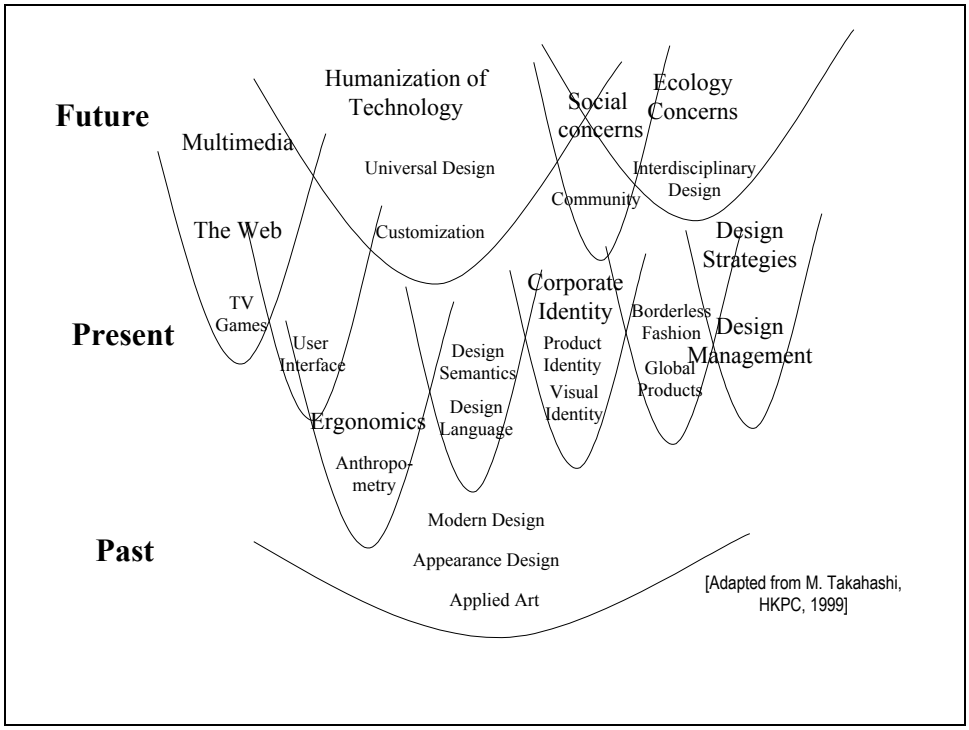
Revision of MEEM UG Curricula

1. A few weeks ago, Prof. Mai had asked me to give a thought to how BEME, BEMTE, and BScIEEM curricula could be improved and convey my thoughts to the respective program leaders. I first focused on BEME and have already conveyed my immediate thoughts to HW. Then, I started thinking about BEMTE and BSCIEEM. It was at that time I realized that I was not satisfied with my own thoughts on BEME for the following reasons:
   (i) I had just listed a few personal prejudices of my own to HW. That is not good enough. My problem arises from the fact that I was very much a party to the drafting of the prevailing curricula. This could be true with even the program leaders. We need a more objective approach.
   (ii) It would be desirable to have a common approach towards revamping the curricula of all the three programs. The approach I had followed while responding to HW would not lead to a common approach.

2. I had got stuck at this stage. I couldn't figure out how to proceed until, by chance, I came upon the following extract from a book by Takahashi on 'Product Design':



Note that one could develop a Product Design course curriculum on the basis of the 'keywords' listed in the figure. But, the more interesting part of the figure is that it is divided into three overlapping sections: Past, Present, and Future. When compared the list of key words with those usually included in product design courses, I realized that the latter was dominated by Takahashi's keywords belonging to the 'past' and 'present'. Only rarely are topics belonging to ' the future' included in contemporary curricula. Let me give some examples:

- BEME—Manufacturing Technology—Milling Control: We teach about milling machines, the milling process and its model, milling cutters, etc. in the context of conventional milling. But, the future is in high-speed milling which is rarely mentioned even in current curricula. We could cover all the basic principles of milling using high-speed milling.
- BEMTE—Control Principles—Motion Control: This is a topic I know fairly well. Most motion is controlled by electric motors. Till the late '70s, DC motors were ruling. No wonder most control books and curricula dwell on DC motor control. Very few have room or time to dwell on AC brushless motors that dominate the contemporary scene (e.g, contemporary CNC machines) and linear motors. Most machine tools of the future are likely to be based on the tripod concept (Gimbal-Strut-Kinematics) and linear motors. Few contemporary UG curricula dwell on these topics. All the basic control principles can be illustrated (practiced) as well brushless/linear motors

as with DC motors. Likewise, most fundamental principles concerning kinematics can be illustrated using the tripod concept as with conventional lead-screw type technology. Yet we hang on to the classic topics.

