Integrated Product Development

The Real Story

A Kaufman Global White Paper

Kaufman Global
Tele: +1 317 818 2430
www.kaufmanglobal.com

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Introduction

Properly implemented, Integrated Product Development (IPD) is a formidable competitive weapon. IPD creates better products faster and at lower cost. Despite these advantages, most organizations have been slow (at best) to implement a full-scale IPD approach as their standard product / service design and development methodology. At the same time, many of these same organizations are vigorously pursuing Lean Manufacturing (*just-in-time*, *synchronous*, *flexible*, *pull*, *kaizen*, etc.) in order to reduce material and labor costs. This is like closing the barn door after most of the livestock have fled. One can fry much larger fish with IPD. For example, the cost of manufacturing labor across all industries averages about 10 percent of total costs. Even a 20 percent reduction of 10 percent yields only a two percent total cost reduction. While this is significant, it pales beside the impact that IPD can create. Why not have both?

Any organization that is facing the competitive pressure of getting better products to market faster and which is still practicing traditional design and development methods (TD&D), is inviting disaster. When (not if, when) an agile competitor turns effectively to IPD, it will be too late for those who waited. This White Paper reviews the basic fundamentals of IPD and an implementation approach that guarantees success if an organization has the wisdom and courage to embrace it.

What Are Traditional Design and Development Methods?

Insofar as IPD is the only feasible alternative to traditional design and development methods (TD&D), it might be wise to describe the characteristics of TD&D before we go further.

A TD&D environment demonstrates many (if not all) of the following characteristics:

1. Budgets and schedules are typically overrun.
2. After every development effort there are post-mortem discussions of everything that went wrong.
3. Many team members miss many meetings due to other obligations.
4. There are middle managers on the design teams who do little real design work.
5. Team members do not feel that they own their design or product.
6. Team members find that critical information is confusing and / or hard to obtain.
7. Often, design team members are low-level personnel selected by management, and to whom management will not listen.
8. A great deal of team members' time is consumed by preparing and delivering briefings and responding to questions from management.
9. Project schedules from different areas, functions and / or project teams don't match and / or are vague.
10. The design process starts before all customer requirements are well-known.
11. Team members have little information about budgets, costs and / or manufacturing processes.
12. Few manufacturing personnel are involved in the development and / or review of designs. Prototypes are often "hand carried" through the production process but not proven at production rates / volumes.

13. Team members find that meetings and briefings are variously disorganized, confusing, vague, hostile, boring and / or pointless.
14. Bad news is not dealt with until it is so bad that it cannot be hidden any longer.
15. There is a sense of defeatism on the part of many team members (and some managers) even at the start of a project.
16. There is no standard design and development tool box that is well-know to all team members.
17. Teams are given narrow tasks, and many technical decisions are made by review committees comprised of senior managers who have little day-to-day involvement with design issues.
18. There is little or no in-person customer or supplier presence on the design team.
19. Design and development team members work in office space in their home sections / departments; the team members meet in whatever conference room they can find.
20. Team members formally report to individuals other than their team leader, (i.e., they work for one person and someone else does their performance appraisal).

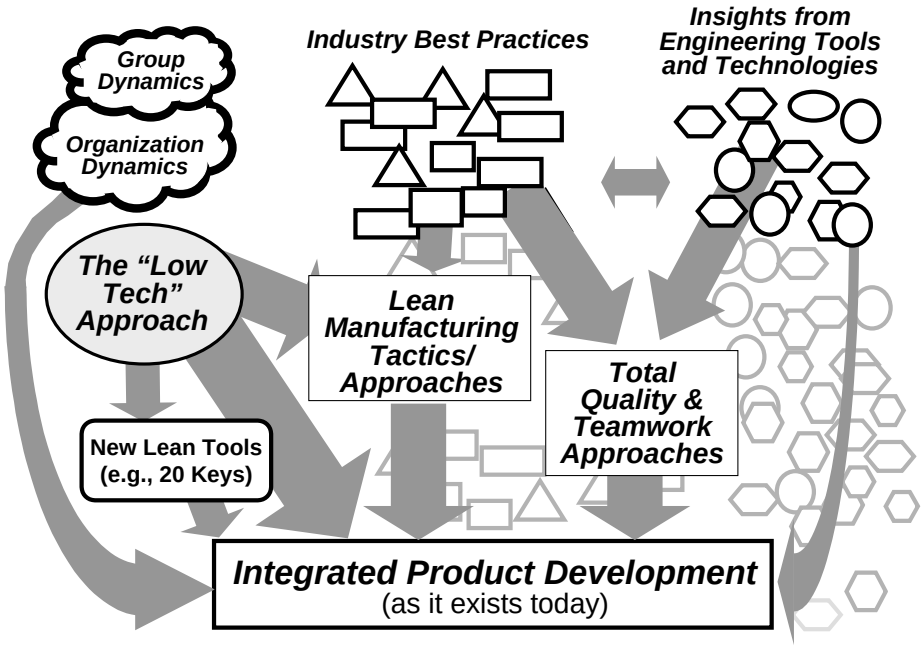
If you can identify more than three of the above conditions in your organization's design and development efforts, the implementation of IPD should become one of your top three priorities. Without it, your organization is at risk of being left behind by the first competitor in your industry that embraces IPD.

What Is Integrated Product Development and From Where Did It Come?

As with most business improvement methods in this age of jargon, there is a great deal of confusion about IPD. The concept has been variously labeled as *concurrent engineering, simultaneous engineering* and *design for manufacturability*. Further confusion is generated from the constant evolution of IPD. The concurrent engineering of ten years ago is not the concurrent engineering or IPD of today. Some managers, upon hearing of IPD, hope that it is a unique, new system or tool a unitary approach that can be mechanistically applied by a few engineers. Others believe that IPD is one or a combination of the many engineering and project management tools that have become available in the last half-century, such as *Value Engineering, Design for Assembly, Configuration Management, Willoughby Templates* and so on. Some managers have been burned by bad experiences with misguided implementations of a hodge-podge of tools. Some believe design and development is best facilitated from inside of a computer, using elaborate project management information systems. Fearing repeated disappointments, a great many employees at all levels reflexively consign anything new to the dustbin of failed fads and gimmicks without bothering to explore it. Leaders cannot afford to let that happen in today's rapidly changing markets.

The truth is straightforward in concept and complex in terms of implementation. **IPD is not a discrete tool or system; it is a philosophy of work and people that employs a set of best practices and methods.** Figure 1 illustrates the evolution of IPD.

Figure 1 – Evolution of IPD



As Figure 1 shows, IPD has roots in some of the "best practices" that industry has developed over the past 150 years. Other roots extend to the various design aids and tools that have been introduced over the past 50 years. Yet, the roots of the IPD tree would have taken much longer to sprout the tree itself if it had not been for the infusion of insights from Lean Manufacturing and related low-technology philosophies and approaches. Lean Manufacturing in Japan was motivated by a scarcity of capital for technology and machines. As Lean Manufacturing developed on the shop floor, engineers were drawn into it, resulting in the first grafting of Lean techniques onto the roots of TD&D; IPD was born! Additional growth hormone was added to the sprouting IPD tree by various "total quality" initiatives and teamwork efforts in the period between 1970 and 1985. Continued incorporation of additional "low-tech" approaches over the last 20 years (such as the 20 Keys® technique) developed IPD into what it is today. It will continue to evolve.

