Lean Enterprise Institute

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Pursuing Perfection

Craftsmanship in Product Development

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Welcome,

So, what do I mean by craftsmanship? You can recognize craftsmanship in products and services by the precise execution of their essential characteristics. Elimination of the superfluous and the simple elegance and seamless fit of the elements that remain. These products feel, look, sound, and at times even taste well made. They are, in short, a joy to experience. However, in a world of the disposable that values speed and novelty more than enduring excellence, they are increasingly the exception despite their exceptional value.

Why? That's hard to say. I suspect there are several reasons unique to each organization's circumstances. Some think it doesn't apply to their business. Some are just too distracted with day-to-day survival to give it much thought. Still, others no doubt think craftsmanship is an archaic and esoteric concept that applies only to artisans and has little to do with today's technology-driven development or the designers and engineers who engage in it. Or perhaps they just don't think the benefit is worth the effort. Who am I to say they are wrong?

But there are a couple of things you may still wish to consider. Product development remains an inherently creative endeavor dependent on the capabilities and motivation of skilled people. And despite the availability of similar technologies, individual organizations have significantly different outcomes in product development. There are, of course, many reasons for this. But one undeniable reason is the skills of the people involved and the way they approach their work every day. I believe that organizations that enable people to pursue mastery of their respective disciplines create better products, have more productive cultures, and happier people.

There is no craftsmanship without craftsmen.

First, please note that I use the term craftsman in a completely gender-neutral way. Becoming a craftsman is a uniquely personal decision. It requires that you commit yourself to the continuous development of your craft. Traditionally, craftsmen developed their skills through apprenticeship to those masters of the craft who came before them.

Although we typically think of apprenticeships in skilled trades, engineers and designers should not be afraid to embrace this paradigm. I have written before about my own experience as an apprentice working for a demanding German tool maker. It was difficult and not always pleasant –- but the feeling of finally getting it right was almost intoxicating. I found the same process worked in engineering and later in leadership. The pursuit of mastery is nearly universal. For anyone considering this path, keep these principles in mind:

- **Find an organization that will and can support your efforts.** Avoid companies that refuse to invest in their people or don't have sufficiently skilled individuals to mentor you.

- **Work in your discipline long enough to master it.** Too many engineers move to other positions to improve their chances of promotion long before mastering their craft. In some cases, they trade the opportunity to create new value to become a bureaucrat.

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- **Find a technical mentor.** Your mentor must be someone who has done it. Someone who knows your craft better than you, who will push you, be candid with you, and support your growth. This can be difficult, especially when your boss does not do your job as well as you. Keep looking.

- **Engage with your work and challenge yourself.** Pursue excellence, not mediocrity. Don't be satisfied with just doing your job. Don't be afraid to invest part of yourself in your work.

- **Learn to accept criticism and react appropriately.** That's how you grow. Nobody likes it when someone "calls your baby ugly." When you put so much effort into something, it can be difficult to hear that what you've done isn't good enough. Get over it. It's not personal.

This journey is not easy – so be patient with yourself. Mathew Crawford sums up my thoughts well in his outstanding book *Shop Class as Soul Craft.* "Any discipline that deals with an authoritative, independent reality requires honesty and humility. If we fail to respond appropriately to these authoritative realities, we remain idiots. And I continue to commit acts of idiocy to this day. But less often, I think." He reminds us that objective, physical reality is an inflexible master, and both the apprentice and journeyman should approach their task with equal parts humility and tenacity.

A culture that cultivates excellence

Craftsmen may be self-made, but their chances of flourishing are much better in a culture of excellence where the organization supports their growth. Organizations can dramatically improve their chances of creating a culture of excellence by investing in their people's skill development early and often. One such organization is Toyota. Jeff Liker and I documented Toyota's intense devotion to developing its engineers in both *The Toyota Product Development System* and *Designing the Future*, and it requires far more space than is available here. This process, starting with "the freshman project" and relying heavily on a strong journeyman–apprentice relationship, along with about 60 technical classes each engineer must take, has contributed to its industry-leading quality, profitability, and growth for many years.

Craftsmen also do better when they are surrounded by like-minded people. Today, most developers work as part of a team and operate in a larger context. Their job gets a lot more difficult when they work with people who are not committed to the same standard of excellence they are, like Robert Pirsig's "chimpanzee" mechanics in his book *Zen and The Art of Motorcycle Maintenance*. These people have no connection to the work. No emotional or intellectual investment. It's just a job. Just one of these folks, especially in an influential position, can hold a lot of good people back. As the old saying goes, "You must change the people, or you must change the people."

