Product Development

Accelerate innovation in your organization by applying lean principles to your product development and engineering processes. From identifying the best development opportunities, through integrated product and process design, to a proven manufacturing launch, lean approaches offer tremendous advantages in product development speed, quality, value generation, and learning. ILS has helped numerous companies restructure their critical engineering processes, allowing them to:

- Deliver new products that provide higher value to their customers and higher margins to their owners
- Dramatically shorten development lead times
- Strongly integrate product and process development
- Minimize engineering rework
- Manage multiple development projects more effectively, keeping all on time and on budget
- Employ highly efficient work methods
- Accelerate internal technology development and learning, constantly advancing both product performance and product design methods
- Create exceptionally skilled engineers and designers who consistently produce innovative solutions

We have done this in diverse applications. These include design and build of large-scale custom capital equipment; development of power system products for tier-one automotive suppliers; product line and catalog development for a major clothing brand including selection, technical design, sourcing, purchase and supply chain management; and sales, quoting, and process development for heavy equipment machining and fabrication. We address not only new product and process development but also their effective integration with the rest of the client'€™s business including sales, manufacturing, and supply chain management.

[wptabs style="wpui-alma" effect="fade" mode="horizontal"][wptabtitle] What We Do[/wptabtitle][wptabcontent]

We help our clients:

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  Improve organizational design and structure to better support the engineering and product development processes.

  This includes defining an appropriate balance between horizontal (program) and vertical (function) dimensions; the best team/teaming structure; insuring effective cross-disciplinary integration for optimal project execution; work balance, flexible deployment, and productivity of engineering staff; and insuring functional leaders focus on staff development and functional excellence instead of the vagaries of project management.

- **Establish effective multi-project management.**

  Capacity management tools are developed that assist in load leveling, identify bottlenecks with key resources (e.g., FEA/math modeling staff or special lab equipment) and enable remediation. We define means to financially support sufficient engineering staff through internal opportunity mining (e.g., value engineering with existing products) to enable peak load management and rapid response to opportunities.

- **Clearly identify and prioritize the best product development opportunities, including enhanced sales and quoting processes.**

  This would include effective opportunity screening filters, efficient quoting systems, full information gathering, strong voice-of-customer characterization, customer relation management, market intelligence systems, and portfolio management.

- **Manage and effectively integrate innovation programs with product development.**

  This ensures high value innovations are identified and completed in advance of product development so that they are off the critical path in program execution. In addition to design innovations, it includes manufacturing process innovations that enable higher value product designs.

- **Realize effective engineering work flow.**

  This includes effective up-front engineering processes that effectively scope the project, identify risks and information needs, and define the strongest concepts and technical approaches. It ensures strong concurrent engineering to ensure effective design from all disciplinary perspectives and thorough exploration of the design space to create highest value. Rework is minimized and supplier, process engineering, and product design activities are fully integrated.

- **Enhance technology development and organizational learning.**

  This includes development of tools for organizing, effectively applying, and continuously updating new learning with each product development cycle. We help define roles for design strategies such as platform engineering, modularity, and set-based methods.

- **Sufficiently document and train the PD process.**

  This includes standardized work; roles, responsibilities, and decision authority; full process documentation; tools/forms/procedures addressing issues such as scoping, information management, PFMEA/DFMEA, etc.; process mapping; and training programs.

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Deploy strong daily management systems.

We provide software tools and procedures to ensure adherence to process and standardize work; to track progress and recognize issues at their incipient stage; and to show the progress in meeting program goals and problem solving. We train your teams and leaders how to follow this systematic approach that helps ensure project are completed on time, within budget, with exceptional results and effective advancement of learning.

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[wptabtitle]Our Approach[/wptabtitle]
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Our approach begins with a detailed **current state analysis** of your product development or engineering processes. We interview key personnel and dissect historical successes and failures to understand the current process strengths and barriers to success. We map out each step in detail.

After sharing these findings with company leadership, we focus on organizational design. The right design varies significantly from company to company. The general goals are to ensure strong **cross-functional integration**, excellence in functional execution, smooth work flow, technical focus and development of expertise aligned with product categories and technology families, flexible deployment of equipment and personnel in a multi-project environment, and strong horizontal leadership. Development teams spend time together for effective **team-building** and learn about asynchronous **collaboration**, allowing people to work together no matter where they are around the globe. Everyone understands their modified roles and responsibilities.

