

Concurrent Engineering: A New Approach for Sustainable Technical Education

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Abstract

Concurrent Engineering (CE) as a new methodology is being focused on academics as well. Concurrent Education may be called as an application of CE in Higher Education. New paradigms of Concurrent Education are being set up and introduced in integrated curricula. Unlike traditional teaching methods, students are not supposed to absorb the knowledge given by instructor, rather they need to participate. This paper discusses the relevance of CE in Higher Education and explains the integrated taxonomy of teaching-learning process which together makes the education system to be sustainable in this fast changing world. It highlights the importance of best practices in Higher Education Research. Besides, it also reveals that application of CE improves the quality of Higher education.

Keywords: Concurrent engineering, sustainable education, integrated curriculum, engineering education, collaborative learning.

1. Introduction

As a new concept and methodology, CE has not been widely implemented in industry, research and higher education yet. This is proposed here to describe a newly developed CE approach, which employs the method of concurrent education. Similar to CE, concurrent education aims to break the barriers of traditional sequential, or step-by-step, isolated curricula. Concurrent education integrates multi stages of curricula and brings inter disciplinary teachings into classroom.

Concurrent engineering is actually a partnership approach. There is an increasing focus on product development in higher education [8]. This change is a response to the need for engineering graduates to be able to provide immediate and tangible benefit to manufacturing companies in an era of neighborhood competitiveness. The focus on integrative product development aspects in the manufacturing process have been termed as concurrent or simultaneous engineering, a focus which echoes long-standing themes in product

development practices. Nevertheless, presenting these ideas in undergraduate or postgraduate higher education calls for a departure from the usual content and pedagogical approaches [3].

Results of survey done by American Society for Mechanical Engineering (ASME), USA in 1996 says that, to better prepare our engineers and to enhance global competitiveness of industries, the industry's top twenty "Best Practices" skills should be taught at the Universities. It is apparent from the result of survey that Concurrent Engineering was ranked under top 10 in the industry's "Best Practices," but it was not even included in academia's top 20 lists. Most of the universities are not practicing CE due to either lack of knowledge and understanding or lack experience in applying the concept of CE in education [2].

Minor modifications in current teaching practices will not solve the existing problems. Teaching success in today's world requires a new approach to instruction. The **old paradigm of college teaching** is based on John Locke's assumption that the

untrained student mind is like a blank sheet of paper waiting for the instructor to write on it. Student minds are viewed as empty vessels into which teachers pour their wisdom [6].

Growing emphasis on teamwork has made the employer to recruit graduates who are good team players. The use of team is widespread in industries and more companies are integrating the team work in their business strategy. One of the best examples of where teamwork plays a significant role is concurrent engineering. To satisfy the current demand of engineers who can lead and work well in teams, universities must include team issues and experiences in their curriculum.

2. Technical Education Innovations for Sustainability

2.1 Concurrent Education

On the line of survey done by ASME, we also carried out a survey in which more than fifty responses were collected and analyzed from more than fifty Engineering colleges across the India. Our finding shows that over the period of time, CE has been able to find place in Education and Research also. But, it still needs to grow up to the level of understanding of a common man.

To prepare our graduating engineers to accommodate the technological changes, we need to replace our traditional teaching environment by a dynamic, vibrant and more interactive model. One of the most important tools for collaborative learning is “learning by doing”. Although multimedia presentation is one of the strongest tools for effective teaching in the class room but learning by doing is undisputed one. In current scenario, collaborative learning (also called networked learning) is becoming the essence of high quality Education.

2.2 Concurrent Engineering Wheel

CE wheel [4] basically represents the integration of product and process organization. This wheel has a centralized hub which acts as a controller where all subsections are supposed to report. Basic responsibility of this hub is to control and to make synchronization among its various arms. Fig [1] shows the CE wheel which has a hub in its inner most ring that acts as a mastermind for all the activities. Hub represents the product development center which is basically a controlling authority for

all other elements in the wheel. The middle ring has been divided in four distinctive teams to act as coordinator between hub and the various elements of concurrent engineering. This wheel has eight arms viz. Manufacturability, Assemblability, Testability, Reliability, Serviceability, Cost, User Requirements and Disposability.

