

**Reducing Cycle Time and Development Time**  
**at**  
**Ford Electronics**  
**Part II: Improving Product Development**

Nelson P. Repenning

Department of Operations Management / System Dynamics Group  
Sloan School of Management, E53-335  
Massachusetts Institute of Technology  
Cambridge, MA USA 02139  
Phone: 617-258-6889 Fax: 617-258-7579  
E-Mail: nelson@mit.edu

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## I. Introduction

### **Excess Capacity**

Between 1988 and 1991, the Electronics Divisions (ELD) of Ford Motor company was able to reduce in its manufacturing cycle time and eliminate a substantial amount of work in process inventory. Under the leadership of its general manufacturing manager (GM), ELD was able to cut cycle time by more than 50% in many facilities in less than three years. At the end of this period, the GM was promoted and became ELD's general manager responsible for both manufacturing and product development. At this time, many ELD manufacturing facilities had excess production capacity. The GM describes the situation,

When I started I was only the manufacturing manager so I did everything I could to fix the manufacturing side. When I became the general manager [in 1991] I realized that, in part because of what we had done in manufacturing, our plants were half empty. If we couldn't [generate new business] we were going to have empty plants, which meant unaffordable plants.

To reduce manufacturing cycle time, the GM had set very aggressive objectives for improvement in ELD's plants and they had responded. He felt strongly that closing or consolidating some of these facilities was no way to reward this extraordinary effort. In his new position, as general manager, he hoped to generate new business for the division so that all the manufacturing facilities would be fully utilized.

However, at that time ELD was already satisfying the demands of its internal customers. External customers (mainly other automobile and automobile components manufacturers) would be the key to increasing demand for ELD products. Outside customers, however, had different requirements. Getting this business would require developing new and different products, and those products had to support the customer's development process whether that customer was Ford or an outsider. As a result, The GM looked to the product development process as the key to increasing demand for ELD products. If ELD could improve its development process to the point where it could design and sell products to both internal and external customers, generating enough demand to fill the manufacturing facilities would be easier. However, the division faced a critical barrier to implementing this strategy: they could not hire extra people to design these new products. The budgeting and resource allocation process within Ford was such that increasing the number of development engineers above and beyond the current growth rate was not possible. Thus, to produce more products, the efficiency of the existing development resources needed to be increased. As The GM recalls,

...we wanted to do more business on the outside because there wasn't enough business on the inside, and we wanted to do this with the same amount of people.

### **Problems in Product Development**

The GM was not the first or the only person in the division to realize that product development was the critical area for improvement. ELD had already made numerous attempts to improve its development process, and many within the division believed that further improvements were still required. The manager who the GM would charge with driving an improvement initiative remembers the issues this way,

I think that by most reasonable metrics that we could attribute to the Product Development Process...we needed some fairly dramatic improvements, and those improvements had to come on many different dimensions....it was generally felt that if we were going to make ELD a world class company that we had to take on the development process as one of the core processes to improve.

The success of the manufacturing area in reducing cycle time and improving quality increased the need for an improved development process. As manufacturing improved, the problems generated by product design and development became more obvious. One unit head recalled:

After manufacturing reaches a certain level of performance the only way to make future improvements is to change the way you design the products. Both the manufacturing guys and the PD guys need the same objectives, and they couldn't all be product objectives.

In addition, even though the manufacturing facilities had excess capacity, the existing development process did not necessarily satisfy the internal customer, the Ford vehicle development programs. A manager recalled,

We needed to get better at delivering functioning prototypes. The customer had a requirement to have certain level of prototypes fed into the vehicle development process in certain time frames, and we were historically late on the prototypes.

And, even if the product was delivered on time, it didn't always satisfy the customer's requirements. Among other problems, the lack of discipline and standardization in the development process meant that the interface between various components was not always well defined. The same manager continues,

...we needed to do a better job of systems engineering....For example, the interrelationships between hardware and software design needed to be more explicitly stated. At the time it was a little bit of a catch as catch can. The software guys would go out and write some code and the hardware guys would go out and tweak some hardware and, you know, who did what in hardware and who did what in software wasn't very well defined, identified and integrated in the overall thing.

Finally, ELD had performed bench-marking studies, and, based on those studies, believed that world class electronics companies were developing products in less than 18 months—approximately half the time it took in ELD. The division would have a difficult time reducing its total product development time because many of its products were still tied to the Ford vehicle development cycle. However, a faster process would be more efficient. Each development team could accomplish more tasks in a given period of time thus freeing up resources that could be focused on creating new business. Reducing cycle time had helped improve manufacturing on many dimensions, and it seemed to many that this mindset could help in product development. As a unit head recalled, “...we could make the product in a day and in took four years to design it, something just seemed wrong...the area was just ripe for a process redesign.”

### **Kicking off the Initiative**

With these factors in mind, the GM and his staff kicked off a new initiative aimed at making fundamental improvements in ELD’s product development process. Just as he had done in manufacturing, he began the effort by analyzing the existing process. He recalls,

I brought in a consultant and asked “What is my development process?”. He came back and said “You don’t have one. Everybody is doing something different.”