At the implementation level, IPD is a set of techniques and approaches that have been proven to work if applied correctly. The difficulty is in the phrase "applied correctly." All IPD efforts share similar characteristics but each implementation is unique in its specific environment. One size does not fit all; each implementation requires significant customization and subjective adjustment. Complicating things further is the fact that the tools and techniques from which IPD practices are drawn cannot be distilled into easy-to-follow steps that can be blindly applied without insight.

For example, co-location (placing the workstations of people that work on a project / team in close proximity) is a critical element of IPD success. Yet, every valid IPD effort has teams that range from 100 percent co-location to zero co-location. What is best for a particular team in a specific IPD effort? It depends upon the nature of the team and the design effort. Cost and space considerations must be balanced with performance expectations, risk, part-time task assignments and budgets. Since there is not one correct answer for all situations, determining

optimum co-location requires the simultaneous understanding and application of numerous tools, skills and techniques. In essence, a leader who is establishing an IPD effort must simultaneously integrate customer requirements, organizational / group dynamics, budgets, supplier constraints, technical considerations and IPD best practices in order to configure the most effective IPD effort.

The best formal definition of IPD is one that is divided into two parts:

1. Purpose (WHAT)	Produce, in the shortest time, on schedule, within or below budget, the highest quality designs and products possible that delight the customer, minimize total life cycle costs and create a barrier to market entry for competitors.
2. Means (HOW)	Tightly focused, empowered, well-organized, well-led, design teams that incorporate all available, relevant information about customer requirements, best practices, engineering tools, materials, manufacturing processes and costs into the design and development effort as early as possible.

Many people confuse the WHAT of IPD with the HOW. Many organizations define IPD with the WHAT definition and then wonder why they are not getting results with TD&D methods. The WHAT portion of the definition only sets the purpose. This purpose cannot be achieved reliably and repeatedly by TD&D techniques any more than a cow can fly simply because we define it as a "flying bovine." Without the techniques implied by the HOW portion of the definition, the WHAT definition only serves to increase anxiety and management tampering. You are not "doing" IPD unless both parts of the definition are being realized in practice. There is a limited number of complementary and interactive approaches and methods that can be used to create and enact the HOW portion of the definition until it becomes the standard design and development approach in an organization. These approaches *are* IPD.

Why Is Integrated Product Development Critical?

The requirement to implement IPD is driven by market pressure. If business today were the same as it had been in 1900, there would be no impetus for IPD. In the past, everyone used traditional and adequate techniques. There was no driving need to move to a new level of design and development speed, quality, flexibility and cost. Times have changed. Falling trade barriers create increased numbers of competitors fighting for slow growth markets. The coins of success in today's high technology, fickle markets are price, quality and the speed with which new product and service features are brought to market. Product innovations generate large profits only for the first to market. The market for new and improved products, services and technology has become a feeding frenzy. Only those organizations with IPD "teeth and claws" will reap the profits shareholders expect.

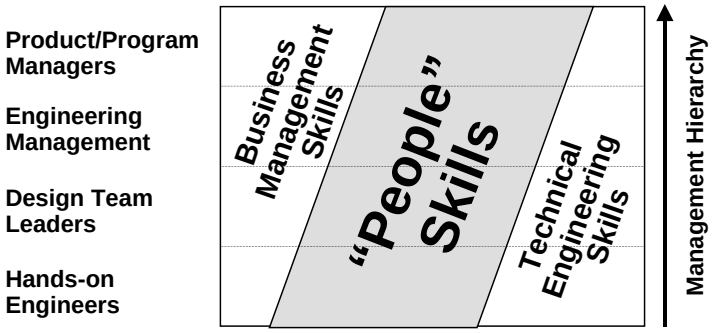
If your organization is still practicing TD&D methods, there is good news and bad news. The good news is that few organizations are employing IPD comprehensively and / or with vigor. The bad news is that at least half of the competitors in any market segment are considering IPD (perhaps for the n^{th} time) with serious intent. Time is running out for late starters; once

relinquished to an IPD practicing competitor, market share does not return to organizations still in the grasp of TD&D methodologies.

The immediate adoption of IPD is essential for a subtler but even more critical reason. Almost every competitor today has access to the same advanced technology, computerized tools and skilled engineering talent. There are few hidden technological niches that provide a long-term advantage to any one competitor in a specific industry. This leaves the last frontier of the design and development struggle: engaging the human element to take maximum advantage of technology. If you revisit the list of TD&D characteristics, you will see that they are all “people issues": circumstances revolving around the effective leadership, organization, focus, structure and empowerment of human beings in a complex system. TD&D does a very poor job of attending to these critical factors. Conversely, IPD sets the optimization of these elements as its central operating philosophy.

Figure 2 demonstrates this situation graphically. As one ascends the management hierarchy, going from design team members to product and program managers, the skills needed for success change. At the lower levels of the management hierarchy, design team members do not typically require the degree of business planning and strategic skills and experience that are valuable in product and program managers. Alternatively, product and program managers do not normally apply the range of hands-on technical and engineering skills that are necessary for design team members to function successfully.

Figure 2 – Requirements for Various Design and Development Personnel



The central problem in TD&D environments is that there is an even more important set of skills that gets little or no attention, at least in a formalized manner. As Figure 2 shows, “people” skills are equally critical at all levels of the organization. From design team members to team leaders to engineering managers to product / program managers, personnel at each level must be skilled in the following critical areas:

- Leading a team and being an effective team member
- Structuring and sharing information
- Dealing with conflict
- Negotiating and listening
- Organizing group activities
- Building consensus

- Understanding and dealing with resistance to change
- Structuring teams for optimum success
- Structuring programs to optimize group and organizational dynamics
- Creating metrics
- Brainstorming
- Installing and / or participating in a Lean Daily Management System® (LDMS®)

Few product failures are caused by absolute technological limits. Efforts such as the initial flawed lens of the Hubble space telescope, the "New Coke" product introduction, and the faulty O-ring on the Challenger were each caused by the inability of project teams to deal with complex information. In each of these cases, the personnel did the best that could be expected from a TD&D environment; but it was not enough.