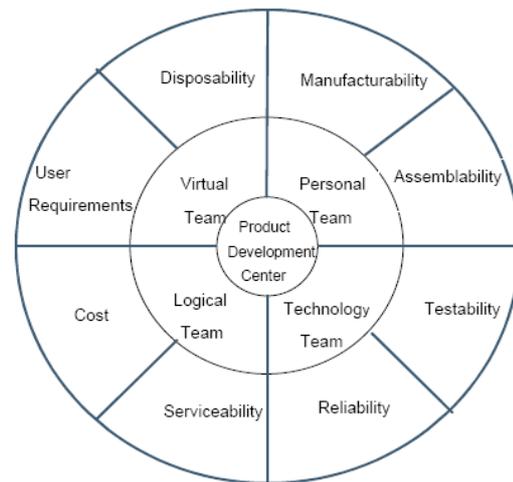


Figure 1: CE Wheel

2.3 Integrated Education Development Program (IEDP).

Integrated Education Development Program (IEDP) has eight arms viz. Team Work, Assessment, Communication Skill, Epistemology, Diversity, Knowledge base, Assessment, Value Engineering and Creative Thinking. IEDP is unlike old teaching methods, implies a very dynamic concurrent education environment. It offers a framework for effective and integrated learning and teaching process. Here the central hub is again a product development centre which works as mastermind for all its sub branches. This centre has four sub sections like CE wheel has. These four sections are further divided in to eight different arms which are basically the pillars for integrated education.

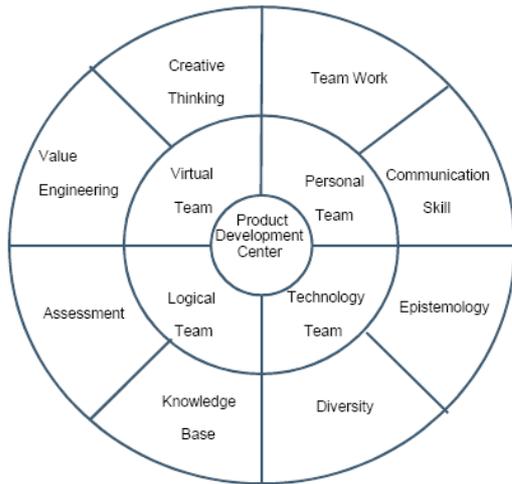


Figure 2: Integrated Education Development Program (IEDP) Wheel

IEDP wheel gives us the close integration between various different disciplines of engineering and the important issues in learning teaching process.

2.4 Synchronization of CE and IEDP wheel:

Figure [3] shows integration of CE and IEDP wheel. Today’s competitive world demands for the engineering graduates who are good enough in their technical skills as well as have a diverse knowledge with the good leadership skills. When we synchronize the CE wheel with the IEDP wheel we get the inculcation of concurrent engineering into technical education which is now called **Concurrent Education** [24]. Synergy between CE and IEDP wheel in education system is as important as the curriculum and assessment is. The implication of this wheel is, we learn mathematics by doing mathematics likewise we should learn manufacturing by doing manufacturing only, not in the class room. Class room teaching is getting obsolete now and Concurrent/Integrated education is taking place of it.

Sustainability depends upon the reliability of course contents and their flexibility to accommodate the technological changes. Interdisciplinary studies make a significant mark over the sustainability of learning-teaching taxonomy. The demands of competence of an engineer seem to be rising and rising. To fill this demand we are supposed to make our engineering graduates versatile in all engineering streams. They must be actively involved in interdisciplinary courses.

3. Paradigms of Concurrent Education

Higher education has seen the drastic changes in its taxonomy over the past few decades. Due to the increasing demand of diverse graduates in the industries, universities are bringing changes in their curriculum and assessment methods [6]. Because of the difference in level of motivation, attitude about teaching and learning and response to specific classroom environments and instructional practices among the students, we need to bring our teaching methodology to abridge this gap [18]. Paradigm shift is taking place in higher education, driven by various accreditation committees viz. NBA in India and ABET in USA, changing expectations of employers, the rapidly changing state-of-the-art of pedagogy, and many other forces.

In many institution classrooms, old paradigms of teaching are being dropped and new paradigms based on theory and research that have clear applications to instruction are being adopted. Table [1] shows the comparison of old and new paradigms of teaching on various fronts:

