Introducing the Design Chain

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About DCOR

The Design-Chain Operations Reference model ("DCOR") is a process reference model that has been developed as the cross-industry standard diagnostic tool for all stages of research and development. DCOR enables users to address, improve, and communicate product engineering practices within and between all interested parties.

By describing design-chains using standard process building blocks, the model can be used to describe design-chains that are very simple or very complex, using a common set of definitions. As a result, disparate industries can be linked to describe the depth and breadth of virtually any design-chain.

The Perfect Design?

A friend recently sent me the Booz Allen Hamilton special report, "Money Isn't Everything" ¹ on the R&D spend by companies. The authors investigate the question of whether more R&D spend means better business results for companies. My interest is aroused when the talks about the innovation processes – ideation, project selection, development, and commercialization – but the definitions of these innovation processes are missing from the report.

The article made me realize that those introduced to the SCOR family of frameworks may have the same problem: What does it mean? Supply-chain as a term is nowadays reasonably well defined. Product engineering, R&D, product development, or what the term I am looking for may not seem well-defined. Where, if any, are the boundaries between product design, developing a new business, and product and market positioning?

I find that the best way to explain the positioning of any of these frameworks is by a (simplified) example. This article specifically looks at the boundaries between DCOR (design-chain) and MCOR (market-chain). DCOR, the design-chain, covers the majority of what the Booz Allen Hamilton report refers to as R&D. MCOR describes the processes that drive business development – which markets, what products for each market, and the pricing and feature levels for each product. Keywords for the market-chain are pricing, margins, and product roadmap.

Imagine your company plans to make widgets. You are a start-up. You are the only employee of your company, so you will be responsible for planning and executing all processes at start-up.

So, you have an idea for a widget, and you think there's a market for your widget. The first thing experts tell you to do is to build a business plan for your company and product. The creation of the business plan is known as the “Develop” process in MCOR. One of the aspects of writing a

¹ Money Isn't Everything by Barry Jaruzelski, Kevin Dehoff, and Rakesh Bordia. strategy+business, Winter 2005. Booz Allen Hamilton, reprint No. 05406
business plan is to describe your market, how you position yourself in this market, and what product or service you provide to this market. The research you perform to understand the market and its customers is known as “Analyze” in the MCOR framework. The information you collect in the “Analyze” process is integrated in the business plan (“Develop” process).

Another aspect of the business plan is the “product.” Your idea is to manufacture and sell widgets. When you think about what that means you quickly find out there's more to widgets then you initially thought: Although simple to use your widget may require some installation support, and periodic maintenance would elevate your widget into the top echelons of widgets. So, you define in more or less detail what each of these products looks like – the widget, installation support, and scheduled maintenance. This product positioning process is part of the “Develop” process in MCOR.

The decision whether or not to offer these services requires details on staffing and other cost. This is when you move into the DCOR process domain.

You take each of these product (positioning) descriptions and decompose those into sub-components. Let’s take the scheduled maintenance. For the scheduled maintenance, you know you will need to be onsite. Once installed, the widget cannot be removed from its environment. You need staff to go on-site. You also know that part of the widget may need to be replaced; the maintenance person needs to have the most common parts on-hand when going on-site. These de-composition activities are within the DCOR “Design” process.

The next question is how to staff the maintenance. You are investigating multiple alternatives: Hire into your company, outsource, or a combination. You talk to companies about outsourcing and review internal staffing possibilities. You ask for quotes and discuss terms and conditions with the outsourcing companies. “Research” describes these processes in the DCOR process framework. Based on all the information collected, you will have to make a design decision later.

Based on the information you collected in “Research,” you can build a description of how you would like to set up the scheduled maintenance service. This detailed and technical description allows you to cost – not price – the service: Cost per visit is the sum of the number of hours on average to perform the maintenance, travel time, and average replacement part cost. The average replacement part cost is information that the design processes of the widget itself generated. All this technical and process information you will use later to price the product and create collateral. The processes described above are the “Design” processes in DCOR.

