Concurrent Engineering in a New Perspective: Heading for Seamless Engineering

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Abstract It is pointed out that what concurrent engineering contributed to industry is that our knowledge is non-physical so that it can be shared. Although traditional concurrent engineering contributed very greatly in reducing time to market and reducing cost, it only paid attention to 1 dimension, i.e. time. But if we expand concurrent engineering into 2 dimensions, i.e. time and space, we can integrate many different industries into one and meet the basic expectations of our customers. And what is none the less important is that we could reduce energy considerably and build up a seamless and smart society. Thus, concurrent engineering tomorrow will contribute to the creation of a new lifestyle.

Keywords

temporal CE, spatial CE, customer's expectation, energy reduction, seamless society

1 CE: Non-physical Knowledge can be shared

Concurrent Engineering (CE) has been known as a tool to reduce time to market, in other words. a tool to increase productivity. The great success of CE may be attributed to its way of thinking. CE noted non-physical nature of knowledge. What CE solved is a packing problem. If we regard all processes as physical objects, then we cannot pack them in a smaller box than the current one. But if we note processes are composed of physical and non-physical elements, then we can share non-physical elements and can pack them in a smaller box (Figure 1).

Let us take an apple for example. If there is only one apple, and two brothers would like to have one, then there will be a quarrel. But if we split an apple into

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half and give each half to brothers separately, then they will be happy. Splitting an apple before giving it to two brothers is wisdom or knowledge. It is non-physical. CE notices that there are common pieces of knowledge so that you can share them.

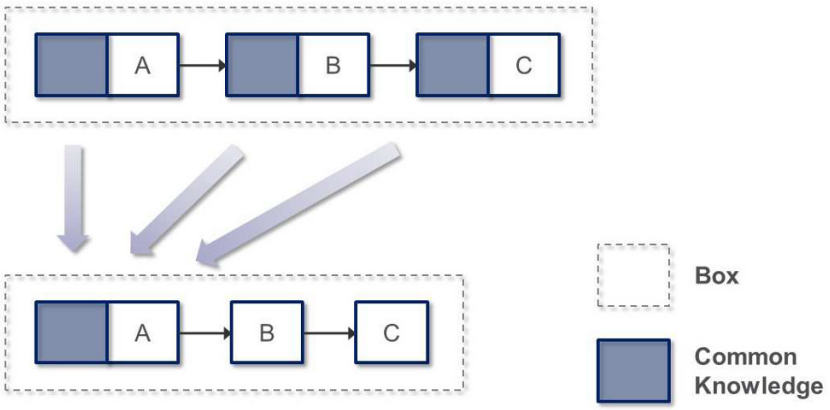

Fig. 1 Concurrent Engineering as a Packing Problem

2 Traditional CE: Reduction of Time

Traditional CE focused its attention on how we can reduce time to market because it was originally developed for military competition, although later it was expanded to industry sectors. Thus, reduction of time to realize a product was mandatory. Reduction of time to market is also welcomed by industry, because they are fighting another war on the market. And this reduction meant nothing other than increase of productivity. Increasing productivity is becoming more and more difficult. But if we note knowledge is non-physical, we can increase productivity remarkably. Thus, CE spread very quickly and widely.

3 New Role of CE: Reduction of Energy

But today CE is not so much appreciated by industry as it was. Why? This is because customers' requirements are diversifying very quickly and extensively. Yesterday, industry can survive by mass production. So CE yesterday had much to offer for industry. But today industry has to customize their products to meet the diverse requirements of their customers.

Another emerging issue of importance is the lack of energy. Industry has to reduce energy consumption. But we should remember energy reduction is very important for industry from the first. Energy saving is important for keeping the world green, but apart from that, reduction of energy consumption is nothing other than cost reduction. The more we can reduce cost by reducing energy consumption, the more profit we can obtain. Then, how can we adapt CE to such changing situations?

4 Expanding CE into 2 Dimensions: Time and Space

If we recall that CE solved a packing problem with attention paid to the non-physical nature of knowledge, we could find our solution. CE yesterday only solved one dimensional problem. It solved the problem with respect to time. But if we expand CE into 2 dimensions, i.e. time and space, then we could adapt CE to the current situations.

Thus, CE today will be illustrated as shown in Figure 2. The core idea of sharing knowledge is the same. In fact, we expand CE from one dimension to two dimensions, the reduction of space would be greater so that we could pack processes in much smaller box.

