INTERNATIONAL CONFERENCE ON ENGINEERING DESIGN, ICED'07
28 - 31 AUGUST 2007, CITE DES SCIENCES ET DE L'INDUSTRIE, PARIS, FRANCE

TEACHING AND MENTORING STRATEGIC DESIGN BEYOND THE STUDIO ENVIRONMENT

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ABSTRACT (250 words max)

As the profession of industrial design is getting more competitive, designers are expected to embark on the *Right Alliances'* to survive and succeed in a global market where end-customers are becoming more demanding. The common practice where Industrial Design consultants operate, as a separate contributor, to generate 'good designs' to R&D processes may soon be obsolete.
The above indicates that there is a need to revise consultant- client working relationships in the field of Industrial design. To offer a more complete service, designers may need to work closely with the client's R&D, or join forces with contract manufacturers to be more proactive in integrating down-stream engineering and manufacturing processes in development and realisation of the end product.
From an educational perspective, teaching and mentoring within and beyond the studio context should be emphasised.
This paper discusses a three stage approach to prepare students early in their design career for the opportunities and challenges in real-life practice. Inherent in this approach is a positive attitude towards mentorship, as well as a well-planned core design curriculum, based on systems and strategic design, which extends beyond the education program.

Keywords: Design Collaboration, Studio Teaching and Mentorship, Systems and Strategic Design

1 INTRODUCTION

With the globalisation of design, the creation of single entity products would no longer meet the needs for solving complex problems within an environment where technologies become more advanced and complex, as well as user needs more diverse. Competitive advantage will only be created through the development of innovative products, services and systems. Therefore, companies are required to become more and more dependent upon supply chain relationships, as these provide a vehicle by which to deliver high quality and value for money products [1].
Within the context of design education, today's challenges are to prepare future designers to operate efficiently and effectively in a design and development environment, which is highly competitive, fluid and collaborative. An Industrial Designer, functioning in a conventional manner as a design consultant or being employed by an organisation to produce design solutions, may soon be obsolete. Not only is the designer expected to solve strategic design problems, but he or she also needs to adopt an own strategic approach, mainly by entering into the *'Right Alliances'* to survive and succeed in a global market where end-customers are becoming more demanding.
Faced with future challenges, an industry is supposed to show structural reform as well as the ability to produce client- and user-oriented solutions, along with innovations aesthetically distinct from those of competitors, in a cost-efficient way. This is not an easy task, but industrial design is a definite asset in facing the competition, because competence in design is what bridges the gap between the user's perspective and technology-oriented product design [2]

2 CHALLENGES FOR AN INDEPENDENT CONSULTANT

A designer's career usually starts with on-the-job training. After normally 1 to 3 years of training, they advance to higher-level positions. Experienced designers in large firms may advance to chief designer, design department head, or other supervisory positions. Others open their own firms.
In a situation where a fresh graduate opts for setting up an own design consultancy, he or she usually capitalises on the need for further development of the final outcome of the design thesis. For example,

Theo Groothuizen has co-founded with Ton Haas and Marcel Vroom Landmark Design & Consult BV and DMD BV Rotterdam, the Netherlands (1987-93), and contributed to start with, with a project from PTT telecom (Dutch Telecom); 'Design of a Public Phone'. The project was initiated and conceptualised as part of Groothuizen's master thesis [3].
Another classical example of a consultancy, which has been established after four co-founders recently graduated from NTNU in 2004, is Kadabra Design. A recent interview with Carl-André Nørstebø revealed that the start was financially difficult. The 3 projects, which were further developed as a continuation from University Projects, proved not sufficient enough to sustain the four member team. Other financial resources were brought, such as a study loan (one of the co-founders decided to embark on another study, while being involved in the consultancy), side jobs, loan from parents, etc. In terms of facilities, the department of product Design assisted in providing a 'working place' for the initial 2 months. Only 9 months later Kadabra Design received a start-up fund of 175000NOK *(Norwegian Kroner)* by joining an incubator.
The positive side of the story is that project acquisition went very well as the Norwegian economy is flourishing. On the average, large and small project came in every 2 - 3 months, mostly through and informal network of referrals. Presently, the four member team has the luxury to focus on core industrial design project and by selecting clients, they like to work with. Unlike in the beginning there is no need to survive on small web, graphic and exhibition design projects. Turn-over has grown exponentially from 70000 – 1200000NOK in the first 3 half-years, whereas the past two half-years have shown a turn-over of respectively 1600000 and 1800000NOK.

