have been responding after all, the response rate therefore was 66% The with this collected data forms the basis for this comparison.

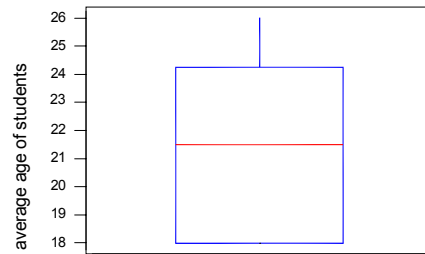


Figure 5.5.1-1, Average age of students attending P&O programmes

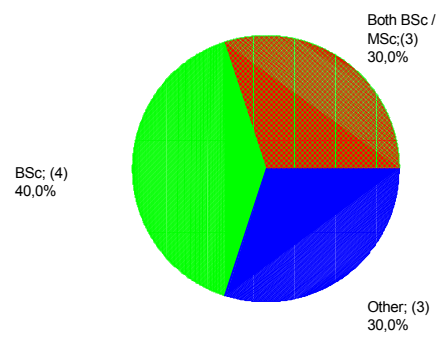


Figure 5.5.1-2, Pie chart of types of P&O programmes, BSc, BSc/MSc, Other

5.5 Data analysis

This paragraph will go into detail of the collected data and explain choices made in data processing. An overview of the original data can be found in appendix 5.5. Leading is the questionnaire send out to the universities. In analysing the data one should realise that a sample of ten is used out of a “known” population of 15. The sample therefore is rather small, this combined with bias formed by differences in interpretation of some of the questions asked in the questionnaire and not every question fully answered, obliged a cautious interpretation of the data acquired.

5.5.1 General information

The first question retrieved general information.

The name of the University is used only to identify the data, it will not be used in data processing. Only one university is a private institute, all the other universities are governmental or linked to the government by a ministry. Seven universities are offering a curriculum leading to a Bachelor title, three of those universities are also offering a Master course. Three programmes awarding their students with a certificate or diploma but not a BSc. or MSc. title.

The average age of students attending P&O courses is 21,5 years see figure 5.5.1-1. It should be noted that the minimum average age is 18 years and the maximum average age is 26 years. These differences are due to the fact that some of the programmes starting after a completed secondary educational curriculum where the average age is relatively low and other programmes are a continuation at an earlier completed bachelor course. In these cases the average age is higher.

Figure 5.5.1-2 shows the curricula divided to program type. Seven institutions offering a Bachelor program, one of these a BSc honour program, three of them also a Master programme. Three institutions offering a course which is not leading to a BSc or MSc award but a certificate. In one case post graduate.

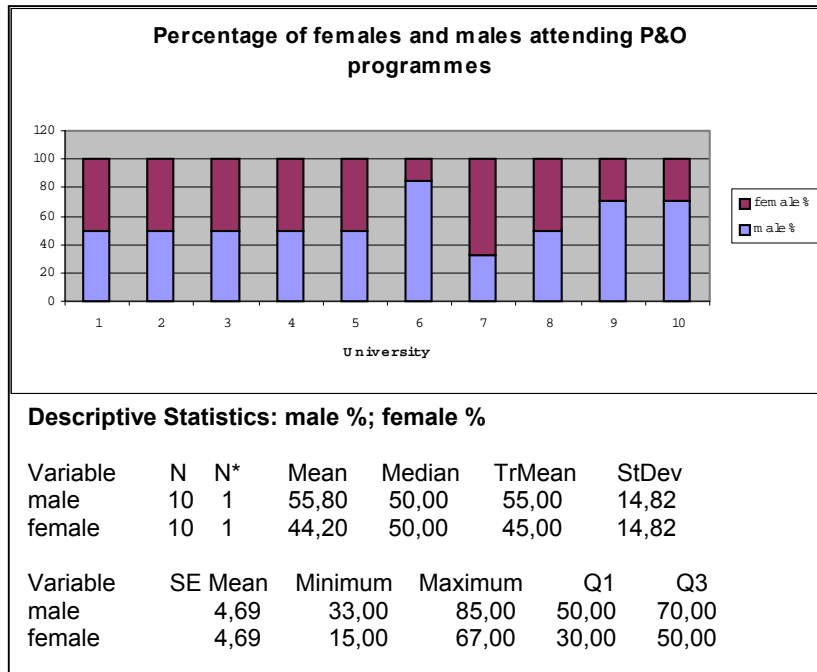


Figure 5.5.1-3, Percentages and descriptive stats. of males and females attending P&O courses

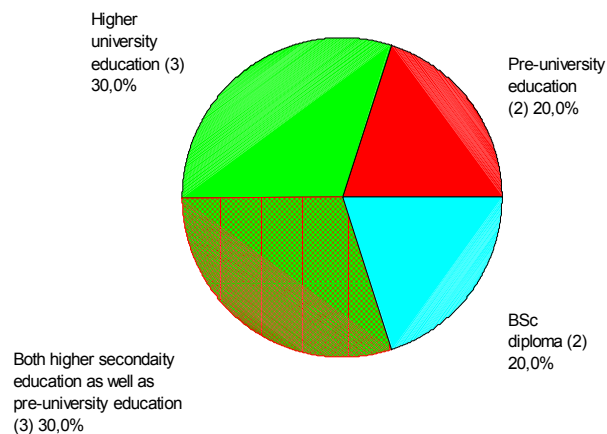


Figure 5.5.1-4, Pie chart of entry level requirements

Descriptive Statistics: Study duration group I						
variable	N	Mean	Median	TrMean	StDev	SE Mean
Study duration	8	3,313	3,250	3,313	0,704	0,249
variable	Minimum	Maximum	Q1	Q3		
Study duration	2,000	4,000	3,000	4,000		

Table 5.5.2-1, Study duration

Analysing the percentages of females and males, the following can be derived. A percentage of 56 % males and 44 % females are attending P & O curricula at a level of higher education, (figure 5.5.1-3). Although in one case a male percentage of 85% was recorded and therefore of course a percentage of 15% female, it does look like that there is a proportional distribution of males and females attending the curricula.

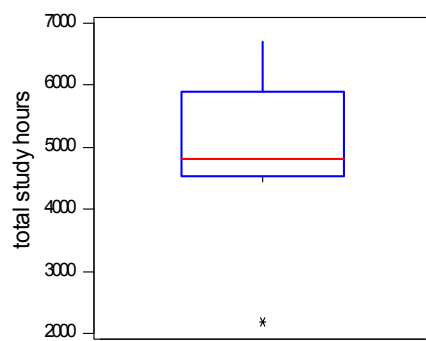
Entry level requirements, figure 5.5.1-4, requirements students have to fulfil before they are allowed to attend the higher vocational or university curriculum in prosthetics and orthotics. In one case a Bachelor degree of whatever former education, is demanded before attending the P&O curriculum. In three cases a diploma of higher secondary education is needed and in two cases a diploma of pre-university education. Three of the applied institutions ask for a diploma of higher secondary education or a diploma of pre-university education.

At this point it is necessary for the curriculum information to split the obtained data into two groups. A criterion in splitting the data into two separate groups is the entry level requirement. This item does have a lot of influence at, as will be shown later, at the number of study years and study hours. A group of two institutions, will be made out of the institutions who are requiring a completed Bachelor programme with diploma, group I. The other group, formed by eight institutions, require a secondary or pre-university education, group II.

5.5.2 Curriculum information

A relatively large variation in study years appeared. Starting from a one year curriculum up and till a four years curriculum. In group I, a study duration of one or two years appeared. In group II a total of study years appears of 2 up and till 4 years. The average study duration in this group is 3,3 years as can be seen in table 5.5.2-1. Although the number 3,3 in itself doesn't tell much, it does tell that the average study duration is longer than three years. The average study duration in group I is 1,5 years. Is it obvious that no much diversity is possible in these two cases.

A rather interesting item is the amount of study hours which must be spent to the study. Group I shows an average of 1715 hours.



Boxplot total study hours

Descriptive Statistics: Total Study hours group I

Variable	N	Mean	Median	TrMean	StDev	SE Mean
Total Study hours	8	4915	4800	4915	1339	473

Variable	Minimum	Maximum	Q1	Q3
Total Study hours	2185	6700	4527	5900

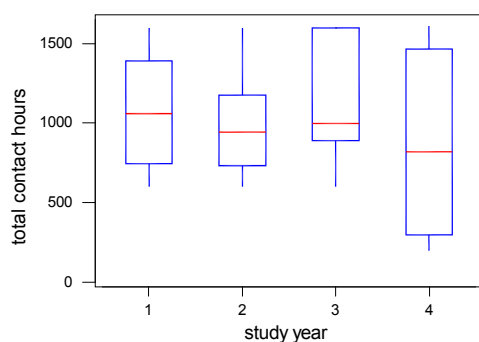
Figure 5.5.2-2, Boxplot total study hours and descriptive statistics

Group II shows an average of 4915 total study hours. Per year an average of 1489 study hours is spend, taking into consideration an average of 3,3 study years.

See also Figure 5.5.2-2, boxplot study hours and descriptive statistics.

The variable: contact hours, shows in group I a value of 1049. This is of course a group of two institutions, therefore very small, so conclusions must be taken very cautious. In group II an average is showed of 1010 hours, this is an average of eight institutions and 4 four study years. The values per year are showed in figure 5.5.2-3, boxplot contact hours and the descriptive statistics. Analysing these figures, it can be noticed that the average values are not that far from each other and that a number of hours are spend in a different way others than in a form of direct contact with students. In studying the various curricula and the declared hours of the institutions it became obvious that a direct comparison in detail is not really possible, due to the fact that, as already mentioned earlier a rather large variation exists in study duration, but also in layout and organisation of the curricula. For example: in one curriculum the hours spend in labs is assigned to clinical hours and in another curriculum this is excluded. It is therefore that a choice is made to compare the curricula in broad way. A comparison between the ten institutions is made whit respect to the clinical hours, academic hours, traineeship hours and final project hours. In figure 5.5.2-4, percentage the differences are showed in a histogram between these study parts. It must be noticed that the showed percentages are related to the total study duration in years. In figure pie chart, the individual components are showed. Remarkable is the fact that at least 37 % of a curriculum is spend to academic hours. For six institutions more than 50 % of the contact hours are spend to academic hours, this includes lecture-, tutorial-, and information technology (it) hours. One institution spends 68 % of the contact hours to academic hours, this is the maximum which is measured.