One such example goes back to my days at Ford. We had started on our improved craftsmanship journey and were at what I considered a tipping point. In the middle of a particularly difficult exchange about product standards, one very frustrated long-time Ford manager shouted, "We will not sell one more damn car because of these tougher standards!"

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He was wrong. Improved body craftsmanship was one of the most noted improvements in our new products. But more importantly, that was not the point. The point was to set a standard of excellence – not just when it was convenient, but during our most challenging times. The manager in question took early retirement soon after, and it was like a breadth of fresh air for his organization.

The matrix organization

A word about the much-maligned matrix organization. The matrix, as practiced by Toyota and others, allows strong functional organizations to develop craftsmen within each critical discipline while the horizontal program side, led by the chief engineer, harnesses this incredible capability in service of the customer and the problem to be solved. When operating at its best, the program side focuses on creating great products for your customers, while the functional side is responsible for creating great people capable of delivering the vision.

The challenge – choosing excellence

This may be the toughest challenge we have yet leveled in a Design Brief. Not only is it difficult at an individual level, but creating a truly crafted product for your customer requires everyone in the organization to make this journey together. Designers, engineers, manufacturing specialists, and everyone engaged in the value stream must embrace the vision of excellence. And that creates massive pressure and stress for everyone –- especially for leaders. It can seem so much easier to settle for mediocrity. It is a decision and commitment that must be made both at an individual and organizational level.

But if you choose excellence and decide to be part of a team in pursuit of perfection, you will not only create truly exceptional products but also have one of your best professional experiences. I hope you do.

Regards,

Jim Morgan
Senior Advisor
Lean Enterprise Institute
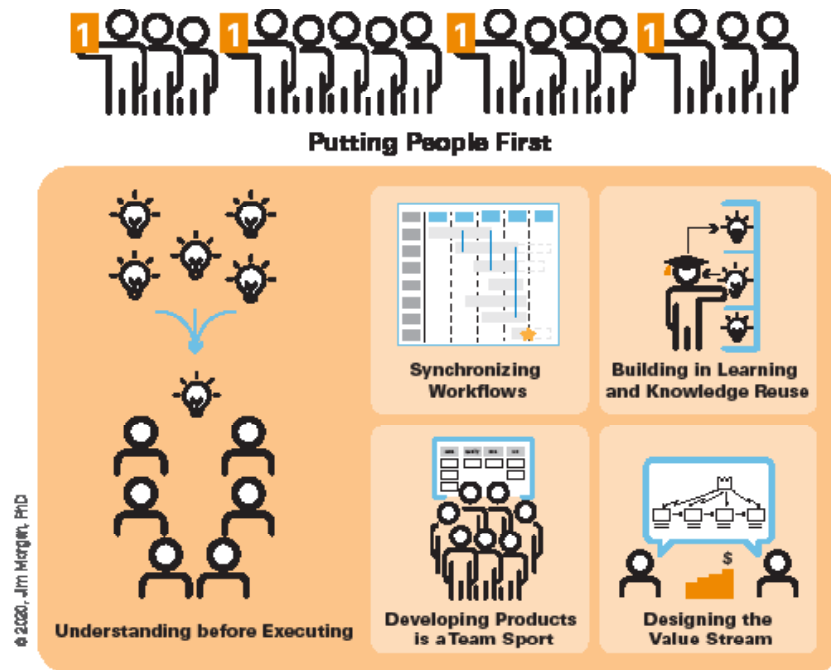
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Lean Product and Process Development (LPPD) Guiding Principles

1. **Putting People First:** Organizing your development system and using lean practices to support people to reach their full potential and perform their best sets up your organization to develop great products and services your customers will love.

2. **Understanding before Executing:** Taking the time to understand your customers and their context while exploring and experimenting to develop knowledge helps you discover better solutions that meet your customers' needs.

3. **Developing Products Is a Team Sport:** Leveraging a deliberate process and supporting practices to engage team members across the enterprise from initial ideas to delivery ensures that you maximize value creation.

4. **Synchronizing Workflows:** Organizing and managing the work concurrently to maximize the utility of incomplete yet stable data enables you to achieve flow across the enterprise and reduce time to market.

5. **Building in Learning and Knowledge reuse:** Creating a development system that encourages rapid learning, reuses existing knowledge, and captures new knowledge to make it easier to use in the future helps you build a long-term competitive advantage.