Although the above two example paints a positive picture of Design Consultancy, the business has always been characterised by a narrow and competitive clientele, which forms a challenge to the consultants. This situation keeps the consultants' turnover low which, in turn, weakens their capacity to seek growth in the international market. Furthermore, consultants and their clients only rarely manage to establish, foster and maintaining long-term client relationships, the benefits of which would be unquestionable both in cost-efficiency and quality, compared to unsystematic, project-based operations [4], [5].
In terms of real-life practice, the interaction between design consultants and their clients considering the competence in their organisation has been discussed as a challenge for the former. Research findings revealed that the design consultants are not sufficiently able to package and sell their skills and knowledge and their challenges seem to culminate in the management of the interface between them and their clients [6]. The reason may be that independent consultants' working procedures, possibly inherited from the tradition of low-tech art and craft manufacture, do not assist the effective utilisation of ID in the field of engineering. This may lead to the situation where the consultant operates infrequently or too far from the company to be able to solve valid problems.
Recent trends have indicated that companies will not construct large inner ID organisations, but needs to find new competitive means and challenges of product development in the network. In the past, most companies placed designers near the end of the product development sequence of activities, which significantly reduced designers' potential for contribution to corporate goals and strategies [7]. This means that from a client's perspective, Industrial Design consultancy services are seen as a separate contribution to R&D processes [2]. In addition, the client usually have very little capacity and hands-on experience of how to bind contracted ID expertise to their own processes, resulting in unsuccessful try-outs to involve design consultants to achieve a competitive advantage.

The above indicates that there is a need to revise consultant- client working relationships in the field of Industrial design. To offer a more holistic approach at the client's side, where Industrial Design will be more integrated in the client's R&D activities, the design consultant should be more proactive in integrating down-stream engineering and manufacturing processes in development of and realisation of the end product.

3 CHANGES WITHIN DESIGN EDUCATION

As described in the previous chapter, developments in the ID profession have initiated some significant transformations in design education [8] and changed the value and core of the traditional skill sets for an industrial designer. Relevant in terms of design collaboration are: 1) The need for designers to understand other design fields and interact more with other disciplines, as the boundary

between design disciplines is becoming fussier. 2) The need for interdisciplinary teamwork, not only involving traditional issues of physiology, materials and technology related to product development, but also user research and lifestyle trends before the product development and social, psychological and ideological issues; 3) The need for systems composed of various products and the interfaces among parts, beyond purely the development of individual products with specific functions [9].
Those transformations need to be carefully brought into formal ID education and Design educators need to take more responsibility to update their knowledge about the professional world in order to help students to prepare for the transition from school to work in order to help students be well prepared for the changes. Otherwise, design graduates would face such problems as feeling unready, lack of self-confidence, business awareness and professional skills [10]. However, compared with the development of design practice, design education has developed more slowly over the past decades, and many design schools continue to teach their students with the traditional design skills, knowledge and processes [11]. Only a few design schools are aware of the trend towards collaborative studio teaching and interdisciplinary teamwork in the real world through industrial design projects with students and faculty from departments of business, engineering and social science.
From a methodological perspective, the extent and content of industrial designers' work have differed from those in the past [12]. Besides focussing only on five out of the seven phases in the product development process (task clarification, concept generation, evaluation and refinement, detailed design of preferred concept and communication of results), students also need to be trained to manage and execute the front-end stages of the design process, namely: product planning, production preparation. This is essential, as the global market is becoming increasingly competitive. For example, some international corporations, including Acer, Apple, Philips, Sony, etc. have adapted a holistic design program to integrate design into the concept-to-market process and let designers participate in decision-making for product planning and positioning [13].