The next decision is a commercial one. Knowing the cost, what will be the pricing? This decision includes questions on margins and profitability of your company. Once you set the price and decide to go (the final steps of the “Develop” process in MCOR) you are ready to prepare for the launch.

This kicks off a whole set of activities: On one hand you focus on the market launch (MCOR); on the other, you need to ensure readiness of the supply-chain, sales, and support processes. You need to sign contacts with the suppliers of goods and services; you need to train the support and maintenance staff, provide them with the technical drawings of your products, and write standard operating procedures for your maintenance staff. This is just a subset of the activities. All the technical readiness is described as the “Integrate” process in DCOR. Obviously, you also need to do this for the widget itself: Establish the supply-chain, supplier contracts, etc.

The simplified model above helps answer some of the frequent questions on the design-chain. No confusion of organizations or functions, just you executing the processes. My recommendation: If you have a question on DCOR vs. MCOR, test it against my simplified example above. I tried the two most common questions below.

The most common question is on product life-cycle management (PLM). Most people see PLM as something that would fit in DCOR (product design or engineering). Reality shows lifecycle decisions and plans are maintained using different parameters than product engineering data. The criteria generally concern one or more of the following: profitability, market share, and customer binding. For example, I sell you a cell phone at a loss to bind you to buy my (highly
profitable) calling minutes. Some service providers are now offering unique phone models: If you want our phone you have to sign up with us. The phones have a shorter lifecycle than the calling plans. Those are market positioning decisions derived from market-chain processes. Sure, unplanned events, such as a supplier going out of business, may trigger review of the lifecycle and the re-design of a product, but the ultimate decision is what is best from a “managing the market” perspective.

Another question is why there are no product quality metrics in the design chain? Isn't the primary objective of design chain processes to create the highest quality products? I believe the answer is no. Companies need to differentiate. Some companies want to offer the best quality; others want to fight on price or service. And companies adjust over time to reposition within the changing markets and the coming and going of competitors. Those are all market management decisions – MCOR. On the other hand, creating products consistent with quality, cost, and functionality requirements is an important measure. In the DCOR model, this is measured as “Perfect Design.”

Does Design Really Chain?

Children have a knack for asking about the obvious — that is, obvious to us that have been around a little longer — where it is completely obvious to me that gravity makes water spread on a flat surface, it is my daughter’s question, “Papa, why does water run out of my cup when it falls over?” that makes me realize that the obvious is not obvious for everyone.

To me, it is equally obvious that design processes chain. In this second Introducing article I want to focus on the chaining-aspect of the design-chain.

First, a little history on the design-chain. How does one design a reference framework? We did not have access to somebody that could answer that question for us. So the first thing we did was look at an example of a reference framework – SCOR. We recognized the benefit of process, inputs, outputs, metrics, and best practices. But we found more. SCOR seems to match the skeleton of a standard process description from the workflow gurus: input, process, output, plan, measure, and control.

The SCOR Plan processes control the rhythm and adjust supply and demand to meet overall plans. The Plan processes are the measure and control processes with regards to meeting quantitative output requirements. The Source processes function as the input to the transformation process. We describe it as the execution process that formats the inputs. The transformation process in SCOR is Make. The raw materials are integrated or transformed into a finished product. The Deliver processes function as the output of the transformation. Deliver is the execution process that performs the output. The Enable processes are the measure and control processes for the non-quantitative performance of the process – quality, regulatory compliance, et cetera.

This explains why there are three execution processes in the design-chain as well.

The process of collecting and formatting the inputs to the transformation process is “Research,” The transformation process is “Design.” In Design the “raw materials” (ideas, technology, components) are integrated in the design of the “product.” The final design needs to be released into the company. The delivery of this design into the supply-chain, marketing, sales, and support is called “Integrate” in DCOR.
The second thing we did was interview “product” people. We found that there are several different types of R&D taking place. There are groups that work on R&D projects that seem to be disconnected from any “product”: How to store music in digital compressed format. Another group works on the products you sell: The MP3 player on everybody’s Christmas list. And, finally, there is the group that builds the stack of products that go together – the website that can only sell music in the format for your MP3 player.