When is assumed that there are two main activities in the curricula, academic hours, and practical hours including clinical-, traineeship- and final project hours, then the maximum percentage spend to practical hours is 63%. The least percentage is 32% of the total of hours. Nine out of ten institutions work with traineeship hours and seven out of ten institutions work with a final project. Analysing figure 5.5.2-4 histogram of percentages, and figure 5.5.2-5 a pie chart table of all institutions, it can be stated that the average time spend on practical activities such as clinical hours, traineeship hours and final project work is 49,7



Descriptive Statistics group II, total contact hours, year 1 to 4

Variable	N	N*	Mean	Median	TrMean	StDev
total contact hrs. y1	8	0	1078	1060	1078	346
total contact hrs. y2	8	0	995	944	995	314
total contact hrs. y3	7	1	1100	1000	1100	371
total contact hrs. y4	4	4	863	820	863	605

Variable	SE Mean	Minimum	Maximum	Q1	Q3
total contact hrs. y1	122	600	1600	746	1390
total contact hrs. y2	111	600	1600	733	1175
total contact hrs. y3	140	600	1600	890	1600
total contact hrs. y4	303	200	1610	300	1468

Descriptive Statistics: group I, total contact hours, year 1 and 2

Variable	N	N*	Mean	Median	TrMean	StDev
total contact hrs. y1	2	0	1318	1318	1318	752
total contact hrs. Y2	1	1	820,00	820,00	820,00	*

Variable	SE Mean	Minimum	Maximum	Q1	Q3
total contact hrs. y1	532	786	1850	*	*
total contact hrs. Y2	*	820,00	820,00	*	*

Figure 5.5.3.-2, Boxplot Total contact hours, group II and descriptive statistics

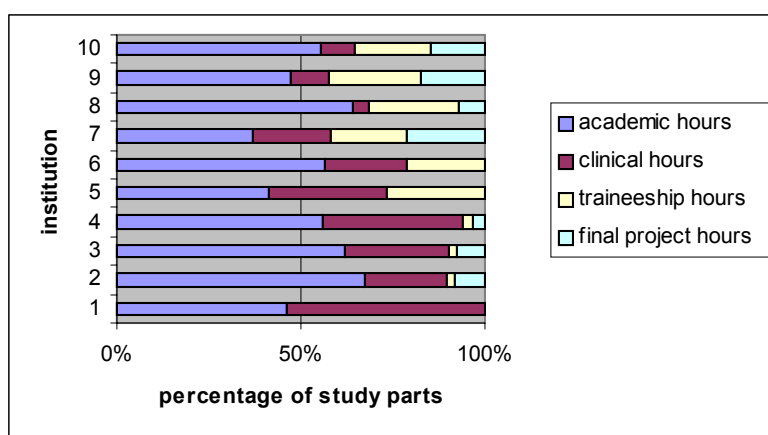


Figure 5.5.2-4, histogram, percentage of study parts

percent, i.e. 50 percent. Practical activities and manual skills are therefore a main part of the curricula.

Most of the institution, eight in total, are using a study activity called problem base learning (pbl.) in training students to their future profession. Problem based learning is an activity which asks of a group of students to cooperate into solving a problem in a learning situation.

In answer to the question; what are in your opinion the core subjects in the p&o curriculum, biomechanics is most frequently mentioned, anatomy and pathology are mentioned secondly most. Subjects like prosthetic science, orthotics science, material science, life science and research methodology were mentioned thirdly. Gait analysis, mechanics clinical theory and kinesiology are mentioned least frequent.

5.5.3 Work field / traineeship and / or final projects information

Freedom of choice in where students can fulfil the traineeship period is offered by five out of nine universities where a traineeship period is necessary. In one case no traineeship period is included and in three cases the university decides where the student has to fulfil the traineeship.

Also freedom of choice of final projects are offered by five institutions, with one exception, the same institution regarding the traineeship period. Two institutions do not offer a free choice and in two other cases it is not applicable.

To be complete, in three cases no field traineeship is included in the concerning curriculum, students must compete after the study one or two years internship.

In all cases a written report on both the traineeship period as well as the final project period must be made, no exceptions are known.

5.5.4 Student progression

In order to get an idea of student numbers attending the prosthetic and orthotics curriculum also questions regarding student numbers and student progression were included into the questionnaire.

Analysing the total of student numbers per cohort, i.e. a group of students who belong to a particular academic year as starting date, shows three institutions with student

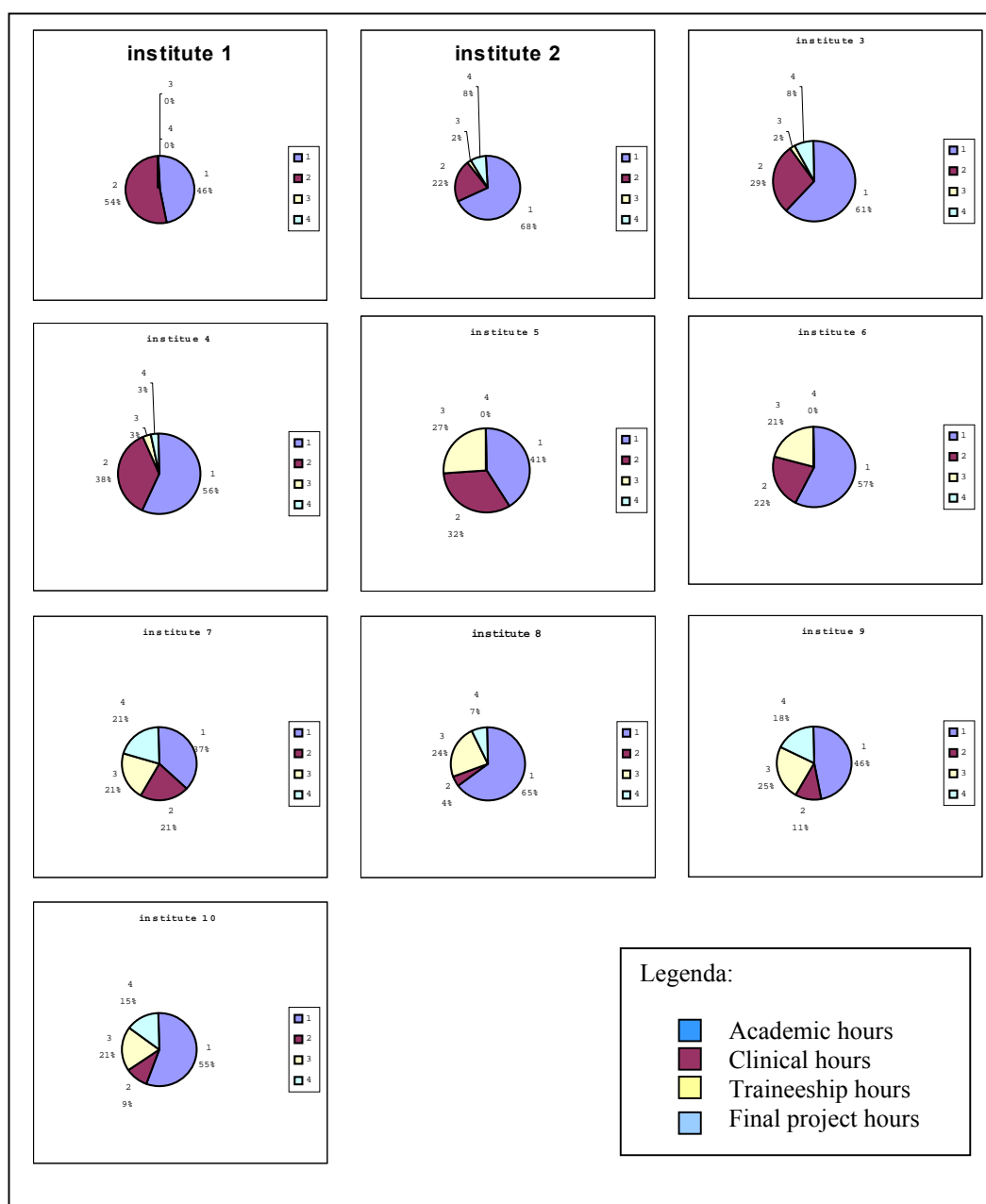


Figure 5.5.2-5, Pie chart diagrams of the individual institutions

numbers above 80, with a maximum of 86. The smallest cohort 16 students. The average is 51 students per institute. Comparing student numbers who are attending the first year with those who are graduating, shows percentages as showed in Figure 5.5.2-6, table of student numbers and % graduation. Two institution shows a percentage of 100% graduates. Also two institutions shows a percentage of 64, and 67 % graduates. The remaining institutions are in between.

An open question to, what part of the program, in your opinion, do find students most difficult? is answered as follows. 26% marked anatomy as most difficult, followed by mechanics and biomechanics with 21%. Pathology, laboratory an technical procedures scored 11% respectively 5%. Other subjects were not mentioned in spontaneous way, see figure 5.5.2-7. table practical segments.

Graduates find most often employment as a prosthetist and or orthotist in an orthopaedic workshop. Other placements are rehab centres and hospitals. A small percentage find employment as a researcher or consultant, see figure 5.5.2-8a and b, figure, table and pie chart of employment positions.

5.6 Summarizing and comparing.

Summarized and compared to the new developed curriculum in the Netherlands the following can be concluded. The institutions of higher vocational and / or university education in prosthetics and orthotics are limited. Fifteen institutions offering curricula as meant are known. The sample size is therefore also not large, even small. In analysing the data, bias in the answers must be taken into account concerning some of the questions which seem to be open for difference of interpretation, mostly caused by the fact that in some cases was asked for a particular detail which is not separate available in a certain curriculum. For instance, a question asking to the amount of clinical hours could not be answered directly caused by the fact that in these hours were part of the laboratory hours. The organisation and name giving of parts of the curricula do have a direct influence on the given answers.