4 THE STUDIO ENVIRONMENT FOR THE 21st CENTURY

The standard criteria to assess the students' abilities in creativity, form giving and model making for the ID students in traditional design studios should be reconsidered. Branham stated, 'student-centered learning will become the dominant pedagogy in design education in the first quarter of the 21st century' [14]. Several learning institutions, such as ENSCI, Les Ateliers and TU Eindhoven have developed educational models, where students are encouraged to self-direct their own learning and determine their role and future career as a 'designer' in the broader context of product development.
However, besides providing students with the flexibility to self-direct their learning, educators should also take up the responsibility to elevate students' future career and employment prospects. This can be achieved by training them how to collaborate structurally within the studio through group work as well as externally with industry. Collaboration refers to a group of people working together to accomplish common objectives and goals within a collaborative framework, which often could not be accomplished individually. The obverse to 'Structured Collaboration' would be unstructured collaboration, which is executed without shared goals, and requires minimally dependency among participants [15]. To constrain the scope of discussion, this paper focuses on structured collaboration within the academic and practice environments of Industrial Design.

4.1 Design Collaboration within the Studio Environment

A process model of collaborative design is to describe certain phenomena in which the design tasks are undertaken to possibly reach the final design [16]. Such a model is important for all stakeholders to understand his/her position in the collaborative project, especially in the field of strategic and systems design. According to Kvan, collaboration is a deeper, more personal synergistic process, and its process involves negotiation, agreement, and compromise in order to achieve success [17]. Figure 1 illustrates a general process of collaborative design driven by decision-making. The design information is delivered from initial state to the final state until the decision-making process is completed. The cyclic process involved consultation, negotiation, decision-making, and reflection. This model helps us to understand how 'structured' design collaboration can be implemented within a collaborative studio environment as well as how design assignments and teaching methods should facilitate this integrated way of learning.

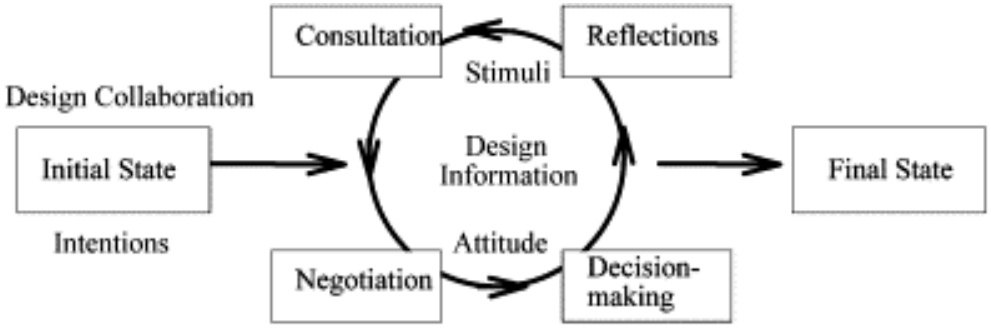


Figure 1. Process model of design collaboration

This structured approach towards design collaboration among project groups as well as between project groups and companies, has been introduced through a systems design project at an early stage of the design education, as well as though a mentoring approach, whereby 'almost' finalised design concepts or solutions are further developed beyond studio teaching.

4.2 A Systems Design Approach

The most inclusive definition of a *'System'* is a set of interconnected entities, comprising people, processes and technologies, which are dynamic in their behaviour and have a purpose or reason for existence [18]. From a system level engineering design approach, complex systems include large products, such as automobiles and airplanes, which comprise of many interacting subsystems and components [19]. In this context of systems design, students need to approach the problem using an increasing number of parallel lines of thought [20]. Those who have a an aptitude to process information and think holistically find it easier to structurally develop the system inclusive of its elements, boundaries and connections, compared to those who prefer to process information in parts independently and sequentially.

Within the context of a studio teaching, systems design facilitates studio collaboration as follows. Firstly, students can work together to gather information for a design project and transform that information into visual formats, such as models, schematics and drawings. Secondly, each student may come up with a different concept or background knowledge for solving design problems and can share that information to help other students. Thirdly, students may have constructive suggestions for others that can help to improve the quality of the group's system or individual designs [21].

4.3 A Mentoring Approach

The scholarship of teaching, in other words 'Mentorship' goes beyond good teaching in terms of mastering the subject and effective delivery. Sachdeva sees mentorship as a more global and long term responsibility for development of the apprentice [22]. For many, the mentoring relationship comprises more personal, closer relationships that demand time, commitment and a level of emotional engagement [23]

Considering the needs of the apprentice, mentoring as a source of learning has become particularly relevant given the boundary-less nature of careers today where changing organizational structures create the need for fast-paced learning [24]. This need for fast-paced learning is becoming more urgent in a transitional and increasingly competitive profession, such as design, where students and junior practitioners are searching for a 'Master' to obtain an added advantage above others.