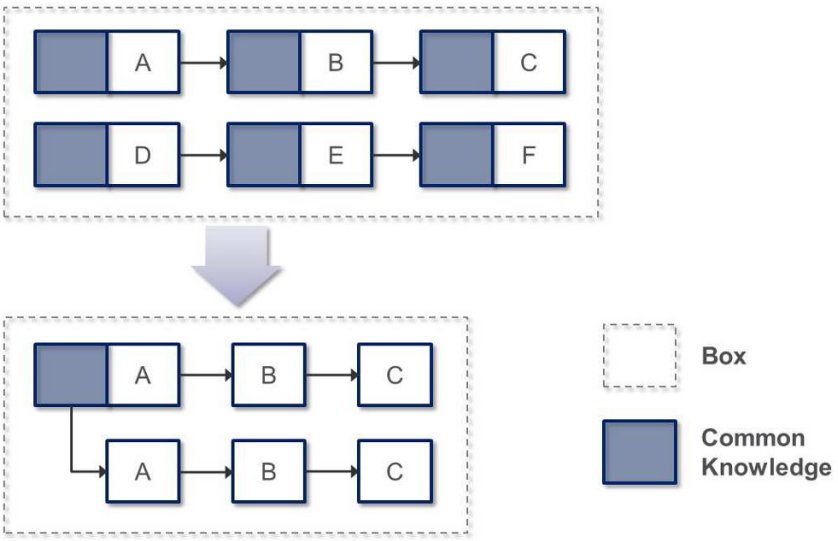

Fig. 2 Concurrent Engineering Tomorrow

Then, how can we share our knowledge across industries?

5 Standardization: An effective Approach to 2-D CE

One way is to standardize components. For example, AWS (American Welding Society) introduce standardization in the form of components. They standardize welding procedures in the form of a box (Figure 3).

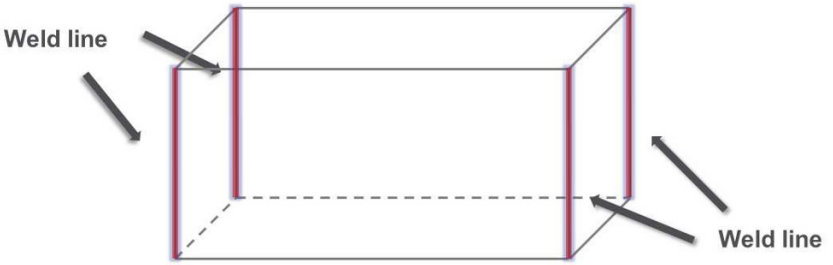

Fig. 3 AWS Standard

Box type components are used everywhere from automobiles, ships, containers, etc. In fact, ship design is basically based on boxes. Thus, if welding procedures are standardized for such a shape as a box, the same procedures can be applied across industries.

The greatest advantage of introducing such standardization at the level of a component is that engineers do not have to take too much time in designing and preparing for production. Especially in the case of welding, deformation, material deterioration and residual stress from heat input vary with the change of shape and geometry.

But if the shape is the same or at very similar, welding engineers can focus only on important issues, thereby increasing productivity to a great extent. And as welding needs a wide variety of knowledge from many different principles, the procedures change from engineer to engineer but if the object shape is standardized, time and efforts for searching an appropriate solution could be reduced to the minimum.

It also will facilitate the introduction of robots as well because conditions do not vary too much from product to product. This standardization makes the most of the feature of non-physical nature of knowledge. The sizes might be different from product to product, but we could share a large amount of information if we have the same shape or geometry in our minds.

Further, if the sizes of the components are same, then we can mass-produce them and utilize them for different products across different sectors. In fact in the case of automobiles, they are now quickly moving toward having the common or identical platforms for different types of cars.

6 CE will introduce a drastic Change in our Society

But this discussion is still based on the current industrial framework. If we note such new ideas as smart grids or smart communities, then we could revolutionize our industrial framework and we could build a seamless society.

6.1 Car-Airplane in One

Currently, automobile industry is making efforts to produce better cars and aircraft companies are doing their best to produce better airplane. Each industry is doing their best to produce better products in their own field.

Let us consider an airplane. Indeed, it was our dream to fly like a bird. Airplanes were invented to make our dream come true. But aircraft companies are still carrying its history of invention and they do not jump out of their silo. They are focusing only on how they can fly better.

Fig. 4 The Transition in the sky

But what a customer wants is to travel from A to Z without much difficulty. He or she never asked for a car or an airplane. What he or she wants is a means of transportation. If this transportation is seamless, then that's far better than the current system of changing from one means of transportation to another. We have various means of transportation only because they still carry their histories of invention and very few, companies really get down to the basic needs of their customers.