Through his experience in manufacturing, The GM had come to believe strongly in the power of ‘stretch objectives’— setting goals for improvement well beyond the perceived capability of the organization. In manufacturing he had given the plants the goal of reducing cycle time to one day when the division average was still over five days, and within four years the division achieved that goal. In a similar manner he set a stretch objective for the engineering organization and then gave them the freedom to accomplish that objective in any way they could. He summarizes his instructions :

All I said was, “ I want a development process that is fast, that will give me a 50% increase in throughput in two years, and I want everyone to follow the same process.”

### III. Background- The Development Process Before PDP II

#### **Relaxing the Discipline**

##### *The Engineering Manuals*

Prior to the mid 1970s, the product development process within ELD was dictated by a set of hard cover books known as the ‘Engineering Manuals’. These manuals dictated a rigid development process that placed substantial emphasis on following well-defined steps and

documenting each of those steps as they were completed. Following these manuals resulted in a disciplined product development process that was closely followed in the division. Unfortunately, the process imposed a substantial administrative burden on the development engineer. To combat the excess documentation and bureaucracy, ELD spent much of the late 1970s and early 1980s implementing change initiatives aimed at streamlining the process outlined within the manuals and increasing the efficiency of the development process. These efforts were successful. The engineering process did become more efficient, but it also became less consistent. A chief engineer recalls,

...in retrospect, what these efforts really boiled down to was the elimination of a lot of the disciplines contained within the engineering manuals. It did become a much less cumbersome process, but it also became a much less consistent, disciplined process.

Without the discipline provided by these manuals, engineers in each area developed their own processes for development. The same chief engineer continues,

We went through a period where we had so little discipline that we really had the 'process du jour'. Get the job done and how you did it was up to you....It allowed many of the engineering activities to go off on their own and as long as they hit the key milestones, how they got there wasn't that important.

As the development process in each area evolved in a different direction, the training given to new engineers also changed. Without the aid of the manuals, new engineers received training largely through apprenticeship. Mentors played an important role in this system as each area developed its own idiosyncratic way of accomplishing its tasks.

### *Problems with Growth*

The mentoring apprentice system worked adequately through the mid-1980s. The lack of standardization in the process became more of a problem as ELD began to grow. The electronic content of automobiles has grown steadily since the late 1970s. The rate of growth increased in the 1980s as the confluence of a strong economy and the growing use of integrated circuits increased the demand for ELD's products. Supporting this growth required ELD to hire a large number of new engineers. As the number of new engineers grew it became more difficult to train them using the mentor/apprentice system. It was no longer possible for people to learn by looking over the shoulder of somebody more experienced because there were not enough experienced shoulders. A chief engineer within ELD recalls,

...when I joined the division [in 1977]...there were maybe four hundred people in the division engineering organization....we went through a lot of growth and a lot of the old processes and disciplines which were part of the old Ford organization started to disappear.

By the 1990, the ELD's engineering staff had grown to over three thousand people.

## **Previous Efforts to Improve ELD's Development Process**

### *Product Development Process (PDP)*

PDP II (as one might expect given its name) was not the first attempt at adding discipline back into the development process within ELD. In 1988 ELD kicked off an initiative called the Product Development Process (PDP, later to be called PDP I). Working with consultants, members of the ELD engineering staff created a standard development process for the division that consisted of a well defined sequence of steps and checkpoints through which every project should go. Through PDP the division hoped to accomplish a number of objectives. First, they hoped to develop a more robust system to insure that products would meet increasing quality standards. Second, they hoped to propagate the best engineering and design practices being used in different parts of division to all of its product development teams. At the time, ELD had no formal method for sharing lessons learned between development teams. As a manager involved with PDP I recalls,

...almost every tool and process is used somewhere at Ford. Does everybody use everything? No, we never had a robust method for propagating best practice... what we needed was a better way to communicate all the lessons that people were learning.

The initiative was a only partially successful. As one of its contributors recalls,

...We had good knowledge through-out the division of PDP I. Each strategic business unit (SBU) had documented their development process at some level, and we developed good team participation. It also got people to think about process.

However, developing a uniform process and getting people to use that process were two different issues. The same manager continues,

...Implementation was a limited success, There were really two pieces; ...making people aware of the steps, And then getting them to actually use it. The second piece was more difficult.

PDP I also took more than three years to complete. By the time the documentation effort was complete in 1991 the GM was ready for PDP II.

### *New Development Process (NDP)*

PDP I focused on documenting the existing development process. As PDP I was taking shape, ELD undertook a second initiative aimed at creating a new development process that could take advantage of many of the new computer technologies available to engineers. ELD had made numerous efforts to get its engineering staff to take advantage of new computer technology. However as one manager recalls, they had not been very successful,

The question was always “why don’t people use the available tools?” We had tried everything– computer rooms, terminals on desks, each engineer with his or her own PC– and at the end of seven years we had seen very little progress except for in the drafting room.

In response to this problem an *ad hoc* group of engineers began visiting other companies to determine which computer tools were being used and how those tools were being integrated within the development process. They soon realized that the actual choice of tools did not matter nearly as much as how those tools were integrated within the development process. As one engineer involved in the project recalls,

The ‘how’ was, for us, the magic bullet. We never found two companies that were using even a vaguely similar toolset, so the actual set didn’t seem to matter, it was how you used the tool set.