5. THE EDUCATIONAL-INDUSTRIAL COLLABORATIVE STUDIO CONCEPT

At the Norwegian University of Science and Technology (NTNU), an integrated two-stage studio teaching-mentorship has been adopted to prepare students early in their educational career for the design opportunities and challenges after they have completed their studies. In addition to this, a third stage is in the process of construction, based on experiences at the National University of Singapore (NUS)

The first stage of the approach has been implemented at undergraduate level *(year 2, semester 2 studio)*. Here, the entire class of 20 students entered into a collaborative project with the Norwegian Postal Service, based on a systems approach in design. Results, deduced from system concepts led to a

wide variety of product solutions. Selected solutions were further developed beyond the studio environment, providing some students with the experience of a real-life industrial design setting.
The second stage discusses a sustainable collaborative studio concept at post-graduate level *(Year 4, semester 1 studio)*, based on *'Product Planning and Management'* principles, where each student was allocated a company, instead of a specific design brief. Based on two rounds of studio teaching, a total of 30 well-known Norwegian companies such as, Stokke, Håg, Jordan, Helly Hansen, Tandberg, Lærdal Medical, Borealis, Vestre, Asono, etc. were involved in the collaboration. In line with Hakatie's observation of *'Metso's division of labour between external consultants'*, close collaboration at strategic level during the studio semester led to sustainable collaboration for selected student-company link-ups after the studio has been completed [25].
The third stage elaborates on past collaborative experiences in mentoring freshly graduated Industrial Designers to pursue an own design consultancy. Capitalising on existing "vendor /supplier – client / end – customer" working relationships, a collaborative win-win concept will be discussed, where the newly graduated designer provided manpower services with the help of the vendor assisting with facilities, such as office space, hardware, software, etc. The collaboration proved to be successful as both were able to offer a more complete product development service to their end-customers.

5.1 Systems design in year 2 undergraduate design studio teaching: The Norwegian Postal Service (NPS) project

In the Norwegian Postal Service (NPS) project, it was obvious that systems thinking exposed students to complex design problems at an early stage of their education. From a design teaching perspective, it was a challenging task to be clear and detailed in the organisation and management of studio teaching, as well as the supervision of students on how to plan and manage their projects. The terms 'system' and 'structure' were introduced in the project, whereby the system is the collection of sub-systems and products which make up the mail distribution service, and the structure is the pre-determined logistic framework on which this mail distribution system is based upon [26]. The term structure is diachronous in nature, which means that the relationships are time and sequence dependent.
In the first stage of the project, student teams iteratively generated and evaluated a wide range of system concepts. To understand current and to develop new system concepts, students were guided to undertake observational studies, user-scenario development, story telling, etc. of a wide range of sequential and parallel activities. The above activities uncovered critical issues in systems thinking and task allocation to student group members concerning where to place the boundaries of the system. On one hand, the tighter the boundaries are placed within the system to define activities, the lesser the number of parameters and variables has to be considered explicitly, but the more the crucial interactions will be omitted or simplified. This has led to errors and an unrealistic understanding of the user's situation. On the other hand, the further the boundaries are placed, the more complex are the set of variables and parameters to be considered, and the more work in systems thinking and management is required [27]. The novice design students experienced difficulties in combining broad boundaries with concrete consequence analysis. In such a situation, customized mentorship was necessary to facilitate segmenting system processes into sub-systems or products and allocating design tasks.

In the second stage, these subsystems and products were individually further developed into two or three detailed design concepts. The selected design concept was then subjected to iterative cycles of refinement, user testing and materialisation. After completion of the formal studio, selected designs were commissioned by NPS for further development and professional prototyping.