This discussion leads to the seamless integration of industries across different fields to respond to the basic needs of our customers. If we could combine car and airplane, then we don't have to worry about a taxi or a car when we land in the unfrequented countryside. In such a big country as Brazil, there are air taxis, but they are useless if we do not have any means of transportation at the destination. What we need is an integration of an airplane and a car into one. In fact, Terrafugia, for example, has developed such a car-airplane-in-one transport The Transition [1] (Figure 4 and Figure 5)

Fig. 5 The Transition on the road

6.2 Personal Mobility

Let us take another example. Segway, Inc invented Segway Personal Transporter [2] (Figure 6). It is well known that iBOT [3], wheelchair led to this invention of inverted pendulum personal transporter.

Further, Segway, Inc, together with GM developed P.U.M.A., Personal Urban Mobility and Accessibility [4] (Figure 7). The word "personal mobility and accessibility" is used for the handicapped in assistive technology so this indicates that such assistive technology not only serves for the handicapped but it helped to create a new society where people can move around easily, no matter they are handicapped or not. Such inventions will help build up a seamless society and create a new lifestyle.

Fig. 6 Segway Personal Transporter

Fig. 7 P.U.M.A.

As can be easily understood from the picture, P.U.M.A. originates from a wheel chair. If such a personal transport can be developed, then there will be no distinction between the outside and inside of the house. Like a person on a wheelchair, you can come into the house directly without parking your car in your garage. Then, the design of a house and a means of transportation will be integrated into one.

In this way it is expected that in the coming years, all different products will be integrated seamlessly to form a smarter environment. Then, we could reduce energy to the greatest extent, because we can avoid the overlaps and thus we can increase our productivity exceedingly.

7 Producer and Customer working together

To cope with the diversifying requirements, Alvin Toffler [5] proposed a Prosumer (Producer + Consumer) System where the producer and the customer work together. And recently C.K.Prahalad and Venkat Ramaswamy [6] proposed Value Co-creation, where the producer and the customer work together to co-create a unique value (Figure 8).

This is in a sense an extension of concurrent engineering, which in the later years developed into collaborative engineering, although most of the discussion

there were how experts can work together across their domains to produce a product to fit better to the diversifying needs of customers. It may be said that these ideas of collaboration of the producer and the customer came up because diversification extends more than what can be expected by the producer. But it should be emphasized that this collaboration of the producer and the customer is still producer-driven. It only adds the customer as another collaborator.

It must be noted that customer's requirements are diversifying because the customer would like to be more active and creative. They would not like to be just passive consumers as they used to be. So although the producer and the customer work together, the customers would like to take the initiative as shown in Figure 9.

This implies that until now, industries are operating in the producer-centric framework and they do not necessary have to consider the basic needs or the basic expectations of the customer. But from now on, they have to get down to the basics of what customers really expect from them.

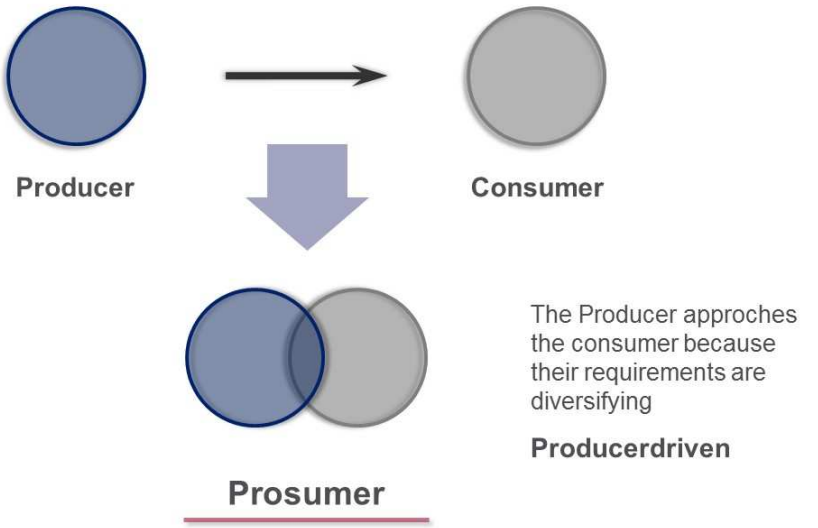

Fig. 8 Collaboration of the Producer and the Customer (Producer-driven)