The Benefits of IPD

The specific benefits that can be expected from a solid IPD effort are:

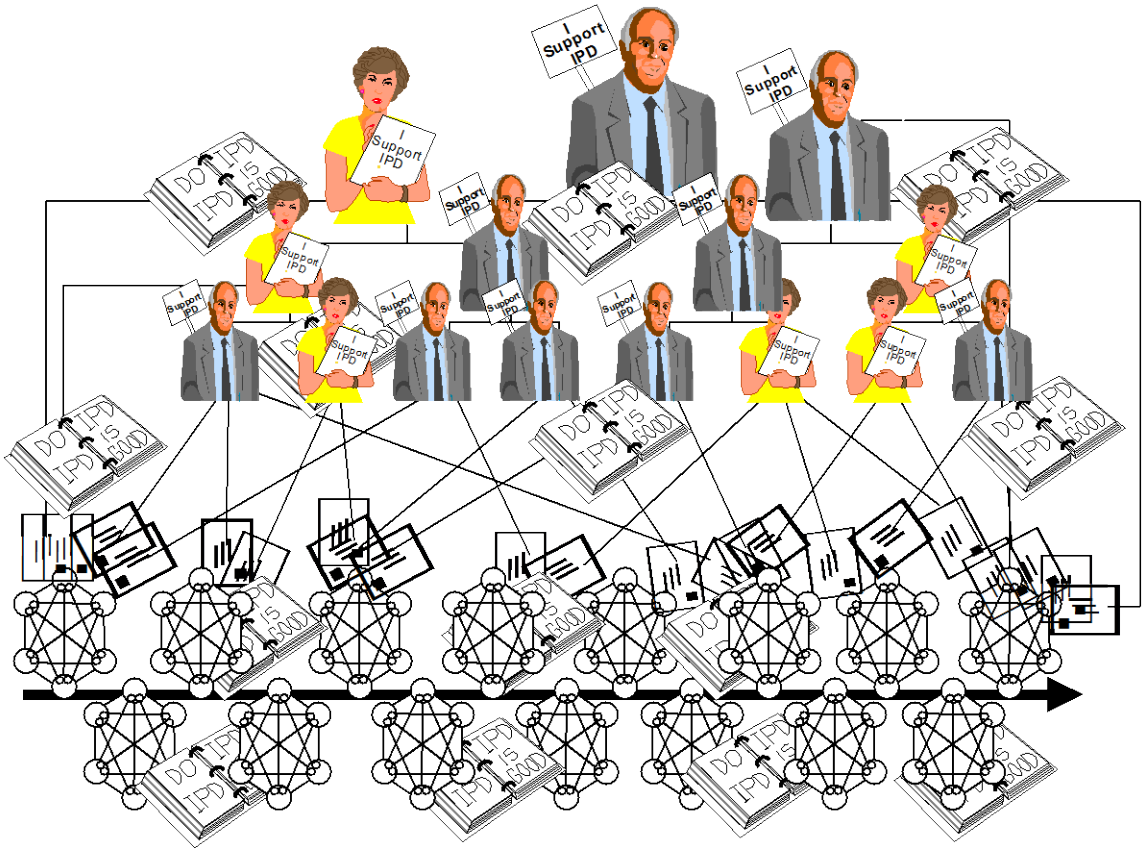
Product Development Time	30 to 50%	Faster
Engineering Changes	60 to 90%	Fewer
Product Part Counts	10 to 70%	Fewer
Scrap and Rework Costs	20 to 75%	Lower
Manufacturing Labor Costs	10 to 90%	Lower
White Collar Productivity	30 to 200%	Higher
Manufacturing Quality Levels (Defects)	30 to 90%	Lower
Litigation Costs	10 to 90%	Lower
Innovative Production Improvements	10 to 50%	More

These ranges of benefits have been found within and among all industrial sectors, in service and manufacturing environments. Organizations employing TD&D methods may experience one or two of these benefits on an individual project every now and then. However, it is an extremely rare organization that is able to translate such occasional isolated successes into a new way of working on all of its future design and development efforts.

This failure to translate a successful project into repeatable success is due to the flawed expectation that IPD can be installed as a set of procedures in a three-ring binder. IPD guidelines

in a binder are only a rough recipe for success. Figure 3 presents a conceptual model of traditional management's fantasy of IPD in action. In this fantasy, all managers and executives demonstrate active support for IPD all of the time. Each of them leads by the letter of the law of the IPD process and procedures manual. Further, the manual is used religiously by the design teams as a day-to-day guidebook through a carefully orchestrated, reengineered process in which each design team and team member works on a specific, organized portion of the overall design process. When process deviations appear or when its wisdom deems it necessary, management intervenes to guide things back on track.

Figure 3 – The Traditional Design and Development Fantasy of IPD



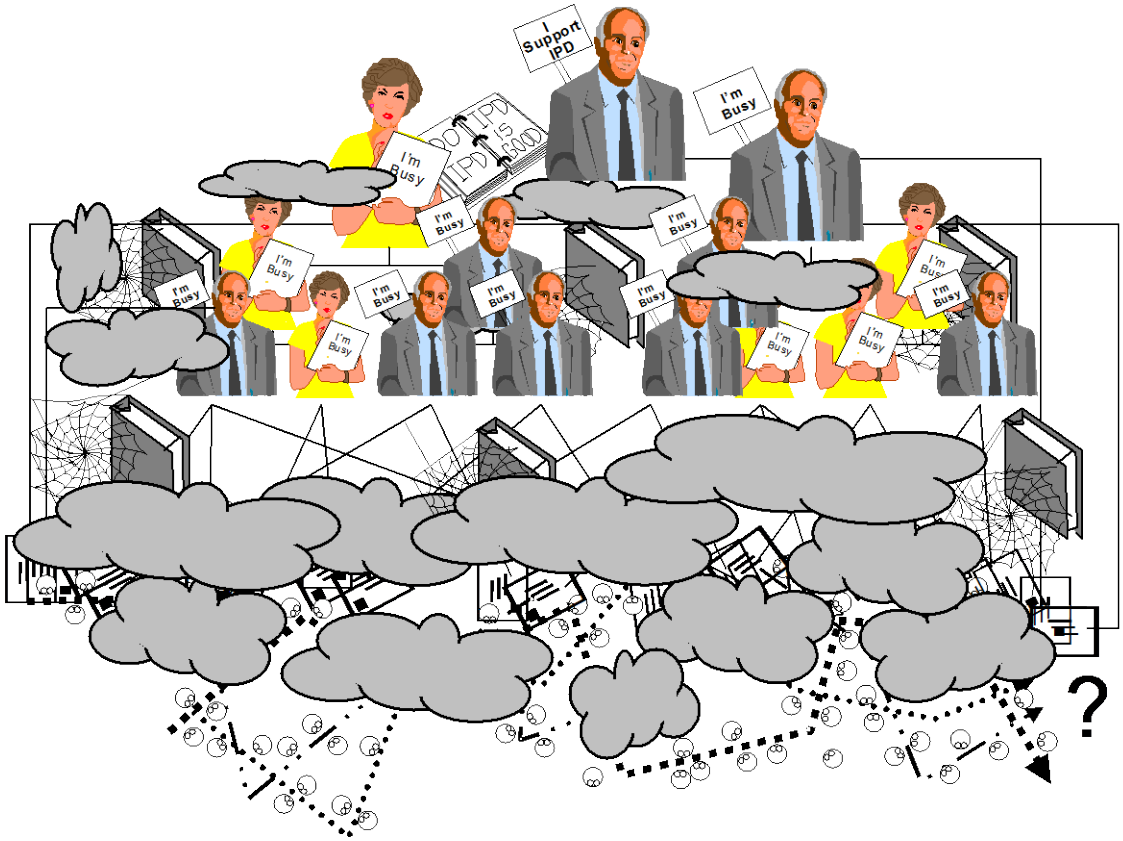
Not one IPD manual in a thousand begins to approach the level of detail that is required to provide day-to-day process guidance to design teams or team members. And even if such detail could be generated, it should not be. The design process is an active, on-going dynamic system. Process and procedure manuals are a waste of time, because they provide vague and inaccurate road maps to destinations that should never be visited while instilling a false sense of security in management.