We ensure that your projects are aligned with true customer needs and designed to create the highest value. Product launch and early engineering are given great attention. Robust processes are developed to define scope, assess risk, and plan systematic information acquisition. Early engineering is designed for concurrent integration of all disciplinary perspectives from materials, structural design, and controls to manufacturability and validation testing. We address early supplier involvement and partnership relations, effective learning through bench studies and math models, and ongoing integration of customer feedback. The goal is to quickly and reliably come to an effective, high-value design concept and to ensure that rework is virtually eliminated.

We give great attention to organizational learning through product and process development. For example, an ILS client created new technology books that included certified product designs presented in a modular format making responses to future similar requirements a plug-and-play activity.

One of the biggest challenges is managing multiple, top-priority, short-fuse projects that seem to hit the engineering staff at random. Weâ€™ve developed custom solutions for various clients such as a **load projection model** that identifies bottle necks, level loads engineering, laboratories, and down-stream processes, and can be used to negotiate delivery dates and understand cost ramifications of early deliveries at the proposal stage. We have used pull-based dispatching approaches to trigger staff assignments to detail engineering in custom design and build operations, insuring prints and components are delivered just-in-time in proper sequence to downstream fabrication and assembly operations.

We ensure smooth, **level-paced work flow** that creates immediate visibility when the flow is disrupted and creates urgency for a quick and effective response. This enables application of Jidoka (a key lean management principle) to the Product Development Process as a means to quick and effective problem resolution and learning.

We create **custom tracking tools** to enhance visibility and project execution. These tools communicate in real time the expectations and status to the entire project team. They ensure percent complete is aligned with the budget burn rate. They provide a strong basis for standardized work and they embed technical learning, tools, and procedures. With these tools we ensure excellence in execution instead of a check-the-box approach. Progress in meeting performance targets and goals is visible along with the status of problem solving efforts to overcome barriers. In addition, we train your teams and leaders to participate in an effective daily management system practicing jidoka.

We work with your leaders and development team members impacted by the process changes to launch the new process. This works best by conducting an immersive multi-day boot camp that begins by training the team on the principles of lean product development, We walk through the future state process in detail and consider what-if scenarios with the opportunity to modify and enhance the new process design. The teams are go over and refine the roles and responsibilities, and they work on a number of development activities such as constructing technical tools or writing detailed standardized work documents. This approach ensures strong understanding, buy in and enthusiasm and it brings the development to a fully completed state.

A sampling of results from these improved processes:

- Major technical risks identified earlier
- Projects completed on time and on budget
- Reduction in engineering hours of up to 40%
- Reduction of material costs of up to 15% through improved sourcing and supplier relations in the design process.
- Strong advancements in product technology

ILS Methodology

1. Form a leadership team...
2. Lean Product Development basic training
3. Current State analysis and historical case mapping
4. Focused brainstorming sessions to resolve challenging issues
5. Concept development
6. Future state design and implementation planning
7. Lean systems boot camp to fully develop needed methods and technologies and launch the future state
8. Training of teams and launch of the future state process
9. Implementation of the daily management system, program leader training
10. Executive team coaching to ensure effective change management
11. Follow through and troubleshooting

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[wptabtitle]Our Work[/wptabtitle]
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The cases below illustrate our work in a diverse range of applications:

- Capital Equipment Design and Build
- Automotive Power Systems Component Design and Process Development
- Product Line Development and Management for a Clothing Catalog Operation
- Process Development for Large Component Fabrication and Machining

Capital Equipment Design and Build

This equipment is custom designed and used in high volume metal forming applications (e.g., automotive and appliance manufacturing). The company, the largest and most sophisticated of its type in the United States, has several product lines, a number of proprietary technologies that customers want, and a strong reputation for technically advanced, high quality products. When the effort began, sales were improving, but its product development process was broken. Performance issues included:

- Engineering was constantly late with design releases and over-budget. Procurement and manufacturing had to take heroic efforts to compensate for lost time, but sometimes they could not do enough. Moreover this lateness, in turn, hurt their efficiency and costs.
- Multiple large and small projects had to be managed concurrently through the engineering process, but often engineers would not be working on the right projects at the right time to meet customer delivery needs.
- Design rework was excessive

- Technology and learning were stagnant.
- It was hard to bring new engineering talent up to speed.
- Quoting was a bottleneck and sometimes the proposed design concepts from sales engineering were infeasible.
- The turnover of projects from sales and application engineering to design engineering was slow and problematic, putting the project behind from the start.