So, how to describe these processes? Are they different? Do I need 3 high level processes? Research technology, design product, design total offering? Do I need 9 high level processes? Research technology, design technology, integrate technology, research product, design product, integrate product, research total offering, etc. More interviews lead to the answer. The activities performed are the same, but the content is different. In supply-chains you can observe the same. The processes are the same, the content is different. One company makes a finished good that is the raw material for the next company in the supply chain. The chaining concept of a supply-chain is therefore universally accepted.

Companies position their design-chains based on market position. Many companies focus on the product (player) design, by using the technology created by another (MP3 encoding) and ignoring the total offering. Other companies focus on creating the technology, but have difficulty translating technology into product. Different companies or departments have different positions (“nodes”) in the end-to-end product design (or design-chain). The tighter the collaboration between these nodes, the better the designs of the total stack (MP3 codec, MP3 player, and MP3 online store).

So, how do these nodes chain? For my MP3 example, the company has a dedicated R&D team focused on audio compression technology. The work of this team is driven by the overall product roadmap. The Plan processes a link to the MCOR processes (see article 1). Research and Design are driven by this plan. The MP3 player team works off the same product roadmap. One of the key design elements for the player is the audio compression technology. The research for the MP3 player encompasses the linkage to the work of the MP3 compression team. The MP3 compression team works with the MP3 player team to “integrate” the technology into the MP3 player design. Thus, Integrate processes link to Research processes (1).

One would hope the activities between the teams are coordinated. This is where the Plan processes communicate (2): “How far are you in completing xyz?”

I realize my example above may cause discussion as I tried to explain how processes connect by using organizational examples: “Why do you have separate teams?”, “Is end-to-end integration not a better alternative?”, “Why does the MP3 player team research the work of the MP3 compression team?” These are all valid organizational design questions.

Those that have used reference models like DCOR before know the risks of using organizations or functions to describe a process: Most people think organization when they say process. Of course, there is no universal best organizational design. There are features of organizations that
work really well. In the world of frameworks-based business process management we call these best practices. The processes, however, are the same in whichever way you structure the organization. The research process for the MP3 player needs to take place: Does the MP3 technology match the requirements for this player? The requirements include costing, form (compression), fit (can it be integrated in the product), function (quality-loss), etc.

To find the best design processes for your company, I recommend you take a look at how you work today. Describe each team using high level processes and see how they interact. The chaining of the design processes will be very obvious after your reviewed two or three teams. Don't take my word for it, prove it yourself, in practice.

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**How To Link Supply And Design?**

The technical development and steering committee of the supply chain council has chartered a team to prepare the DCOR model for official release. Some excellent work has been done to review processes and metrics, add best practices, and resolve the open question about how the SCOR engineer-to-order engineering processes would link into the DCOR design processes.

The bigger question remains unanswered: How does product design generally link to the supply chain, and visa versa? In this technical brief I am presenting some of the original guidelines we used when we created the first version of DCOR in 2004.

**Can one design a product without designing its supply-chain?**

As supply-chain experts, we say no, right? Simply creating the bill-of-materials, the assembly instructions, and selecting the materials doesn't do the job. Only approved suppliers may provide parts; the parts need to be delivered to a specific location; packaging dimensions may lead to different fulfillment needs; etc. Sure, we will re-use the existing supply-chain infrastructure as much as possible to ensure asset management objectives are met. But if you were only shipping boxed TVs to stores before, and now you want to deliver 50+ inch plasma TVs to the home, then you may need to set up a white glove delivery network. To achieve this, you may use the existing stores and have them deliver to the home, or you may ship directly from your distribution points to the customer. The market requirements will determine the outcome of this design activity.

