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## **Be Lazy: A Motto for New Concurrent Engineering**

Shuichi Fukuda

Stanford University

**Abstract.** This paper is a position paper to point out that concurrent engineering is entering its 3<sup>rd</sup> generation. 1<sup>st</sup> generation concurrent engineering was proposed in 1989 when DICE project started. The primary purpose of the 1<sup>st</sup> generation was how effectively we can reduce time to market. Their only concern was time and “earlier and faster” were the keywords then.

Then 2<sup>nd</sup> generation concurrent engineering came. We became aware that if we really have to process things in a concurrent way, we have to discuss at a strategic level. The tactical discussion would not solve the problem. That was what we found out after many years of practicing concurrent engineering. The primary task in 2<sup>nd</sup> generation concurrent engineering was how we can set a strategic goal across all different development processes. To achieve this, communication and collaboration became essential. So some researchers, including myself, called this 2<sup>nd</sup> generation concurrent engineering “collaborative engineering”.

Now, we are entering 3<sup>rd</sup> generation. With the growing diversification of customers and with our traditional markets going out, we have to consider every constraint as soft and negotiable. In short, our 3<sup>rd</sup> generation concurrent engineering is “negotiable engineering”. Everything is put on a negotiable basis. There are no more fixed dimensions. Everything changes in a dimension and sometimes the number of dimension itself changes. Our way of solving the problem changed to constraint-driven from our traditional way of goal-driven.

This paper describes how concurrent engineering changed with time and what will be our new challenges in our 3<sup>rd</sup> generation concurrent engineering.

**Keywords.** Concurrent Engineering, Yesterday, today and tomorrow, Soft and hard constraints. Negotiation, Constraint driven, Postponement, Lazy evaluation

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Shuichi Fukuda

Stanford University, Consulting Professor

3-29-5, Kichijoji-Higashicho, Musashino, Tokyo, 180-0002, Japan

Phone: +81-422-21-1508 Fax; +81-422-21-8260

Email: [shufukuda@aol.com](mailto:shufukuda@aol.com)

## 1 What is in the back?

With the growing diversification, more flexibility and adaptability are called for in product development and marketing. Therefore, new business models are proposed for marketing and product development. One of them is one to one marketing where product development focuses more on individual aspects and considers life time value of a customer. But unless the product is very large or very special so that it has to be made to order, which means production would not start unless price covers all the expense, we have to compromise between mass production and personalized production, because if we produce products completely to individual order, then the price would become too much high and we cannot sell the product. So if the product has to be sold at a reasonable price to secure marketability, we have to compromise between mass and personalized productions.

## 2 What 1<sup>st</sup> Generation Concurrent Engineering Brought to Us

This means that every item or part to be developed will be put on a negotiable basis. Our old product development was such that each developing item or part is a box which has fixed sizes, i.e., height, width and length with order priorities and that how we can pack them together appropriately in a larger box. Thus, fundamentally the problem of our old product development was a packaging problem or a scheduling problem (Figure 1).

Concurrent Engineering changed the situation [1], [2]. It told us that by noting the content of each item or part, some items or parts can be processed at the same time. This means that the size of items or parts become changeable if we note their contents (Figure 2).

This is quite revolutionary because until the emergence of concurrent engineering, everybody endeavoured only how we can pack them adequately. i.e. All our efforts were done until them with all the sizes as hard or non-negotiable constraint. Until concurrent engineering was proposed, there were no ideas to relax the constraints. What concurrent engineering really proposed was how we can relax the constraints.

But initial concurrent engineering only noted a temporal constraint. If we can process some items or parts together, we could reduce time to market. So their only concern was how we can reduce time.

## 3 2<sup>nd</sup> Generation Concurrent Engineering

As the initial or 1<sup>st</sup> generation concurrent engineering spreads, it soon became clear that we should change our ways of production. We processed items or parts sequentially and information flew in one way from upstream to downstream. But to effectively process some parts at the same time, we have to communicate. At the

earlier stages, communication remained at the tactical level. But soon it was realized that to more effectively relax the temporal constraint, we have to communicate and negotiate. Thus, communication to strategically determine the goal across all development processes became important (Figure 3) [3]. Therefore, some researchers, including myself, prefer to call the method “collaborative engineering” [4] rather than concurrent engineering. We should note that the primary activity of this collaboration is nothing other than constraint negotiation or constraint relaxation. But most of our concern was how we can process everything faster or how we can reduce time. So our attention was paid only to time constraints. This was because if we put our products faster into market, then it would be more probable we could wind up as winner.

#### **4 Creating a New Market**

But this is based upon an argument that our market does not change much. If we borrow the words from Kim and Maubogne [5], our attention was paid only to the red ocean. Everybody has to fight for the old traditional market so that even a minute earlier means better chance of win. But as they point out we are now entering the age of blue ocean. If we look aside, the blue ocean is expanding infinitely.

With the growing diversification, the customer’s preferences changed remarkably. Each customer has a different sense of value based upon his or her life. Thus, our traditional market which was based upon an averaged sense of value lost its meaning. How we can create a new market or how we can find a blue ocean becomes our most important challenge.