IPD is best viewed as a set of values that enables a dynamic system to constantly adjust itself in real time. The values and the general types of practices they engender never change, but the processes used to achieve them constantly evolve. Those leaders who can successfully implement IPD are the ones that can distinguish values and practices from box and line flow charts in three-ring binders. IPD leaders must be trained and coached to optimize results in real time on every design and development effort. **A cultural change must occur in which IPD**

leadership is viewed as a long-term survival strategy that must be applied from the start of every project's conceptual design.

Figure 4 is a representation of the design and development environment that is actually operating in most organizations. Often, the top executive is aware of IPD and actively supports its values. He / she believes that the guidelines of the attractively printed IPD process and procedures manual are being applied. Other managers and executives, if asked, would say that IPD is "good," but they have little time to figure out how to make it work during the chaos of the typical work week. Various levels of management don't see what's going on beneath the cloud cover generated by the ever-changing problems, priorities, issues, emergencies and politics at their level. If they are aware of an IPD process and procedures manual, they never refer to it because they know intuitively that they cannot make it work in the part of the organization they control.

Figure 4 – The Reality of Design and Development in a Traditional Organization



Meanwhile, the design and development personnel do the best they can with what they have. Processes are hardly ever defined in more detail than "general requirements." There are conflicting processes from different sections of the organization that require duplicate efforts and numerous compromises. Very seldom does real teamwork form and very rarely does a team get enough information to do the job the way it thinks it needs to be done. In the midst of heroic struggles, random bolts of management tampering shoot from the clouds to change plans, disrupt work and demand briefings. It is a tribute to human perseverance that TD&D approaches achieve as much as they do. Properly implemented IPD provides an environment in

which the majority of human effort is put into the design and development process rather than into battling the system to get some work done.

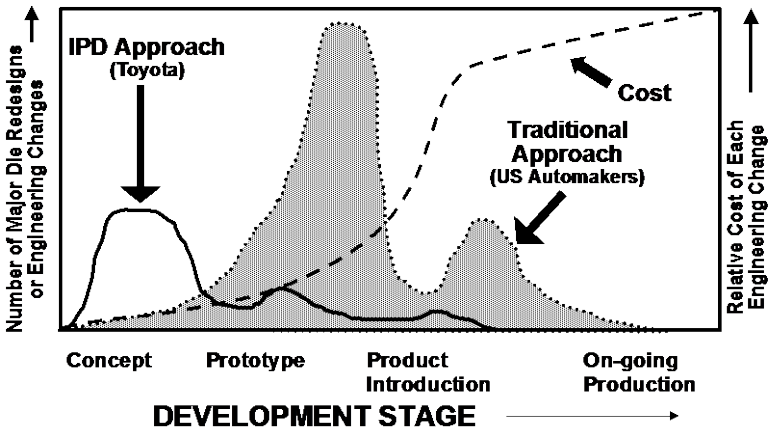
IPD Must Start Early and Aggressively

The bar graph in Figure 5 demonstrates why the most critical focus in design and development (and thus IPD) must be on the conceptual and early design phases (CEDP). Decisions made during CEDP lock in approximately eighty-five percent of the total life cycle cost of a product or service. Total life cycle costs include cost of materials, customer service, repair, warranty, R&D, manufacturing labor, capital equipment, litigation, administration, after sales service, market share advantage and so on. Eighty to ninety percent of total life cycle costs, from small (a customer return) to mammoth (a product liability suit) costs, are driven by decisions made during the design and development phase. Once the CEDP are complete, it is too late to recover the majority of future lost costs.

Figure 5 – Impact of Product Design on Total Life Cycle Cost

The first hints (at least in the US) about the potential impact of IPD and its primary focus on the CEDP became apparent in the mid to late 1970s. American automakers learned that the Toyota Motor Company had dramatically reduced the number of die design changes required in the development of new car models. In the automotive industry, as in most others, it is very expensive to change die designs late in the design and development process. For decades these changes had been assumed to be "part of the business." American automakers were shocked to discover that Toyota had been able to dramatically reduce this expensive practice. Figure 6 illustrates the patterns of die changes for Toyota and the typical US automaker at that time.

Figure 6 – Patterns of Engineering Changes



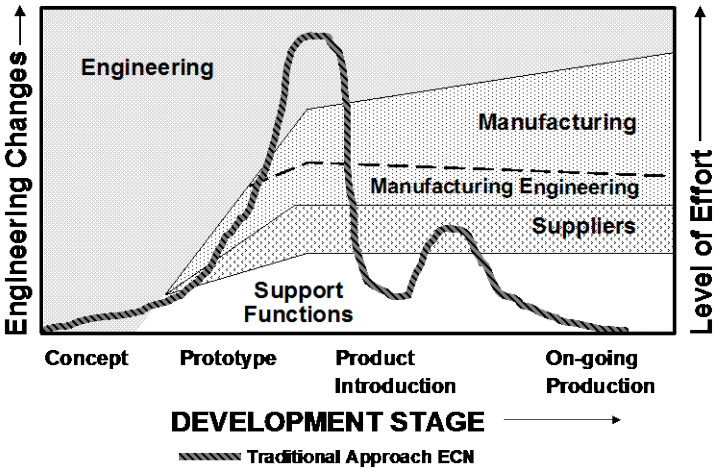
The Detroit automakers were experiencing the pattern of die redesigns labeled "Traditional Approach" (the gray area). Many late changes were resulting in losses of millions of dollars of

pure profit. Toyota was experiencing a profile similar to the curve labeled “IPD Approach.” As a result of making comparatively few changes close to prototype assembly and product launch, Toyota was enjoying a dramatic competitive cost and quality advantage. It took almost ten years for the causes behind these different profiles to become clear to the Detroit automakers.

It was discovered at about the same time that almost identical profiles were being generated for engineering design changes, or engineering change notifications (ECN). Toyota tended to make several ECN early in the design process and almost none later. The Detroit automakers made very few changes early but made several as the product moved towards launch. As you might expect, there is a strong relationship between ECN and die modifications. It is estimated that the cost of the average ECN in the automotive industry at or after product launch during that time was almost one million dollars.

Upon investigation, it was discovered that Toyota was organizing its engineers and supplier representatives into more closely-knit teams *early* in the design process; first generation IPD was being practiced. Detroit automakers (and almost every other product / service designer in the world) were using the TD&D approach to integrating information from different sources. This approach is shown in Figure 7, with the traditional approach curve of ECN superimposed.

