India Design Council

A Concept Note - Design Spine for Undergraduate Engineering Students @ NIT's

Submitted to

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Chairman
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Introduction

We are proposing to build a “Design Spine” within the engineering curriculum. The Design Spine courses would be the major vehicle for developing a set of competencies to meet educational goals in areas such as creative thinking, problem solving, teamwork, and Design.

The purpose of the proposed program is to enable undergraduate engineering students to develop design knowledge and skills that will prepare them to be innovative and creators of new value.

A sequence of 6 courses will be delivered concurrently with the first six semesters at a rate of one course per semester. The sequence will arm students with sufficient knowledge of fundamental design principles and will encourage multidisciplinary and interdisciplinary design processes, challenging students to develop their intellectual competence and project management skills. Students will develop analytical skills, and creative potential.

The program would focus on innovative engineering design in a team-based, cross-disciplinary setting. “Innovative Design” implies both identifying and solving real – world problems for real people.

The program proposes to engage engineering students with a real problem, which has no given solution in an industrial / social context, develop social and collaborative skills, introduce new product development methods in a project environment.

The program will enable engineering students to develop products and services around those products that are innovative, useful, safe, aesthetically appropriate, ecologically sound and socially beneficial while serving the needs of society, consumers, manufacturers and the environment.

While reading this proposal there are two pertinent things to note.

1) The term design is used in the context of industrial design and design thinking and not expressed as engineering design and

2) The goal of this proposal is not make designers out of engineering students, but to augment their engineering education by adding the design component to their thinking and doing.

The Need

It is an uncontested fact that engineers need to broaden their outlooks to be relevant and successful. The education and general orientation of engineers have been directed inward toward the profession, rather than outward toward the rest of society and the world. Engineering education should create a broader outlook and understanding in graduates and thereby engender newer capabilities to effectively face the challenges of the future world.

The complexity surrounding engineering projects is increasing everyday. Natural resources are dwindling and the world population is increasing. The global infrastructure and economy are becoming more intertwined. In such a scenario, the creativity and innovation necessary to address the big issues facing civilization— maintaining the infrastructure; providing food, water, shelter, and power to the population; and growing sustainably and safely—will only increase in importance.

Exploring human creativity improves our understanding of the discovery and invention of new artifacts. It also contributes to an understanding of its role in productivity improvement and the enhancement of the quality of human life. The aim of infusing design into engineering education is to contribute to the understanding of human creativity.

Engineering curricula, with their focus on the disciplinary contributions to design, encourage a mindset in which students seek technical solutions often rooted in a specific engineering discipline with little regard for the context in which their product, system, or service may be deployed, the societal or business need it may fulfill or even its relations to all the other engineering, business or ‘environmental’ domains that can contribute to success.

Over 90% of new products introduced into the marketplace fail. A good portion of these failures are due to lack of understanding of end consumers and their needs. To develop truly successful new products, it's not enough just to ask people what they need or want.

Engineers need tools and techniques to get beyond what people can explicitly state and determine their implicit needs. The requirements extend beyond the traditional discipline specific technical knowledge to include product and system building knowledge and skills, personal and professional skills and interpersonal skills.

Design & Design Thinking

Steve Jobs, CEO of Apple Computers said “In most people’s vocabularies, design means decoration. But to me, nothing could be further from the meaning of design.

Design is the creation process through which we employ tools and language to invent artifacts’ and institutions. As society has evolved, so has our ability to design (Charles Owen, 1993).

Arnold Wasserman perceives design as “the integration of art and technology for the creation of products, communications and environments that serve human needs.