It is therefore that the interpretation of the answers of the individual questionnaires and the interpretation of the outcome of it must be taken very cautious.

In these cases that the p&o curriculum is offered as higher vocational and or university level curricula the age of first year students lies between 18 and 20 years.

student numbers per cohort	% graduation
16	100
86	93
31	91
20	82
74	90
40	100
86	83
81	95
51	64
21	* 67

* assumed

practical segments	indicated as difficult (%)
anatomy	26
mechanics	21
biomechanics for P&O	21
pathology	11
materials	5
lab/tec. Procedures	5
orthotic science	5

Figure 5.5.2-7, Table % graduation

employment positions	%
hospital	6
rehab centre	13
private practise	13
prosthetists	25
orthotists	25
orthopaedic shoemaking	6
research	6
consultant	6

Figure 5.5.2-8a, Table Employment positions

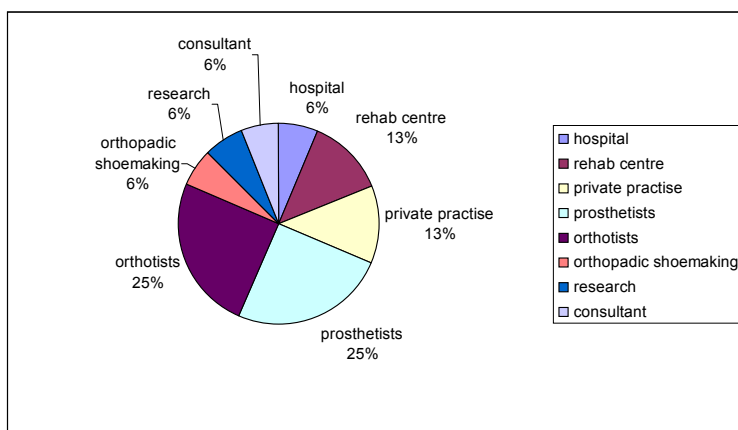


Figure 5.5.2-8b, Pie chart employment positions

Also can be mentioned that 56% males and 44% female students are attending these courses. It is therefore not a typical male or typical female course. In comparison to the Fontys curriculum; the average age of first year students is about 18 years and as far as it now shows, 70 % are male and 30% are female students.

Regarding to the entry level requirement. Group II, the group which offers a higher vocational and / or a university curriculum as a follow-up to secondary or pre-university education , can be seen as a “normal” entry level requirement as also is offered at Fontys university. Although a higher vocational education in the Netherlands has a duration of four years, the mentioned average number of contact hours per year is also valid.

For as far the practical parts of the curriculum concerned, these are, clinical hours, traineeship hours and final project hours, it is very difficult to separate analyse these figures in an absolute way, caused by the fact of the organisation and interpretation of the curriculum. Therefore these figures were analysed as a percentage of the whole curriculum. Looking at the combined clinical hours, the traineeship hours and final project hours it can be stated that around 50 % of the curriculum time is attended to these parts. The remaining 50% is dedicated to theoretical aspect of the prosthetic and orthotics curriculum. Comparing these percentages to the curriculum at the Fontys university, were about 55% of the curriculum is dedicated to theoretical aspects and 45% percent to the practical aspects of the curriculum, it can be stated that there are no large differences.

The core subjects as well as the subjects marked as the difficult parts of the curriculum, which were answered to an open question illustrates the picture of a p&o curriculum and confirms the ideas which played a role in developing the Fontys curriculum.

Most of the institutions are working with or according to problem based learning methods. At the Fontys university, and certainly its first year curriculum is perhaps different from the other curricula. A large amount of time is spend in problem based learning activities.

Finally student progression. Two institutions showed a percentage of 100% of graduates. Two other institutions a percentage of 67% respectively 64%. The other institutions shows a percentage in between.

Up and till now there are no graduates of the Fontys university since the start date was September 2001. The first regular* graduate is expected in July 2004. According to the expectations and extrapolations of student numbers and experience of our partner, the percentage of graduates is estimated at 67%.

*:A special group of students will be probably graduating in July 2003.

6 Reviewing the curriculum design in a context of PDCA and EFQM quality assurance systems and the acquired data by the questionnaire.

6.1 The state of affairs.

In the foregoing chapter, the design as a process, the design itself, arguments and specific details as competences and curriculum content are discussed. Also a comparison has been made between the Dutch curriculum with other curricula.

This chapter concludes and reviews the design, for as far a curriculum design can be concluded, because in reality it is a continuous process, in relationship to the acquired data and the quality assurance systems used at the Fontys University.

Although it is a common use to design courses using the experience of staff and copying ideas from those who were first, it shows also that designing and evaluating courses on the hand of design principles and "evidenced based" data, see appendix 2.1 mind map part II and III to obtain a desired course is also possible.

In order to achieve this, research has been done in the field of "how to design education", quality measurement techniques and evaluation methods.

By doing this, answers were found for questions like, what kind of subject should be or must be covered in the study. Finding answers as:, what percentage of certain educational parts or specific subjects is an optimum, and what kind of learning styles are appropriate, and the discussion about the length in years of courses are more difficult to answer.

To start with the last mentioned item. Study duration is most often a legally described period. In cases of regular, initial education it is therefore three or four years., depending of political choices.

Studying chapter 8 and reviewing the acquired data in order to retrieve the answers for, for instance, the optimum percentage for clinical lab activities of traineeship period of theoretical aspects of the curriculum, it is appeared to be very difficult to come up with one absolute percentage, thus a number of hours. In practice although

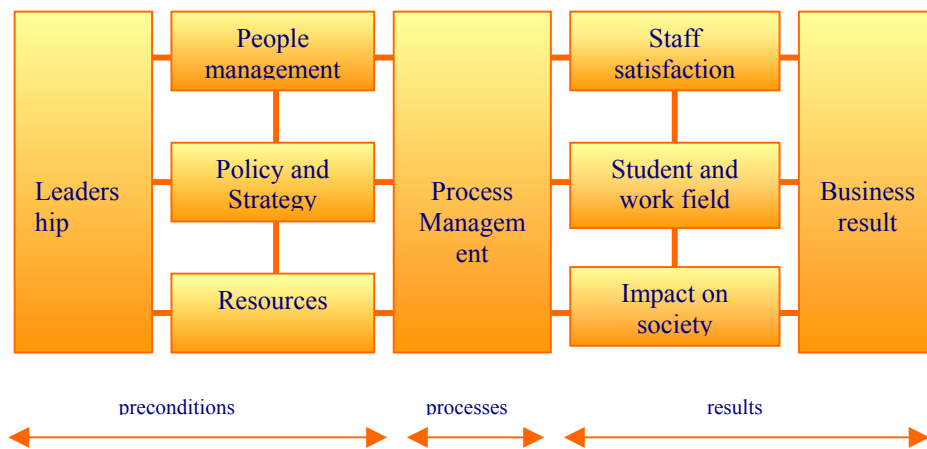


Figure 6.2-1, EFQM European Quality Award assessment model. The European model for self-appraisal.
(source: total quality management (Oakland, 1998))

all general expected items are covered, there is however a large variation within the allocated hours for curriculum and study parts.

6.2 The near future

For future data acquisition and evaluation also methods and techniques like desk and field research will be used. Quality assurance models like the EFQM (see figure 6.2-1, EFQM), and the by Fontys internally used quality assurance system, "voortdurend verbeteren"(Veerman, 2000), and 'Kwaliteitszorgsysteem bacheloropleiding β -versie' (Rexwinkel, 2001), see also appendix A [IV] models will also be used for future data acquisition and evaluation. Point of departure is Philip B. Crosby's definition of quality: Quality is fulfil requirements (Crosby, 1998). One of the reasons for this is that the KHKempen is using the EFQM model in quality assurance and Fontys is using the PDCA cycle (figure 4.6-1 pdca), with can be seen as a derivation of the EFQM model and can be fitted in the accreditation model in the Netherlands.

To be complete, in the end stage of the design process, and in relation to quality assurance and future accreditation the two quality systems will be discussed in a broad way, because these tools will be able to generate valuable information in order to improve the designed curriculum.

6.2.1 EFQM.

The main objective of EFQM, the European Foundation for Quality Management is to help profit or non-profit organisations is realising in improving their results. The EFQM-model which recognize a number of approaches to become an excellent organisation whit an excellent product. Within this approach a number of basic assumptions can be distinguished. These assumptions forma also the basis of the EFQM-model. Mostly are these basic assumptions summarized into the term, Total Quality Management (TQM). Figure 6.2-1, EFQM is a proposed quality review process which uses the TQM model criteria and lists questions that should be asked. The Total Quality Model criteria can be described in a summarized way as follows

:

1. Leadership and behaviour.
2. Strategic planning
3. Techniques and continuous improvement
4. People
5. Quality assurance, process management.
6. Quality and business results
7. Customer satisfaction
8. Community (impact on society)

In the scope of this dissertation it goes to far to describe and analyse in detail the whole EFQM concept. Important for this analysis is that the EFQM-model offers an instrument for management and control of the organisation and quality improvement.

Accreditation is a process of quality assessment, whit at the end a result of an approval / non approval.