6. **Designing the Value Stream**: Making trade-offs and decisions throughout the development cycle through a lens of what best supports the success of the future delivery value stream will improve its operational performance.

The LPPD Guiding Principles provide a holistic framework for effective and efficient product and service development, enabling you to achieve your development goals.

Craftsmanship Revolution: GE Appliances Redefines Appliance Product Development

By Dave Leone, senior director, dimensional control, and Mark Weaver, technical director, craftsmanship, GE Appliances

The transformational craftsmanship movement at GE Appliances is as much a revolution in how to think about new product development and manufacturing as it is a revolution in the use of digital technologies.

Traditionally our product design focused on reliability, performance, and quality – and we're good at them – but craftsmanship opened a whole new way of thinking about developing products that naturally made sense to us. Our products are used in half the homes across the country and play an essential role in how people live on a daily basis.

 We define craftsmanship as how customers perceive the quality of products based on all the things they can see, feel, and hear on a retail store showroom floor as well as how they work at home.

It means not just delivering products that work well but ones that consumers love because of how color, finish, and form harmonize; how buttons and controls operate, how drawers and shelves move, or how a range or refrigerator door sounds when it closes.

"Apple-esque" design thinking

Craftsmanship means transitioning away from thinking about appliances as utilitarian tools to thinking about them as experiences. Sure, they perform jobs in the home, but daily interactions with them present continuing opportunities to delight people with not only how well an appliance works or how long it lasts, but how elegant it looks within the home, or how conveniently it updates its software through your home Wi-Fi. It is not just some plain white box that washes your clothes. It is taking the "Apple-esque" way of thinking about design and applying it to appliances.

The current craftsmanship movement began around 2017 when several company efforts converged. The "zero distance" and "cocreation" philosophies emphasized getting closer to consumers and designing products with their input. A "house of brands" strategy gave GE Appliances' product lines unique identities, so consumers, designers, and builders understood what brands met their needs, lifestyles, tastes, and price points.

Finally, a benchmarking study on how other industries used digital technologies gave the GE Appliances' team the inspiration and practical knowledge to execute craftsmanship – in product development and manufacturing – digitally and differently.

Digital tool sequence

Three-dimensional scanning, the first digital technology we adapted, opened the door to digital engineering. If you can point a scanner at a part, prototype, or finished product you can digitize it. Coupled with new software, engineers transitioned from working with spreadsheets and in a one-dimensional design space to a data-rich digital environment. Engineers overlay digital scans of physical parts with CAD designs to generate colored "heat" maps of how well – or poorly – the part matches design tolerances. We discover and solve problems in hours or days that would have taken weeks or months.

Virtual reality, the next digital technology we deployed, allows for a much more cost-efficient and seamless process from the industrial design phase to final product engineering. Engineering and manufacturing experts can quickly assess initial industrial design concepts at the beginning to ensure that certain concepts can be executed well. If a design cannot be effectively engineered for manufacturing, it will ultimately lack craftsmanship. Beyond that, involving product managers, industrial designers, and manufacturing engineers early and often throughout the process gives everyone a chance to regularly visualize the current design state and apply their expertise to ensure concerns are raised as early as possible.

The company has also successfully used VR to involve consumers in product design. For example, a proposed top load washer design had a very deep tub. Some consumers interacting with the design in the VR lab noted that a sock at the bottom of the tub would be unreachable for some people. Without VR, we would have incurred costs building a prototype to figure that out.

A lot of craftsmanship is attention to detail, and it must go to an obsessive level. VR lets us do that by bringing design teams together in the lab. They examine, among other issues: do joints align; do edge radii enhance appearance,

assembly, and fit; what colors look best on range knobs and; is the joint between the range frame and glass top easy to clean; will a highlight on an edge look good to consumers.

We now do a much better job of having debates and discussions around such questions early in the development process.

Next, GE Appliances implemented digital dimensional control technology, a game-changing design philosophy. The program teams learned to recognize and manage variation in product and process design through a "design for dimensional control" approach. With new dimensional simulation software, the design teams can build products virtually to ensure they achieve craftsmanship and quality targets before building any physical products.

They identify any issues with surface quality, gap and flush, critical clearances, and fit. Programs where we have driven rigor in dimensional control and craftsmanship have resulted in exceptionally better products and manufacturing processes. At all build phases, parts fit as they should, even on prototypes. In some past designs, production workers might have had to hold panels in place, move them, or press them to align screw holes. Now we are designing craftsmanship and quality into the process, rather than trying to control it on the back end.

