CURRICULUM DIFFERENTIATION FOR MASTERS IN PRODUCT DEVELOPMENT

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ABSTRACT

Based on the input from industrial competence centres and consultative group meetings with academics and practitioners, the product development department of the faculty of design sciences has developed a new masters programme giving students the possibility to differentiate by concentrating more on specific domains: interaction design, strategic design, advanced product design and systems design. Although the programme maintains the focus on the integrated approach of a development process for products and services, throughout the first masters year students will be able to gain more skills and competences on specific issues, in order to become more proficient and to adapt their skills to their future professional targets. The programme is to be implemented the coming years.

This paper describes the new masters programme concept and goes into detail on the theoretical principles behind the programme, the approach, the nexus with the research programme and the consequences of this programme in function of the assessment of students in applied product development courses. Milestones and deliverables have been redefined in order to guide the student's applied development or research projects. New sets of criteria have been developed to assess the milestone and final deliverables throughout the projects.

Keywords: master programme, strategic design, product design, interaction design, systems design

1   INTRODUCTION

Typical to the rather young professional field of product development is the fact this field is changing rapidly due to a changing world and emerging trends in innovation. These trends not only influence the nature of the new products to be developed but also the way they are developed and the way innovation makes part of our daily life. On the other hand, the basic approach to develop new products and services remains very much the same. Every design cycle has an analytical and a synthesis related component. There is also the same need for simulating and evaluating new proposals and to make decisions based on qualitative or quantitative data.

As such, the main stable component in the field of product development is its generic process, which builds up a reasoning from the abstract to the concrete, from function to form, from need to requirement and which can and should be adapted to its specific context.

The master programme in product development chose to adapt to a changing context. However, not by getting rid of its traditional process approach but, instead, by focusing on a deep-rooted process knowledge and understanding of the underlying rationale. This way, it creates the opportunities for students to elaborate and diverge on this process in a specific context.

As a result, the faculty of design sciences developed a new curriculum, based on the input from students, academics, practitioners in industry and the accreditation commission visiting the institute. The proposed curriculum was challenged on different occasions with a diverse expert team of practitioners both from industry and specific competence centres and academics from similar faculties at other universities. They were questioned on the relevance of the choices made and the possible critical consequences of these choices.

2   FOUR SPECIFIC MAJORS

As a result of inquiries both on student's profiles and group meetings with representatives from industry and academia, four majors have been defined in the master programme: **strategic design**, **interaction design**, **advanced product design** and **advanced systems design**. Each of the majors covers a specific part of the product development process cycle or covers a specific issue.
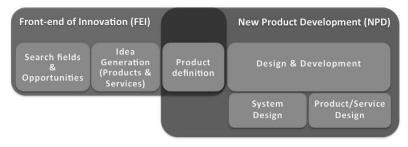
*Figure 1. Process Model for Product Development,
based on Buijs (2008), Braet & Verhaert (2007)*

Figure 1 represents the entire product development process cycle with two major components. The Front-end of Innovation (FEI) where new products are defined prior to development [1][2][10] and the New Product Development (NPD) phase in which products are actually developed. NPD ends with the start of product production and launching. The design & development phase is divided in two parts: system and product design [7][9]. System solutions give an answer to the critical and primary development issues. Product design solutions cover the materialization and actual designed shape of a product. Product design solutions are more detailed than system design results. The additional milestone of system designs provides an opportunity to break a complex design problem into manageable parts and to approach this problem in a broad and creative way.

Although this cycle is represented as a linear sequence, we know that these processes occur often in a more circular way. The end of the cycle is often the beginning of a new one [11].

The four majors focus on a specific aspect of this process model. Each of the majors defines a specific kind of development project and is related to a specific kind of product development job or even a designer's specific profile. However, although every major focuses on a specific aspect of product development, in general, every major follows an integrated product development rationale.