Aspect	Accreditation	EFQM-model
Objective	assessment of a university Meets the HBO – standard	Control of organisation and improvement
Result	Accreditation Yes/No	Clear view on point of Improvement , ambitions
Way of Assessing	Verification points: Good/moderate/insufficient Final opinion Good/not good	Orientated around activities total quality care

Comparing the objects of the accreditation (according to the HBO-council) and EFQM makes it clear that the accreditation process sets high standards to process management and Staff, Student, Work field satisfaction and impact on society, (Kemenade, 2001), the main focus is directed towards process management. Within this, the question whether the curriculum is of sufficient HBO-level. Next to this questions are asked to educational policy and prefixes. The verification points from out of the accreditation are more operationalized than the posing of EFQM. EFQM gives less standards with respect to “HBO-level”, “assessments”,

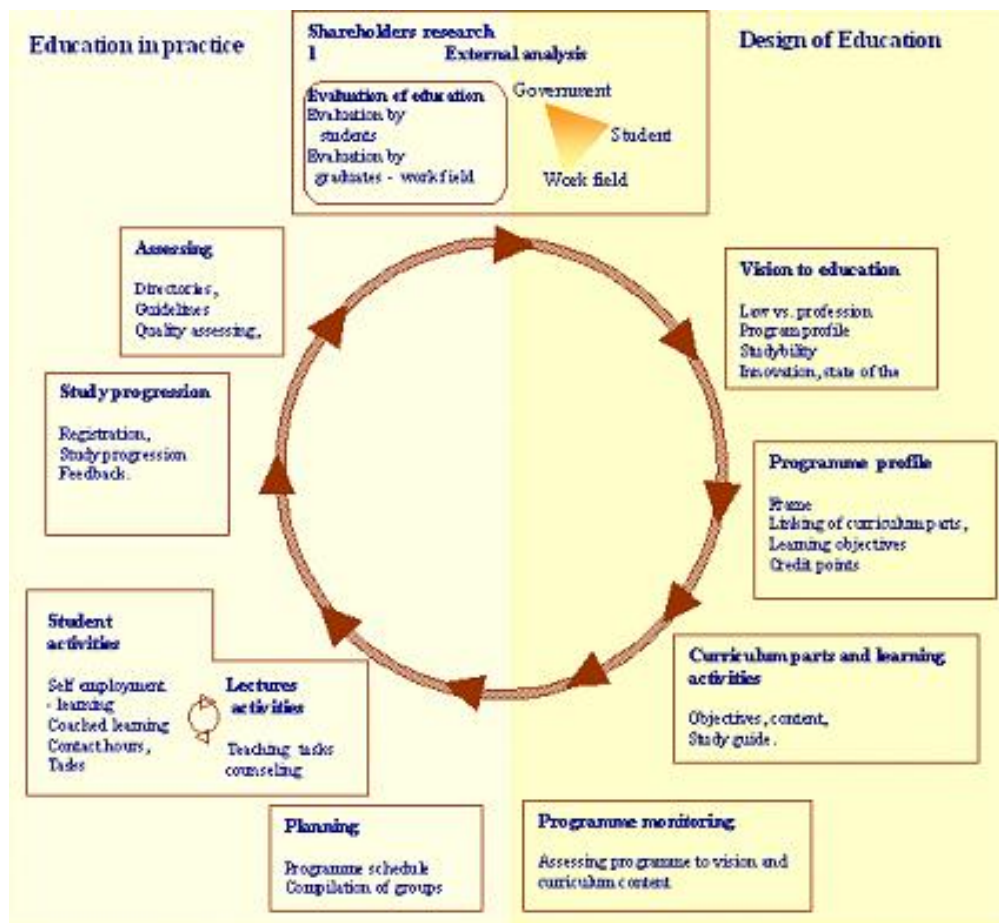


Figure 6.2.2-1. EFQM appraisal
Version june 2nd 1999, L.Heuvelmans E. van Kemenade.
(source: Methode voor kwaliteitsverbetering van het hoger onderwijs naar het EFQM model.

and “methodological requirements of evaluations”. EFQM therefore gives more attention toward suppliers and competitors.

Reorganising the EFQM model into the form of a circle, supplemented with the model “Design of Education” figure 2.3-1, in which to a certain extent the specific educational objectives are guaranteed, especially the items of process management, see figure EFQM appraisal. Two phases, the design and the practice are combined within a continuous process. This figure shows the individual elements which are to be assessed, starting from out of the design process toward the evaluation. All specific elements important for education are mentioned separately.

If these two departure points, are joined together, both the EFQM model, figure 6.2-1, EFQM, as well as the EFQM appraisal, figure 6.2.2.-1 (EFQM appraisal), the PDCA cycle, Plan – Do – Check – Act cycle is there to come into being. This PDCA cycle, because of the fact that the individual items can be assessed separately, is the instrument which will be used.

6.2.2 The PDCA cycle.

As already mentioned in paragraph 5.3.6.1.2. “Quality requirements of a BSc. level course” twelve quality requirements are being assessed. This assessment will take place using the PDCA cycle (figure 4.6-1, PDCA cycle) as a quality measurement tool.

This PDCA circle describes the process of a continuous improvement of education as well as content as process concerned. After making plans an implementation phase is provided. After implementation, measurements are taken and analysis of this data is executed.

The PDCA cycle consists out of six phases namely, Planning/ integral improvement, Implementation, Measurement, Feedback, Integral analysis measurements, Development integral improvement, and than again, Planning, etc.

Planning.

Every academic year a planning and procedures are drawn, (if necessary adjusted) of the measurements which will be taken. Analysis which were made and the follow up must be described.

Implementation / Execution.

Execution means, the education, curriculum bringing into practice. The development of research instruments. For example, formulate questionnaire by experts of the curriculum, researchers and a consultant of the Project Quality Assurance of the Fontys University.

Measurement.

A member of quality control of the university will take care of the measurements as planned, using questionnaires, reviews, analyses etc. Main issue here is to retrieve information from students, lecturers, work field and graduates.

Feedback.

The researcher of the Project Quality Assurance of the Fontys University will process the data and is also preparing an analysis.

Feedback of the results of this analysis will be given. In this case

measurements which are taken from	: feedback will be given to:
-----------------------------------	------------------------------

Students	: Student consultation
Teaching staff	: Teaching staff (collective, individual)
Alumni	: Alumni society
Profession	: Advisory board
Management Board	: Audit and control

This integral analysis of the measurements taken, lead to the development of plans for improvement. The whole system is continuously and constantly running.

Integral analysis

The results of the various measurements are linked together. It is of importance to make cross links. The overview of these links and cross links are showed in the matrix, figure 6.2.2-1, connections can be made in a horizontal or vertical way but also in a diagonal way and will result into management documents. The outcome of the integral analysis will form the basis of an integral improvement plan.

Results Measurements Work field	Results discussion board of advisors	Results former questionnaires	Publications work field developments	Curriculum profile	Final project policy	R&D policy
Results measurements graduates	Results discussion alumni society	Results former questionnaires	Analysis final project dissertations	Visitation report Examiners committee	Inspection report.	HOOP.. Final project coordinator
Results measurements students	Results conference	Results former questionnaires	Outcome Fontys questionnaire	Selection guide HO	Visitation report Assessment analysis	Mentor/lecturer IOWO OCW
Results measurements lectures	Results conference	Results former questionnaires	Results questionnaires staff	Publications HMR	Outcome student questionnaires	Policy HMR
Results consultations reflection group	Results former con discussions	Relevant policy	Visitation rapport	Material goods	Selection guide HO Student questionnaires	Reaction directors management

Figure 6.2.2-1, : Matrix integral analysis.

Developing integral improvement

After collecting all the required data, analysing this data as is pointed out, conclusions will be drawn for the benefit of an integral improvement plan. Which must be discussed with the education committee, institution participation committee and director of the institute. After receiving the advice of the, mentioned committees the advises and plans must be implemented.

After implementations the whole cycle starts all over again.

It is here where this dissertation stops in describing the design process of a new curriculum.

7 Discussion and conclusions, suggestions for further research

This dissertation describes the whole design process from the beginning of the development of this course, up until the, due to the educational reform process in Europe, evaluation and accreditation process.

After a number of attempts in 1999 a cooperation between the Fontys University of professional education and the Catholic University Kempen (KHKempen) has been effectuated in relation to a common orthopaedic technological curriculum. In the February 2000 a formal approval has been asked to the Dutch government which has this acknowledged in May 2000. The new designed curriculum started in August 2001. How the complete curriculum is built is visualised in appendix 7.

An answer has been found to offer a curriculum in the area of prosthetics and orthotics at the level of university education.

One of the main goals in cooperation between Fontys and the KHKempen is to offer for the Dutch speaking students an approved, recognised and subsidized curriculum at the level of university education, in which the realisation, research and developing take place in cooperation with each other, has been accomplished.

At this moment already four school years are operational. A regular first year group, and a regular second year group. The third year is formed due to switching of study. The fourth year group is formed by a number of students whom are working already in this work field and fulfil the requirements to join this final project year. It is in the line of expectation that the first students of this curriculum are graduating in July 2003.

Also the area of competence and competence development has been described in order design tools to be able to distinguish what makes a graduate an orthopaedic engineer.

Analysing the data acquired by sending out questionnaires, although for an in dept analysis perhaps somewhat scanty, gives a broad view of how other Institutions performed and made choices concerning learning methods study load etc. A marking fact is that this new developed curriculum take four years.

Most of the other curricula a not that length in years. Study load and contact hours are when the study duration in years is taken into account on average equal.

Also time spend on clinical combined whit practical internship and final project work reasonable equal. The main conclusion for this designed curriculum therefore is that taking the analysis and directives of Dutch educational law into consideration, this is sound orthopaedic curriculum based on a firm fundament, which is also under a consequent evaluation and quality assurance.

An answer to what the optimum study duration for this particular work field is not easy to suggest. In the Netherlands a study like this, at HBO –level must have a duration of four years (by law) In Belgium it is three years. In other countries variations in study duration has been found form one year up and till four. In case of the one year curriculum it was a “post-curriculum”. Students therefore must have finished an other type of education before they are able to attend this particular course. In an other case, the internship is excluded from the curriculum time. After graduation students must first do a trial period, to get experienced, of one or two years, which must be finalized by a separate exam. It can be therefore questioned if the study duration is therefore the time in the University of this time combined whit the trial period.

The availability of problem based learning methods is also widely included, although a large variation in number of study hours did occur.