#### **5 Diversification: Even One Customer’ Sense of Value Changes with Time**

When we talk about diversification, most people only think of spatial diversification, i.e., from customer to customer. The argument is how customer’s requirements vary from customer to customer at a fixed point of time. But we should note that diversification is happening not only with respect to space, but with respect to time. Even one customer changes his or her sense of value throughout his or her life, because their life style changes with time (Figure 4).

#### **6 All Constraints are Turning Soft Now!**

This means that all the constraints are now negotiable or turn to be soft. In our traditional concurrent engineering, all data are single elements. Even if data is in the form of a list, the number of elements in it did not change. What the first and second concurrent engineering did was how we can effectively change the value of

composing elements. The number of elements was a hard or non-negotiable constraint.

But now the number of elements in the list can be changeable or negotiable. Apparently there are no hard or non-negotiable constraints. What becomes important for us is to prioritize the constraint according to their level of hardness or negotiability.

It becomes useless to rush. It would be far better to choose the right time to make a final decision. Once a final decision is made, then some of the constraints turn into hard or non-negotiable ones, we have to solve the problem by prioritizing these hard or non-negotiable constraints. Therefore, our way of solving the problem becomes more constraint-driven, and once again constraints are very much on a negotiable basis. It should be noted that some of the elements are not known at the earlier stages so that the size of a list changes with time.

## 7 From Goal-driven to Constraint-Driven

This calls for a new paradigm of concurrent engineering. Constraint driven or negotiation based concurrent engineering. This new framework will be our 3<sup>rd</sup> generation concurrent engineering. Then, how can we deal with the problem?

Postponement or lazy evaluation is the solution. We have to know how much later we can make our decision. What will be our latest time when we could make our decision becomes more important than making decisions as early as possible. Things are turning in the opposite direction. “Postponement” and “Be lazy in our evaluation” will be the keyword for our new or 3<sup>rd</sup> generation concurrent engineering.

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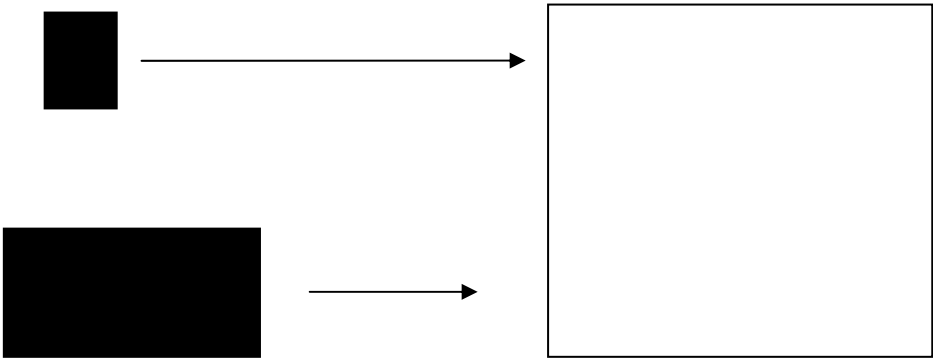


Figure 1 Packaging Problem

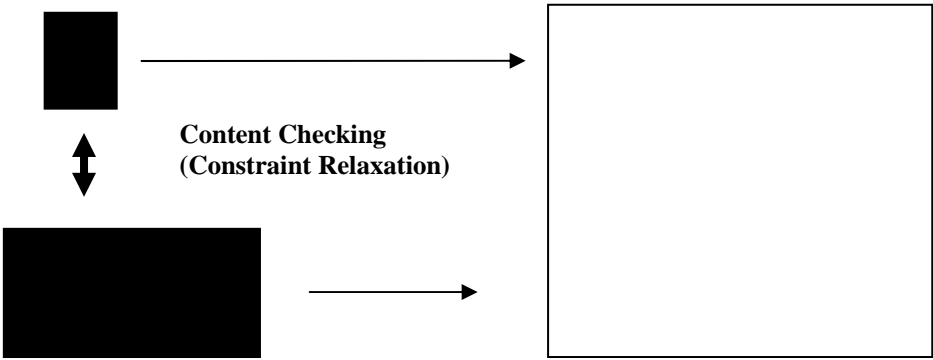
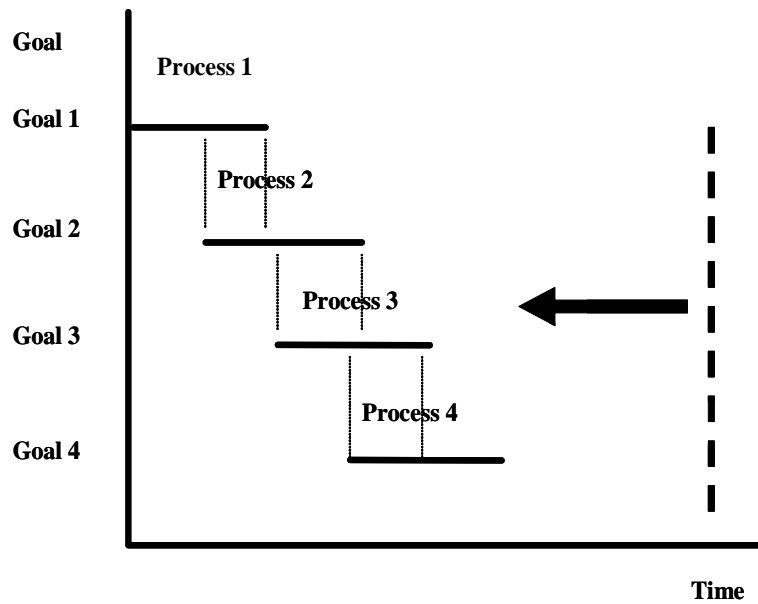
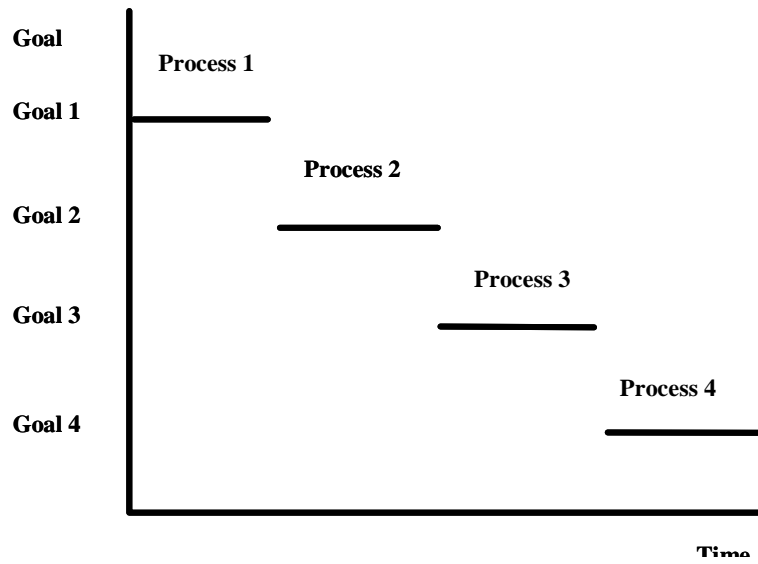