**Do you consider the design or redesign of your supply-chain network a supply process or a design process?**

Sure, your best supply-chain experts are working on those projects to optimize your supply-chain network or to do a multi-dimensional grid-model to determine the best location of a new distribution center, but are they performing design or supply activities? Isn't the purpose of the SCOR family of frameworks to eliminate the organizational aspects and focus on the process?

Acceptance of the above answers assumes you are willing to remove some significant processes that some perceive to be encompassed in the SCOR enabling processes: e.g., network design,
supplier selection, and validation. The resulting guidelines listed below suggest that the enabling processes do not negotiate supplier contracts but trigger the negotiation processes and integrate the supplier information and rules.

**Guideline #1** – SCOR describes any supply chain process. The traditional view in the supply chain council is that SCOR describes the core supply chain of your company. This is the supply chain that enables the revenue generation. In practice, you can apply SCOR to any type of supply chain. We worked on many non-traditional supply chains and found SCOR can be applied successfully. Examples? The supply chain of buying a laptop for your employees, installing standard software, delivering it to the workplace, and returning the old laptop; the supply chain of sales and marketing materials; or the supply chain of releasing programming code; and, finally, the supply chain of delivering process improvement projects (we have since translated this to the PCOR reference model).

**Guideline #2** – DCOR describes any design process. Same as guideline #1.

Guideline #3 – Enable processes as communication hubs between process domains (e.g., DCOR and SCOR). Take the enable process ED.5: Manage Deliver Capital Assets. The description of this process is “Acquisition, maintenance, and disposition of order management, warehouse, and transportation capital assets. Determine material handling, (inventory) pick, pack & ship methods (inventory), and equipment.” Is this process really at the same level as D2.9: Pick Product or P4.3: Balance Delivery Resources with Delivery Requirements? In process improvement projects we used the Enable processes to “translate” supply chain plans into capital asset needs – e.g., the shipment volume information from Plan Deliver can be used to determine storage capacity constraints based on expected volume growth. The expansion of the warehouse itself is a process framework by itself, not simply a single level 3 process step.

**Guideline #4** – Integrate links product design processes to the supply chain processes through Enable. The purpose of the Integrate process is to release new products into the company operations. Design chain processes do not deliver physical products to the supply chain but deliver information such as bills of material or recipes, assembly or mixing instructions, workstation or factory routing information, product weight and packaging dimensions, supplier contracts, business rules and regulatory information, and more. All of these received and “maintained” in enable processes in the SCOR model. We used the SCOR enable processes to format the information for the specific supply chain node we looked at. Execution processes (Source, Make, Deliver, and Return) and the Plan processes pull the information as needed. An example: Every time you build another one of your standard products you don't go into the engineering database, pull and format the bill of material to the specifics of your shop floor system, and then train your operators. That's the role of enable processes.

**Guideline #5** – Supplier qualification and contracting is a design-chain process. This is a result of guideline #2. The selection and qualification of suppliers is dependent on many factors. The optimal combinations of these factors qualifies the supplier: product quality, ability to support volumes, location and logistical process capabilities, price, warranty, ease of repair, et cetera, et cetera. The validation and prioritization of these factors may be differentiated by product and are an integral part of the design of a product or service. Opponents to this view argue that “you should never let an product engineer select the supplier; you get the best quality, too expensive and always short.” My counterpoint: You confuse organization (engineers) with process.

**Guideline #6** – Design and redesign of a supply-chain network is a design-chain process. This is a result of guideline #2, and a product or service cannot be defined (i.e. Designed) without defining the supply chain that supports it.

Why is this important? Because the linkage between the frameworks is an unanswered question for many of the council's members and, more importantly, for practitioners. The SCOR model has long been considered to cover all aspects of supply-chain management. The view presented above reduces the scope of the SCOR model, but, at the same time, expands the view of the SCOR model by integrating DCOR. The best way for practitioners to answer the question is to use the SCOR and DCOR frameworks on a project. The way you organize your processes will
clarify the integration of supply and design processes. Thus, today’s take-away: “Don't take my word for it, prove it yourself, in practice.”

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