- BEMTE—Mechatronic Equipment Design: The future is in micro-mechatronics. Yet, we hang on to describing mechatronic equipment of conventional size.

Why does this happen? Perhaps, we are all prisoners of what we had learnt while we were at school. We understand it too well. We are emotionally linked to it. Hence, we can't let go of the classic material ('past'). Further, few contemporary textbooks contain much material about futuristic topics. Much of the material is available in journals and magazines. Some material is available only on the Web. We know that we will have to burn much midnight oil if we take the bold step of focusing on futuristic topics. We therefore go back into the cocoon of classic topics (I admit some of us do venture at least into contemporary topics).

This is a pity for the following reasons:

- The technological and management world is changing rapidly. The technologies and management paradigms to be faced by our graduates will be vastly different from this we have faced in our own careers. We owe it to the students to be much more future-oriented than we presently are.
- Our Chief Executive is trying to make HKSAR into a world-class center for technological innovation. An important part of our job is to provide the engineers who will engage in technological innovation. Much of this innovation will be in what w presently call the 'futuristic' topics.
- Our cocoon mentality creeps into our research agenda too. We stick to well-beaten paths. So, as a department, we are known for nothing specific (no indigenous school of thought) in the world. I venture to suggest that we what we teach profoundly affects our research agenda.

3. Based on the above thoughts, I suggest that we adopt the 'systematic modernization' as one of the guiding principles during our curriculum redesign exercises. The principle can be applied uniformly across all our UG programs. By applying it consciously, ruthlessly, and systematically, we can distinguish our programs from rival programs offered elsewhere in a significant manner. It would also change the way we develop our research agenda. We may have to work much harder to reorient ourselves. But, at the end, we will become much more enthusiastic towards emerging technologies (e.g., micro/nano) and managerial paradigms. We can also prepare our students much better for the future. Most importantly, we can make our students much less textbook-oriented (most reports by students contain copied material from textbooks) and more journal/magazine/Web oriented. For example, some SCAs could be redirected towards web-oriented literature reviews on specified futuristic topics. This would animate the students better and, in the process, make them much more 'intellectual'. This comment is prompted by personal opinion that our students are not intellectual enough and some of the blame lies on us. In the past, I used to think that less intellectual students need to be given more 'hands-on' experience. I now temper my prejudice. I now think that, rather than giving up, we should force the students to engage in deeper and more intellectual activities.
4. <u>A Methodology for Systematic and Objective Modernization of Curricula</u>:
   (i) Divide the core component of your program curriculum into broad sub-area.
   (ii) For each sub-area, select two or three colleagues who have expertise in that area as the area-specific review team.
   (iii) Each review team progresses through he following steps in sequence:
      i. Collect all keywords (at a coarse level) included in the current program curriculum that pertain to the team's subject area.
      ii. Peruse the relevant syllabi from good universities (as Prof. Mai had previously suggested) and collect all the relevant keywords. Merge the key words to the indigenous list. Delete duplicates.
      iii. Classify the keyword list into three categories: "Classical", "Contemporary", and "Emerging"
      iv. Include only contemporary and futuristic keywords in the revised syllabus. This means that the team has to <u>ruthlessly</u> discard all classic material from the present syllabus. Avoid the tendency to argue that the some contemporary and futuristic material cannot be understood without the support of some classic material.

Leave the job of providing supporting classic material to the dynamics of the classroom. The key is to force the teachers to focus on contemporary and futuristic material at least until they get used to the new future-oriented curricular paradigm.

(iv) Rearrange the program curriculum in terms of the new lists of keywords. Reorganize current courses. Add new courses if necessary. Do not be emotional while deleting some existing courses entirely. Rewrite the course and program objectives as well program publicity material to highlight the futuristic orientation.

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