Design is explained by the UK Department of Trade and Industry (DTI) as:

> *‘Design is a structured creative process. Design is readily associated with industrial product design for manufactured products — specifically the ‘look’ of a product. However, the application of design is much broader, for example designing for function; for aesthetic appeal; for ease of manufacture; for sustainability; and designing for reliability or quality and business processes themselves. Service design affects how customers will experience the delivery of a service, such as a bank or a fast food restaurant. Elements of design, particularly graphic design, will form part of product, service and company branding and advertising strategy.’(DTI 2005)*

Design has evolved from being a vocation dealing with the form and function to a new approach of developing business models. Design has evolved over the past years from being a mere function of styling or aesthetics (where form and function are the focus) to design as a process (where design thinking is integrated into the development process). Today it is moving towards becoming a strategic element. (Heather Fraser, 2006).

Design Thinking transcends disciplinary boundaries and adopts a fluid process to address a wide range of problems and issues. While there is no single definition for it, a useful starting point is the description below:

“Design thinking can be described as a discipline that uses the designer’s sensibility and methods to match people’s needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity.” – Tim Brown CEO, IDEO

Harvard Business Review, 2008 defines Design Thinking, as a methodology that imbues the full spectrum of innovation activities with a human-centered design ethos... Innovation is powered by a thorough understanding, through direct observation, of what people want and need in their lives and what they like or dislike about the way particular products are made, packaged, marketed, sold and supported."

Design thinking encompasses people (by observing them and gaining insights through their behavior patterns), ideating (brainstorming, looking at a problem from multiple perspective), prototyping (visually representing the thinking) and story narration (implementation by selling compelling narratives not "concepts").

Design Thinking has the potential to provide learning opportunities for engineering students to explore human desirability, technical feasibility and business viability. It means systems thinking, breaking out of the normal confines, solving the fundamental issues, not the symptoms. Design thinking is a powerful approach to innovation and problem solving in the diverse contexts of engineering.

Why Design in Engineering Education?

Similar to design there are numerous definitions of engineering. Engineers "scope, generate, evaluate, and realize ideas" (Sheppard). This definition focuses on how engineers think and embrace the heart of the design process by highlighting the creation (i.e., scoping & generation), assessment, and selection (i.e., evaluation), making or bringing to life (i.e., realization) of ideas.

The National Academy of Engineering in the United States of America recognizes that engineering is, since its origin, a "profoundly creative process", and suggests a very provocative definition: "engineering is about design under constraint". This definition advances a significant connection in the practices of engineers and designers, which is possibly the core aspect of any education intended to correspond to the one proposed by the National Academy of Engineering: "the engineer designs devices, components, subsystems, and systems".

All educational theories that emphasize experiential learning are consistent with design activity. Design is the experiential activity central to the practice of engineering. It is through the experience of engaging in design that students are able to develop knowledge and skills necessary for professional practice.

What is critical in contemporary world is that innovations are occurring at an astonishing pace, which are most apparent, and this has important implications for engineering practice and engineering education in the future. Thus design becomes an extremely important driver, which would enable actualization of ideas, making them concretely available in their diverse possibilities.

Program Objectives

- To engage students in possibility-based thinking that is powered by design.
- Lead in the creation and operation of new products and systems.
- Learn how to frame the design challenge properly
- Ideate, prototype, and iterate solutions
- Develop skills and attitudes such as experimentation, design thinking, teamwork, communication, societal context and business context
- Learn from the overall design process how to create value, prepare for their careers, and participate more fully in society

The Program

The proposed design spine coursework is optional for students those to choose to travel on this unique and innovative path. The students will have the freedom to discover and follow their passion in design and to choose the challenges that they wish to undertake.

The program emphasizes the use of Project Based Learning where students participate in active and experiential learning through real product development situations. It will start with an open-ended situation of identifying a problem to solve and eventually end with a solution that can actually be implemented in the market. By the time they are graduating, they would have already become innovators and practitioners and might have a venture to take forward.