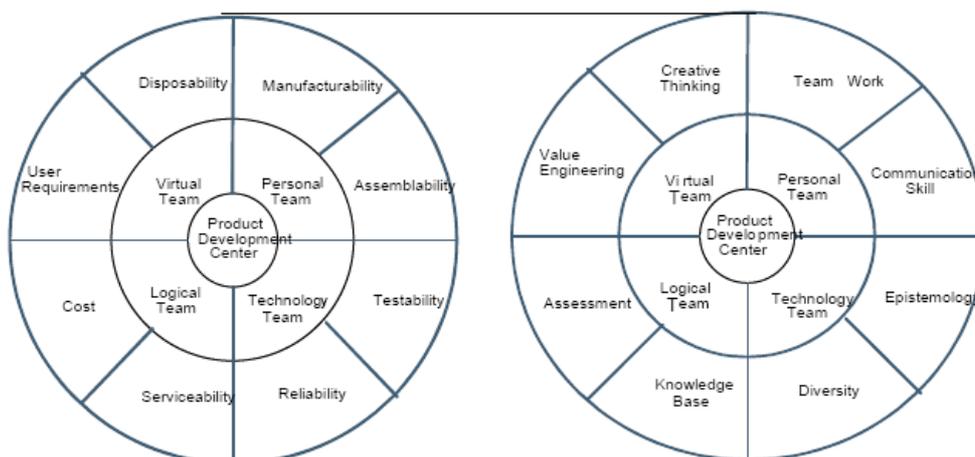


Figure 3: Synchronized CE Wheel

	Old Paradigm	New Paradigm
Knowledge	Transferred from faculty to students	Collaboratively constructed by students and faculty
Power	Faculty holds the authority and power	Students are empowered: power is shared among students and
Relationship	Interpersonal relationship among students and between faculty and	Personal transaction among students and between faculty
Faculty Responsibility	Classify and sort students	Develop students competencies and talents
Mode of Learning	Memorizing	Relating
Context	Competitive/Individualistic	Cooperative learning in class room and cooperative teams
Climate	Conformity/Cultural Uniformity	Diversity
Assessment	Rating at the end of course	Continual assessment
Ways of Knowing	Logico-Scientific	Narrative
Epistemology	Reductionist: Facts and Memorization	Constructivist: Inquiry and Invention
Teaching Assumption	Any expert can teach	Having trained for considerably time can teach

Table [1] Comparison of Old and New Paradigms [6]

Sr. No.	Best Practice	Percentage (%)
1	Team Work	85
2	Creative Thinking	82
3	Communication Skills	81
4	Course Management Techniques	80
5	Diversity	78
6	Value Engineering	78
7	Design for Reliability	76
8	Educational Processes	76
9	Concurrent Engineering	76
10	Design for Performance	75
11	Knowledge Base	75
12	Epistemology	71
13	System Perspective	69
14	Use of Multimedia	67
15	Professional Ethics	63
16	Leadership	62
17	Sketching/Drawing	53
18	CAD System	48
19	Finite Element Analysis	42
20	Passive Absorption	39

Table [2] Best Practices in Engineering Education

4. Best Practices in Technical Education

Similar to the survey done by ASME, USA in 1996, a survey was carried out in which the top 20 best practices in academics was sorted out and academicians were asked to give the rank depending on their subjects. Those practices are as follows:

1. Team Work
2. Creative Thinking
3. Communication Skills
4. Course Management Techniques
5. Diversity
6. Value Engineering
7. Design for Reliability
8. Educational Processes
9. Concurrent Engineering
10. Design for Performance
11. Knowledge Base
12. Epistemology
13. System Perspective
14. Use of Multimedia
15. Professional Ethics
16. Leadership
17. Sketching/Drawing
18. CAD System
19. Finite Element Analysis
20. Passive Absorption

Table [2] shows the result of survey which shows the importance of best practices. It is apparent from the survey that over the period of time Concurrent Engineering has been able to find place in academics also. Now it stands in the top ten best practices in academics. Result shows that in making the academics fascinating, Concurrent Engineering has played a vital role. Without CE it would not be possible to make academics lucrative, of highly improved quality and up to more satisfactory level of students as well as faculty.

RESULTS & DISCUSSION:

The biggest and most long-lasting reforms of undergraduate education will come when individual faculty or small groups of instructors adopt the view of themselves as reformers within their immediate sphere of influence, the classes they teach every day. (Cross, 1993)

Traditional teaching needs to replace with the new integrated teaching methodology. Black board teaching is now being obsolete from universities and more interactive like multimedia teaching is taking place. Concurrent engineering is finding its place in education and now networked education is being emphasized. Concurrent degree is a very new concept in engineering and various concurrent

degrees viz. integrated engineering with applied mathematics, integrated engineering with bio materials, integrated engineering with computer science, integrated engineering with material science, integrated engineering with medical biophysics, integrated engineering with law etc are being offered at international universities.

Concurrent Engineering has been able to find the place in top ten best practices in academics. For a long time, CE was the attraction only in industries and was not able to find the place in education. Our survey shows that CE is now able to abridge the gap in interdisciplinary work, and able to give the improved and high quality of education.

We need to explore CE a lot and have to put it in engineering education system as an integral part. Tremendous interdisciplinary research, courses, improved education system and interesting teaching-learning process is only the outcome of Concurrent Education System.

5. Conclusions:

Our findings show that Concurrent Engineering has been able to find the place in top ten best practices in academics. Because of the rapid changes in technology and uncertainty, we need to take care of the extent to which activities are to be done simultaneously or sequentially. Industry's top 20 best practices must be taught at the colleges and universities. Old traditional style of teaching must be replaced by the new integrated, collaborated and practical centered curriculum. Emphasis on the team work must be given in the universities. Emphasis is to be given on the multi disciplinary education and total education must be practiced.

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