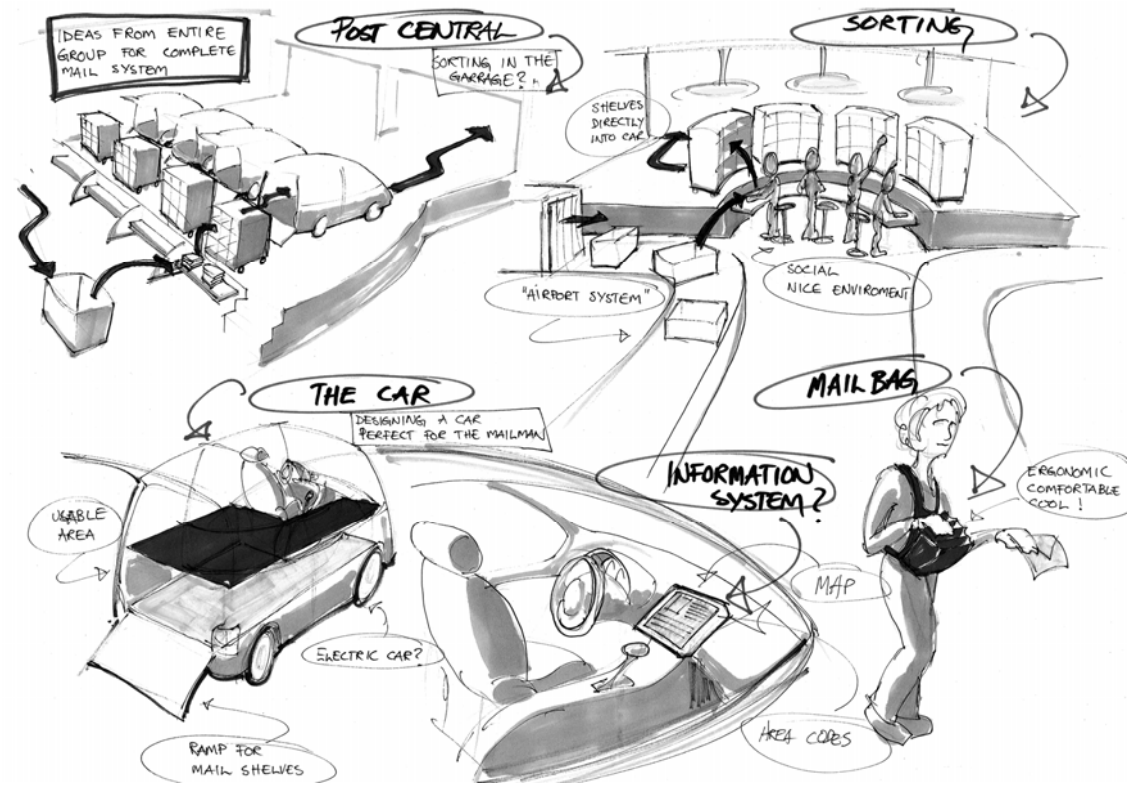


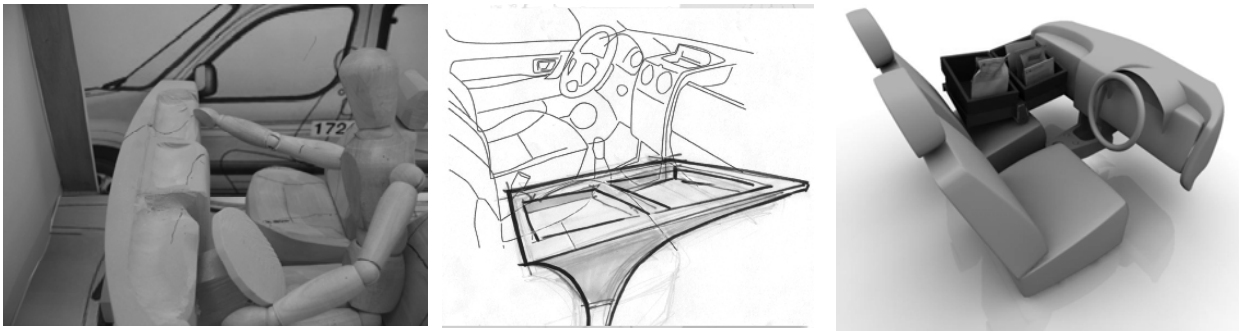
Figure2. Sub-systems and products within the overall system of mail distribution

The example below shows how a selected design concept has been further developed into serie-production after completion of the studio. The design concept refers to a 'Mail Organiser', which is place in the front passenger seat, next to the postman.

Directly after completion of the studio, Norway Post took the lead in the materialisation of the project. They found two different companies to produce the product, and were attempting to make the best product against the lowest price. Very little design input was asked from the student in terms of further development and detailing. The interim result was not satisfactory and several design changes had to be made. This was due to the fact that Norway Post suddenly discovered that it wanted at least 4 cassettes and 3 of them had to be reached easily. The above scenario is identical to a situation what has been described earlier in chapter 2, where Industrial Design consultancy services are seen as a separate contribution to R&D processes.