The ideas which existed about the so called “core” an difficult subject were confirmed by the answers of the questionnaire. Both anatomy as well as biomechanics were pointed out as core subjects and also the most ones.

Although this curriculum is now two years old a number of suggestions to improve the curriculum can be suggested. These suggestions were made by the first and second year students.

Firstly, Introduce a small practical period (1 day) in an early stage of the study, (in the first semester) to give students the opportunity to “experience” the prosthetic and orthotics work field. This is already realised in the curriculum for 2003-2004.

Secondly, The projects in the first year curriculum must more recognisable for students as “orthopaedic modules”. This is something were in the coming months effort must be put in.

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10 Glossary

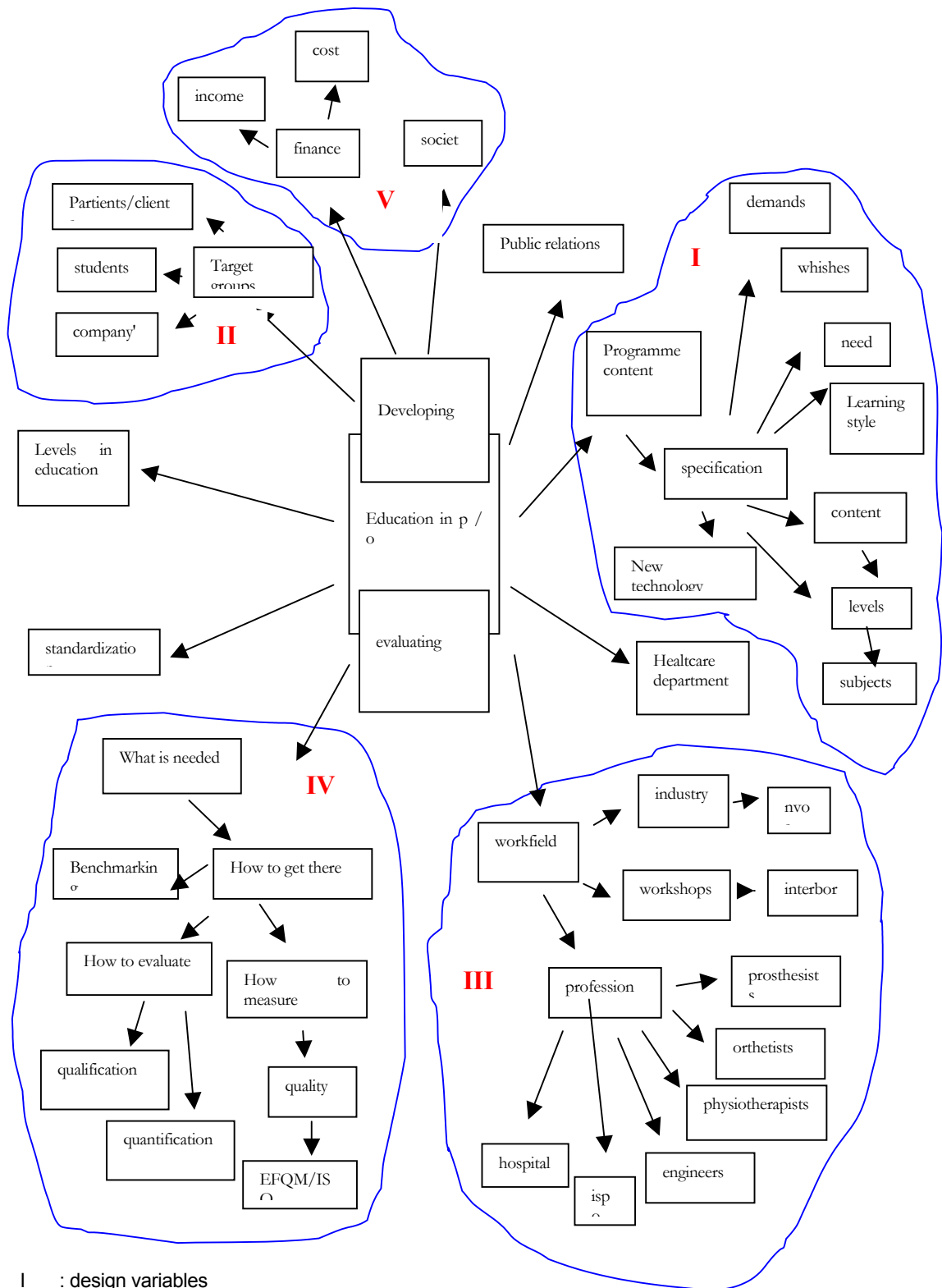
lower general secondary education	MAVO.
(lower) technical school	LTS
intermediate technical school	MTS
Intermediate secondary school	MBO
technical college	HTS
higher vocational education	HBO
HBO council, (council for higher vocational education)	HBO raad
school/institute for business administration and economics	HEAO.
modern apprenticeship	leerlingwezen = part of VMBO
university	universiteit
pre-intermediate vocational education VMBO	Voorbereidend Middelbaar Onderwijs
school of higher general secondary education	HAVO = Hoger Algemeen Vormend Onderwijs
pre-university education VWO	Voorbereidend Wetenschappelijk Onderwijs
Pre-intermediate vocational education	VMBO Voorbereidend Middelbaar Onderwijs in eng.
Secondary education	Voortgezet onderwijs
Visitation and Judging Institute, VJI	Visiterende en en Beoordelende Instantie, VBI
The Netherlands Accreditation OrganizationBody	Nederlandse Accreditatie Organisatie NAO
Intermediate vocational education	MBO Middelbaar beroeps onderwijs
Pre-intermediate lower vocational education	VBO Voorbereidend Beroeps Onderwijs
Lower general secondary education	MAVO Middelbaar Algemeen Vormend Onderwijs.
Professional column= a column in which all specific vocational education routes are situated, beginning with lower via secondary up and till higher vocational education.	Beroepskolom

Appendix

The appendices have been given the numbers of the sections they are connected with.

Appendix 2.1	Mind map of design variables
Appendix 2.2	Professional profile
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Appendix 2.3.5-1	Brochure Cover
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Appendix 5.3	Questionnaire with introduction letter
Appendix 5.5	Original collected data
Appendix 7	Credit point system of the complete curriculum

Appendix 2.1. Mind map of design variables



- I : design variables
- II : target groups
- III : evaluation group
- IV : qualification and quantification
- V : exploitation

Appendix 2.2. Professional profile

Professional profile (dutch version)

Beroepsprofiel van de afgestudeerde Orthopedisch Technoloog

Deze paragraaf beschrijft het beroepsprofiel van de afgestudeerde Orthopedisch technologisch ingenieur zoals deze in Nederland gehanteerd wordt.

Het beroep Orthopedisch Technologisch ingenieur is in Nederland een technisch beroep met een grote paramedische inslag. De afgestudeerden zullen op het gebied van de prothesiologie, orthesiologie, bandagie en algemene orthopedische techniek werkzaam zijn waarbij de patiënt centraal staat en de technologie en techniek aangewend wordt om de mobiliteit te behouden of te herstellen. Naast het mobiliteitsbehoud of -herstel wordt tegenwoordig ook veel meer dan in het verleden aandacht besteed aan preventie, juist ter voorkoming van dit verlies.

De werkzaamheden die de afgestudeerden in de samenleving verrichten vloeien enerzijds voort vanuit de veranderende wet en regelgeving, niet alleen met betrekking tot het herintreden en reïntegratie van gehandicapten en ontwikkelingen binnen de gezondheidszorg, maar ook op het terrein van bijvoorbeeld productaansprakelijkheid, anderzijds door de veranderingen in de maatschappij met betrekking tot de complexer wordende techniek, veranderende organisaties, mondigere patiënten en ontwikkelingen in het buitenland. Dit laatste moet zowel gezien worden in relatie tot de technische ontwikkelingen en vakuitoefening als ook in relatie tot wet en regelgeving. Als voorbeeld kan genoemd worden de ADA, de American Disability Act.

De afgestudeerden van de hogere beroepsopleiding orthopedische technologie verrichten werkzaamheden vooral ten behoeve van orthopedische bedrijven, revalidatiecentra, gezondheidsinstellingen en onderzoekscentra. Hierbij moet opgemerkt worden dat de werkzaamheden steeds meer een gevolg zijn van de door de overheid opgelegde wet en regelgeving.

De afgestudeerde van de hogere beroepsopleiding orthopedische technologie zal als beginnend beroepsuitoefenaar voornamelijk de volgende werkzaamheden in de samenleving uitvoeren.

- ❖ Analyseren van revalidatieproblematieken in een intermediaire rol tussen medici en technici.
- ❖ Adviseren van werkgevers en patiënten ten aanzien van arbeidsomstandigheden
 - Inzicht en kennis hebben van de anatomie, fysiologie en pathologie.
 - Inzicht, kennis en kunde hebben van preventie en reïntegratie mogelijkheden.
- ❖ Aanmeten van orthopedische voorzieningen (prothesen, orthesen en bandages),
 - Inzicht, kennis en kunde hebben van de vervaardiging van orthopedische voorzieningen.
- ❖ Opstellen van specificaties ten behoeve van het ontwerpen en ontwikkelen van orthopedische voorzieningen (prothesen, orthesen en bandages) waarbij innovatie een grote rol speelt.

- ❖ Managen van een bedrijf, instelling of organisatie welke zich met het gebied van orthopedische voorzieningen bezig houdt.
 - Leiding geven aan werknemers voor de vervaardiging van orthopedische voorzieningen (prothesen, orthesen en bandages)
 - Het coördineren van werk, werknemers en andere sectoren van de dienstverlening nodig ten behoeve van het vervaardigen en afleveren van de verstrekkingen.
 - Zorgdragen voor het voldoen aan richtlijnen en wetgeving ten aanzien van beroepsvereisten en de daaruit voortvloeiende aansprakelijkheden en certificering van voorzieningen.
 - Zorg dragen voor een juiste financiële afwikkeling van de verstrekkingen in relatie tot zorgverzekeraars en patiënten.