Figure 2 Packaging Problem With Constraint Relaxation



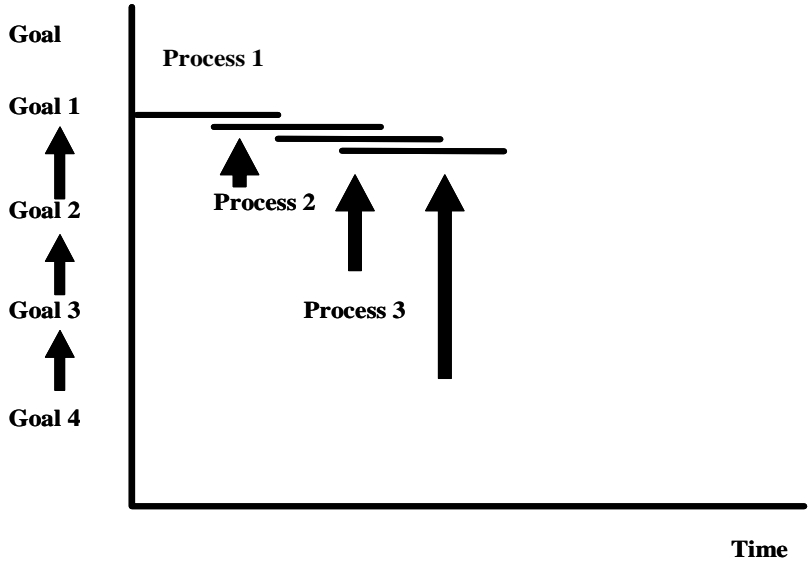


Fig.3 (c) 2<sup>nd</sup> Generation Concurrent Engineering

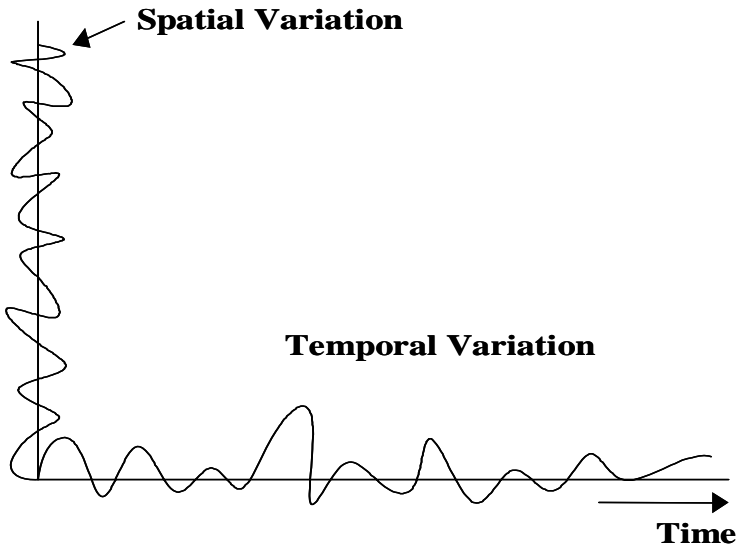


Figure 4 Diversification