I’m David Cochran with my associate Jason Barnes representing the IPFW Center of Excellence in Systems Engineering.

I would like to thank our center partners and supporters: Sean Ryan – IPFW office of engagement, Joe Sepkovich Purdue TAP and MEP, and Gary Schott, IPFW continuing studies. And I would like to thank our Dean Prof. Max Yen and Prof. Nash Younis, Chair, IPFW Dept. of Engineering, who have made this opportunity to work with you possible.

The Center is funded by a grant from the Lilly Foundation through the Talent Initiative.

Our work is to develop partnerships with industry in our region. Our program in concert with The IPFW College of Engineering offers a Purdue University Master of Science in Engineering Degree with specializations in systems engineering, electrical and computer engineering, mechanical and civil engineering.

Our program offers technical assistance and graduate-level research in the DoD product lifecycle development and acquisition process and its adaptation to non-defense industries over the product life cycle that includes design of the “lean” enterprise itself, product development and manufacturing with our unique approach called Collective System Design which integrates the best of Lean, Six Sigma and Systems Engineering that uses learning organization principles developed by Chris Argyris, Peter Senge, Margaret Wheatley, Tom Johnson and others.
This question is about sustainability as well as growth. Sustainability is achieved through the combination of organizations that can learn and can think together AND have mastery of technical/engineering skills. Growth requires innovation, innovation engineering and R&D. Sustainability and innovation require us to design effective enterprises and value streams within those enterprises... and we must have the ability to lead those changes.

Our Center’s purpose and this lab, the Enterprise Design and Leadership lab, considers our people and our relationships with our partners as our most important asset. We think a hybrid of lean, six-sigma, systems engineering and organizational learning are key to long-term sustainability and innovation for the region. We are working with Matt Kramer at Therma Tru, National Furniture and St. Francis Hospital in Indianapolis and have recently started a project with Bio Poly here in Ft. Wayne. Our work ranges from overall Enterprise Design, Value Stream Design, SE Lifecycle, to Lean-Sigma Applications.

Our Partnership with Joe Sepkovich and Purdue TAP / MEP first of all is to offer the existing classes and certificate programs and to develop new classes and certificate programs. One idea that I have had for years is the possibility of using Collective System Design to transform, sustain and to certify the enterprise design and its value streams... in addition to the certification of individuals. We all have experience with lean and are looking to advance to the next step... but, the question is, “if lean is so easy, why is it so hard?”

For more information, please contact Dr. David Cochran, cochrand@ipfw.edu, © 2013, all rights reserved
A Ford executive once asked me this question. The approach that I call Collective System Design attempts to answer this question.

Last month, Jason and I had the opportunity to visit Wendell Aldrich and Rick Sereno at Oji Intertech. From Oji, we learned that people are their most important asset and about the steps that they are taking in their lean journey.

Our affiliation with the Lean network helps us to understand where companies are at and to understand what is working... and what isn’t working.

We are pleased to be asked to be part of the Lean Network. Discussions with you and visits to your facilities can be a benefit to us all to advancing to the next level.

If I wear a systems engineering hat, I ultimately think that we need to de-buzzwordify and demystify what I think we should be calling Enterprise Design and Leadership, or Enterprise Leadership through (System) Design, depending on your perspective... rather than advancing “lean.” Lean is a result of a system design, it should not be the activity that we do, in my opinion. The challenge is that we tend to talk about the tools that have been invented by Toyota that are used to sustain an Enterprise Design that results in “Toyota’s Lean-ness.” Copying tools as with the case of Andon boards, doesn’t always work.
With the case of the Andon Board, this is a Physical solution to a Functional requirement of the Enterprise Design at Toyota, called the Toyota Production System. This particular Andon board is from Toyota’s Tsutsumi plant, east of Nagoya in Aichi prefecture. It is part of Toyota’s enterprise design (which consists of many value streams).

I have consulted with companies who have implemented this type of device… and it has failed, why? Because an organization implements the “how to” of the Andon board, before understanding its purpose and requirement that the Andon board fulfills. I think Shingo stated it best, to “know why, not how.”

Collective System Design is a methodology for communicating an enterprise design… it provides a language for Enterprise Design; it requires us to understand the problem that we are solving by first stating what we want to achieve, called the purpose or Functional Requirement (FR) of our enterprise / value stream design. It is my experience that when an enterprise copies and implements a tool, called a Physical Solution (PS), without understanding its purpose, viscerally, and co-created together, that it will fail.

This lab, the EDL, the Enterprise Design and Leadership lab provides the opportunity for our partner companies to work together to co-create effective enterprise designs. Our practice is CSD, Collective System Design, which provides a Language to express and to understand the design of a system and facilitates learning organization and leadership principles to understand the “rules in use” within existing systems and...
...a methodology to design new or to re-design existing systems.