Naast de hierboven algemeen gestelde doelstellingen moet een afgestudeerde van de hogere beroepsopleiding orthopedie kunnen inspelen op: de veranderende inzichten van verzekeraars, veranderende regelgeving, mondiger wordende patiënten, hogere eisen en snellere levertijden geëist door voorschrijvers, concurrenten, internationale ontwikkeling, voorraadbeheer en relatiebeheer ten behoeven van efficiënte bedrijfsvoering, het protocoliseren van productkeuze en het standaardiseren van de werkwijze zijn ook zaken die de laatste jaren steeds belangrijker worden. In de beroepspraktijk is de afgestudeerde diegene die optreedt als gesprekspartner in relatie naar artsen, patiënten en de orthopedisch medewerkers die zorg dragen voor de productie van de voorzieningen. Hiertoe moet hij of zij de kennis bezitten van de verschillende vervaardigingsprincipes en -technieken om medewerkers aan te sturen, maar wordt minder een beroep gedaan op routine die nodig is voor het daadwerkelijk produceren van deze voorzieningen.

Voor de volledigheid is ook het beroepsprofiel van de gegradueerde in de orthopedie opgenomen zoals dit voor Vlaanderen geldt.

Beroepsprofiel van de gegradueerde in de orthopedie, (uit de OER van de KHK overgenomen)

Beroeps- en functietypering

Beroepen

De beroepen "bandage", "orthese" en "prothese" zijn paramedische beroepen in de zin van artikel 22bis van het koninklijk besluit nr. 78 van 10 november 1967 betreffende de uitoefening van de geneeskunst, de verpleegkunde, de paramedische beroepen en de geneeskundige commissies. Hoger genoemde beroepen worden respectievelijk uitgeoefend onder de **beroepstitel "bandagist", "orthesist", "prothesist"**.

De orthopedietechniek (bandagen, orthesen en prothesen) richt zich op het voorkomen of herstellen van aangeboren of verworven misvormingen of functiestoornissen door gebruik te maken van individueel aangepaste technische hulpmiddelen en ook op het vervangen van ontbrekende lichaamsdelen.

Werkveld

De bandagist, orthesist en prothesist oefent hogergenoemde beroepen uit ofwel **als zelfstandige** in een eigen praktijk ofwel **als werknemer** in een orthopedisch bedrijf.

Functies en taken

Erkend bandagist, orthesist en prothesist

De orthopedisch technoloog functionerend als erkend bandagist, orthesist en prothesist dient een aantal technische prestaties en handelingen uit te voeren die wettelijk vastliggen. De patiënten raadplegen de bandagist, orthesist en/of prothesist op verwijzing van de arts of op eigen initiatief.

Erkend bandagist

Een bandage en aanverwant hulpmiddel zijn uitwendige technische hulpmiddelen ter ondersteuning van het fysisch welzijn, de hygiëne of de verplaatsingsmogelijkheden van de patiënt.

De functie van bandagist omvat: de maatname, het bespreken, ontwerpen, vervaardigen, aanpassen, afleveren en controleren van bandagen, drukverbanden, borstprothesen en hulpmiddelen voor thuisverzorging en verplaatsing; zowel voorlopige als definitieve, zowel immediate fitted (pasklare) als naar maat, zowel esthetische als functionele. Volgende handelingen zijn wettelijk vastgelegd:

- het afnemen en/of opnieuw aanleggen van een gips, gipsvervangend materiaal of verbanden, enkel voor maatname, aanpassen of afleveren van bandagen;
- het preoperatorisch aanleggen van bandagen;
- het aanbrengen van toebehoren aan gipsen of gipsvervangend materiaal;
- het aan- of afkoppelen van tractiesystemen, enkel voor maatname, aanpassen of afleveren van bandagen.

Erkend orthesist

Een orthese is een uitwendig hulpmiddel ter stabilisering, verbetering of bescherming van een misvormd of efficiënt lichaamsdeel, huid of orgaan.

De functie van orthesist omvat: de maatname, het bespreken, ontwerpen, vervaardigen, aanpassen, afleveren en controleren van orthesen; zowel statische als dynamische, zowel voorlopige als definitieve, zowel pasklare als naar maat, zowel esthetische als functionele, zowel werkend door eigen lichaamskracht als door uitwendige krachtbron, evenals de

antikeloïde hulpmiddelen en hulpmiddelen voor bestralingstherapie. Volgende handelingen zijn wettelijk vastgelegd:

- het afnemen en/of opnieuw aanleggen van een gips, gipsvervangend materiaal of verbanden, enkel voor maatname, aanpassen of afleveren van orthesen;
- het preoperatoir aanleggen van orthesen;
- het aanbrengen van toebehoren aan gipsen of gipsvervangend materiaal;
- het aan- of afkoppelen van tractiesystemen, enkel voor maatname, aanpassen of afleveren van orthesen;
- het klinisch evalueren van de spieractiviteit met het oog op het aanleggen van een orthese.

Erkend prothesist

Een prothese is een uitwendig hulpmiddel ter vervanging of ter vervollediging van een ontbrekend of deficiënt lichaamsdeel.

De functie van prothesist omvat: de maatname, het bespreken, ontwerpen, vervaardigen, aanpassen, afleveren en controleren van prothesen uitgezonderd tand- en borstprothesen; zowel voorlopige als definitieve, zowel pasklare als naar maat, zowel esthetische als functionele, aangedreven door om het even welke krachtbron. Volgende handelingen zijn wettelijk vastgelegd:

- het afnemen en/of opnieuw aanleggen van een gips, gipsvervangend materiaal of verbanden, enkel voor maatname, aanpassen of afleveren van prothesen;
- het preoperatoir aanleggen van prothesen;
- het aanbrengen van toebehoren aan gipsen of gipsvervangend materiaal;
- het aan- of afkoppelen van tractiesystemen, enkel voor maatname, aanpassen of afleveren van prothesen;
- het klinisch evalueren van de spieractiviteit met het oog op het aanleggen van een prothese.

Voor het erkend uitoefenen van deze beroepen moet de kandidaat **een RIZIV-erkenning** bezitten voor de aflevering van de artikelen voorzien in de nomenclatuur van het RIZIV onder de hoofding bandagisterie en/of orthese en/of prothese. De wettelijke vereisten hiervoor zijn:

- voor **bandagist**: de personen dienen gedurende drie en een half jaar een theoretische en praktische opleiding van bandagist te hebben gevolgd en voldoen aan een door de erkenningsraad georganiseerd technisch bevoegdheidsexamen.
- voor **orthesist**: de personen dienen gedurende vier en een half jaar een theoretische en praktische opleiding van orthesist te hebben gevolgd en voldoen aan een door de erkenningsraad georganiseerd technisch bevoegdheidsexamen.
- voor **prothesist**: de personen dienen gedurende vijf en een half jaar een theoretische en praktische opleiding van prothesist te hebben gevolgd en voldoen aan een door de erkenningsraad georganiseerd technisch bevoegdheidsexamen.

De examens i.v.m. zijn technische bevoegdheid handelen over de kennis over de artikelen vermeld in de desbetreffende nomenclatuur. Het programma van het examen wordt bepaald bij KB van 14 februari 1966, zoals gewijzigd, na advies van de erkenningsraad. De inhoud van dit KB met wijzigingen is opgenomen in bijlage 9.4 (van dit KB). Bij gunstige uitspraak van de erkenningsraad wordt de kandidaat een certificaat bezorgd waarbij een erkenningsnummer wordt toegekend. Indien de bandagist, orthesist en prothesist door het RIZIV erkend is, kunnen de verstrekkingen door hem geleverd aan de verzekerden terugbetaald worden. Deze verstrekkingen moeten door hem individueel aangepast en afgeleverd worden, conform de geldende voorschriften en kwaliteitseisen.

De bandagist, orthesist en prothesist draagt de volledige verantwoordelijkheid.

De opleiding tot gegradueerde in orthopedie telt voor 3 jaar mee in de wettelijk vereiste periode voor het afleggen van het RIZIV-erkenningsexamen aangevuld met 0.5 jaar, 1.5 jaar en 2.5 jaar stage voor respectievelijk bandagist, orthesist en prothesist.

Tijdens deze stage heeft de kandidaat minstens het statuut van werknemer zoals beschreven in de paritaire overeenkomst 128-06.

Orthopedisch onderzoeksmedewerker

De gegradueerde in orthopedie functioneert ook als **medewerker in onderzoeks- en ontwikkelingsinstellingen en -diensten**. Hij is er verantwoordelijk voor het uitvoeren van opdrachten en onderzoeken bij het ontwikkelen en in gebruik nemen van nieuwe technieken, producten en toepassingen met medische oriëntering.

Hij verricht er op zelfstandige wijze goed omschreven opdrachten op gebied van toegepast en fundamenteel onderzoek voor preventieve en wetenschappelijke doeleinden binnen de gezondheidszorg. Hij vervult deze taken in laboratoria en werkhuizen verbonden aan universiteiten, onderzoeksinstellingen en industrieën.

Technisch-commercieel en administratief medewerker

De gegradueerde in orthopedie wordt ook tewerkgesteld als **technisch-commercieel medewerker** in bedrijven met orthopedische artikelen, medisch materiaal,... .

Hij is er binnen een team verantwoordelijk voor:

- de promotie, presentatie, prospectie, marketing, verkoop, lancering en advisering van medisch-technologische producten, diensten en apparaten;
- het uitvoeren en opvolgen van offertes, bestellingen, leveringen, distributie, technische dienstverlening en ondersteuning van klanten;
- productverbetering en versteviging van de marktpositie.

Appendix 2.3. Mission statement Fontys University.

Mission statement (English Version)

Fontys: a learning community

Fontys is an open organisation, where learning is a process of interaction with the environment.

Fontys is a specialist in training.

A broad range of courses offers students and course participants the possibility to make their own choices.

Within the Fontys community, you learn together, with one another and from one another. You above all learn with others: lecturers and students in ever changing groups. Academic people training: this is the ideal we share together.