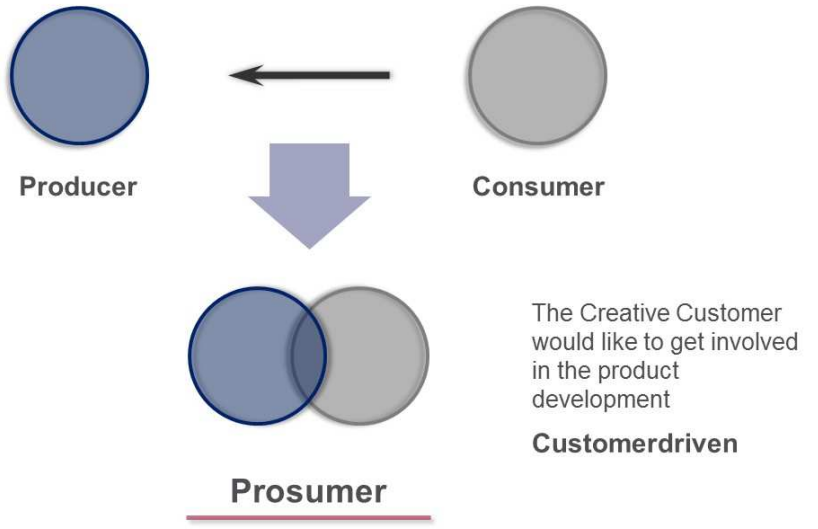

Fig. 9 Collaboration of the Producer and the Customer (Customer-driven)

8 Supply Chain and Demand Chain

To describe this in terms of supply chain and demand chain, the traditional Supply Chain and Demand Chain concept was as shown in Figure 10. But Customer-driven Collaboration of the Producer and the Customer will lead to the true demand chain as shown in Figure 11, where customer's true or basic expectations will be realized as a product.

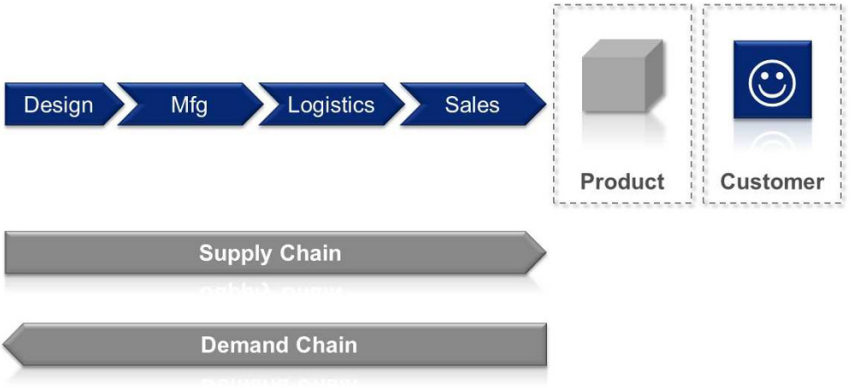

Fig. 10 Traditional Supply Chain and Demand Chain

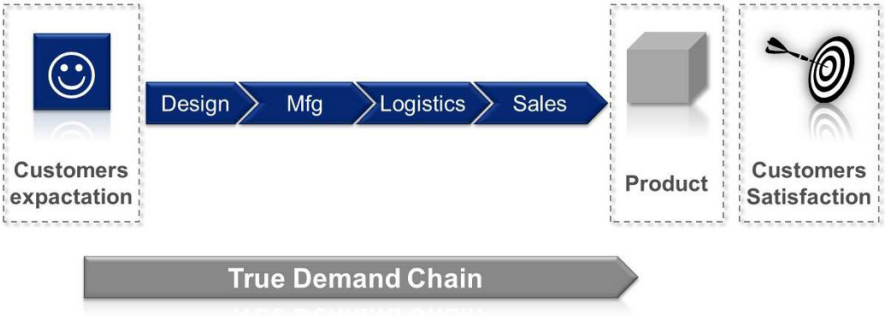

Fig. 11 True Demand Chain

9 Summary

CE tomorrow will be heading toward seamless engineering and what we will be designing are not products but societies. There will be no walls between products and/or between industries and we will be fusing them to build up a smarter community and create a new lifestyle.

10 References

1. http://www.terrafugia.com
2. http://en.wikipedia.org/wiki/Segway_PT
3. http://en.wikipedia.org/wiki/IBOT
4. http://www.segway.com/puma/
5. Toffler, A (1984) The Third Wave, Bantam,
6. Prahalad, C K, Ramaswamy, V (2004) The Future of Competition: Co-Creating Unique Value with Customers, Harvard Business School Press

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