This company undertook total-enterprise-level transformation to address these performance issues. Sales, application engineering, procurement, design engineering, manufacturing, assembly, run-off/commissioning, and field service processes were all reviewed, restructured, and integrated using lean principles. Interested readers are referred to this link for a more detailed description of this transformation. Three examples of these improvements include:

- **Enhanced up-front design process.**

  The original process started with a reference case and the job passed sequentially through functional efforts by mechanical design, controls, and fluid power engineering departments to adapt the reference design to the current customerâ€™s needs. This process resulted in late discovery of technical issues, rework, ineffective designs, cost overruns and late delivery. It was replaced by a process where an interdisciplinary project team comprised of experts in the product family would start by constructing a new system-level analytical model. This model first establishes performance requirements for each machine, interfacing needs, and footprint. Subsequently, system timing charts are defined that specified key requirements and enabled structural design, controls engineering and fluid power work to proceed quickly and concurrently. The team identifies performance enhancement and cost saving concepts up front. Rework is avoided, risk issues are identified early and machine interfacing is given strong attention. Using this process, not only was engineering design faster, there have been major technical discoveries that have boosted system performance and reduced cost, making the companyâ€™s products far more desirable.
- **A new system for design standardization, learning, and application.**

  This system has had major implications on the efficiency and quality of both the quoting and engineering design process. It consists of certified design lots and confirmed proposals. Certified design lots are established on an ongoing basis as new products are designed. Major subsystems are now extensively tested during run-out to establish their full range of capability (speed, rates, material types the machine can handle, etc.), understanding performance and capability beyond the scope of design of the current project. Moreover, field performance is closely monitored and design weaknesses corrected. Once these refinements are established, certified design lots are developed for use in future design and quoting activities. In a parallel effort, a modular confirmed proposal library has also been established based on key historical reference design cases, insuring the design is fully accurate and bills of material and costs are up to date. Collectively, the certified lots and confirmed proposals are documented with descriptive writings, analytical models, engineering drawings, budgetary data, performance data, application ranges, vendor quotes on purchased components (that are routinely updated), etc., to provide a basis for future designs and proposal development. This has enabled:

- Highly-efficient, modular plug-and-play construction of detailed and accurate quotes and technical proposals,
- A firm basis for pull-and-release engineering when appropriate,
- Reliable and complete reference cases for initiating design of new products with strong guidance on the best technical solutions to accommodate unique customer needs in the new case, and
- A strong foundation for design standardization and modular design

- **A novel pull-based approach to multi-project management.**

Under the new process, during up-front planning, design and manufacturing teams meet to systematically plan execution of the new project. Overall machine build sequences for large systems are defined that match engineering lead-time needs and available capacity (engineering, machining, assembly) across the value stream. A small number of assembly bays are dedicated to the new project, each assigned a sequence of machines or subsystems to build, and the bays assemble concurrently. A lot release sequence (lots are a set of related purchased and internally machined components) is defined that will enable efficient assembly and this is the sequence that work is released from engineering detailing (where manufacturing drawings and bills of material are produced) into purchasing and machining. A special pull system is used to manage activities across the value stream on a day-to-day basis. This system keeps a small, constant buffer of work ahead of each bay at all times, one that maintains the lots in the desired sequence. It enables effective prioritization of work from engineering into manufacturing. Engineering keeps a queue of released BoMs and drawings and has clear visibility of manufacturing'€™s needs so that it completes the right detailing job at the right time. (Detailing is the most time consuming component of engineering and the most critical to manage.) This system has greatly enhanced on-time project completion and has improved assembly efficiency by 40%. A related program to enhance the procurement process has significantly reduced purchased component costs, significantly increasing project margins.

Power Systems Component Design and Process Development

This company is a major power systems supplier to the global automotive and commercial truck industries. Its new product and process development process had become dysfunctional. Projects were taking too long and were over-budget, rework was excessive, project management was weak and engineering managers were reactively directing day-to-day activities instead of focusing on their functional duties in technology advancement and human talent development, and the companyâ€™s historical position as a technology leader in its industry was being threated.