If we see a physical manifestation of something like an Andon Board, the Collective System Design (CSD) approach creates a mindset where we ask, what is the Functional Requirement (FR) that is driving the implementation of the PS? In this case, the Andon Board is the Physical Solution (PS) that is implemented.

These days, I hear senior-level people making decisions based on an assertion that this practice or that practice is or is NOT lean. I do not think that Jim Womack intended us to dismiss good ideas (FRs) and good solutions (PSs) by calling them lean or not lean! Lean in my view is the result, or consequence, of an Enterprise Design process. My understanding of “lean thinking” is that it requires us to think... not to avow to disavow ideas, as lean or not lean.

Also, it is easy to say that Lean is something that we go do... but I think that it is best to keep in mind that lean is the result or consequence of an Enterprise design that meets internal and external customer needs. The objective of lean is not to cut personnel. In fact, Toyota requires companies not to lay off personnel as a result of implementing the Toyota Production System (TPS)... the operative word being “system” in TPS. Toyota’s system has many purposes (FRs) that it must achieve simultaneously.
An Enterprise Design is a large system that consists of sub-systems that are called value streams. I really like the term value stream. Because a Value Stream provides value to its internal and external customers. A value stream must achieve multiple FRs all at once. A value Stream, in the Collective System Design terminology, defines (communicates) and most importantly achieves the FRs of the internal and external customers. But how does it achieve the FRs?

... through first gaining collective agreement within an organization of what the FRs are within an organization. Collective agreement is a learning process... that is layered. As we learn we have three options: we can change an FR, add an FR or eliminate the FR entirely. The physical solutions (PSs) are also modified as we learn.

The key to change and to sustainability is that the team of people who are running and working within a value stream collectively agree, first of all, on what the value stream is and what it is supposed to accomplish! The CSD (Collective System Design) language calls the purpose of each Value Stream – Functional Requirements or FRs. With CSD, a team is able to express the many FRs that a value stream must achieve... all at once, every day...

Do you think that it is possible to use a language for enterprise design to express the multiple FRs of your enterprise?
In Toyota, the andon board is in response to a Functional Requirement to be able to Rapidly Identify a Problem condition... and to be able to do something about it... and to resolve it for the long term.

A different tone and mindset, I think, caused the creation of this FR:

1. That problems will occur (that systems aren’t perfect and we must be able to deal with issues). This requires us to accept that nothing is or will be perfect... that we must strive for “True North” and to treat problems as inevitable and...

2. That exposing a problem (muda / waste) is an opportunity for improvement to correct (instead of creating a culture of finding someone or some thing to blame for a crisis, to put in place a methodology for identifying and resolving problems).

We see the Andon Board, but we don’t see the underlying process to resolve the root-cause of the problem, in many Toyota facilities there is an underlying triage and escalation process to resolve an identified problem condition. The escalation process brings the plant manager into the problem solving process after a problem goes unresolved after a pre-determined length of time (usually within several hours).

So no wonder the Andon Board, the physical entity, doesn’t work for many enterprises, and is nearly impossible to sustain!
I mentioned that we had the opportunity to visit Oji Intertech. I also visited Wayne Metals and saw their continuous improvement work. We would like to increase our work with the Lean Network in the region. I think that our relationship with Purdue TAP / MEP to offer classes is an important next step.

CSD enhances lean-sigma practice by offering the Language for Enterprise Design and the flame model of Enterprise Design and Leadership to diagnose existing systems and to design new or to re-design existing systems (page 12).

When we speak of the kata (the way) a key starting point is the mindset (or what CSD calls the tone) through which we can approach organizational learning ... and ultimately enterprise design.

The above framework for Enterprise Design is not MBO – management by objectives. Tom Johnson (Relevance Lost with Robert Kaplan, Relevance Regained and Profit Beyond Measure) called it MBM – management by means... which is a process of aligning Physical Solutions to achieve customer needs, stated as Functional Requirements, of each Value Stream. This is the first step of the design... to meet customer needs. We add... for the least cost... as a constraint on the design. The old way of thinking, that says we can comprise delivery time or quality to give a customer a lower-priced product is a thing of the past. We must provide high quality, rapid, on-time delivery AND low cost to sustain an enterprise in Today’s environment. The dotted line tells us path dependency.
Path dependency indicates the sequence of implementation of the physical solutions. This part of CSD enables us to predict whether an enterprise design is being implemented in a cost and time effective way.