However, after an iterative process of design and modifications with the design input of the student, Norway Post tested 3-4 different variations of the product before selection. Final modifications resulted in a product, which fits 3 cassettes on top and 2 under, with a modification to be made to the divider between the front and cargo side of the vehicle.

Although the development process after completion of the formal studio was tedious, feedback from users has been positive. Up till now, 1200 pieces, worth 3,5 million NOK have been ordered from contract manufacturer Loyds Industri (Frederikstad, Norway)



Figures 3A, 3B & 3C, Analysis and concept development of a front-seat mail sorter (Bjørn Hembre, during Year 2 design studio)

Figures 4A, 4B & 4C. User testing and detailing and prototype development (Bjørn Hembre, after year 2 design studio)

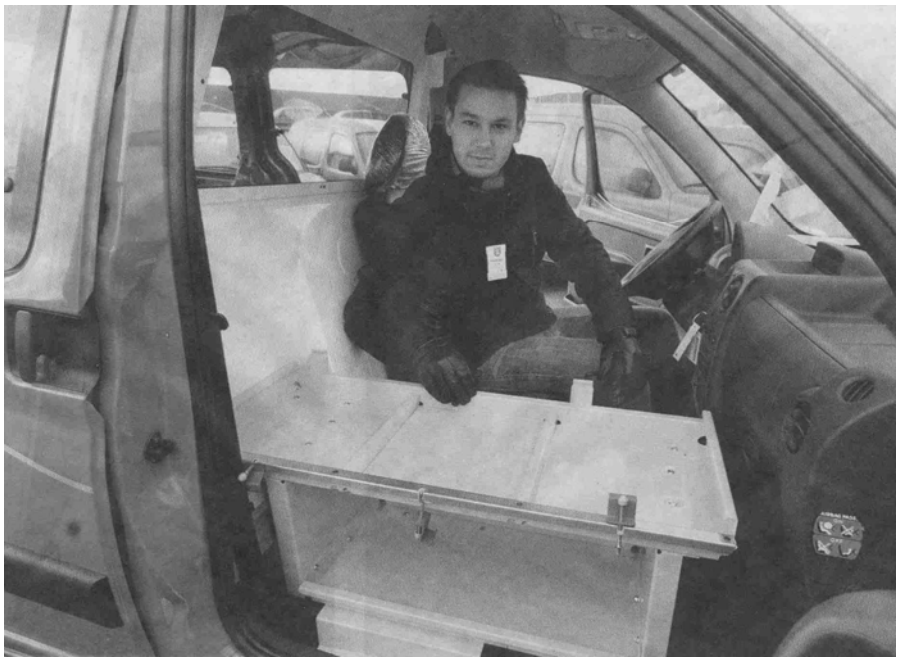


Figure 5. Final product as used by Norway Post

5.2 Strategic design in post-graduate studio teaching

The post-graduate design studio lasted for 19 weeks and comprised of lectures, seminars, and collaborative studio project. The collaborative studio project involved 12 established Norwegian companies, such as, Stokke, Håg, Jordan, Helly Hansen, Tandberg, Lærdal Medical, Borealis, etc., and was divided into two stages: a Product Planning & Management (PPM), and an Industrial Design stage. Innovation and strategic design were emphasized, where user functions and technological aspects must also be considered.

In the PPM stage of the project, students were subjected to a model for integrated Product Development where they had to follow a systematic innovation-step model, which guided them to determine their design brief and stage for design activity [28], [29]. This activity of strategy development and Goal Finding lasted for +/- 6 weeks. Buijs' innovation process was used to introduce strategic design among the students, as no other direct applicable models were found in the area of Systems Engineering, Macro-ergonomics, PSS Design or Human-Centered Design.