An early member of this group describes the next steps,

...we decided that what we really needed to do was put together a group to develop an engineering process that looked more like what we had seen at the companies we had visited and to encourage the use of the new tools.

Just as this group was beginning its effort the manufacturing facilities were beginning to experience excess capacity. Many senior managers within ELD had already begun looking to the design area as the key to increasing volume in the plants. The *ad hoc* group took this opportunity and made a presentation to the division’s management and argued that the use of the new tools would be the key to increasing the productivity of the engineering organization. Based on the presentation, the division agreed to support the group’s effort which was called the New Design Process (NDP). As a team member describes, the group planned to “...take a clean sheet of paper and re-define how an engineer would do his or her job.”

At the time, PDP I and NDP were viewed as complementary efforts. The same manager describes the two,

The goal of PDP was to map the current process into the corporate product development process and eliminate any of the existing steps that did not help satisfy the customer’s requirements. In NDP we were trying to come up with the minimum set of steps that would allow us to produce quality output...In theory the two efforts should have converge.

However, the two efforts didn’t have time to converge. By 1991 The GM was ready for a new design process that could generate the magnitude of improvements needed to fill his manufacturing facilities.

#### IV. Creating a New Product Development Process

##### **Designing PDP II**

###### *Forming a Steering Committee*

To start the initiative, a PDP II steering committee was formed. The manager leading the committee describes his role,

....with anything as big as this, it has a funny habit of either becoming so big that it's like oil in the ocean and you can't make any real forward progress or springing off hundreds of little initiatives that don't necessarily interrelate .... So I had to keep my thumb on the overall project and make sure that everything was focused and headed in the direction we wanted.

The PDP II steering committee needed to represent the rest of the organization. The team was comprised of people from each major organization within the division. The division assigned many people to work on the process full time. The team was also given substantial support in terms of both financial resources and access to needed information within the division. The steering committee started the effort with three steps; hiring a consultant to assist them, bench-marking themselves against world class electronics manufacturers, and analyzing their existing development process.

###### *Finding a Consultant*

The outside consultant would be used to provide basic methodology and to provide an outside 'check' on the policies and processes the team was proposing. The consultants could also accomplish certain tasks that were difficult for internal people. As one team member recalls, "...they were a big help in the sense that they provided an outside change agent. They were independent, they could push and shove and they weren't constrained by our resources." However, some felt that the consultant underestimated the complexity of ELD's operations. The same team member continues,

...they had revolutionized the world at other places...And I think that they thought they were going to come and in six months they would give us the magic gospel for the electronics division. I guess they walked in with the idea that we could document the 'as is' come up with the 'to be' and bang you're done. They had no concept of what the division did, the complexities of operating within the Ford Motor Company environment, or any understanding of the culture that was here.

###### *Bench-marking*

The NDP effort had already invested time in analyzing the development processes of other electronics manufacturers. Early in PDP II design process, this effort was continued. Members of the team looked at more than just how the tools were being used. One member recalls,

We spent a substantial amount of time looking at what other people did. How they structured their processes and the problems they had. We looked at that and the current state of our process and tried to net out a process that had all the things we wanted and that allowed us to do things much more quickly.

In the course of this effort the design team also developed close relationships with other electronics companies. The design team would later use these connections as another external check on the validity of the process that the team was developing.

#### *Documenting the Current Process*

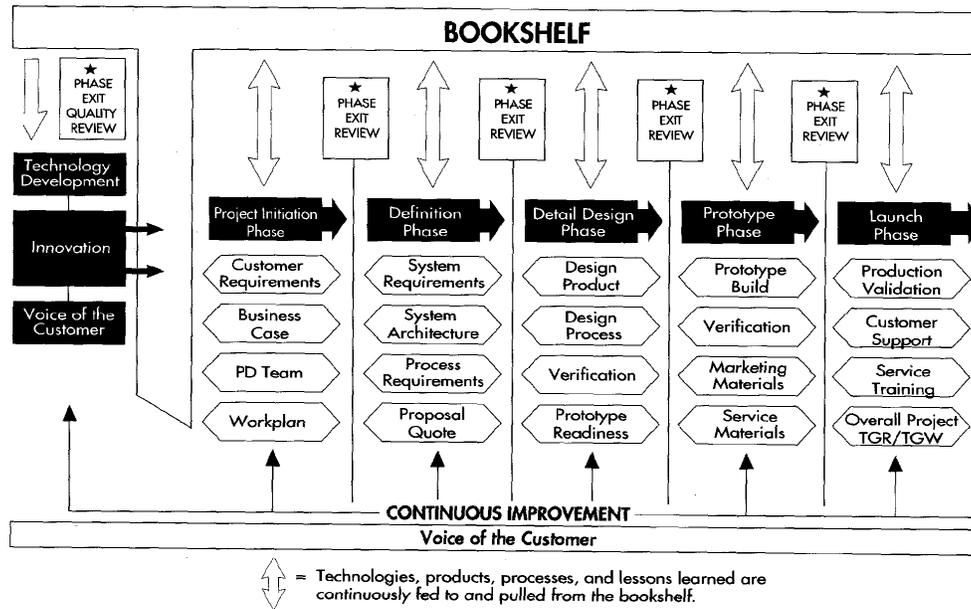
Finally, building on the work done in the PDP I initiative, the group spent time documenting the current process and determining how many of the problems that occurred repeatedly had come to be part of the process. A team member explains,

Part of the initial process was trying to figure out why we did things the way we were doing them now....”why can we not deliver products on time?” “why do they not have high quality?”...”what were some of the root issues?”...A lot of them were pretty obvious after a very small amount of analysis.