Performance measure definition comes after designing each value stream’s set of FRs to meet customer needs... through collective agreement about the FRs. MBO starts with sometimes obscure and arbitrary performance measures that may be an abstraction from the gemba (the work) and are usually not based on an understanding of Genchi Gembutsu, the 3 reals, to go and see reality as it is, really. The first practice of CSD is consciousness... to realize that one’s own perception of reality is through one’s own lens of one’s own fabrication. This is an oversimplification of the enterprise design view of modern physics, that if we look for a particle we get a particle and if we look for matter to be a wave we get a wave... similarly, human behavior in systems is a manifestation of the underlying tone and mindset of the people involved.

The safe play in enterprise design is to build models of the work (gemba). In this way, every one can see, can go see reality as it is... really. The modeling of work does not have to be limited to manufacturing and part production. Any, ANY, value stream process can be modeled! This is the purpose for this lab, The Enterprise Design and Leadership lab, to enable breakthrough and innovative thinking and implementation that advances our partners to the next level.
Standard work is the foundation for each PS; each Physical Solution is treated as a hypothesis to achieve each FR. The Enterprise Design map describes the design thinking and implementation path / sequence. It serves to communicate the thinking. The PDSA loop creates the mindset that learning is a trial and error process that requires iteration and... most importantly experimentation... and the physical doing of a PS with standard work is a hypothesis to achieve an FR. If there is no standard work, the doing can not be treated as an experimental design or as an experimental construct to achieve an FR.

Building a physical model enables a safe environment to learn... and to develop the standard work that DOES achieve the set of FRs for a value stream. This lab, the EDL, provides an environment to design an enterprise or value streams within an enterprise. The vision is that IT and ERP systems may be integrated as part of the physical work flow.

CSD offers principles of enterprise design. The lesson from the Andon Board is that each value stream must be designed to have a nervous system... that people in a system must be able to recognize when a problem condition exists... and then must know what to do and be able to do something about it. This is not talk, each person must write down their own standard work and be able to resolve a problem condition.

This lab is set up with the philosophy that we REALLY learn by what we say and do... For an enterprise, I have found that it is what we agree to do together, as a team, that really matters... starting with customer needs, FRs, and PSs implemented with standard work.
I have learned by working with Joe Swartz at St. Francis hospital that there is not one right path to have change accepted. And ultimately to change an enterprise requires the acceptance of change. There must first be collective agreement about what the change is supposed to accomplish. In systems engineering language, we call this the FR – the Functional Requirement --- what a value stream / system is supposed to accomplish. The caveat is that the FR should be tied first to meeting an internal or an external customer need.

For example, if a team can agree on just ONE FR and can achieve it together, this can be the beginning of change that lasts. This simplicity of Mike Rother’s embodiment of the PDSA approach is appealing.

For example, St. Francis hospital did this by moving the blood bank to the center of the ER. It was an idea that they collectively agreed on to accomplish. Joe and I are now writing a paper to express the ER teams’ evolution of their value stream design with CSD.

The promise of Systems Engineering through Collective System Design is that we can facilitate organizational learning and have a language that enables us to design, communicate and achieve multiple FRs (Functional Requirements) simultaneously. Enterprise Design requires a team to collectively agree on and to define a set of FRs and hypothesized Physical Solutions (PSs) to achieve those FRs.
People will implement what they create together... Joe Swartz says in a recent Shingo Webinar. One reason for adapting Mr. Ohba’s original TPS simulation to a design exercise is to create an environment for co-creation and learning.

We describe now an example of doing the Lego Value Stream design exercise and the experience with one client, before and after lunch. Before lunch, we followed CSD, and worked as a team:
0. CSD provided a language for designing the value stream.
1. To understand customer needs of the value stream
2. The team Developed FRs based on Customer Needs
3. Ran model to determine the PSs to achieve each FR as a hypothesis
4. Implemented PS through standard work (each team member wrote down their standard work on the mini white boards)
5. We deferred defining metrics so that they would be determined after the FR and PS relationships were debugged ... aka this is a pathway to “accounting for lean”

After Lunch:
1. To hurry up, I told the team, the solutions, PSs; the enthusiasm dropped profoundly.

Why? The team no longer worked together to achieve the collectively agreed FRs... I switched from role of the facilitator and “answerer” of technical questions, at the time they were asked by the team members to teaching the tools of lean.
Our vision is to work with you to design your Value Stream(s) using the practice of CSD. CSD offers a language to communicate and describe your enterprise design internal to your organization and describes enterprise design principles that I think every value stream must consider. CSD also facilitates organizational learning and leadership, and provides a framework for investing the necessary resources to sustain your enterprise. The flame model of CSD illustrates that the tone of the members of the team creates the environment in which the thinking can be positive and “generative.”

We have guidelines that the participants use to practice regarding tone. For example, “I think” language... “I think” language sets the tone for a person to recognize that their thinking is their thinking... and leads to the possibility that their thinking could be wrong. CSD is practiced.