Through dimensional control principles, our engineers recognize that design float, the design clearance between mating features of parts, is enemy number one. The more design float you have, the more variation you will see during assembly. This key insight has driven robust locator solutions. In fact, using product and process locators is one of our most important design strategies going forward.

No Pareto to craftsmanship

Ultimately, the consumer, not technology, is central to craftsmanship. Engineering team members spent hours observing people shopping for appliances. They noted, for instance, that when considering a range, customers stepped back, looked at it, then walked up and grabbed the knobs. Their first physical perception of range quality was how the knobs feel. If they wobbled, the customer frowned and moved to the next product. It was a revelation.

Seemingly small issues – like the feel of knobs – were actually big ones. If knobs are loose or the edges of refrigerator drawers are sharp, customers get a subconscious impression of mediocre quality. They assume that what they cannot see is executed with the same level of quality as what they can see and touch. You can't Pareto that. You can't achieve well-crafted products by focusing on the critical few and ignoring the trivial many. You must pay attention to all the details.

The engineering team also pores over online customer product reviews to gain insights into consumer preferences. For example, in a major redesign of GE Appliances' slide-in and freestanding ranges, the team learned that consumers often noted that the sound of the timer on current models was too soft to hear in a busy kitchen or from an adjacent dining room, so we made it louder. Traditional quality focuses on meeting engineering specifications, so it misses areas where design doesn't meet consumers' needs. By taking the time to listen to feedback, we can address these pain points as we design new products.

People sequence

Bringing people on board for change is a critical element in implementing new technology at an organization. At GE Appliances, support for these new tools started with CEO Kevin Nolan. Investing in tools and equipment is key, but you also must invest in people. We got the authority to hire people who had digital technology and dimensional control experience to build a critical mass of people with the needed skill sets.

We also trained many other people in subjects such as dimensional control and 3D tolerance analysis. But training alone was not decisive in adopting digital technology with a craftsmanship mentality.

Hands-on experience is key to success. For the redesign of a major platform, we put together teams that included a mix of experienced dimensional control engineers to work side-by-side with colleagues who were new to these tools. Lessons from training classes don't sink in until you are faced with the challenges of how to fit two parts together or how to control the flushness of a joint. You work through it with someone with expertise who coaches you through this new design approach.

Finally, if a business wants to create a meaningful and lasting transformation, whether it's craftsmanship, digital technology, dimensional control – you name it – it must have a small set of people who eat, sleep, and breathe the transformation daily. They are passionate about it. They generate the continued momentum to keep pushing, pushing, and pushing the transformation because they show up every day expecting a certain level of excellence. They get people to look at products the way customers see them and be passionate about them too. They get people to think, "I'm only doing the hinges, but I'm going to do them better than anybody else."

That way of thinking about craftsmanship coupled with digital technologies has fundamentally redefined how we design products. It has led to a tremendous amount of innovation, which has fundamentally changed our company for the better. ∎

Craftsmanship – the Lost Art in Product Development

By Steve Shoemaker

More than 1,000 engineers were at work in the design office at the Mossville, IL, engine facility of Caterpillar Tractor Company, now Caterpillar, Inc. when I walked into the vast space for the first time. Seated in rows of horizontally set drafting boards that stretched as far as I could see, they were designing engines for Caterpillar machines and the on-highway truck market. Electrical cords dangled from the ceiling to power the new CAD terminals that were replacing the boards used for the last five decades. The now defunct boards served as desks for the CAD terminals. As my first day on the job progressed, a haze filled the immense room; no-smoking policies had yet to arrive

I vividly remember one other thing from that first day on the job 33 years ago. One board had no CAD terminal. It was tilted to the desired angle of its user, who had his own three-walled cubicle steps away from the chief engineer's office. His cubicle was bare except for the tilted board, stool, ashtray, and coffee cup. No diplomas hung on the wall for self-promotion. He was always studying his drawing and thinking. Seldom did his phone ring; he just drew hour after hour. He was one of the most senior engine designers in the company. His name was Benny.

Benny had no direct reports, no fancy title, and no intention of learning how to use a CAD terminal. He had

only two responsibilities: Create the concept design for the next engine and mentor the next generation of engineers. No new engine proceeded without his involvement. He regularly provided counsel to the chief engineers and their assistants. Benny had joined the now extinct high school apprentice program and mastered his trade over the next five decades. He was the first true craftsman I would meet in the world of product development.

Benny was a craftsman, not because he worked the old-school way with drafting table and pencil but because of his perseverance to gain deep knowledge, dedication to the science and art of design, and willingness to mentor the next generation of designers. These qualities, fused with the company's commitment to retaining that deep knowledge, made Benny a competitive advantage.