ILS worked closely with this company to understand the reasons these problems were occurring. Numerous improvements were implemented including:

- **Major changes in organizational structure and leadership roles to enable an effective matrix management approach.**

  This approach insured effective work flow through the various functional departments, rapid response to execution problems, and strong accountability for results at all levels.
- **Transition from ineffective functional execution and excessive work handoffs to interdisciplinary team execution of all programs.**

  Local and cross-regional teams were established and assigned to select sets of similar programs. This enabled them to take advantage of inter-program synergies; achieve work balance for team members; insure full integration of product design, process development, and supply chain development; insure ownership and accountability to management for design performance as well as time and budgetary control, and to insure fast work flow. Select teams were static with new projects added to their plate as old ones were wrapped up. This facilitated capacity management and enabled exceptional skill building and learning over time.
- **A capacity management tool to identify and negotiate work execution bottlenecks**

  (focusing on key engineering/technical and testing resources) in a complex multi-project environment.
- **A system for advance deployment of new product development teams.**

  An aggressive program was initiated to identify product maintenance opportunities, i.e., cost savings projects involving minor design improvements, warranty cost reductions, or supply chain improvements. These opportunities are used to fund new engineering teams. In turn, this approach prevents resource crunches as new development programs are launched and insures teams are experienced and effective prior to their initiation of key development projects.
- **Strong concurrent engineering immediately upon program launch,**

  insuring effective integration of product engineering, testing and validation, process development engineering and early supplier involvement. This methodology enables high value creation and dramatically shortens execution timelines by reducing iteration and rework.

- **Changes in testing and validation laboratory management**

  that insured that the right projects were being worked on at the right time and that all testing was value-add. Bench scale labs were established for different product families so that such testing could be integrated early in the product development process.

- **Establishment of an advanced process development engineering group**

  to focus on new manufacturing processes from a "€œmanufacturability for design"€• perspective, where new manufacturing processes would open doors to enhance product functionality and value.

Product Line Development and Management for a Clothing Catalog Operation

This company sells women'€™s fashions through web and catalog media for multiple clothing brands. Product line development is executed as a cyclic process repeated twice annually for cool (fall, winter) and warm (spring, summer) seasons. Briefly, this process consists of:

- High level product line development, including overall line composition and fashion trends, marketing/media strategy, budget planning, and financial performance targets
- Clothing assortment selection and fabric plans
- Preliminary media and catalog design, addressing themes and layout concepts
- Technical tasks including technical design packs for manufacturers and fabric testing
- Item sourcing and buy plans
- Photo samples, generation of creative content (e.g., photo shoots), and detailed media/catalog design
- Execution of marketing plans and control buying during the sales season

There were numerous problems that limited the effectiveness of this process. These included:

- The overall development cycle was very long, approximately 15 months. This meant that major up front decisions on next year'€™s offerings, including product line structure, market trends that would be pursued, budgetary allocations for purchasing, etc., were made in an absence of knowledge regarding the current year'€™s performance. Clearly, in a dynamic industry such as fashion, the quality of these early decisions would be suspect and this requires either major rework of the merchandizing plan or living with the consequences of decisions based on stale information.

- The development process was highly phased with large batch releases of work to functional departments. For example, technical design would be overwhelmed with the sudden release of work after initial item selection was complete and would rush to complete preliminary technical packs (sizing and construction drawings) to obtain proto samples. Similar work surges occurred for the sourcing, purchasing, and the creative departments. This dynamic bottlenecking of the work flow was, of course, a major reason for the excessive process cycle time and it also was a significant barrier to quality of work.
- The work was highly functionalized. Input from sourcing and buyers in up front merchandising decisions and line builds was weak, and consequently these early decisions often were reworked. Media plans, used to forecast financial performance were locked in up front before defining the assortment. There were numerous handoffs between the functional groups that created communication and work flow issues, again lengthening the process.
- Fabrication strategies, where common materials are used across multiple products, have high potential value in reducing item costs, reducing minimum purchase quantities, improved sourcing, and creating opportunities for reactive purchases once early season sales begin. However, the existing process failed to develop effective strategies.
- Early sales information that occurs upon release of the first catalogs of the season is highly predictive of total season sales and can dramatically improve buying, avoiding lost sales and reduced margins through markdowns. The existing process however, did not enable effective reaction to this information.