Figure 7 – Traditional Involvement Approach

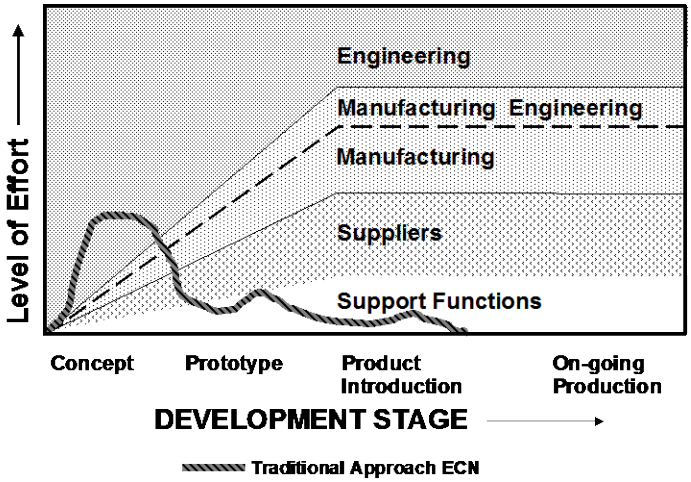


As Figure 7 demonstrates, the TD&D approach has design engineers working in isolation in the early concept stage. There are few ECN at this stage. This is due to the lack of conflicting data and / or viewpoints; like groups of people almost always agree with each other. As the time to build a prototype nears, other interests are brought into the design equation. As these diverse groups begin to notice issues and problems relevant to their requirements, the number of ECN rapidly climbs. The ECN are almost brought under control by product launch. When the customers receive the product, a final surge of ECN is generated each one at incredible cost.

Figure 8 illustrates the IPD approach. Although the initial concept phase is predominantly a design engineering effort, all parties are involved from the beginning. As we will see later, this involves more than just exhorting the designers to “get some input from others” or “read the requirements.” As the effort moves from concept to prototype design, the participation of manufacturing, suppliers and so on increases. Many ECN are generated as concepts and

approaches are discussed. Each of these changes is comparatively low in cost (relative to later changes) and serves as a learning laboratory for the product. By the time the prototype is prepared, most design issues and potential problems have been satisfactorily resolved for all parties. ECN generated after the prototype are few and far between. They represent the last frontier that all IPD efforts try to minimize.

Figure 8 – IPD Involvement Approach

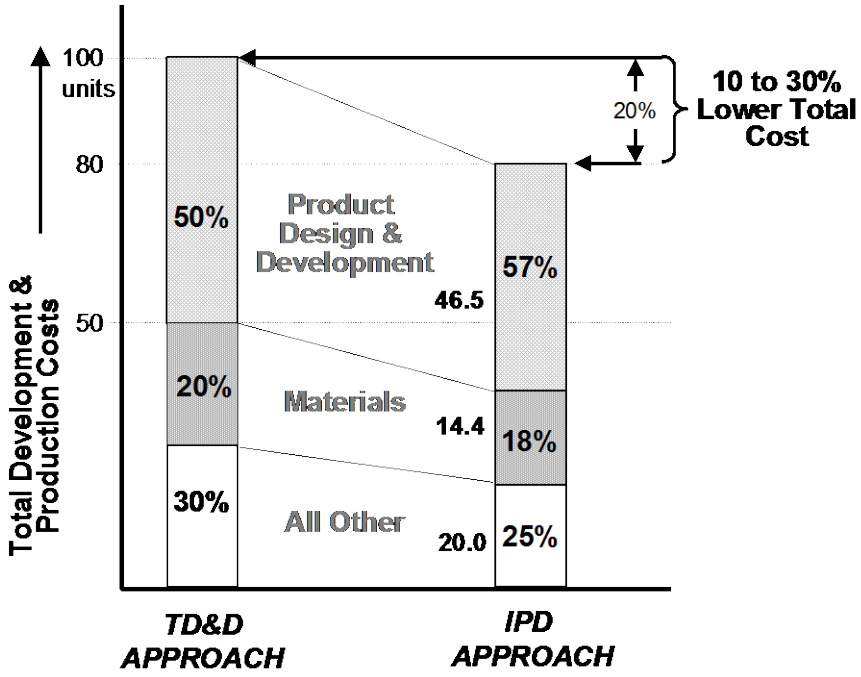


The TD&D Allocation of Effort Must Change

Even in times of crisis, TD&D begins slowly and leisurely. Concept designer's work in isolation and problems only appear when other groups view the suggested design characteristics. This approach, while obviously flawed, has the attractive quality of being very inexpensive in the short-term. The difficulty is that every dollar saved early is spent later in the design and development effort. IPD requires that the effort begin more aggressively and cross-functionally. In the short term, this appears to increase costs. Appearances are deceiving. Every dollar spent up front with IPD will save many more downstream and will contribute to a shorter design cycle and a better product or service.

Figure 9 presents a numerical comparison of the three main sources of costs in taking a product from concept to "ready to market" (production is ready to begin). The figure uses the two stacked bar graphs to compare a typical TD&D cost profile to that of a typical IPD profile. The overwhelming consensus view of industry practitioners is that IPD can lower the total "ready to market" costs of a TD&D effort from 10 to 30 percent. Figure 9 uses a conservative 20 percent reduction for comparison purposes. The base total cost of a representative TD&D approach is set at 100 units on the left axis and is demonstrated by the height of the TD&D stacked bar graph on the left. Of this 100 unit cost, the TD&D approach allocates 50 percent, or 50 units of cost, to design and development. Twenty percent (20 units) of cost is consumed by materials, and 30 percent (30 units) of total cost is attributed to all other costs.

Figure 9 – "Ready to Market" Costs



Using our conservative 20 percent reduction attributable to the impact of using IPD methods on the same project, the total "ready to market" cost falls to 80 units, compared to the 100 units of the TD&D approach. The heart and soul of the IPD approach revolves around allocating proportionately more resources to the design and development effort than in the TD&D approach. Typically, IPD-driven efforts devote 5 to 10 percent more resources to design and development. For comparison purposes, let's select a conservative seven percent additional resources. In our example, the TD&D design and development cost was 50 units. A seven percent increase would result in an IPD design and development allocation of 57 percent of total costs. Yet, the absolute cost of this 57 percent is only 46.5 units, seven percent less in terms of absolute dollars compared to the TD&D strategy. As you can see, the shifted emphasis of allocating an increased proportion of total costs to up-front design and development creates lower absolute design and development costs and lower absolute total costs.