2.1 Strategic design

The strategic design major focuses on the Front-end of Innovation. It covers mainly the part of product definition. The final deliverable of a project is the definition of a product or service to be developed, within the strategic context of a firm. Due to the fact these strategic design projects don't reach deep in the development cycle, they are supposed to gain importance in depth and breadth.
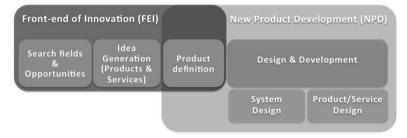

Figure 2. Process model for strategic design

2.2 System design

The system design major covers mainly the New Product Development (NPD) phase. In addition, within the NPD the focus is on the sub-phase of system design. These kinds of projects are often more technology oriented as systems development requires often the screening and decision-making on availability and deployability of technologies. However, although system design is an NPD issue, projects are supposed to be an integrated product development project, starting from a definition

process in the FEI and leading to a product design in the end. Due to the nature of the project and its main issues, the focus will be on system level design problems.
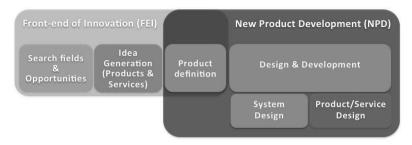

Figure 3. Process model for system design

2.3 Product design and Interaction design

Unlike system design, both product design and interaction design focus more on the materialization phase of development. The challenge of good design within this context is to be found in the way the actual integration is fulfilled between the production techniques, the general construction issues, the usability of the product and the final appearance, delivering added value in its functionality, characteristics and styling. However, these parameters could differ somewhat for physical products compared to services.
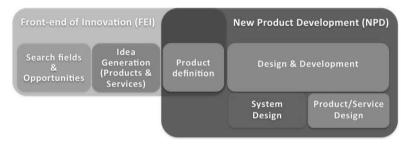

Figure 4. Process model for product and interaction design

3   ARGUMENTS AND INTENDED RESULTS

A number of causes and arguments have led to the development of the new curriculum.

First of all, individual innovating firms have different needs on behalf of their future employees. Large companies seek for a wide range of competences: there is the need for product developers to work in the development, design or R&D labs. However, they also have the need for innovation managers to support these processes and initiate the new innovation programmes of the firm. Their tasks are more strategic oriented, rather than actual developing and designing new products. This is mainly a need in larger innovating enterprises, investing in exploration of new business opportunities. Although typical design skills might not be perceived useful in FEI, design thinking and visualization techniques can add major value to the approach in the Front-end. FEI requires divergent and convergent thinking just like the rest of the innovation process cycle.

Nevertheless, there is also a broad need for young designers with the traditional and essential design skills. These profiles are both required in the design and development departments of SMEs and larger firms but also in small design consultancy firms. However, even then, a specialization is an advantage. Depending on the nature of the firm and the nature of its products or services, advanced skills in system design, interaction design or product design provide the student with the appropriate profile for a specific job. Moreover, it gives the student the opportunity to elaborate on his or her own strengths, rather than to experience frustrations on specific aspects of the education programme.

In addition, to fulfil its academic mission, the master programme is to be embedded in a scientific research programme. A clear focus on dedicated research topics provides the necessary channels for research in order to implement a clear link between research and education.

4   THE APPROACH

The full masters programme covers 4 semesters of which the first semester is an orientating semester. Specific courses introduce the four majors essentials and support the students to make the right choice at the end of semester one. The four majors are presented as different modules. Every student is supposed to enrol for two modules in semester 2, each module representing 6 credits. Related to one of those modules the student will also work on a dedicated design project and the master proof. This programme track is the Major. The student will also follow the track of a second module, without additional design projects. This is the Minor. See the example in Figure 5, which shows a Major in strategic design and a minor in interaction design.

Semester 1	Semester 2	Semester 3	Semester 4
Advanced Strategic Design essentials (3)	Advanced Strategic Design module 1 (6)	Advanced Strategic Design module 2 (6)	**Major** **Strategic design**
	Advanced Strategic Design Project (12)	Advanced Strategic Design Masterproof (6)	Advanced Strategic Design Masterproof (24)
Advanced Interaction Design essentials (3)	Advanced Interaction Design module 1 (6)	Advanced Interaction Design module 2 (6)	**Minor** **Interaction design**
Advanced Product Design essentials (3)	Advanced Product Design module 1 (not chosen in this example)	Advanced Product Design module 2 (not chosen in this example)	
Advanced System Design essentials (3)	Advanced System Design module 1 (not chosen in this example)	Advanced System Design module 2 (not chosen in this example)	
Design Project (12) Compulsory courses (6)	Compulsory courses (6)	Compulsory courses (12)	Compulsory courses (6)

Figure 5. Example of a major and minor track, alongside the compulsory courses

5   EVALUATION CRITERIA

The Masters programme focuses on a (design) project-oriented approach. In addition, every design project in the integrated product development consists of specific milestones and specific deliverables and has to meet specific criteria. Related to the above-mentioned process, a design project is divided in three major phases, resulting in a specific milestone for in-between evaluation and feedback:

5.1   Product definition level

All FEI-activities lead to the product (or service) and project definition deliverables. This definition phase mainly leads to the proposal of a new innovative product idea that has been underpinned by market and technology related research. It clearly demonstrates the added value it will deliver for all stakeholders in the value chain. The product definition gives an overview of all the decisions made along the way but also provides inspiration for the development to come.