#### V. The PDP II Process

With the help of the consultant, the team consolidated learning from the bench-marking efforts, lessons from the internal analysis, and the input of numerous people throughout the company, into a new design process for ELD. An overview of the process is shown in the figure below. In PDP II, development is divided into six main phases; Innovation, Project Initiation, Definition, Detailed Design, Proto-typing, and Launch. The process is quite detailed, and within each phase there are a large number of steps. However, a number of key elements separated this process from those that ELD had used in the past.

## PDP Process Model



### The Specifics

#### *The Bookshelf and the Wall of Innovation*

The first change required by the PDP II process was embodied in the concepts of the ‘bookshelf’ and the ‘wall of innovation’. Past ELD projects had frequently fallen behind schedule due to difficulties with new and unproven technology. The problem was compounded by the lack of communication between projects—a particular project might struggle with a technology that had already been used somewhere else. The PDP II process was designed to solve this problem by communicating key learnings via the *bookshelf*, and by setting an early deadline for demonstrating the feasibility of new technology—the *wall of innovation*. The bookshelf was an engineering library: every time a new technology was used within ELD it was the user’s responsibility to ‘bookshelf’ that technology by fully documenting its uses, capabilities, and limitations and placing it in the library. The wall of innovation was the point in the development process at which all technologies to be used in the design must have already been placed on the bookshelf. As a manager explains, in PDP II “...innovation takes place early in the process long before the actual design. There is a wall of innovation that is not supposed to be crossed.”

### *Documenting Customer Requirements*

During the design of the PDP II process, the lack of product definition at the outset of a development project surfaced as a key problem in the development process. A PDP team member recalls,

...we had a very poor process for identifying what the customer wanted...and then sticking to that concept. The whole up front definition phase was really flaky...starting with that, you were headed for disaster from the very beginning.

The PDP II process provided for rigorous documentation of the customer requirements. To propose a new product under PDP II, a detailed business case had to be produced that documented all the key assumptions going into the product including the features and functions of the product, the anticipated sales volumes, required quality levels, and the project's variable cost. The case also included analysis of potential competitors, estimates of the development costs, and an assessment of risks and opportunities. Once the project was approved, the PDP II process also required a complete and rigorous definition of the product to be designed. Starting from product level requirements and working down to the part level, the goal of the definition phase was to articulate the product and required manufacturing process in sufficient detail so as to insure that customer requirements would be satisfied and the product would be manufacturable.

Further the PDP II process was designed to accommodate any customer's requirements, not just those to the Ford vehicle programs. As the PDP team's leader said,

PDP II was designed to be flexible and to fit into any customer's requirements. Ford North America has its own set of requirements. Europe has its [process], Mazda has its system, and Volkswagen has a different one. PDP is modular and flexible enough to fit any particular customer's requirements.

### *Quality of Event and Phase Exit Quality Reviews*

Drawing on ideas from the PDP I process, PDP II also contained a strong focus on what those in ELD term 'the quality of the event'. It was not sufficient to simply place a check in a box every time a particular step was accomplished. Instead, the execution of a step needed to be critically evaluated before proceeding. To enforce this discipline PDP II requires a sequence of phase exit quality reviews. Engineers working on a project are required, at the end of each phase, to assemble all the documentation for that phase of the project and present it to a management team. The management team has to agree that the phase of the project is complete, and the quality of event is sufficiently high, before the project is allowed to move to the next phase. Another member of the PDP II design team describes the process this way,

...phase exit quality reviews are the significant gateways of the process....[those] reviews and the attentive work that has to be done to achieve them with high quality are the keys to having the processes support our objectives....at each one of the critical points in the process there is a management review and a detailed description of what should be contained in that review.

#### *Disciplined Approach to Project or Program Management*

An additional major component of the PDP II process, not shown in the process diagram, is the use of program or project management. Traditional vehicle programs had a timer— a person who was responsible for keeping track of the project relative to its milestones. With project management the division hoped to move away from the traditional timing approach to a more sophisticated method that would make it possible determine when a program was in trouble before it missed a key milestone. As PDP team leader recalled,

It was a little bit of a Wild West culture...Everybody was keeping project records differently, program management techniques were being used differently. In general, it was a poorly documented and poorly disciplined process. So we were trying to instill more discipline by requiring everyone to use the same project management system.

To gain efficiency and discipline, the PDP II process relied on each project being run using standard project management techniques such as developing workplans, creating Gantt charts, and use of project management software. To make the transition to this new approach the division created a new position called a process leader. Process leaders were assigned to a number of projects and they were responsible for keeping track of the work plans and assisting the design teams with project management. As one manager said ‘...we put them in place to jump start project management.’