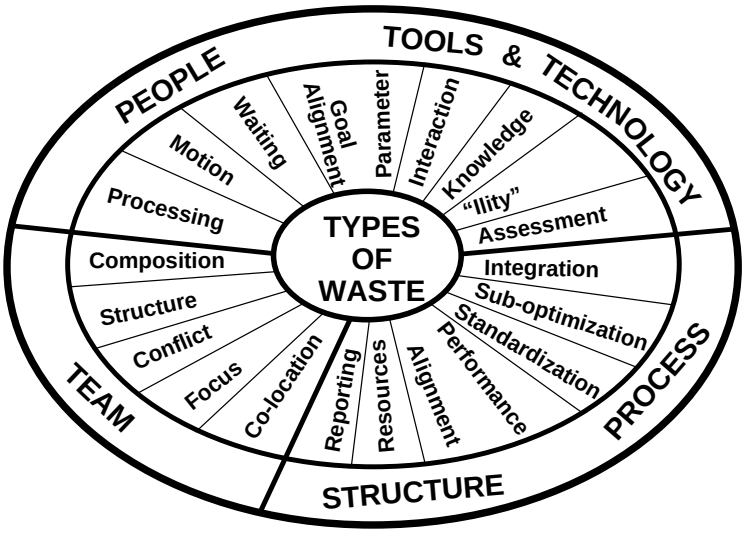
That's not the whole story. The total cost of quality lost (missed opportunities, lower sales, increased service costs, legal costs, quality problems and so on) is dramatically lower with the IPD approach. The typical benchmark numbers for the cost of quality lost in TD&D efforts ranges from a low of 25 percent to a high of 50 percent of total life cycle costs (D&D, production, litigation, customer losses and all related expenses over the life of the product). The IPD approach routinely reduces the cost of quality lost to 10 to 25 percent. The difficulties created by cost of quality issues are typically those that disappoint customers, create downward price pressure and decrease market share.

As this example demonstrates, much more emphasis and effort must be expended in the CEDP to yield greater savings later. This is often at odds with the policies and procedures of traditional organizations.

The Tools and Techniques of IPD

Figure 10 presents the 21 different types of waste that compromise TD&D activities. IPD works its magic by systematically attacking these various sources of waste. This waste diagram was inspired by Taiichi Ohno's presentation of the seven manufacturing wastes that are targeted by the Toyota Production System. It is interesting to note that TD&D approaches do little to address wastes in the general categories of team, people and process. TD&D efforts typically attend only to tools, technology and structure. This focus tends to become even more myopic in design and development projects involving cutting edge technology. There seems to be an underlying belief (or hope) that as products move up the technology ladder, technology itself will come to the rescue of the design effort by increasing design team effectiveness. Nothing could be further from the truth.

Figure 10 – Types of IPD Waste



Ironically, as the technology in a product or service (or the technology used to produce the product or service) becomes more complex, the people element shown in Figure 2 (page 5) becomes monumentally more critical. The application of complex technology requires several contributors, each with a somewhat narrow technical specialty. Communication between and among these specialists is the central design and development challenge in most organizations today. Every aspect of people, process and teams must be optimized to facilitate the accurate and timely exchange of complex, rapidly changing and sometimes difficult to describe information.

Many of the tools used to facilitate this "people focused" IPD approach are shown in Figure 11, the "Master Jargon Chart of IPD." The various categories of IPD waste are shown in the two left-hand columns. Columns three and four (from the left) list many of the principle approaches and tools of IPD. The final column presents the desired outcome of IPD.

The key portion of Figure 11 is the gray area in the focus points and tools column. These highlighted techniques and tools are the absolute minimum defining practices of IPD. Without them, any or all of the remaining tools and approaches, however well applied and however high-tech, will be only marginally successful (compared to potential results). The purpose of an organizational IPD change initiative is to replace the practices of TD&D with at least the tools

and techniques of the gray section of Figure 11; and, to assure that their use will be automatic on each and every future design and development project (a learning organization has been created).

Figure 11 – IPD Approaches and Techniques

CATEGORY OF WASTE	TYPE OF WASTE	WASTE REDUCTION APPROACHES & METHODS	FOCUS POINTS, PRINCIPLE TOOLS AND WORKSHEETS	DESIRED OUTCOME
PEOPLE	Processing Motion Waiting Goal Alignment	Daily Leadership System Workplace Organization Consensus Management Process Ownership Kaizen Metrics and Measurement	20 Keys of Project Management Lean Daily Management System • 20 Keys of IPD • Design Team Primary Visual Displays • Kaizen and Error Proofing Action Sheets • Work Group Daily Stand-up Meetings • Micro-process Metrics for Work Teams Cause/Effects Diagrams Affinity Diagramming Co-location RACI Analysis and Planning "Brown Paper" Analysis ("As Is" & "To Be") Rapid Resolutions (Problem Issues) Approach Meeting Effectiveness Interventions Teamwork Skills Improvement Process Benchmarking Group Brainstorming Process Structure Analysis Technical Skills Training DFA & Design for "Ilities" Tools Monte Carlo Analyses Boundary Analysis Design Criteria Development & Evaluation Design Efficiency Analysis Theoretical Minimum Part Count Assessment Workplace Layout Analysis Kaizen Target Sheet Skill Versatility Matrix	Tightly Focused, Empowered, Well-organized, Well-led, Design Team(s) that Produce, in the Shortest Time, on Schedule, Within Budget and at the Lowest Possible Cost, the Highest Quality Designs and Products Possible that Delight the Customer and Create a Barrier to Market Entry for Competitors
PROCESS	Integration Sub-optimization Standardization Performance	Process Alignment with Plans Process Analysis Process Reengineering Process- Strategy Rationale/Alignment		
TEAM	Composition Structure Conflict Focus Co-location	Cross-functional Alignment Co-location Team Effectiveness Training Structured Cell/Area Teams Team "Chunking" to Product Element Configuration		
TECHNOLOGY & TOOLS	Parameter Interaction Knowledge "Ility" Assessment	Parameter Design Computer Modeling Experiments Simulations Signal to Noise Analyses Design Assessment		
STRUCTURE	Reporting Resources Alignment	Organizational Analysis & Reconfiguration Reassignment of Personnel Reporting Changes		

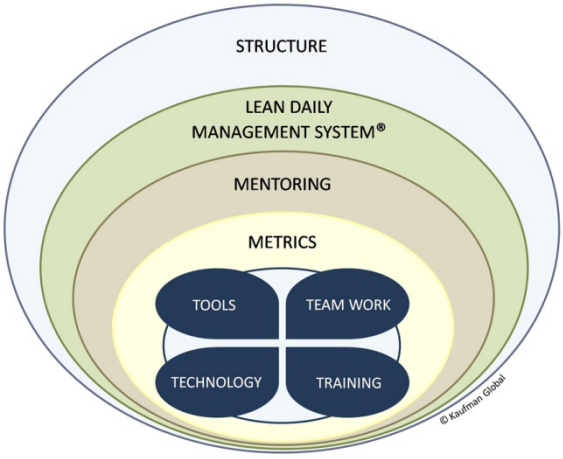
Implementing IPD

Almost every organization with an engineering department has at least a policy statement that reinforces IPD as a desired approach. As we discussed earlier (and represented in Figures 3 and 4), many have detailed IPD process and procedure manuals. Yet, almost all of these organizations can identify most of the TD&D characteristics we discussed earlier in their design and development efforts. It will take more than policy handbooks and exhortations to implement IPD. Kaufman has developed the SLIM-IT® methodology to implement and support IPD as a cultural change. Displayed graphically in Figure 12, SLIM-IT (SLMMTTTT) is an acronym for **S**tructure, **Lean** (Daily Management System), **M**entoring, **M**etrics, **T**ools, **T**eamwork, **T**raining and **T**echnology. SLIM-IT can implement and sustain behavior changes long enough to create a lasting cultural change in any environment.