The new process addressed these issues as follows:

- Organizational structure and roles and responsibilities were revised. In particular **Product Line Teams** consisting of a Product Line Manager, Team Analyst, Control Buyer, Technical Designer and Production Manager (with sourcing and were developed for each major product line and brand (with the Shoes Team shared across multiple brands). The Product Line Manager served as the team leader. This insured strong cross-disciplinary input during all phases of the cycle and helped to balance workloads. As an example, the entire Product Line Team reviewed buying decisions during the ongoing season, providing team input on reactive purchasing and marketing as well as creating valuable learning useful in design of next year's lines. Brand Managers coordinate across all of the Product Line Teams within the brand and assume leadership of important cross line developments.
- Fabrication strategies were fully developed early in the process and were designed for effective deployment not only across product lines but also across brands. This was a key role of the Brand Managers and required them to strongly coordinate their efforts.
- Batch turnover of work between departments was eliminated. The overall line development was broken into five major flows based on merchandise categories: rolling development items, key items, firm assortment itemss, non-firm assortment items, and market items (complete items that would simply be purchased on the market). This

breakdown of the work effectively created a continuous flow process, leveling workloads, improving work and work-life quality, and shortened time lines.
- The above changes enabled development of a much shorter development cycle. Importantly, line development did not commence until this year'€™s early season sales were in, providing much stronger information upon which to base line assortment, trend identification, and marketing decisions. Indeed, a lesson'€™s-learned meeting that closes the current cycle and addresses issues such as the appropriateness of media space allocation decisions, critique of the assortment value, missed trends, color mix appropriateness, retail pricing, effectiveness of markdown strategies, lost demand quantification, and evidence of cannibalization now is part of the kickoff for the next cycle. (Previously, this review occurred mid-cycle.) Moreover, buying decisions could be delayed, thereby enhancing the quality of information available to forecast demands. In addition, financial planning was coordinated with line development so that firm budgets would be available for line planning and buying decisions. Work was also phased so that there was no major need for team members to simultaneously work on warm and cold season lines.
- External agents from outside companies were now directly integrated into the product development process, taking full advantage of agent capabilities. There is a seasonal "Agent Showcase"€•, timed to match line development. The agents would provide trend information (fabric, color, styles). Relationships were established between the product managers and design talent at the agencies. In particular, the agent would be charged to identify items that match specific target features for the garments that the product manger wants for the line. In this manner, garments displayed at the Agent Showcase would be much more valuable and more likely to be adopted. Agents were not valuable partners working in a win/win relationship with the company instead of ad hoc participants in the line development process.

Process Development for Large Component Fabrication and Machining

Product development is not complete until an effective manufacturing process is operational. Ideally, product and process design are fully integrated and conducted in parallel, and, indeed, that was a major emphasis of the effort in Power Systems Component Design case. This case describes improvements in process development for new products from the perspective of sophisticated suppliers charged with that activity by their customers who are major heavy equipment manufacturers in the agricultural, construction, oil, and defense industries.

Some of the important improvements that were implemented at these operations included:

- **Proactive identification of strategic customers.**

  Rather than reacting to opportunities that came along, the companies sought to build relationship and business with customers that made strategic business sense. This included companies that produced products in growth sectors, enhanced diversification, had strong track records in early supplier involvement for collaborative product and process design, and products with strong fit to the suppliers,€™ operations. Concerning fit, one fabricator looked to identify unique processing opportunities so that it could grow its internal capabilities to provide higher value service solutions to its clients. For example, this might involve enhancing its already extensive "œplate-to-paint"€• capability for manufacture of large machined weldments to incorporate technologies such as select automation and robotics to reduce labor costs for high volume production or an ability to integrate new products with existing large tack and weld fixtures so that tooling and floor space requirements could be minimized, lowering costs. There was a strong effort to identify these customers, understand their needs, and impress them through strong proposals that provided valuable feedback and high value for the customer while demonstrating the high competency of this firm.

- **Early supplier involvement in product design.**

There was strong effort to build relationships and engage the customers in Design, Process, and Assembly Review (DPAR) at the early stages in product design so that opportunities to reduce cost and enhance manufacturability were captured and information for process design fully documented. Even when customers had only weak supplier involvement in the design process, there was a strong early effort to clarify customer needs and manufacturing issues as well as provide feedback on design improvements that might be possible.