#### *Use of the Tools*

The final major component of PDP II was the use of computer-aided design, engineering and manufacturing tools. The committee hoped to develop a process in which analytical computer models would replace the large number of physical prototypes that ELD normally created within a given design cycle. PDP II was predicated on the use of CAD/CAE/CAM tools to do a large portion of the design and testing work. Achieving ‘first-past success’ became an important battle cry of the PDP II effort. As a manager remembers, “..the old way of building it, taking it to the lab, and seeing if it worked was causing a lot of build and bust cycles.” The manager who led this portion of the initiative, said,

We wanted to re-engineer the engineer’s job by giving them both the tools and the process that would allow them to create quality products without multiple prototype cycles.

## **Metrics**

### *What Should We Measure?*

To start the initiative, the GM set an objective of a fifty percent increase in through-put in two years. Along with that goal, the PDP II team needed to design a new set of metrics that would allow the team to assess both the state of the development process and the effectiveness of PDP II in changing that process. Developing that metric package was difficult. The PDP II leader discusses the dilemma the team faced at the outset,

What metrics should we be measuring?...metrics have an innate method of driving cultural change...we wanted to be very careful with which metrics that we picked. We didn't have a desire to pick a whole spreadsheet full of metrics and impose a bureaucracy upon the organization, but at the same time there was a fair amount of disagreement...as to which metrics would be the most meaningful.

An executive engineer who co-directed an intensive effort to develop a set of metrics that could be used to guide the PDP II process recalls,

We [the committee] developed an entire set of metrics for PDP II....what we came up with had everything from what...[the general manager] needed to look at down to what the engineers should be watching....I think we developed something that could be used to run the business on a day to day basis

Many of the new metrics were new in ELD and were not accepted by some of those involved. Many metrics related to a project's adherence to the PDP II process. Another team member recalls,

...we started coming out with a series of metrics that were not recognizable to many people in the company, such as, the number of products using simulation and people would say, "Well that's a nice academic metric, but who cares? I mean you're making a tacit assumption that simulation equals goodness."

### *What Can We Measure?*

The difficulty with metrics was exacerbated by the existing data collection and reporting systems within Ford. Many of the metrics being suggested had never been used in ELD before and as a result there was no data by which to compare performance. The PDP II leader comments,

Problem number one was that we didn't have a baseline from which to measure...the data had no integrity, things weren't always charged to the right project...the departments would use whatever charge number they had open and money in it.

Another major problem was creating a system to report those metrics on a timely basis. Just as no baseline data existed for comparison, in many cases the existing information system simply did not produce the required data. The engineer leading the metrics effort recalls,

The infrastructure to provide the information we needed simply did not exist. For example even today an engineer has great difficulty finding pricing and cost information... Every program should be concerned about cost, but we make it so difficult for people to get that type of information that they either fudge it or forget it.

## VI. Piloting PDP II

### **Testing the Handbook**

To disseminate the process the design team created a series of handbooks. When a draft of the first handbook was completed, the team wanted to test it to see if what they had put together would actually work. As a member of the team recalls,

What we [the PDP II Handbook authors] wanted to do when we put together the handbook was a pilot of sorts....We're talking about extremely long cycle times...so there's no way we're going to have a two year pilot. But we wanted to get a pilot team going on the handbook so that we could determine whether or not it made sense to the people...If it didn't, we'd have a chance to take a crack at massaging a little bit.

The team chose four programs to be 'alpha' pilots. These projects were supporting vehicles that would be launched in the '95 or '96 model year. After collecting initial results from the alpha pilots, the team planned to roll out the process to one project in each product area on '97 model year programs. These tests would be called the 'beta' pilots. However, as a team member recalls,

Executive engineers started coming to the PDP II office asking for books for their people. Executive engineers are the third rank in the division -- general manager, director, executive engineer -- and when they say "I need 500 books," it's not easy to say no.

Thus, before the team had any time to collect data from the pilots, the PDP II process began rapidly diffusing throughout the division. As another manager recalls,

There were four PDP II alpha pilots, one in each of the business areas. We had planned to then move to beta pilots with one in each product area... Pilots were 1995 and 1996 model years...however, before there was any time to evaluate the pilots and the program was quickly moved to all 1997 projects.

As another manager recalls, "...in the first two months we published 1700 books which is not a pilot."

### **The Alpha Pilot**

One of the first areas within ELD to implement a PDP II alpha pilot was the audio group. Starting in 1992, the audio group used the PDP II process to develop Project Alpha which would be rolled out in the 1995/6 model year. The team working on the alpha project was given training in the PDP II methods and the assistance of a consultant to develop a project

workplan. Team members were also provided with new CAD and CAE software. The vehicle associated with this product was a high profile project for Ford, so, if Alpha was successful, it would be a good vehicle for demonstrating PDP II's usefulness.

### *New Technology and Tools*

The project did not, however, follow all of the PDP II dictums. An engineer associated with the project said, "...everything on this program was new— new technology, new suppliers, new software and new people." From the very beginning Project Alpha made a big departure from the PDP II process. The same engineer continues,

PDP II has a wall of innovation that should not be crossed, and if it is crossed you should have a back-up plan. We did not have a back-up...we crashed right through the wall of innovation and didn't look back....If we didn't get the project finished there was going to be a big hole right in the middle of the car.

