Understanding The Collaborative Engineering Design Process In A Global Environment: Observations of Japanese and American Approaches

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Abstract: In an increasingly competitive and global environment, it is not uncommon for corporations to pursue joint partnerships, and strategic alliances in order to rapidly introduce products and services into the marketplace. These partnerships can and do occur between corporations that are located in countries with significant cultural and societal differences. Inherent in these partnerships is the continuing need to design and develop products and processes for rapid introduction into the marketplace. Concurrent engineering and collaborative engineering are approaches that have proven effective for bringing high quality products into the marketplace very quickly. Because the concurrent engineering process relies extensively on communications and various interactions among diverse team members, understanding how cultural and societal differences impact this process may prove critical to its successful implementation where strategic alliances or partnerships are concerned. What happens when team members are not culturally and socially identical? What are the potential barriers to successful use of concurrent engineering in this scenario? We will seek to identify some of those barriers in this paper. This discussion is based in part on case study research conducted in Japan and the United States specifically for packaging design. Background material on concurrent engineering and packaging/packaging systems is also provided.

Keywords: strategic alliance, packaging, concurrent engineering, JSPS

1. Motivation

During the period 23 March 1998– 22 December 1998, the lead author (Raper) had the privilege to live and conduct research in Hino, Tokyo, Japan at Tokyo Metropolitan Institute of Technology as a Japan Society For The Promotion of Science Research Fellow. This fellowship occurred at Tokyo Metropolitan Institute of Technology with the second author (Fukuda) of this paper serving as the research sponsor. We were interested in studying how traditional product or process design tools, techniques and methodologies might be utilized for packaging (containers in particular) design and development. A general description of packaging and packaging systems is given in a later section of this paper. A small number of case studies/interviews were conducted with companies that either used or manufactured packaging materials. However more observations of cultural and social differences were gained just by living in Japan (multiple home-stays) for a period of nine months! As an educator, it is easy to tell students that an understanding of cultural differences is essential if one is to live and work in a "foreign" country. Furthermore, one can gain this understanding by studying books and literature prior to living in that foreign country. Suffice it to say, that book learning only provides a small view of actual reality!

As the world becomes "smaller" and more connected and corporations seek to grow and penetrate new markets, it seems obvious that companies must seek to grow outside of their own "borders". Various types of international strategies exist to facilitate this growth, such as licensing of products, strategic alliances, and joint ventures. (1) Many other mechanisms exist to allow this growth, but of particular interest is the use of strategic alliances and joint ventures. These methods, in theory, should allow companies to very quickly and rapidly introduce products into the marketplace. This is particularly true if a method such as concurrent engineering is used for the development of the product. However, successful use of concurrent engineering is heavily dependent upon communication and interaction among diverse team members. Communication is never easy, even among socially and culturally identical team members. What happens when these teams are made up of individuals from different countries? Based upon the author's experiences, we will attempt to point out differences between our cultures that may indeed impact successful product development in a joint venture scenario.

2. Concurrent Engineering

Concurrent engineering is a term usually expressed in reference to product, or process design. In general and from a philosophical point of view, concurrent engineering is a technique, which stresses product, or process development utilizing a parallel team based approach. It is further suggested "team members or contributors to an overall design effort provide their particular expertise at the same time, or nearly the same time rather than as isolated entities in a serial fashion." (2) The overriding goal of CE is to shorten or minimize product development time while minimizing costs, and increasing profits of the product over its entire lifecycle.

A common and widely accepted definition of CE is provided by Winner et al. They describe CE as "a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. This approach is intended to cause the developers, from the outset, to consider elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements". (3) Another common definition as stated by the Institute for Defense Analyses (IDA) states: "Concurrent Engineering is the systematic approach to the integrated, concurrent design of products and related processes, including manufacturing and support. This approach is intended to cause the developers to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements."

Biren Prasad expands the concept further in a two-volume set entitled, "Concurrent Engineering Fundamentals: Integrated Product and Process Organization". His view raises CE to a way of conducting business rather than just a product or process development technique. Of particular note, he lists the following seven influencing agents as integral to the CE concept: talents; tasks; teamwork; techniques; technology; time, and tools. (4)

Professor Don P. Clausing, of the Massachusetts Institute of Technology describes so-called "World-Class Concurrent Engineering". In a video series, he breaks it into the following three parts: Management, Enhanced QFD, and Quality Engineering for Robust Design. His management philosophy focusing on improved processes (better game plan), and closer cooperation (better teamwork) provides qualitative approaches where as enhanced QFD and Quality Engineering for Robust Design provide actual quantitative techniques for use in the CE Process. (5)

The above paragraphs provide just a small sample of the literature associated with concurrent engineering. There is much more literature available that is either general in nature, or very focused on a particular technique or aspect of CE. The literature reviewed thus far provides clear and compelling evidence of the abundance of literature available that one can access to aid in product or process development.