What does being a craftsman and craftsmanship have to do with the art of product development? Reflecting on more than three decades in the engineering profession, I would say everything. Without craftsmen, product development becomes an exercise of countless iterations in relearning and seeking what seems natural to the craftsman. Craftsman in the world of product development is not a title assigned but rather attained. Craftsmanship, therefore, is a standard of excellence sought by many but all too often not attained.

How to grow more "Bennies"

Is there a recipe for craftsmanship? What are the ingredients that make a person a craftsman (craftsperson)? The answer is simple – patience and perseverance. Patience from the organization to plant many seeds and perseverance from the individual to learn and grow. While Benny was near the end of his career and not willing to learn CAD, he was always seeking more knowledge that would expand the options for engine design.

Benny taught an engine design class every year. Getting in was competitive because you had to demonstrate the potential to become a craftsman. Throughout his career, Benny mentored hundreds of engineers. Most did not have the grit to stick with it and, gradually, the company made it difficult to stick with it. Becoming a craftsman requires that people dedicate themselves to both the science and art of design. There are many ways to design a solution but typically only one elegant solution yields the best combination of performance, quality, and cost.

Craftsmanship requires a deep understanding of the product being developed and the processes necessary to build it. In a complex system like an engine or a machine, hundreds of components work together to create a product the customer will value enough to buy. In the early days of companies like Caterpillar, Deere, and many of the automakers, the Original Equipment Manufacturer (OEM) not only assembled the final product but also built most of the pieces it needed. They designed and made engines, transmissions, axles, gears, and even hoses. This ecosystem – internal or close by -- fostered a deep understanding of each part of the machine or engine.

For example, the Mossville factory machined blocks, heads, and crankshafts. An hour's drive away, a foundry cast the parts. In another direction, a plant built the fuel systems. Just 25 minutes away, another plant made transmissions and many of its parts for Caterpillar. Moving downstream, I could drive to the assembly factory installing components into bulldozers, motor graders, or haul trucks. A product developer, in my case an engineer, had access to 90 percent of the value stream. That was more than 30 years ago. Today, those same trips would consume weeks and require a passport.

This was fertile ground to grow craftsmen. People like Benny were not the only mentors. I had access to people on the factory floor who were happy to give me their thoughts, especially when my design was not what it should be. Early in my days as a designer, I was called to the engine line. "Show me how to install your new part," challenged the zone leader. "Well, it's easy. It goes like this," I confidently stated as I began to demonstrate. "Uh-oh. I guess it is not so easy," I humbly admitted.

From that point on, I spent time on the floor talking to the people building or assembling my parts long before I completed my designs. You see, many of these people were craftsmen themselves. They had insights from years of experience assembling or machining things that could make me a better engineer. I only had to be open to learning from anyone willing to share their wisdom.

Respect your company's "oak trees"

So, where are all the craftsmen today? Unfortunately, in the US most have retired or soon will. These are people who benefited from the proximity of the supply chain (value stream) through countless design cycles. As I said, it takes grit and perseverance to become a craftsman.

Furthermore, the financial rewards along the way are challenging and often frustrating for the individual. Too often rewards are based on hitting dates irrespective of the quality of the design. Post-launch rework has become commonplace as customers shake out the designs rather than the company doing things right during development. The value placed on a designer in pursuit of becoming a craftsman is outpaced by the person who manages people. This is not a knock on the challenges associated with managing people. However, the difficulty in measuring the value of an expert is challenging for most HR systems. Things like span of control and managed budget beat out deep expertise.

A wise man once told me the best time to plant a tree was 30 years ago and the second-best time is today. In my company, we called our senior most people "oak trees." This was a respectful way to recognize the vast knowledge they had developed. We need to start planting oak trees.

As I studied companies with the most respect for developing and retaining knowledge, I discovered three common threads:

1. **Learn:** They make things, so they deeply understand the trade-offs in the design and manufacture of components.

2. **Reward:** They invest in people, so they can retain deep expertise.

3. **Sow:** They teach the next generation, so they can nurture and grow knowledge.

Learn

As mentioned, OEMs made components for their machines and automobiles. Over time, suppliers secured this role as they developed world-class capabilities. Many of the experts in design and manufacturing supported the migration of components from in-house factories to external suppliers. At this point, a company must decide how to remain relevant in the component's value stream.