The team ran into difficulty trying to use the new design and simulation tools. Many of these tools had never been used within ELD. Engineers did not have computers powerful enough to use the new software, and even when the designs were completed, other areas within ELD were not equipped to accept them. One engineer recalls,

...the first big problem was that either the tools weren't in place or their output weren't accepted by anybody else...just getting a computer workstation powerful enough to use the software was difficult.

Further, learning how to use the tools was both difficult and time consuming, and engineers on the project felt that management had not adequately accounted for the amount of time required to get up to speed with the new technology. The same engineer continues,

...the value of the tools was way overestimated...we never had time to take the courses and get the equipment we needed to really make this stuff work...it was really exhausting trying to learn how to use the tools and do the design at the same time.

As dictated by PDP II, the team also tried to use project management. They ran into difficulties there as well. First, it was difficult for the team to find the appropriate level of detail in the work plan. As the team leader for the project recalled,

We had almost 1000 steps in our work plan and every time something would change it would take us hours to update the rest of the plan. In the beginning we probably spent more time on the plan than we did working on the project.

The program had so many new elements that it was difficult for the team to make any estimates about how long a particular steps might take. Another engineer recalls,

...we were asked to give goals and objectives for time per step and stuff like that But we had nothing to compare our program to. We were just shooting in the dark. We came up with all these numbers, but I don't know if they meant anything.

Project management also became a source of frustration for some engineers on the project because it added extra work and highlighted the fact that the program, in its early stages, did not have the required staffing. The same engineer remembers,

...we spent all this time making these nice charts with person hours and hours per task and stuff like that, but if you didn't have enough staff, how did that help you? We went through all this effort to show that we hadn't even started the project and we were already behind.

### *Old Process*

Another source of frustration for the engineers involved was that many senior managers didn't seem to adhere to the PDP II process that they were supposed to follow. A participant describes his experience with the first phase exit quality review,

...we prepared very thoroughly for our first phase exit review....put together all the preliminary documentation. We got to the meeting and a lot of managers attended, and they just started jabbering...the general manager showed up late and then left early...and here is a stack of stuff that I spent a week putting together and no one looked at it and I didn't even get to stand up and give my presentation. That was phase exit one.

Team members also became increasingly frustrated with how their experience was being presented to the rest of the division. The team had experienced a number of difficulties on the program, and many did not feel that ELD management was listening to their feedback or trying to correct the problems. As one engineer recalled,

...PDP II had a big budget at the beginning and it seemed like it was being used to impress us [the engineers]. They had PDP II magazines, fliers, slogans etc. Early on one of the members of our team got interviewed for one of these and she wanted to mention some of the problems, the tools weren't ready, stuff like that. They took what she said and totally sugar coated it....we kept seeing these magazines that said our project was signed up for PDP II and doing really well...we were just shaking our heads...everybody in the division knew we were having problems.

He continues,

...they did the same thing with the design tools. They would have an article that said the [new design software] was the best thing since sliced cheese, "people are getting things done quicker smoother and faster"...we would read this stuff and just laugh...who was reading this and believing it?...they just kept pouring out this slop...it was really frustrating.

The frustrations were further intensified by the fact that many members of the team did not even have the appropriate equipment with which to use the tools. Another team member said,

...when we would hear this stuff and people in our group would just roll their eyes and say, "well if this is so great, where is that workstation I need so I can actually use this stuff?"

### *Overall Results*

As the Project Alpha progressed it strayed further from the PDP II process. Late in the project much of the existing design was scrapped in favor of a new concept. In order to stay on the vehicle's schedule, the alpha team was forced, as one engineer said, "...to do a complete re-design in about six weeks", a process that normally takes over a year. The timing meant that much of the PDP II process was ignored in favor of hitting the required deadline. The same engineer continues,

...clearly what we were doing did not show up in the PDP II handbook...to do a complete design from concept to engineering release in six weeks....we took a lot of short cuts.

Another engineer discusses the consequence of the crash re-design,

...I have already made three trips to a plant because we had serious issues with the vehicle. What do the words PDP II mean when the customer is calling you up telling you that you better get this problem fixed or your product will shut down the line...who cares about PDP II then?

He continues by discussing his overall feeling about the PDP II process,

...I don't see where PDP II made a big contribution except that when we started the project PDP II was the buzzword...we could use our status as a PDP II alpha pilot to get purchase orders filled more quickly, to get computers and software we needed etc. but after a while even that didn't work because everybody was using PDP II.

Another engineer on the project summarizes his thoughts, "...I believe PDP II is a good process. I'd really like to work on a project that actually follows it."

### **The Beta Pilot**

The audio group also sponsored a PDP II beta pilot; Project Beta. Among other goals, it was supposed to follow the reusability concept suggested in PDP II by using much of what was developed in project alpha. A project beta team member recalls, "...originally the project was supposed to take everything that had been done on Project Alpha that was good and incorporate it." Unfortunately, due to the difficulties experienced with Project Alpha, the Beta team had to do much of their work without the learnings of the Alpha team. Even with this difficulty, the beta team had a more favorable experience with PDP II. As one of the team's leaders recalls,

I think PDP II helped us. When I left that program ...we were probably in as good shape as any program that had ever gone through and probably better than a lot of them.