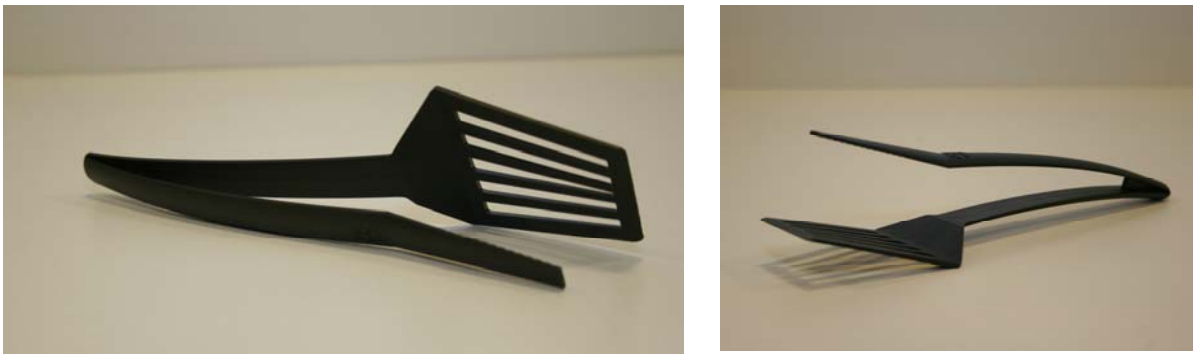
The Industrial Design stage of the project comprised mainly of Systems and/or Product Design, where students iteratively analysed and redefined the problem fields, as well as diverged and converged in the search of design solutions using a wide variety of analytical and generative methods.

For this post-graduate studio, the task was presented at a business rather than a product level. This is in line with the student's progression from novice to expert user, whereby the latter is expected to demonstrate strong skills in managing goal-limited strategies and domain-specific knowledge [38].

Because of close collaboration with companies from a product planning and management starting point, several projects were selected for further development, detailing and prototype building,

demonstrating another avenue of strategically uplifting an educational to a real-life design project, see figures 6A & 6B, 7A & 7B, 8A & 8B.

Figures 6A & 6B: Collaborative project with Oyø AS has resulted into a set of utensils for opening Oysters (Marikken Høiseth, year 4 design studio).



Figures 7A & 7B. After completion of the studio project, the student continued to work on a clip-spatula (Marikken Høiseth, year 4 design studio)

Figures 8A & 8B. Collaborative project with Tandberg AS on the design of a portable video conferencing unit was continued after completion of the studio. (Kristian Remer Guttulsrud, Year 4 design studio)

5.3 Mentoring a design consultancy service

When teaching at a higher institute of education, such as the National University of Singapore (NUS), it was common that faculty members are involved into real-life design practice. Within the context of 'mentorship' the author of this paper, who was previously a teaching fellow at NUS, decided to involve a promising graduate in his business endeavours of offering design services. Both, faculty member and graduate, did not have the financial means, but had the support of a contract manufacturer, Valen Technologies Pte., to start up a design consultancy, named 'Design Insight'. Valen's area of specialisation was in the moulding technology of light guides and other optoelectronics. The collaborative initiative between Valen Technologies and Design Insight was based on a unique win-win concept. Being both strongly involved in the coordination and manufacturing of products, Valen Technologies was able to provide his customers with a one-stop design, development and manufacturing service, even up to the design of the product's packaging. In return, DI was given considerable help in terms of facilities, start-up assignments and manufacturing expertise. An interview with founder Chun-Beng Quek has led to the following detailed story:

In February 2004, Design Insight (DI) started as an "in-house" design consultancy under local Contract Manufacturer /Original Design Manufacturer (ODM): Valen Technologies. Operating at a corner inside Valen Technologies's office, Design Insight's modest two-man operation started on projects assigned by the manufacturer. These projects ranged from the design of consumer products (Electromagnetic Filters, flashlights, Electric power taps) to basic mechanical design of simple products (Automotive meter pointers, light guides, etc). Start-up and investment cost were very low as the only assets were 2 old computers with some basic software and stationery. Furniture, printing supplies and electricity were all free, provided by Valen Technologies.
Invaluable knowledge and experiences was gained in areas such as tooling, moulding and production by working with staff from Valen Technologies and his clients. A product design engineer joined in the team in October 2004 to assist in the mechanical coordination and design of some of the products.
At the end of 2004, DI caught the attention of a private investor, who invested and grew the consultancy into an independent full-fledged company. DI relocated the design studio to its own premises in December 2005, a sub-unit located conveniently just above Valen's offices. This was to continue on-going working relations with Valen Technologies. Besides focussing on industrial, packaging and graphic design, DI also begun working on the mechanical design of simple/basic products, like product casings and other top bottom housing assemblies.