The literature base for collaborative product development is also quite extensive even though it is still in its relative infancy as a concept. In general, this concept seeks to apply concurrent engineering principles to the case of the Intranet, or Internet. Much of the literature surveyed via the world wide web focused on the communications based technical issues rather than depicting a given methodology or approach. From the literature studied thus far, collaborative product development appears to be the next logical extension to concurrent engineering. Moreover, given that corporations are partnering in a global environment, this extension and enhancement to concurrent engineering is timely and appropriate.

The benefits of successful implementation and use of concurrent engineering as a product or process design method are well documented. The benefits include, among others, reduction in product development cycle times, improved product quality, and reduction in product development and product lifecycle costs. It is reasonable to assume the same benefits would apply to collaborative product development techniques.

3. Packaging and Packaging Systems

While concurrent engineering is a well known and understood concept relative to product and process design, a package, packaging, and packaging systems are not, unless one works in a related area. Therefore, in this section, we will provide discussion on a package, packaging, and packaging systems.

The Institute of Packaging Professionals defines a package as the following: "The enclosure of products, items or packages in a wrap, pouch, bag, box, cup, tray, can, tube, bottle or other container form to perform one or more of the following major functions: containment for handling, transportation and use; preservation and protection of the contents for required shelf and use life and sometimes protection of the external environment from any hazards of contact with contents; identification of contents, quantity, quality and manufacturer — usually by means of printing, decoration, labeling, package shape or transparency; facilitate dispensing and use. If the device or container performs one or more of these functions, it is a package." (6)

While this definition may seem a little bit cumbersome, it really indicates a package is a product of one kind or another that must perform one or more of the noted functions. A package can be further classified as a primary package, secondary package, tertiary package, and quartenary package. The primary package is the container that is in contact with the product and is also salable in a retail environment. The secondary package unitizes several primary packages into a saleable unit. The tertiary package is the shipping container and may hold one or more primary packages, or one or more secondary packages. The quartenary package unitizes the shipping containers and is generally restricted to pallets, stretch wrap and strapping.

When we refer to packaging, we are referring to more than just a container at noted above. Packaging includes packages and the industry that manufactures them, the packaging machinery used to combine the products and packages at the end-use organization, and the functional organization within the end-use organization. As noted before, packages in and of themselves are a product. This product must be manufactured by a converter, or multiple converters. For example, glass bottles, and two piece aluminum cans are typically manufactured and sold to an end-user of some kind, whereas many of the flexible containers and wraps may require several converting operations by different organizations prior to final use by the end-user.

Most packages require packaging machinery, if not entire packaging machinery systems to combine the product with the primary package and the other packages (secondary, tertiary, quartenary) that follow. An entire industry segment designs, manufactures and sales packaging machinery within the United States as well as abroad.

Packages must be combined with some product at some end-use organization. In general, packages are designed for industrial, consumer, and military applications. Each of these categories has multiple end-use applications. For example, consumer packaging may be further subdivided into consumer foods, beverages, pharmaceuticals, cosmetics, and a many more. Each type of organization places multiple functional demands on the package and packaging machinery.

This leads us to the idea of a packaging system. In this case the packaging system is actually a subsystem that we include into the "total productive systems" concept. It is not within the scope of this paper to describe this concept in depth, but we would like to point out that this concept follows a cradle to crave approach in the design, use, and disposal of high quality products, including packaging. It is based on a systems view where system refers to inputs, processes, outputs, and external influencing agents. In our view, various subsystems include product, process, and packaging research and development; manufacturing systems; packaging systems; warehousing and distribution systems; wholesale and retail systems; marketing (including consumers) systems; and environmental systems. External influencers include the legal and regulatory climate that exists in a particular industry, consumer activism, and global competition to name just a few. No one individual can successfully develop packages or packaging systems, rather an interdisciplinary approach is required.

4. Observed Societal and Cultural Differences Between

As noted previously, the lead author spent nine months in Japan as a research fellow. The focus of the research was to determine the Japanese approach toward packaging development, and to find out whether or not concurrent engineering methods or collaborative methods were used. This effort was only moderately successful in that it was difficult to find companies or individuals willing to discuss this issue with a non-Japanese. This is the first difference noted between American and Japanese companies that most likely would adversely impact collaborative product development in a joint venture or strategic alliance relationship. The lead author has had much success in conducting case study research with American packaging companies at both the end-user and converter level. Companies were very willing to discuss packaging development issues and allow visits to their companies. This seems to be true in most cases. The Japanese companies on the other had are not so inclined to do this sort of activity. Apparently this is true even for Japanese researchers and educators. The second author and other higher educators on more than one occasion noted the difficulty in conducting research between industry and universities. The underlying reason for this is the issue of trust and relationship building that exists in the Japanese society. This was observed in each case study undertaken and really highlighted based upon in-depth conversations with a supply chain management consultant to a major worldwide consulting company. He noted that it is not uncommon to spend years developing trust and nurturing relationships prior to engaging in consulting and change activities. This was further evidenced based upon interactions in the host university laboratory. Trust and relationship building also occur in larger part during after hour's activity in the Japanese society. While this occurs in American society, it does not occur to the level observed in Japan. Thus, a legitimate question is whether or not (in this specific case) could American and Japanese engineers and other team members come together quickly to realize rapid product development and introduction in the marketplace? Or, will this issue of trust and relationship building prove to be a roadblock?