To unlock and to change stuck systems, sometimes requires suspending judgment and to not make assumptions.

There are many more things to learn... with you!
The Enterprise / Value Stream Design Map aligns enterprise FRs and PSs necessary to minimize waste and to become lean for an aircraft manufacturer’s value stream.

The “accounting for lean” methodology that is a consequence of building the Enterprise Map with CSD is that the enterprise leadership team collectively agrees to achieve the FRs on the Enterprise Map. Collective agreement, means more than “buy in.” This means that the leadership team of a company is committed to achieving the FRs stated in the Enterprise Design Map... for the least cost; while at the same time, resources and investment MUST be made that is sufficient to achieve the FRs effectively.

FRs can not be taken off the table, for example, just because a budget is cut. The FRs must be achieved to enact the Enterprise Design. This said, for the company, management could not do the right thing because of the investment and management accounting policy.

To unlock, the stuck system, we identified with the team the cost of not achieving just 6 of the Enterprise FRs shown on the Enterprise Design Map, per aircraft. This cost amounted to over 18,000 direct labor and 25,000 indirect hours per aircraft. The new investment policy states that resource allocation and investment can by equal to the cost avoided by not achieving each FR.... In other words, the dollar equivalent of 18,000 direct and 25,000 indirect labor hours per aircraft could be spent to ensure successful achievement of the FRs of the Enterprise / Value Stream Design.
We have developed this lab for modeling value streams and the computer technology to also overlay your ERP software on top of the value stream... on the manufacturing floor and in the office functions.

We can run your software on our server for your enterprise system-design purposes.

Our Center Offers to the region:

1. Purdue Master of Science in Engineering (MSE) Degree with Systems Engineering Specialization (5 SE Courses)
2. Custom Applications and Projects through TAA / TAP / MEP
3. This Lab Facility to develop your Enterprise Design and to Lead development of the standard work that kicks off implementation and improvement... consisting of one or more Value Streams
4. Ability to do Research about what works and what doesn’t (and why)
5. Custom and public courses; Enterprise Design certification

One possible model for enterprise design certification requires a feedback loop with a third party board review consisting of a mix of industrial and academic partners. It could serve as a self-check or assessment of your enterprise design implementation...

I will now hand over the presentation to Jason Barnes, Associate Director of the Center.

For more information, please contact Dr. David Cochran, cochrand@ipfw.edu, © 2013, all rights reserved
The Enterprise Design and Leadership (EDL) lab is a facility dedicated to design your enterprise as a system (consisting of one or many value streams).

The lab provides a setting for collective agreement and experiential learning through system design and the practice of standard work.

The EDL lab is located in IPFW Modular Classroom Building (MCB 136 & 140). We offer:

• Modular configurations that allow the lab to be used for classes, seminars, conferences, business meetings, hands-on simulation, and distance learning

• Built to demonstrate the design principles of Lean and how to effectively use Lean-Sigma ideas in the context of enterprise design, all while integrating real-world tools such as ERP software and Minitab

• Latest versions of engineering software for system design, enterprise resource planning (ERP), scheduling, statistical analysis, 3D drawing, and simulation packages for almost every engineering discipline

• A collaborative environment that puts whiteboards and projector screens at the fingertips of every team member
Our software and modeling suite includes the above-listed software.
The benefits of this work to Therma Tru are:

1. To have the ability to model the production line without having to physically make changes --- ability to navigate through zone of uncertainty better.

2. Understand interactions between different machines / equipment and physical processes running at different cycle times (for a complex process 200 to 300 feet)

3. Ability to cost justify improvements – can now say here is the proof. For example, “for $50k here is the benefit!”

4. Use of Industrial and Systems Engineering tools helps you to get better. At process, plant, enterprise levels however far up you go…
QUESTIONS

- Are we on the right track?
- What would you like to see the center do / accomplish?
- Are there examples / case studies that we can share with you, or that you would like us to research, that would help you to make changes in your organization?
- Is it important to work on the culture, in addition to learning about the lean-sigma tools?
- Can an organization's culture be changed through techniques like Kata and Collective System Design?
- Would you agree that a Functional Requirement (FR) is to design a value stream to be sustainable?
- Teaching SE 540 Systems Architecture this spring. What topics should we cover in the SE Masters Program? Do you have students for our Masters Program?
- What topics should we cover in our courses with Purdue TAP/MEP?

Review and feedback questions for the Enterprise Design and Leadership Lab.
CONTACT US

David S. Cochran, Ph.D.
Associate Professor and Director
Center of Excellence in Systems Engineering

Office (260) 481-0341
Email cochrand@ipfw.edu

Jason Barnes
Associate Director
Center of Excellence in Systems Engineering

Office (260) 481-6370
Email barnesj@ipfw.edu