- **Strategic Investment in Process Development at the Quoting Stage**

Systems were developed for classifying quoting opportunities and status. In situations where there was strong likelihood of quoting success, or strong value in impressing a strategic customer, the process development process was immediately launched. The supplier recognized that quoting itself directly addresses the key issues and tasks of process development. With careful design of the quoting process, this information can be augmented at little cost and captured to make it highly useful in process development. For example, information for quoting was directly captured in a full bill of materials during the quoting process so time would not be wasted in setting BoMs up once the customer awarded the purchase order. Process design was established carefully with an eye to eliminating waste. Fixture, template, and tooling designs were developed and drawings completed, fully addressing needs and opportunities to improve process safety, quality, capacity utilization, and efficiency. Under the current state, it was common to rush process development in order to meet tight delivery deadlines that the customer had imposed. In such a circumstance, these process development opportunities were short-circuited. Moreover, it was rare for them to come back and attend to them at a latter point in time. With the new system, these processing devices were fully designed and the supplier was ready to pull the trigger for purchase and fabrication as soon as the P.O. was awarded. This effort included multi-disciplinary input from key technical specialists at the supplier where appropriate.

- **Capacity Analysis**

  Careful analysis was undertaken to define how the capacity needs for the new process could be delivered in the most cost effective manner. Plant layout itself was modified in one facility so that machine operators could be flexibly deployed to concurrently run multiple products without equipment moves so that very high labor utilization could be realized on long machining cycles. Cases where low run ratios (the ratio of actual to planned manufacturing cycle times) were forcing investment in new equipment were identified and continuous improvement teams were dispatched to solve the problem so equipment purchases could be avoided. Special fixture solutions were developed so that new products could be added to existing work centers with minimal capital costs and no additional floor space needs.
- **Team Execution in a Standardized Work System**

  Teams would be formed for each new process development project and they folled an effective standardized work process. This included strong interdisciplinary efforts early in the process to integrate safety, quality, tooling, machine and manual work design efforts; strong communications; clearly delineated roles and responsibilities; and clear timetable and procedure for execution. The teams fully piloted and refined the new process.
- **Performance Targeting and Closure Rule**

  A standard analytical procedure was developed to identify process wastes, opportunities for improvement germane to the type of manufacturing process, capacity utilization effectiveness, quality targets, and quoted standards. These are used to establish performance targets for the process. The team is not allowed to disband the effort until these targets are realized and sustained for a significant interval of time. Moreover, the process development team uses structured problem solving methods to close the gaps. A final report out to top management documents team performance during the project and confirms attainment of the goals. It is also used to capture lessons learned to improve future process development activities.
- **Custom Tracking Tool and Daily Management System**

  Special tracking tools were developed and implemented and such tools provide valuable support for effective process execution and management. The specific roles of this tool included:

  - **Communication of key information to the entire work team.**

    This includes key decisions, requirements, and plans along with identification of missing information and what is being done to obtain that information.

- **Clarification of status of all work activities.**

  This includes early identification of schedule slips and explanation and status of all ongoing problem-solving efforts to countermeasure complications that have surfaced. Budgets are planned prior to process development and conformance is reported on a daily basis. In addition, performance of the process, once initially operational, is tracked and expressed in terms of KPIs such as scrap rates, process capability, labor content, machine cycle times (as required for the capacity utilization plan), changeover times, and realized run ratios. Deviations from KPI targets are noted as are the specific activities being undertaken to close the gaps as mentioned above.
- **Reinforcement of standardized work.**

  The tool, including steps, schedules, responsibilities, forms, etc., it set up around the defined standardized work process. It provides descriptive information on the process at appropriate steps. It requires that the standardized process be followed, that responsible persons report their activities and that results are posted.
- **Embedded Guidelines, Checklists, and Technical Procedures.**

  These are aids and analytical procedures to assist in effective process execution. They include items such as quoting checklists to insure full cost recovery, gauge selection criteria, tooling selection criteria, safety checklists, etc.
- **Support of the Daily Management System.**

  The tracking tool is available to all team members and management. Everyone is responsible for self-reporting and updating information. Regular team meetings and management reviews are held as part of the daily management system. Problems are highly visible and there is ownership and accountability to resolve these issues in an effective and timely manner.

parking lot....