In 2005, DI got to know BC2L Pte Ltd, a local OEM dealing with Bluetooth related products, through Valen Technologies. BC2L's parent company: SAC Pte Ltd happened to be a customer/supplier working with Valen Technologies in various areas. DI first started a pioneering project with BC2L on a blue-tooth headset design to be proposed to Comsoc Technology, a local agent for Samsung Electronics Co. Ltd in Korea. The product was successfully launched as Samsung Bluetooth Headset WEP170. Simultaneously, various Bluetooth devices were designed for BC2L as OEM products and concepts. Besides blue-tooth related products, Design Insight was also involved in various projects with local OEM/ODM. The Team grew to 8 members towards the end of 2005.

In Early 2006, DI's area of expertise in the design of Bluetooth headset/devices led to Samsung's agent, Comsoc Technologies, to contact DI directly to work on projects with Samsung in Korea. Around the same period, Valen Technologies was bought up by Unisteel Techology Limited (a public listed company), and therefore DI has chosen to part with Valen Technologies as most of Valen's resources and manufacturing will be relocated to China since the takeover. In the meantime, Design Insight already built a network of clients and suppliers in its 2 years of operation; while the number of projects with Valen Technologies has been limited and declining. In June 2006, DI relocated its design office to a more conducive and comfortable 3-storey shop house along Tras Street. The reason for the move was also to collaborate with Qbian, a Belgian-based company developing and designing marketing and training materials for Nokia. Presently, the collaboration DI and Qbian has resulted in 2 business areas: Content Development and Visual Communications. In 2005, the Visual Communication department has won a local STAR packaging award for a Sushi takeaway/delivery party pack. The work with Samsung and some local and a US-based ODM, OEMs is still on-going. Overall, the turn-over of DI has doubled on a yearly basis. From 2004 to 2006, turn-over has

grown from 70,000 - 400,000SGD *(SingaporeDollar)*, and is expected to reach close to 1 million SGD in 2007.

Figures 9A & 9B. New premises of Design Insight and Qbian

Figures 10A & 10B. Design Insight's design studio.

When comparing Design Insight with Kadabra Design, both consultancies did very well for the past 3 years. Though informal, Design Insight has the advantage of having an academic, as well as an industrial mentor, who helped the consultancy with the basic facilities, projects and contacts to start up. The case of Kadabra Design is a clear classical example of how a design consultancy has started, without a formal or informal mentorship to support the initiative.

6 DISCUSSION AND FUTURE RESEARCH

When preparing design students for the challenges of design practice, it is necessary to consider core-curriculum as well as mentorship aspects in the overall education and grooming of the student or newly graduate. Studio teaching forms a conducive environment to develop long-term collaborations with a wide variety of companies. Dependent on the management of the studio teaching program, these collaborative initiatives may extent beyond the formal studio, providing students with the opportunity proof themselves and gain experience in real-life practice, at an early stage of their careers.

From an educational perspective, teaching and mentoring within and beyond the studio context have revealed the following findings:

- An emphasis should be placed on strategic and systems design to facilitate innovation and the further development of design solutions beyond the studio environment.
- A systems approach in studio teaching will lead to a wide variety of product proposals, which can be interesting for the industrial collaborator to further develop after the completion of the formal studio.
- A strategic design approach in studio teaching, where the task was presented at a business rather than a product level, students developed closer links with their industrial collaborators.

As the scope of work is rather extensive, expectations of the final result to be submitted at the end of the semester were set at concept detailing level. This provided ample opportunities for further development

- To provide newly graduates with a head start, faculty should consider taking up interest in serious mentorship. For example, facilitating and introducing an industrial mentor or investor in the start up of a design consultancy

In terms of future research, the following aspects in terms of studio teaching and mentorship should be explored:

- The development of a structured and formalized student / graduate mentorship program, where time and manpower resources are allocated through the involvement of faculty members.
- The development of awareness in the education of future designers concerning value chain as well as cross-cultural design and manufacturing alliances as a tool to achieve competitive advantage
- The introduction of 'Vertical Studio Teaching' based on systems and strategic design.

7 ACKNOWLEDGEMENT

Thanks to Chun-Beng Quek (Design Insight), Carl-Andre Nørstebø (Kadabra Design), Bjørn Hembre, Marikken Høiseth and Kristian Remer Guttulsrud (Year 4 NTNU students) for their contributions in the form of interviews, write-ups and photographs.

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