5.2   System design level

System level design focuses on the invariant elements of a product-service-system. It will mainly deliver the answer to the question how the product/service works and of which essential critical elements it consists. Decisions made on system design level should never be overruled by decisions on the product design level. It provides the integrated solution for critical issues.

5.3 Product design level

This design level is the most concrete and should result in the final and integrated product design. Materials, production techniques and styling are the main ingredients.
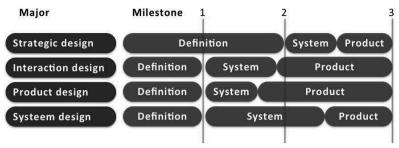

Figure 6. Project milestones timing

Every project level has its own specific topics and deliverables and is assessed by dedicated criteria to inquire whether or not the student meets the milestone terms (Table 1).

Table 1. Generic deliverables and evaluation criteria

5.1 Product definition level	5.2 System design level	5.3 Product design level
Deliverables		
Product functions	Product principles	Product solution
Product architecture	Sub-system interactions	Product styling
Product requirements	Technology screening	Product construction
Feasibility screening	Technology integration	Usability verification
Design verification plan	System verification	Market verification
Market verification		Integrated design
Criteria - The quality of the …		
Target analysis	System analysis	Integrated design solution
Definition synthesis: Ideas-architecture-requirements	System Design Solution + Evaluation of alternative solutions	Evaluation of alternative solutions
Scientific Foundation (Human-Economical-Technological)	System verifications (Human-Economical-Technological)	Concept verifications (Human-Economical-Technological)
Design related research	Design related research	Design related research
Project management	Project management	Project management

However, due to the fact that every major has a specific approach and specific criticalities, the milestones timing is incompatible with the organized feedback and evaluation moments (Figure 6). An option could be to organize dedicated in-between evaluations adapted to the major. However, it could also mean that the assessment criteria need to have a specific character throughout the different evaluation periods.

Table 2. Specific deliverables (D) and evaluation criteria (C) at the different milestones (1)(2)(3)

Strategic design	Strategic	Interaction	Product	System
Deliverables (D) and criteria (C) at specific milestones (1) (2) (3)				
Strategic analysis,	D1, C1			
Trends (external) analysis, Market analysis	D1, C1	D1	D1	D1
Road mapping	D1, C1			
Technology screening	D1, C1	D2	D2	D1, D2, C1, C2
Product portfolio analysis and development	D1, C1			
Brand design	D1, C1		D3, C3	

Opportunity scouting	D1, C1	D1, C1	D1, C1	D1, C1
Business model definition	D2, D3, C2			
Product functions definition	D1	D1	D1	D1
Product sub-functions definition	D1	D1	D1	D1
Product requirements & architecture definition	D1, C1	D1, C1	D1, C1	D1, C1
Technological feasibility screening	C1, C2	C1, C2	C1, C2, C3	C1, C2, C3
Economical feasibility screening	D1-3, D1-3	D1	D1	D1
Design verification plan		D1	D1	D1
User touch points analysis		D1, D2, C1	D1, D2	D3
Interface development		D2, D3, C2, C3	D3, C3	D3
Usability verification		D2, C3	D3	D3
Materialization, construction		D3	D2, D3, C3	D2, D3, C3
System verification			D2	D2, C2
Styling		D3, C3	D2, C2, D3, C3	D3
Design related research	D1, D2, C1, C3	D1, D2, C1, C3	D1, D2, C1, C3	D1, D2, C1, C3

6   CONCLUSIONS

The feedback on the proposal for the new curriculum is very positive, both from the point of view of the practitioners as the competence centres due to the fact that the existing strengths have not been abandoned. Instead, new opportunities have been created to obtain an even higher level of competence output, giving students the possibilities to position themselves strongly in the market. The upcoming implementation of this curriculum will possibly bring positive evidence on the choices made.

In an attempt to implement a correct and objective assessment system, existing deliverables and assessment criteria have been altered to obtain a dedicated set of criteria. Despite the fact that this would add complexity to the assessment system for the staff, it provides the necessary tools for objective assessment.

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