In contrast to the alpha team, the leader of the Beta team found the project management approach and the supporting process leader to be useful, “If I had to pick any one thing that probably did me the most good, that would be having the process leader doing the project management...”. On this project the process leader was helpful both in keeping the project on track and in keeping track of the project. He explains,

...let's say that we had a job that goes to drafting at some point in time, one of the things that she would do is follow up with drafting to make sure that it's still on schedule....Basically just doing a lot of that follow up on it in terms of checking all of these big boxes until you find one that has a problem and break that down into something more manageable.

He continues,

It really helps a lot to have somebody full time doing nothing but just getting you set up, getting all the interrelationships and interdependencies in place... they get a good handle on the overview of the program because they interface with a lot of different places...They have a little bit more global view of what's going on.

However, while project management was useful to the team leader, many of the engineers involved with the project still found the PDP II process frustrating and tiring. First, just as the alpha team struggled, many of the new tools were still not ready. One participant recalls,

...the basic infrastructure for using the tools was not there when we started. We didn't have a release procedure...we couldn't get workstations fast enough to use the software.....other than getting the tools on our desks, they really weren't ready...we had to develop all our own methods and procedures.

Perhaps more difficult than the technical problems with the new tools, was that the ‘re-engineering’ of the engineers job had added to the engineer’s responsibilities. Under the old system much of the detailed design work was done by the drafting department with the assistance and the supervision of the engineer. With the new tools the drafting department did a much smaller portion of work. A beta team member describes the problem,

...under this new system the engineer was responsible for the doing the physical design work using the new tools...however, none of our old tasks went away, so the new workload was all increase...in some cases your workload could have doubled...many times you were forced to chose between doing the physical design and doing the project and administrative work. To be successful you had to do the design work first, but the system still required all this extra stuff.

Learning how to use the new tools, adapting them to the existing structures, and doing all the work greatly increased the demand on the engineer’s time. Many complained that they were required to work many extra hours, one recalled,

...we worked a tremendous amount of casual overtime...it was almost impossible to predict how long it would take to design something, it could take an hour, it could take days.

While another said,

How do we catch up? We stayed late. Most of the team was working from 7:00 a.m. to 8:00 p.m. and on weekends. A lot of people worked right through the Christmas vacation.

Further, the time required to learn the new skills plus the increased workload meant that some engineers never really learned how to use the tools. Another engineer recalls,

...I had some background in CAD/CAE from my master's program and I still stayed at work until midnight every night for a month learning how to use the tools and trying to figure out how to get my work done...some of the older engineers, even with training, they just have a [computer] sitting on their desks gathering dust....there are still three guys in my section that don't use the tools.

### *Customer Changes*

Just as in the Alpha Project, many Beta engineers felt that management did not adhere to the PDP II process and that the resulting function and requirements changes made it almost impossible to follow the PDP II process. An engineer describes his experience with the phase exit quality review,

...we scrambled to get ready for the definition phase exit review, get all the paper work done and not miss the exit. We put on this show that says we exited this phase on time...Well 3 or 6 months later the customer is still making changes to the features of the product...Even though they are making changes, Job One doesn't slip...so we are supposed to have, say, a year for the detailed design phase, and it ends up we have more like six months.

The changing requirements problem was exacerbated by the turn-over on the vehicle program. Another member of the Beta team recalled,

....since '92 we've had three car program managers. Each one has either changed or suggested changes to the product without even looking at the definition to see why we might not have done it that way... everybody wants to put their mark on it....it's late in the game now because we're in launch phase and people are still coming up and saying, "I want this." It's like, excuse me, time out, we have to stop making changes [and freeze the design].

An interesting side effect of the use of the new tools was that the team was actually able to accommodate the later requirements changes more easily. As the team leader recalls,

...we ended up making a major design change in the middle of the program and based on my past experience with the system that we were using prior to that, we'd have never made it without the new tools.

### *Reactions of Beta Members to PDP II*

Managers and supervisors from the beta team felt that PDP II had helped. The team leader believed that PDP II enforced a discipline that aided the project. He recalls,

...Really [PDP II] was a framework to tell you to do things that you knew you should do but for various reasons didn't usually get done.

The engineers working on the project, however, saw less value in the experience, one said,

To be perfectly honest, I really don't think PDP II changed the way engineers did their jobs. In many ways we worked around the system. Good, bad, or indifferent that's what happened. We had a due date and we did whatever it took to hit it.

While another had an experience similar to those that worked on the alpha project, he said,

...the basic tenets of PDP II are good. Using them is a different story..."

## VII. Rolling Out PDP II

With the pilots underway, ELD began to roll out PDP II to the entire division in 1993. The goal was to have every 1997 model year program using PDP II by the end of 1993, and to have every ELD program on PDP II by October 1994. The roll out strategy took place at a number of levels. The manager leading the effort explains,

We had a fairly robust communications strategy...We targeted all levels of the engineering community....we had documentation targeted at different levels of people within the company....we had a full time dedicated team working on this.