The portions of SLIM-IT that differentiate it from standard IPD rhetoric and TD&D failures are the shaded areas of Figure 12. Almost all design and development approaches pay at least passing attention to metrics, tools, teamwork, training and technology (the innermost white areas). The problem is that these critical elements are rarely attacked with the precision that design and development success demands, because the other elements of Structure, Lean Daily Management System and Mentoring are not formally addressed. For example, metrics are often set by management but are too broad to be successfully applied by any one particular design team. Teamwork is mentioned but is rarely created and sustained. Technology is worshipped

but the design personnel rarely have a consistent set of design and development technologies and tools that is well understood among all personnel. As an outrageous but all too common example, we have found instances where numerous design teams on a large design and development effort each had different schedules for deliverables and events and their scheduling software was not even compatible!

Figure 12 – The SLIM-IT® (SLMMTTTT) Approach



On occasion, despite the odds, circumstance will bring together the right amount and types of people, teamwork, tools, technology, training and metrics, and a design and development effort will be significantly more successful than the norm. Almost every engineer can fondly recall one or two such projects in his / her career. They remember a strong sense of ownership and commitment from team members. The problem is that such efforts are almost always followed on the very next project by the more typical TD&D effort: disorganization, apathy, confusion, lack of ownership, overruns and problem after problem. Circumstance will occasionally bless the lucky, but luck will never create a cultural change that will sustain IPD success time after time. SLIM-IT will.

The first element of SLIM-IT is *structure*. The basic structure of a SLIM-IT driven IPD effort is displayed in Figure 13. This structure is absolutely essential in order to establish management commitment to IPD and create design team ownership and commitment. The various elements and characteristics of this structure are:

Executive Steering Committee (ESC)

- Meets once a week for 1-2 hours to review progress
- Selects integration team members (design team leaders)
- Selects work stream team areas of focus (if any)
- Sets initial performance expectations and broad goals
- Fully empowers IPD integration teams
- Each ESC member “champions / mentors” one of the full-time team members

Integration Team

- Co-located (work in large open office); split time there and with their design teams
- Members are "worker bees," not administrators
- Mostly full-time members; organizationally cross-functional
- Select their own design team members
- Most "lead" a design team that reports directly to him / her

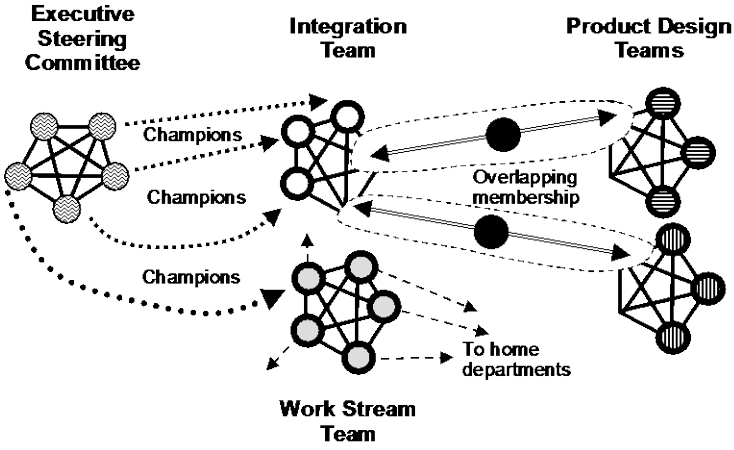
Work Stream Teams

- Cross-functional
- Rarely co-located
- Deal with policy and procedure issues that new IPD practices impact
- Report to home department
- Accountable to Executive Steering Committee for the work stream
- Part-time assignment to team

Product Design Teams

- Co-located (work in large open office)
- Mostly full-time members
- Members assigned to and report to design team leader (integration team member)
- Major supplier representatives on team(s), full-time, co-located
- Major partner (if any) representatives on team(s), full-time, co-located

Figure 13 – The SLIM-IT IPD Structure



The second major element of SLIM-IT® (from Figure 12) is the *Lean Daily Management System (LDMS®)*. We have found that the LDMS is integral to all activities in which teams of people work together for a common goal. The LDMS has been successfully applied in factory, administrative,

service, IT and engineering environments. It is particularly critical in design and development environments where individuals might be working closely with people that they have not worked with previously. The LDMS® works to quickly establish teamwork, commitment and focus.

The elements of the LDMS, applied to each and every team, are:

- Daily stand-up meetings at the start of the day to review events and plans
- A primary visual display (PVD) that presents key metrics, events, issues and schedules (and in front of which the daily meeting is held)
- A kaizen action sheet team improvement system
- A team *20 Keys® of IPD* assessment and improvement plan (The ESC would use the *20 Keys® of Project Management*)
- A detailed set of micro-process performance and status metrics that is specific to each team, designed by them and approved by the integration team

The next element of SLIM-IT (Figure 12) is *mentoring*. This is not the usual, "once-a-month let's have lunch" mentoring that was popular some years back. SLIM-IT mentoring is "in your face, up close and personal" coaching on a day-to-day basis. This is the key action requirement for getting IPD up and running. All of the other tools and techniques, from the LDMS to the ESC will not work in most traditional environments unless player-coaches are on the ground to ensure that everyone does what they are supposed to do every day. This coaching must continue long enough at all levels (ESC to the design team) to establish new patterns of behavior and expectations on everyone's part. This is what cultural change is all about.

Player-coaches are highly experienced change agents, process experts and personal coaches that work closely with teams and individuals on an hour to hour basis, if need be, to install IPD practices in real time, on the job. As a key part of each IPD project, Individuals from the organization must be trained extensively as IPD player-coaches, so that future IPD efforts can be led by internal resources. Further, a policy must be established to require all future engineering supervisors and managers to be experienced as trained-in-real-time IPD player-coaches. If managers cannot "do" IPD, how could it become a cultural practice?

Inside the mentoring band of the SLIM-IT model (Figure 12) is the *metrics* element. Player-coaches work with each team to develop a set of project metrics that serve both management objectives and the team's requirements for clear focus and ownership. These project metrics are used to drive each team's development of the micro-process metrics in its LDMS. The project metrics are then reviewed daily on each team's visual display at its morning meeting.

The aggressive IPD emphasis on metrics cannot be overemphasized. If a team does not know what to measure, it cannot know what is important. That is why many types of metrics, jointly developed up-front, are so critical. In addition to the project metrics and the team micro-process metrics, an extremely helpful set of metrics (and an accompanying action plan) is provided by the various sets of 20 Keys® that the teams will use. The 20 Keys® assessment and improvement plans provide teams with tremendous insight into critical success factors on which their performance has been sub-IPD level but of which they were not aware.

The innermost elements of the SLIM-IT® model (Figure 12) are *tools*, *teamwork, training* and *technology*. Teamwork gets a nod, but little else, in TD&D efforts. One of the problems with TD&D is that it attempts to correct for the consequences of poor structure, few metrics, no LDMS and no mentoring with a perfunctory dose of team building exercises for design teams. This is much like trying to stem a bubonic plague epidemic by teaching people to floss their teeth. Almost any group can benefit from better teamwork, but such improvement efforts should not be addressed until the larger overall IPD success factors are resolved. SLIM-IT does just that, by clearing away the dead wood of poor structure and focus. Through the application of the outermost rings of SLIM-IT, teams are free to focus on getting their work done in an effective manner, rather than struggling with the bureaucracy. If teams require team building and meeting help, player-coaches work with them in real time to deliver what they need, right when they need it and are using it.