In that sense, Fontys is a true learning community.

To learn is to experience.

To learn is to train your entire being: heart, head and hands.

A fascinating process, which means pleasure and offers satisfaction.

Learning influences behaviour and ideas: education makes you a richer human being.

Learning forms knowledge and opinions; study pays off.

Learning deepens the dialogue between the student and the world around him, maybe even over national borders.

Learning at Fontys is to live and experience life.

The Fontys student designs his own career.

The Fontys student organises his own route through the range of courses available.

He formulates his own learning demand.

He reflects critically on his own learning process, his strengths and weaknesses.

He uses the rich learning environment with fascinating ICT possibilities offered by Fontys, and manages his own learning process, with lecturers as consultants for learning routes, resulting in a personal portfolio.

In other words, the student designs and implements his own education.

Fontys is big in the small-scale approach.

Fontys is one of the largest educational organisations in the Netherlands.

Fontys is multicultural and multicoloured. Everyone wishing to go into higher education is welcome there, and can find a suitable course of studies.

The numerous students and course participants can all find their own niche.

Because Fontys is so large, we can focus on the small scale.

A large tree, after all, has many branches.

Intensive knowledge circulation.

The Fontys University of Professional Education is a gate to knowledge, a hub for theoretical knowledge and experience from the world of work.

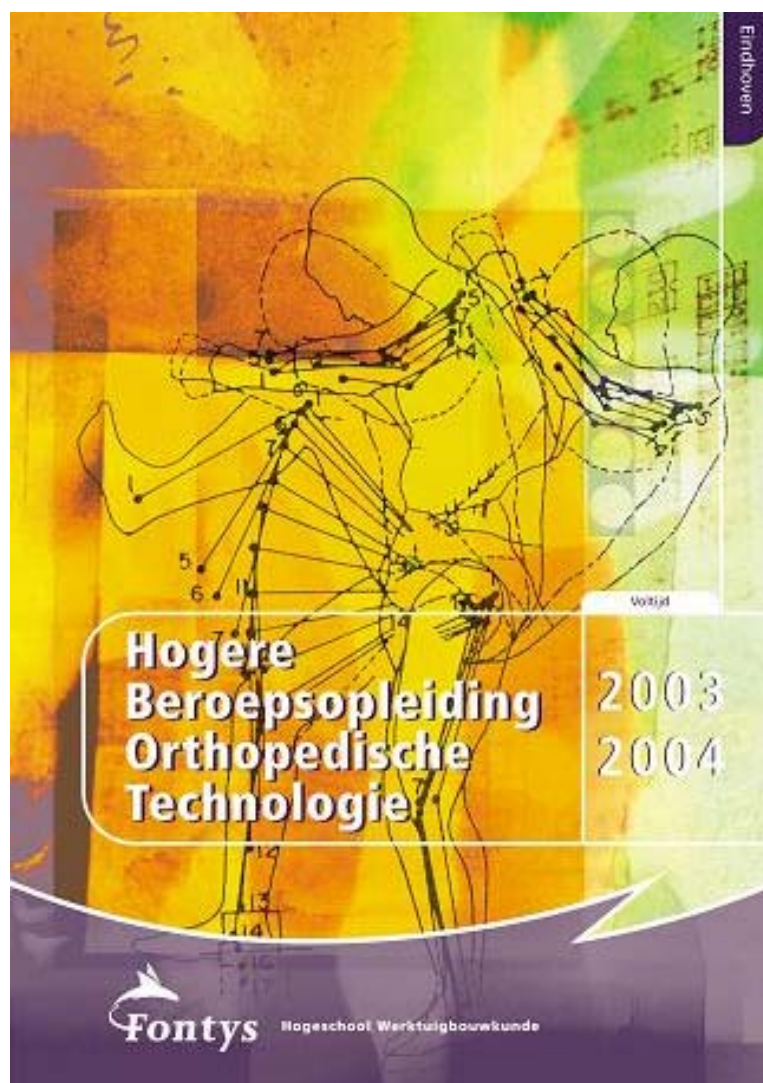
The Fontys student becomes a professional; courses are ever practical.

Theory and practice go hand in hand, and by necessity complement one another.

The course lays the foundations for a lifelong learning process.

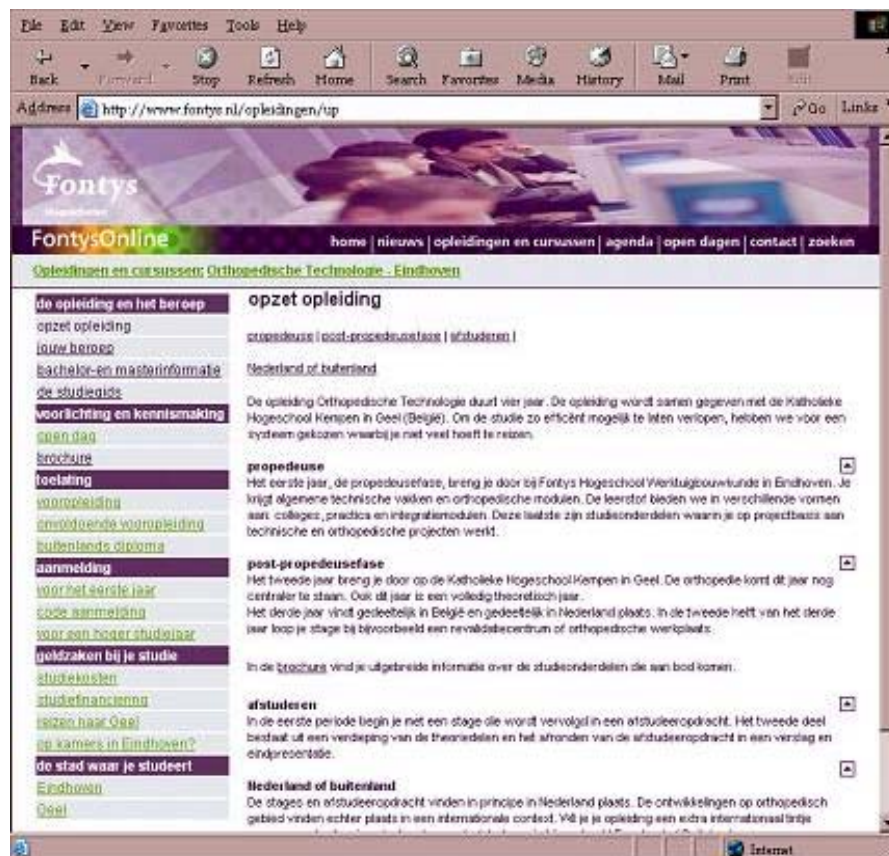
Lifelong learning: a never ending story.

Appendix 2.3.5-1 Brochure Cover



The cover of the Prosthetic and Orthotic course.

Appendix 2.3.5-2 The internet-site



The homepage of the internet-sit of the prosthetic and orthotic course.

Appendix 5.3 The questionnaire and introduction letter



from : F. C. Holtkamp
address : Fontys University of professional education
Faculty of engineering
Dept. Prosthetics and Orthotics / Medical Engineering
P. O. BOX 347
5600 AH Eindhoven
the Netherlands
tel. : ++ (0) 877 875510
fax : ++ (0)877 876233
e-mail : F.Holtkamp@fontys.nl
date : Friday, 06 September 2002
ref : qua_info_2_2002

Dear Sir., Ms.

As already mentioned at the POEM congress in Jönköping Sweden, last August, I hereby send you this letter with a small questionnaire. As you perhaps can remember, last year in The Netherlands we started a four year full time Bachelor degree level Prosthetics and Orthotics course. In relation to these developments I'm also working on a research study. One of the goals of this research study is to collecting some information from other courses worldwide to compare with our course, in order to adjust (if necessary) our course. In order to compare the diversity of programmes, I would like to get a little insight by asking questions like what is the entry level for the p&o course at your University and at what level graduates find employment after finishing there education. The data which will be collected will be handled anonymously.

Therefore I would like to ask you politely if you would answer the questions about your course in prosthetics and orthotics. The questionnaire is attached below this letter and will take about 10 tot 15 minutes of your time. You can send the file with answers back by email, this is the fastest way. If this doesn't work then you can send this questionnaire back by the "old fashioned mail". The address is listed above.

If you would wish to see the results after the study is completed please let me know.

Thank you for your co-operation,

Yours sincerely,

Fred Holtkamp

This question form is firstly intended to collect information about BSc courses in P&O. If you also provide a MSc course, please copy this question form and use one for the BSc and one for the MSc course.

1. General

1.1 Name of University			
1.2 Jurisdiction (e.g. Government / State etc.)			
1.3 Type of programme (e.g. full-time, part-time etc.)			
1.4 Final award (e.g. BSc, MSc)			
1.5 Average age of first year students			
1.6 Gender	% male	% female	
1.7 Entry level requirements to enter the course:			

2. Curriculum:

2.1 Duration of study					
2.2 Total study hours of the complete programme					
	Year 1	Year 2	Year 3	Year 4	Year 5
2.3 Total contact hours (clinical plus academic)					
2.4 Total clinical hours (inside the university, lab hours)					
2.5 Total academic hours					
2.5.1 Total lecture hours					
2.5.2 Total hours of problem based learning (if applicable)					
2.5.3 Total practical hours					
2.5.4 Total tutorial hours					
2.5.5 Total IT skills hours Computer exercises, Cad / Cam, Simulation / modelling / programming					
2.6 Total hours in work placement / traineeship (outside the university)					
2.7 Total hours final project					

Please **X** which is appropriate

2.8 Do you use problem based learning methods in your teaching materials?	Yes	No
---	-----	----

2.9 Which, if any, are the core subjects in your curriculum?

--

3. Work field traineeship and / or final project

Please **X** which is appropriate

3.1.1 Who supervises the student during the clinical periods?	the university	clinic or company
3.1.2 Who supervises the student during traineeship provided?	the university	clinic or company

3.2 Placement of traineeship usually in :	Private sector	National health service	Both
---	----------------	-------------------------	------

Please **X** which is **not** appropriate

3.3.1 Can students choose their own placements during the Traineeship /practical period?	Yes	No
3.3.2 Can students choose their own placements during the final project?	Yes	No

3.4 Do students have to write a report on their period of practical training?	Yes	No
---	-----	----

3.5 Do students have to write a report on their period of final Project?	Yes	No
--	-----	----

4. Study progression

4.1 On average how many students progress annually from Year 1 to Year 2?	
4.2 On average how many students progress annually from Year 2 to Year 3?	
4.3 On average how many students progress annually from Year 3 to graduation or to year 4 <i>(if applicable)</i>	
4.4 On average how many students progress annually from Year 4 to graduation or to Year 5 <i>(if applicable)</i>	
4.5 On average how many students progress annually from Year 5 to graduation <i>(if applicable)</i>	

4.6 In your opinion which part of the programme do students find most difficult?

4.7 In what kind of positions do final graduate students find employment?

If you want to share any other kind of information concerning this questionnaire, please you the box below.