Some companies chose to continue designing but let someone else do manufacturing. This requires a close learning relationship to ensure that the product design and process design happen concurrently. Other companies decide that investing in deep expertise in both design and manufacturing is no longer required and divest both elements to the supply base.

> "The decision-makers who jettisoned the deep learning and capabilities are seldom around when the magnitude of craftmanship's demise hits."

This is a slippery slope. Over time, anyone inside the company who knows anything about the component moves or retires. This is not a digital kill switch, but a slow loss of lessons learned -- a silent killer. Losing a deep understanding of component trade-offs -- for a transmission, sheet metal stamping, or any product -- leads to the demise of craftsmanship unless the company maintains some level of competency through prototype manufacturing cells, deep collaboration with suppliers, or retention of manufacturing capacity for a portion of the portfolio.

This requires learning by company leadership through to the board of directors, all of whom must develop a thorough understanding of the value stream. Cost pressure creates the illusion that it is better to outsource rather than retain learning inherent in talent and capability. But the lesson companies continually re-learn is that it is far less expensive to maintain a capability to understand the trade-offs than it is to discount the knowledge and then re-learn it to fix quality issues in the field, which can quickly erode cost savings. The decision-makers who jettisoned the deep learning and capabilities are seldom around when the magnitude of craftmanship's demise hits. No company seems immune to this as highly publicized quality issues have struck the most iconic companies like Boeing, Ford, Caterpillar, and even Toyota.

Reward

An old adage says that what gets measured gets done. A close corollary is what gets rewarded gets repeated. In my experience, I witnessed job hopping rewarded. Job hopping is when someone moves to get more money before learning and repaying the company with experience in the job. It became easier to get more money by moving to a new area than by building knowledge within a selected discipline.

I saw an HR policy that required a move outside of your current department to receive a promotion. HR relegated to slower salary grade growth and advancement people who wanted to develop deep expertise within a particular component.

"He's just a tractor guy, we can't promote him any further," I heard my boss exclaim. Throughout my time in management, I heard this phrase repeatedly, albeit with different disciplines, e.g., engine, wheel loader, electronics, etc. My view was that was exactly why the individual should climb further in the organization. Unfortunately, that is not the conventional wisdom of management in top corporations these days. Terms like "pigeonholed" and "siloed" describe people who have become craftsmen of their professions.

However, the same managers who dismissed the benefit of deep expertise recognized these individuals when a significant quality escape subjected the company to high warranty exposure and eroding market share. The lesson is that we want the expertise, but we do not want to pay for it until there is an emergency. Obviously, this is an impossible contradiction to explain or manage.

Thus, when a company decides to outsource a component, it must put lots of resources into the relationship with the supplier or suppliers responsible for the part. Investment in personnel who will work hand in hand with suppliers to maintain an understanding of the trade-offs of the part's design and manufacture is vital to the lifeblood of the part.

A simple example is Caterpillar bolts. For decades, these bolts were regarded as the best in the machinery industry. Even people who maintained their own equipment would go to the Caterpillar dealer just to buy bolts, a simple component that one would think was commoditized years ago. However, this is an example of a company decision that was then followed through with investment in people who could retain knowledge to ensure a deep understanding of the materials, heat treatment, and coatings that make a bolt qualified to have the Caterpillar trademark stamped on its head.

Sow

A man reaps what he sows: Galatians 6:7, New International Version Bible. A company reaps what it sows. Obviously, the opposite is also true. If one does not sow, there is nothing to reap.

> "Craftsmanship is a level of excellence that should be sought as a competitive advantage."

While managing the Caterpillar Hydraulic Excavator Design Center in Akashi, Japan, I witnessed the process of sowing and reaping. It was common practice to hire an equal amount of manufacturing and design engineers. Manufacturing engineers filled operations and purchasing

roles. Design engineers flourished in the world of design, development, and testing.

To nurture a deep understanding across disciplines, component teams combined manufacturing, purchasing, and design people focused on a particular part of the machine. For example, heavy structures, hydraulics, powertrain, and electronics had component teams. This practice ensured concurrent design of both the product and the process. Furthermore, a high percentage of the parts were either made in-house or manufactured by suppliers within a day's reach of the factory. The proximity allowed continuous interaction with suppliers both from an operations and a development perspective.

Another key element foundational to the center's success was consistent hiring. The number went up and down annually, but the center hired college interns and graduates every year. This was necessary for many reasons. The most important was the circle of life. New engineers coming into the business required training. The center assigned each new engineer a mentor and a project. Technical leaders taught classes to link the key principles by discipline to the development of the product, excavators in this case. Even in difficult times, new people were brought in, perhaps in smaller numbers, allowing the people development process to continue.