Year	Content
Year 1	**Opportunity Recognition** Students will identify new opportunities, areas to address, problems to solve. Students work on an engineering project, which provides a technological solution to an identified problem. One course per semester, i.e. Two courses in this year will be taught which would help the student to identify new opportunities. The year will end with a clearly defined problem with its boundaries and parameters. Opportunity recognition is an approach that puts people and their needs at the center of product development and business strategy creation. It is an approach for developing deep insights that provide strategic direction and open up new possibilities for product development. Students will gain a toolset from which to develop their own approaches to conducting researching for design: learning how to think about other people, about culture, and about new perspectives. They will also learn tactical skills: how to define research questions, how to conduct observations and interviews, how to interpret results, how to synthesize information to form a unique meaning, and how to communicate their findings in a way that is compelling and actionable. Students will move into a broad realm of unpredictable often-incalculable time-constrained problem solving. They will explore a wide variety of problem definition, exploration and solving "tools," and a variety of surrounding "design thinking" topics.

Year 2	**Ideation, Conceptualization** Vis-à-vis the identified opportunity, the students will ideate, generate ideas, move from divergence to convergence, and start the development of a concept. Again here two courses, one per semester will be taught in relation with the year objective. Students will first take a step back from what and how they are designing and ask the question of why they are designing it. They will understand stakeholder needs and translate those needs into their design. They will develop greater awareness of the personal, social, competitive and technological contexts that their products fit into, and to learn how to design for those contexts. They will learn several ideation techniques and visualization methods. The success of any creative work depends not only on the ability to find good ideas, but also on the skills for developing, managing and presenting those ideas to others. Here the students will explore different techniques for finding and developing ideas (such as brainstorming, improvisation games, and whiteboard techniques), and apply them in their chosen project and situations, such as pitching ideas to peers or superiors, and winning debates with others. Students will be equipped with a level of visual literacy that will enable them to analyze, evaluate and articulate visual information in a variety of forms. Students will learn how to translate complex information into simple visual solutions. Within the context of identified problem area students will be led through the process of investigating cultural, emotional, technological and business factors to develop new concepts, and iterative design. Principal focus will be placed on understanding the interaction of people and products / services.

Year 3	**Realization** Students will work to realize the concept they have worked on through the first two years. Here there will be course work i.e. two courses, per semester and in addition they will be paired with the design students studying in other design institutions. They will be provided tools and methods for creating new products, which will culminate in the creation of a prototype. One important means for involving users is through prototypes. Through prototypes, users can react to ideas and even take part in building and modifying them. Prototyping methods move from low to medium fidelity: paper sketches, storyboards, Pictive, scripted simulations and so on, each getting slightly more sophisticated. Early versions of prototypes should be very low cost (e.g., paper and pencil, postit notes, etc), and its purpose should be to garner high-level reaction and input from the user. As the design progresses, prototypes should become more refined and the user's input should reflect smaller, but still important, design and usability decisions. The students will be introduced to a systematic “Differentiation by Design” strategy. Students will become aware the path from “concept to commercialization” and customer / product experience. The focus will be on design as a strategic offering from a product design and development perspective.

Teaching & Learning

Discipline Agnostic

The proposed program will be agnostic to engineering disciplines and will seek to combine depth in a discipline with cross-functional, multi-disciplinary design teams and projects. The idea is to bring students from different departments together to tackle interesting needs and innovations. These collaborations will enable us to mine deeper than individual disciplines can alone. Design thinking will be the glue that binds all these people together.

Learning by Doing

The emphasis will be on learning rather than teaching. Students will be encouraged to ‘learn through the projects and subsequent discussions in a self-motivated manner. The idea is to create an exciting and charged environment, where cutting edge solutions are created.

Peer Group Learning

Throughout the program use will be made of peer group learning by which students develop an appreciation & understanding of different aspects of design, through formal & informal discussion with their peers.

Team Based Learning

Successful teamwork is essential in today's time. Teamwork requires a number of skills, especially those of inter-personal communication & role negotiation. The projects will be team-based projects. This will provide learning experiences, which extend the student's appreciation of team based operations, building on personal skills individually developed in other modules.