Basic communication is another issue that certainly was an impediment to this research effort, but could drastically undermine attempts to collaborate in joint ventures and development of new products. The ability to speak the language is a basic issue. The Japanese language is extremely difficult and takes a long time to learn. Suffice it to say the lead author spoke no Japanese. Even so, through either using interpreters or speaking Basic English, communication was possible. However, more importantly with regard to communication is the issue of verbal and nonverbal communication. The second author in a previous paper notes the following: "Westerners communicate by words, but Japanese apparently do not. Japanese transfer their knowledge and experience though behaviors, not words. Thus instructions for Japanese should be given in some other form than a manual in the form of a text. And Japanese try to understand others by observing how others do it or how others reason. This seems to be a big difference from the Western world, where knowledge and experience are transferred symbolically and discussion are made mainly in terms of language."(7) Although this could be the discussion of a very long paper, it is sufficient to say that this is a significant difference between Americans and Japanese. This was evidenced via case study, laboratory, professional, and personal interactions. The Japanese place significant reliance on non-verbal communication that is very subtle, which is also different from non-verbal American communications. What sort of barrier or impediment to successful collaboration toward collaborative product development might occur because of this difference in culture and society?

Another difference noted during two of the case studies was the idea of negotiation and contracts. Americans are very legalistic and written contract oriented. The Japanese are not. It was surprising to learn that relationships between suppliers and end-users often were done without written contracts! It would seem that this also ties in with the idea of trust and relationship building. It also ties in to non-verbal communication used by the Japanese. Dr. Fukuda notes the following: "What we have always discussed was how we should do it. Thus, "how" has been more important in Japan than "what". This can also be observed when a man transfers his knowledge or experience to others. Japanese transfer them in non-verbal or behavioral manner. Thus, manuals are not so well accepted as in the western world. Japanese behave by watching how others do and try to collaborate or try to achieve good quality. In the Western world, manuals come first ...". (7) Clearly a concurrent engineering team consisting of Japanese and American members would have difficulties with this issue!

Another significant difference between the two cultures that was noted that is similar to negotiation in the legal sense but is in fact much broader. Americans tend to be more results oriented. In other words, Americans are interested in the final result and don' t pay particular attention to the process to get there. The Japanese on the other hand are very focused on the process. In another paper, Dr. Fukuda, describes it in this manner: "In the Western countries, when people talk about negotiations, they are talking about the final results. In other words, they are negotiating on what' s. But I feel Japanese behave somewhat differently. We are negotiating on hows. We are discussing how we should navigate through pieces of knowledge rather than what each piece of knowledge represents. Thus, navigation or processes seem to be more emphasized than the final results in Japanese way of negotiations."(8) This particular aspect of Japanese society was also noted during many personal situations that the lead author encountered during his stay in Japan. A rather heated debate with an individual in the university laboratory about whether or not a Kanji or Chinese character was correct if it was not done in the proper stroke order very pointedly emphasized this point. The Japanese student said it is wrong if the proper stroke order is not used. The American researcher took the view that the end result was correct regardless of the stroke order! An entire paper could be written about that experience! Could a collaborative effort work when such a significant difference exists, such as process versus end result?

5. Final Comments

To be sure, many more examples could be given that would at the very least, show that it would be challenging for Americans and Japanese to work together in a collaborative or concurrent engineering environment because of their cultural and societal differences. We believe the examples given here are probably the ones that would provide the greatest challenge if Americans and Japanese were working together to develop new products and introduce them into the marketplace.

For the lead author, the research fellowship was an eye-opener, to say the least. It was a shock to go to a foreign country, and not find products and services that he had grown accustomed too, or if he found them, discovered that they were not quite the same! It is truly a global economy. Corporations will do business on a global scale. As educators we should do a better job of preparing our students to succeed in this environment. It is not enough to read books about other cultures and societies and expect to succeed in that "foreign environment." Therefore, the use of joint ventures, strategic alliances, global collaborative engineering efforts, and other similar activities between "different" companies and cultures will be necessary. Furthermore, understanding that significant differences in approaches to problems may occur. As educators, we need to get out of our own culture either by going ourselves, or bringing others to our domain. We need to share experiences and learn from each other. In this paper differences between Americans and Japanese were illustrated. No criticisms of differences were given because it is our belief that our differences are opportunities for learning and improving! And lastly, as educators we need to hammer this point home to our students.

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