This experience was 25 years after my first interaction with Benny in the engine world. Not every engineer would ultimately become a craftsman. However, the process of developing engineers sharpened both teachers and students. The process taught what craftsmanship looked like and gave individuals the knowledge needed to be better and the opportunity to choose to become excellent.

Final thoughts

Craftsmanship is a level of excellence that companies should seek as an internal capability because it's a competitive advantage. It can't be bought in an emergency. True craftsmanship is at the core of the best companies even though, at times, it seems to be smothered by market pressure and the tyranny of the urgent. When a company gives the technical community the accountability and associated investment to nurture the art of development, craftsmanship will emerge. ■

Crafting Quality Software: a Conversation with Robert Martin

By Robert Martin and Matthew Savas

In this episode of the WLEI podcast, LEI speaks with software industry veteran Robert Martin. Robert is one of the original signers of the Agile Manifesto and the author of several influential books, including *Clean Code: A Handbook of Agile Software Craftsmanship*.

During the conversation, Robert shared insightful perspectives on some of the biggest challenges facing software development today. From the demographic problem of perpetual inexperience to his pioneering approach to development dubbed "software craftsmanship" that aims to promote quality work, Robert covered a wide range of issues impacting the industry. Some other topics discussed include:

- Balancing speed and quality in development and emphasizing a quality-first mindset.
- The benefits of test-driven development, such as providing freedom to change code safely.
- AI's potential impacts and appropriate uses of AI-generated code.
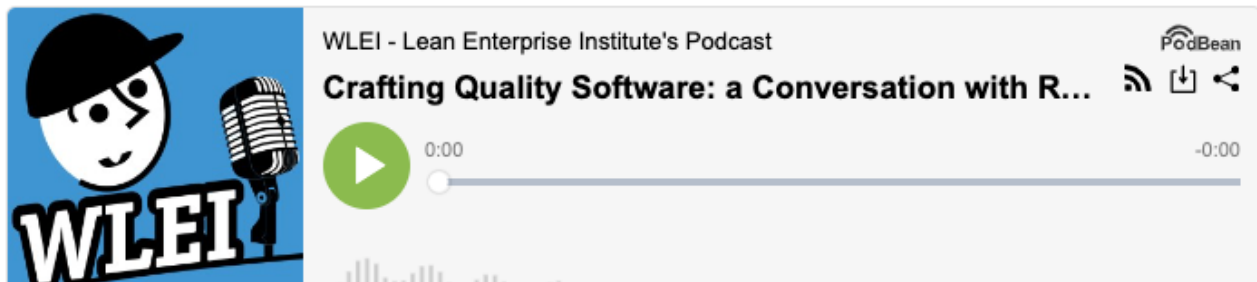
Listen at lean.org/crafting

Contributor Highlight

Dave Leone and Mark Weaver

Dave Leone and Mark Weaver work at GE Appliances' Appliance Park headquarters and main manufacturing center in Louisville, KY, a 750-acre site with 8,100 employees, including 1,600 design and manufacturing engineers who develop and make the company's lines of refrigerators, freezers, cooking products, dishwashers, washing machines, dryers, plus other home and commercial appliances. For more information visit geappliances.com

Robert C. Martin

Robert C. Martin, better known as "Uncle Bob," is a prominent figure in the software development world. With a career dating back to 1970, he's a self-taught engineer, instructor, and author. Robert is a champion of clean coding practices and software craftsmanship. He's written influential books like *Clean Code* and was a signor of the Agile Manifesto.

James Morgan, PhD

Jim is a senior advisor at Lean Enterprise Institute and a board member at Adrian Steel. He has a unique blend of industry leadership experience and rigorous scholarship, which he draws upon to improve organizational performance at a select group of companies.

Jim's most recent industry experience was as chief operating officer at Rivian, an electric vehicle manufacturer on a mission to keep the world adventurous.

Before joining Rivian, Jim spent a little over ten years at Ford Motor Company. He began by leading the development of the Global Product Development System. He then served the last nine years as director of Global Body and SBU Engineering and Tooling operations, where he and his team contributed to the company's historic, product-led revitalization under then-CEO Alan Mulally.

Before Ford, Jim served as vice president of operations at Troy Design and Manufacturing (TDM) during a period of dramatic growth. TDM is a tier-one global automotive supplier of engineering services, prototype tools, and low to medium-volume production parts and subassemblies.