5.1 Comments:

Thank You for your time!

Appendix 5.5 Collected data (original data)

DATASHEET.(original data)

University	1.2 jurisdiction	1.3 Type of programme	1.4 Fnal award	1.5 average age	1.6 gender %
	gvernmt min of edu. / health	1 full-time	1 BSc	1	male female
	private	2 part-time	2 MSc	2	
		both	3 both	3	
		other	4 other	4	

1	1	1	4	24	50	50
2	1	3	3	19	50	50
3	1	1	1	25	50	50
4	1	1	4	24	50	50
5	1	1	3	20	50	50
6	2	1	4	26	85	15
7	1	1	3	18	33	67
8	1	1	1	23	50	50
9	1	1	1	18	70	30
10	1	1	1	18	70	30

University	1.7 Entry level req.	2.1 study duration (yrs)	2.2 total study hours (cp)	2.3 total contact hours				
	school of higher general secondary education	1		Year 1	Year 2	Year 3	Year 4	Year 5
	pre-university education	2						
	Both high. Gen endu or pre-univ	3						
	BSc	4						

1	4	2	1600	786	820			
2	2	3	4800	1100	1100	1600		
3	3	3	4800	1600	1600	1600		
4	1	2	2185	1239	946			
5	1	4	6000	600	600	600	600	
6	4	1	1850	1850				
7	3	4	4436	942	942	972	1610	
8	1	3.5	5600	1440	1200	1000	200	
9	2	3	4800	680	890	1040		
10	3	4	6700	1020	680	890	1040	

University	2.4 total clinical hours (lab)					2.5 total academic hours					2.5.1 total lecture hours				
	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

1	320	320				256	290				158	280			
2	300	400	400			1100	1100	1100			200	200	200		
3	506	506	506			1093	1093	1093			546	546	546		
4	399	447				805	447								
5	100	325	300			450	275	200							
6	520					1330									
7	438	588	588	1610		942	942	972			505	336	384	0	
8	80	80	80			1360	1120	920	200		790	820	680	180	
9	260	180	40			420	710	1000			350	300	300		
10	10	260	180	40		890	420	710	1000		450	350	300	300	

University	2.5.2 total PBL hours					2.5.3 total practical hrs. (in U.)					2.5.4 total tutorial hours					University
	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	

1	98	110				210	210				0	0				1
2	120	120	120			200	400	400								2
3	160	160	160													3
4																4
5																5
6																6
7						438										7
8	320	80	40			210	180	120			80	80	80	40		8
9						200	180	80					20			9
10	560		40	40		80	200	180	80		40			20		10

University	2.5.5 total IT hours					2.6 total Traineeship hours (out U.)					2.7 total FP. hours				
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 1	Year 2	Year 3	Year 4	Year 5	Year 1	Year 2	Year 3	Year 4	Year 5

1	0	16				0	0								
2	30	30				30	30	50					400		
3	10	60	80			21	32	60					400		
4	5	10				35	35					68			
5						30	0	90	480						
6						500									
7	21	24							1610					1610	
8	40	40	80	20		160	400	480	320				120	280	
9	40	60	20				320	800					800		
10	40	40	60	20				320	800					800	

University	2.8 Use of PBL		2.9 core subject	3.1.1 supervising cl.p.		3.1.2 supervising traineeship		3.2 placement in traineeship		3.3.1 Free choice of	
	YES	1		University	1	University	1	private sector	1	YES	1
	NO	2		Clinic/company	2	Clinic/com	2	NHS	2	NO	2
				Both	3	Both	3	Both	3	Non Applic	3
				Non Applicable	4	Non Applic	4	Non Applicable	4		

1	1		3	4	4	3
2	1		3	3	3	
3	1		1	3	3	2
4	2		3	3	1	2
5	1		3	4		1
6	1		3	2	3	1
7	1		1	2	3	2
8	1		3	3	3	1
9	2		3	3	1	1
10	1		3	3	3	1

Core subjects indicated by the universities

clinical theory	111
clinical practicum	1111
biomechanis	11111111
material science	11111
life science	11111
prosthetic science	11111
orthotic science	11111
anatomy	1111111
pathology	111111
neuroscience	1111
research methodology	11111
gait analysis	111
kinesiology	11
mechanics	111

University	3.3.2 Free choise of		3.4. Written report on		3.5. Written report on	
	YES	1	YES	1	YES	1
	NO	2	NO	2	NO	2
	Non Applic	3	Non Applic	3	Non Applic	3

1	3	3	3
2			1
3	2	1	1
4	2	1	1
5	1	1	1
6	3	2	3
7	1	1	1
8	1	1	1
9	1	1	1
10	1	1	1

University	4.1 nr. Student progres 1-2	4.2 nr. Student progress 2-3	4.3 nr. Student progress 3-4 nr. Student gradu-ation	4.4 nr. Student progress 4-5 nr. Student gradu-ation	4.5 nr. Student gradu-ation
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1	8	8			
2	30	28	28		
3	11	10	10		
4	11	9			
5	20	18	18	18	
6	40				
7	24	22	20	20	
8	21	20	20	20	
9	22	15	14		
10	12	8	1	**	

** not available yet

University	4.6 most difficult parts		4.7 employ- ment posi- tions	5.1 Rem-arks
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1				
2				
3				no field traineeship, after study two
4				after study two years internship
5				
6				after study one year internship
7				
8				
9				
10				curriculum started in 2001

Indicated most difficult parts of curriculum (university independent).

practical segments	1
anatomy	11111
mechanics	1111
biomechanics for P&	1111
pathology	11
materials	1
lab/tec. Procedures	1
orthotic science	1

Indicated employment positions (university independent).

hospital	1
rehab centre	11
private practise	11
prosthetists	1111
orthotists	1111
orthopaedic shoemaking	1
research	1
consultant	1

Appendix 7. The credit point table, curriculum p&o.

Credit point table curriculum 1st year HBOT FHW year 2002/2003

year	semes	study subjects						tot. ECTS
1	1	CO 11 competence developent	Math 11 basic math w11	T 11 Medicine science anatomy / physioloiy	T 12 material science p1	OO 11 Introduction General Orthopedics	PCCS	30
				applied electronics m1	introduction production techniques P3	4 sp	1	
		competence developent	differentiate & integrate	construction / desing k5	material science introduction production techniques P1	OO 12 Orthopedic technology/ production	2	
		2 nSP	6sp	7sp	7sp	4sp		
	2	CO 21 competence developent	Statica 21 Mechaics k1 / k2	T 21 applied electronics m2	T 22 cad /cam / constru.	OO 21 Orthopedic technology/ wheelchairs 4 SP	3	30
				math w3	Innovation			
		competence developent	Mechanics K2 / K3	math w2	mech. Engineering k4 math w4	OO 22 Podiatry / inlays	4	
		2 SP	6 SP	6 SP	7 SP	5 SP		
								60

Year 2

Year	semes	study subjects										tot. ECTS
2	1	1. comm. Skills	2. data processing 2a. statistics	2. data processing 2b. Informatics	3. mechanics 3a. mechaics 3b. mechanics practice	5. medicine science 5a. anatomy 5b. fysiology 5c. Gait	6. general. Psychology	10. production techniques 10b. Productin techniques	9. orthopedic technology	10. production techniques 10a. Production techniques	8. math. 8a.math.	10
	2		7. chemistry materialsc. 7a. chemistry		4. biomechanics 4a. biomech. 4b. Measurement			7. chemisrty and material-science 7b materialscience		8. math and electricity 8b. electricity	50	
		4sp	2sp	4sp	6sp	10sp	4sp	2sp	6sp	10sp	2sp	60

Year 3

year	semester	studysubjects												tot. ECTS
3	1	1. comm. Skills	3. orthoses 3a.theory	4. Drawing techniques drwaing / cad cam	10. bio-mechanics	2. general pathology 2a. Pathology 2b.first aid	11. Medicine science hygiene en rehabilitation	6. Production techniques	5. orthopedic technology	8. electricity theory & practicek	7. Business administrati on 7a. Business administratio n Production technology	7. Business administratio n 7a. Business administratio n	9. Material science	18
			1sp		4sp	6sp				3sp	2sp	2sp		
	2		3b orthoses practice											3
		internship work placement										14sp		14
		4sp	2sp				4sp	5sp	6sp				4sp	25
														60

Year 4

year	semester	studysubjects												tot. ECTS
4	1	internship and final projectwork										30		30
	2	2. comm. skills	1. Social studys 1b.filosofy	3. law & ethics. 3a. Law	4. Business administration 4a. Mangement	6. Medicin science 6a patholo. 6b. H&r	1. Social studys 1a.	7. orthope- dische technology						3
		4sp	2sp	3. law & ethics 3b ethics	4. Business administration 4a. cadcam	6. medische wetenschappe 6a path. 6b. H&r	5. electronics Theory 5b. Praktce					completion final project, dissertation, presentation, defending		27
														60