Independent Learning

The concept of independent learning is an important part of the design spine. It refers to the idea of student centered learning whereby the student takes primary responsibility for setting his or her own goals & creating his or her own program of studies within the framework of the course.

Written Work

The courses will involve a range of written assignments. These include: essays derived from questions generated by the content of the module, seminar papers, written reports as project outcomes.

Oral Presentation

Throughout the design spine program the student will be required to use the spoken word to support his / her work in both formal & informal situations. This would involve: seminar presentations; oral reports to support studio projects; contributions to seminars & group tutorials; individual presentations of findings.

Supervision

Good supervision is an important element of any program. We propose to train one faculty supervisor from the NIT to take the role of supervision and coordination for students opting for design spine.

Mentoring

The program design involves tapping the knowledge and expertise of leaders in the field. We will have a professional network of guest lecturers including thought leaders from around the world to speak with students over a distance mode and to guide them through their own experiences.

Online Learning

The final aim of design spine is to deliver the content through the Learning Management System over the Internet. Initially till the time the content is ready, a working framework is evolved, it is proposed that the content of the courses in the first year is delivered in person by faculty identified by us.

Student Pairing

Starting with beginning of third year, each team of engineering students will be paired with a design student. As much as there is a need for engineering students to learn and know about design, there is an equal and urgent need for design students to appreciate technology and engineering and its nuances. This will be an equal partnership between the students of engineering and design where the objective is that they learn from each other.

This kind of pairing will be full of vibrancy, continuous dialogue between engineering and design and full of new ideas. This collaboration will be facilitated through an online platform other than the other platforms the students may use within themselves. The design students will offer their design inputs right on aesthetics, form, user interface, human machine interaction ergonomics, usability, user convenience, etc. The engineering students will help the design students with technology aspects of the design students' project.

Execution

- We propose to implement the Design Spine from the beginning of academic year of 2014.
- We can start first with 5 NIT's and then scale things up with a complete online delivery to all other NIT's from 2015.
- In the year 2014 we can start with the delivery of course work to first year students and also we can start the pairing of 3'rd Year engineering students and design students.
- The experiences and learnings will help us in our scaling-up from year 2015.
- The India Design Council will facilitate the online platform as well as the delivery of lectures in person as well as help with the design student pairing.

Industry – Institute Interaction

The design spine will seek to put students to work on real design problems submitted by individuals, non-profits, entrepreneurs, and industry members. The Industry – Institute Interaction will be facilitated in two ways:

Industry / Society Challenges

The industry, local bodies, NGO's local Governments can put up open challenges where they are looking forward for technological solutions. These are not specific projects. These are open-ended challenges. All of these challenges will be up for being taken-up by the students during there opportunity identification phase. It will not be mandatory for students to work around these challenges; they can find their own challenge and work around with it.

Venture Studio

The projects identified by the students along with their conceptualization and realization will be put together in an online virtual fair. The industry / society will be invited to look at those and for areas which interest them they can start working with the students when they are in their fourth year.

Way Ahead …

- India Design Council is keen to start this program with the NIT's.
- The council will take full responsibility for the execution of the program as is proposed.
- Once after the program is agreed between the council and management of NIT's, the council will develop the finer program along with a detailed plan for execution.
- Once after the program is agreed between the council and management of NIT's will be submit a techno-commercial proposal for acceptance by NIT and further action.

About India Design Council

India Design Council is an autonomous body of Government of India established under the aegis of Department of Industrial Policy & Promotion, Ministry of Commerce & Industry. India Design Council is a strategic body for multi disciplinary design. It envisions to make Indian industry a design enabled industry. Mr. Anand Mahindra, Chairman and Managing Director of Mahindra and Mahindra is the President and Prof. Pradyumna Vyas, Director of National Institute of Design is the Member-Secretary of the India Design Council. Government of India nominates the members for a period of 3 years. The council comprises of eminent personalities from various walks of life.

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