Matthew Savas

As content director at the Lean Enterprise Institute, Matt is responsible for the institute's content strategy in all mediums. He previously served as director of the Lean Global Network, where he supported its 30-plus institutes and partners to spread lean thinking around the globe.

Matt has a BA in East Asian studies from Bates College and an MBA from the Isenberg School of Management, University of Massachusetts Amherst. He lived in Japan for five years. When he's not at work, he enjoys reading, roasting coffee, and exploring the outdoors with his wife.

Steve Shoemaker

Steve Shoemaker retired as vice president of engineering in Caterpillar's Earthmoving Division after 33 years. Over his career, he worked as a designer in the company's engine segment before moving into technical leadership in engines and later electronics. He spent the last half of his career developing machines in the Building Construction Products Division, where he led engineering and oversaw the building of the Clayton Machine Development Center.

In 2012, he moved to the Excavation Division in Akashi, Japan, where, as chief engineer, he led the Hydraulic Excavator Design Center. In 2017, Shoemaker assumed his final role as vice president of Engineering. He led the global design organization for the company's core machine portfolio, which included bulldozers, wheel loaders, motor graders, and paving equipment. In this final role, the pursuit of zero-defect quality levels benefited from his 15 years of experience with lean product and process development. Shoemaker now serves as a senior advisor with the Lean Enterprise Institute.

Are you a leader who wants to dramatically improve how your organization develops – and profitably delivers – new products and services? Do you want a chance to collaboratively run experiments with other leaders like you to help your team achieve that goal?

Then become a Co-Learning Partner

Apply to join fellow leaders in the Lean Product and Process Development (LPPD) Learning Group, our longest-running, co-learning partnership. Each partnership is focused on an industry, business function, or lean management discipline.

The LPPD group brings together diverse companies committed to transforming their product, process, and service development systems through lean thinking and practice. Much of this group's noteworthy improvements were captured by authors Jim Morgan and Jeff Liker in *Designing the Future*, co-published by the Lean Enterprise Institute (LEI) and McGraw Hill. Who knows, maybe your lean transformation story will become part of an upcoming LEI book.

Like all our co-learning partnerships, the LPPD group is open only to organizations demonstrating:

- Executive commitment to lean transformations;
- Enthusiasm for collaborative learning where work actually happens;
- Willingness to share results with the global lean community.

This learning approach allows organizations and their teams to learn from one another. While participants in the learning groups collectively direct the learning, LEI coaches facilitate meetings organized three to four times per year on-site at learning group companies or in virtual gatherings.

Companies we've partnered with

Coaches guide you as you design and evaluate the experiments that will help you discover the best lean approach to address a business problem or achieve breakthrough performance. We don't offer "cookie-cutter" solutions. Instead, coaches bring their decades of lean thinking, practice, and coaching to bear on the business issues you need to resolve. They guide you through discovering — for your organization and specific situation — how to resolve it.

By offering targeted, immersive experiences that demonstrate the value of addressing all five dimensions of the Lean Transformation Framework, LEI coaches ensure you and your team gain an in-depth understanding through crucial guided practice.

To learn more about becoming a Co-Learning Partner, schedule a call today with an LEI coach.

Lean Enterprise Institute
lean.org®

Continue Your Learning

The Lean Enterprise Institute (LEI) offers a wide range of learning resources, all with the practical knowledge you need to sustain a lean transformation:

Learning Materials

Our plain-language books, workbooks, leadership guides, and training materials reflect the essence of lean thinking — doing. They draw on years of research and real-world experiences from lean transformations in manufacturing and service organizations to provide tools that you can put to work immediately.

Education

Faculty members with extensive implementation experience teach you actual applications with the case studies, worksheets, formulas, and methodologies you need for implementation. Select from courses that address technical topics, culture change, coaching, senior management's roles, and much more.

Events

Every March, the Lean Summit explores the latest lean concepts and case studies, presented by executives and implementers. Other events focus on an issue or industry, such as starting a lean transformation or implementing lean in healthcare. Check lean.org for details and to get first notice of these limited-attendance events.

lean.org

A quick and secure sign-up delivers these online learning resources:

- Thought-leading content delivered monthly to your inbox.

- First notice about LEI events, webinars, and new learning materials.

About the Lean Enterprise Institute

The Lean Enterprise Institute, Inc., was founded in 1997 by management expert James P. Womack, PhD, as a nonprofit research, education, publishing, and conferencing company. As part of its mission to advance lean thinking around the world, LEI supports the Lean Global Network.