- 90/90 early launch of product dev process -€“ avoid short changing process in rush to meet delivery requirements
- Stronger budgeting process dev -€“ targets and control, investment in fixturing/tooling either customer paid or performance payback

- Checklists -€“ items customer pays, tooling selection guidelines, etc.
- Capacity analysis- leveling, labor utilization, wind down, run ratio barriers to adding prod to existing equip
- It is noted that by using the classification system, it is reasonable to put much more extensive effort into
    - Fixture design
    - Special tooling design
    - Capacity analysis and determining where the part will run (or whether new capacity will be purchased)
    - Determining the processing approaches and details
    - Feasibility and risk assessment

- All of this effort will make the quote more accurate and then it can be fed forward and directly used to streamline the process development process.
- Kickoff, sw, timeline, collaborative meetings (tooling, layout, gauging, fixtures)
- Process development team procedures devel - waste identification, "€œby the numbers"€•, safety checklists,...

Some selected improvements for Case 2 (Metal forming capital equipment company):

- Total modification of up front design efforts. The initial process started with a reference case and the job passed sequentially through functional efforts by mechanical design, controls, and fluid power engineering departments. This process resulted in late discovery of issues, rework, ineffective designs, cost overruns and late delivery. It was replaced by a process where an interdisciplinary project team comprised of experts in the product family would start by constructing a system-level structure giving performance requirements for each machine, interfacing needs, and footprint. System timing charts are defined that specifies key requirement and enables structural design, controls engineering and fluid power work to proceed quickly and concurrently. The team identified performance enhancement and cost saving options up front . Rework was avoided, risk issues were identified early and machine interfacing was given strong attention. Using this process, not only was engineering design faster, there have been major technical discoveries that have boosted system performance and reduced cost , making the company'€™s products far more desirable.
- Development of a related system of certified lots and confirmed proposals that has had major implications on the efficiency and quality of both the quoting and engineering design process. Certified lots are being established on an ongoing basis as new products are designed. Major subsystems are now extensively tested in run-out tests to establish their full range of capability (speed, rates, material types, etc.) Moreover, field performance is closely monitored and design weaknesses corrected. Once these refinements are established, certified lots are developed for use as discussed below. In a a parallel effort, a modular confirmed proposal library has been established based on

key historical reference design cases, insuring the design is fully accurate and bills of material and costs are up to date. Collectively, the certified lots and confirmed proposals are documented with descriptive writings, engineering drawings, budgetary data, performance data, application ranges, etc, to provide a basis for future designs and proposal development. This has enabled highly efficient modular plug-and-play construction of detailed and accurate quotes and technical proposals a firm basis for pull-and-release engineering when appropriate, reliable reference cases for initiating design modifications to accommodate unique customer and a foundation for design standardization and modular design.

The organizational structure was changed, leaders were put in place, and new roles were defined so that it functioned as an effective matrix organization with strong horizontal leadership for each major project. This included Co-captain leadership with an Application Engineer (AE) and Design Engineer (DE) partners responsible for all technical decision making through design completion,with AE assuming the voice of the customer and DE focusing on technical problem solving, technology advancement, and design execution. Fixed interdisciplinary teams, based on technical focus groups, joined these leaders with strong up front planning and design, and this team followed the project through to the end The team dedicated 100% on the project from launch after contract closing until point of conceptual design completion. Pooled engineering resources join for detailing activities, timed to meet deliver needs on all active projects.

ILS has helped many corporations implement effective lean product/process development systems and to integrate these systems more effectively with the rest of the business. Some recent projects include:

1. Total restructuring of product development for a major Tier 1 electronic and power systems supplier to the global automotive and commercial truck industries (see below). Implementation is on going.

2. Complete restructuring of product design/development of a major capital equipment manufacturer of metal forming equipment for the automotive and appliance manufacturing industry from sales and quoting, through product design, procurement, machining and assembly (see below). This has enabled the company to deliver on time, reduce engineering hours, dramatically reduce material and manufacturing costs, and significantly advance the technology of their products.

3. Restructuring of design participation and process development for a manufacturer of large weldments for the oil and gas, large construction equipment, and defense industries. These changes in conjunction with related operational improvements have taken this business from failing to a strongly competitive and growing entity.

4. Redesign of the product development process for a major paper-catalog and internet-based clothing retailer (product line design and catalog development). By shortening the development

process, it was possible for next season'€™s catalog selections and purchases to consider current season sales, dramatically reducing the potential for unsold inventory. In addition supply chain restructuring strategies were developed to reduce lead times and enable reactive sales in ongoing seasons.

5. Redesign of process development strategies for new products for a rapidly growing manufacturer of large machined parts for the construction, agricultural, and wind power industries. Implementation is ongoing and to date new processes have reached higher performance targets much faster than in the past.

We outline some of the more significant changes for the first two cases below.
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