The final elements of the SLIM-IT model (Figure 12) are *tools, teamwork, technology and training*. These get the most attention from TD&D approaches. One would think utilization of tools, technology and training would be in outstanding condition in most design and development efforts. They are not. Often, there are conflicting and poorly coordinated applications of everything from design criteria evaluation methods to configuration management systems. It is not uncommon to find that different teams use different combinations of personal spreadsheets and server software for critical analyses. The opportunity for confusion and disaster is immense; (the recent loss of a Mars probe due to a metric-English conversion conflict is a dramatic but typical example of such conflicts). **A key element of the IPD planning and structuring activities of SLIM-IT is to develop a single, mutually agreed upon set of tools, technologies and training for the entire project.**

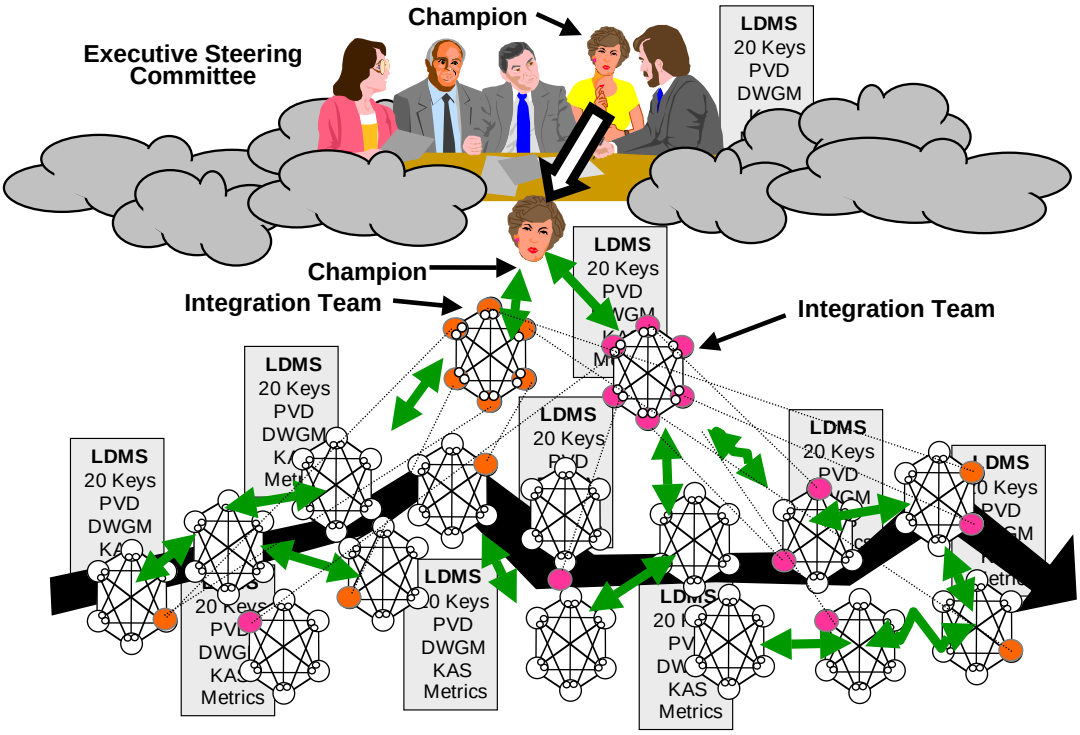
What Does "Good" IPD Look Like?

Figure 14 displays a representation of how the people and process of “good” IPD operate. The process is in a state called “structured, persistent disequilibrium.” “Structured” means there are defined processes and metrics that everyone understands and utilizes. “Disequilibrium” means that these processes are continually adjusted, modified and improved (in a structured way), in real time, by the various team members. “Persistent” means that the entire system is always being pushed past the edge of equilibrium towards but not into chaos.

A system in equilibrium does not change on its own and cannot be easily modified. Once an IPD approach gets to a point of equilibrium, it becomes calcified; it can no longer adjust quickly to unforeseen circumstances. A system that is always pushed just past the edge of equilibrium will be forced to continually improve itself. This is where the structure and the metrics demonstrate their highest value. They keep the system improving but in a controlled, focused manner. Change is never-ending and usually for the better.

As you can see from Figure 14, there are still “clouds” between management and the design teams. In “good” IPD efforts, this is okay. The ESC knows what it has to know to make the big decisions, and most of the day-to-day details are handled in real-time by the integration teams and the design and work stream teams. Each champion from the ESC keeps in close touch with his / her assigned team and passes required information back to the ESC. There is no misguided tampering.

Figure 14 – Best Case: Structured, Persistent Disequilibrium



There is no formal IPD process and procedures manual, because it would be pointless to continually modify ever-changing processes. The IPD process as it exists at any one moment is understood by the design teams. It is not an ideal, pre-designed process. From project launch, all teams are making changes that continually force other teams to adjust. This is the dynamic tension that drives improvement in all Lean systems. These continual changes push the teams and the entire process out of a comfortable state of equilibrium. The structure to keep the system on track towards objectives is provided at all levels by the LDMS®. Each team has a set of project and team metrics that it strives to improve daily. Additionally equipped with 20 Keys® plans, work group meetings and a kaizen action sheet improvement system, each team is focused in laser fashion on improvements that serve the entire process.

Summary and Conclusion

Traditional design and development (TD&D) efforts are plagued by a litany of all-too-familiar problems from lack of ownership to missed schedules to overlooked (except by the customer) design flaws. The majority of these problems are directly attributable to the failure of TD&D approaches to incorporate well-documented, industry best practices that have evolved in the last fifty years. Integrated Product Development (IPD) methods provide a template for creating better designs in less time and at a lower cost. However, even though there are easy-to-understand best practices available, there is no easy-to-apply step-by-step template for implementing IPD. All too often, organizations with good intentions create IPD policy and procedure manuals and then watch their IPD effort crash and burn into the hillside of business-

as-usual. IPD must be led and structured around a system that is long on coaching and day-to-day leadership of design and integration teams and short on policy and procedures. This requirement does not play to the strong hand of a traditionally led organization.

One answer to this challenge is the SLIM-IT® approach. SLIM-IT focuses on establishing structure and leadership in the day-to-day trenches of IPD where the designs and costs are created. With SLIM-IT, engineering managers are turned into actual system coaches, and team leaders actually lead. This type of activity, when supported by the proper management structure and practiced long enough to become second nature, creates the cultural change that makes IPD a way of life. In the tough new markets of the new millennium, IPD is the only force of design and development life that will endure.

About Kaufman Global

Kaufman Global is a proven implementation partner that focuses on accelerating performance. For 20 years we have worked with clients around the world to drive enterprise-wide change initiatives and cultural transformations. Leveraging Lean, Six Sigma and proprietary change management techniques, Kaufman Global delivers structured implementation and transformation projects that enable sustainable operational and financial results.