The roll out had three major components: A high level awareness campaign designed to show senior management's support, a middle level effort to create interest in the actual PDP II process, and intensive training that would give supervisors and engineers a detailed working knowledge of PDP II

### **Creating Awareness and Showing Senior Management Support**

PDP II was rolled out to the division with the strong support of the senior management team, particularly the GM, the division's general manager. The GM was very visible with respect to PDP II. The division published an audio magazine— a print booklet combined with an audio tape—that was circulated to every engineer within the division. On the tape the GM, a Ford Vice President, and an executive engineer discuss how PDP II would be critical to the future of the division. The GM begins his message on the tape with,

...I have a message to share that is vital to our success...PDP II is changing the way we do business at ELD....To be successful we must allow ELD's product development process to be successful. We must embrace PDP II as our business process, period....Not understanding PDP II is likely closing your eyes to the division's vision. [The GM from the 'Be the Best' audio tape]

The tape continues with a description of the PDP II process and a discussion of its appropriate integration with the rest of the division's policies.

## **Pull vs. Push**

Members of the design team felt that it was critical that the engineering community ‘buy-in’ to the PDP II process. This meant accepting everything– the new tools, the PDP II process, and project management. As a team member and chief engineer describes,

We wanted to get the engineers in pull mode rather than us in push mode... because if they didn’t own the process nothing was going to happen, and at the time it was fair to say that a lot of engineers viewed this as a neat way to get some fancy tools and to hell with process.

To initiate this process the team relied on the assistance of the consultants, and on an approach that involved a number of different documents. The same team member continues,

At the end of 1992 we had the handbook mostly finished and we started using the consultant as a driver to roll out the handbook and roll out project management. We also generated a supplement to the handbook called the Competitive Sprint that tried to put everything we were trying to do in lay-person’s terms.

‘The Competitive Sprint: Empower Yourself with PDP II’ was a high gloss, multi color, magazine–style booklet that described the PDP II process via experience of the mythical ‘Mercury’ team. The first page of the booklet contained a letter from the GM stating the purpose and the goal of the effort. The booklet went on to describe the entire process of PDP II starting from the inception of a new idea through the product’s launch in a new vehicle. The booklet was designed to capture people’s attention and to get them interested in PDP II. It also gave them an overview of the entire process, so that those people that worked in one particular function could get a better feel for total span of the process.

## **The Training**

The Competitive Sprint and other efforts took care of creating awareness about PDP II and getting people interested in the process. However, it only provided a high level picture. Using the process required training. The steering committee developed a detailed training and dissemination strategy. As one manager describes,

We used a cascade approach. Training began with a four hour overview of the process given to each manager. Each manager was given a set of slides to present to his team. The plan was for everybody in the development part of the division to receive some type of training in PDP II.

The training did not end with the four hour overview. The handbook would not even be given to the participants until they attended a second four hour training session. Beyond the second class, there were many other training programs that were given to engineers depending on their functional discipline and the area in which they worked. A manager

recalls, “There were literally hundreds of hours of training programs. The handbook held all the pieces together.”

However, while the team had planned an extensive training effort, they had not anticipated the high initial demand for the handbook. Just as they did not have the opportunity to make changes based on the experience of the pilots, the rapid diffusion of PDP II completely overwhelmed the division’s ability to provide training. As a team member recalls,

The team that wrote the handbook made it clear...that they felt nobody should get the handbook directly. They should get it in a training session....The whole idea was to set the stage for this is a vision.... Of the 1700 books we published, probably 200 were received with the appropriate training.

### VIII. The Results of PDP II

Evaluating the success of the PDP II initiative is difficult. The time delays are sufficiently long that, as of the fall 1995, only the alpha pilots have reached the launch phase. Further, the difficulty that the PDP II team experienced with the metrics persists to this day. There is very little quantitative data with which to evaluate the success of the initiative. As effort’s leader said, “...when you ask people [about PDP II] all you will get is opinions. We don't have the right analytical data to support the opinions.” However, problems with data aside, many people involved developed some strong feelings as to the successes and failures of the effort.

#### **Senior Managers**

The GM felt that PDP II had only been a partial success, “It [PDP II] wasn’t as successful as I would have wanted, maybe 60% of its potential”. In 1994 both he and the initiative leader left the division and the GM felt that initiative had suffered without their guidance. He explains,

If there’s not somebody there leading the charge and providing leadership, its not going to happen, and in the case of PDP II, the people who needed to be there to finish it off were not there.

While pointing out many of the problems in the design, implementation and execution in PDP II, the initiative leader still felt it was a critical factor in the success of the division,

...I will tell you that without it, we probably wouldn't be in business today....if we were doing our designs the way we were doing them back then, we would be in deep trouble....we were at capacity in all areas....and not by the absolute number of products coming through but the number of different times the same product came through. Fifty percent of the work was rework. Now you just can't afford to be in business if your designs are that far off when they reach initial prototype production.

He continues by discussing the success that PDP II had on the objectives that had been set at the outset,

With customer requirements, we made very little progress, maybe 20% of our goal. Program management and the disciplines associated with it—it started at zero, maybe its at 15% now and headed up—...We reached 75% to 80% of our goal with the tools...and without them we wouldn't even be in business today and that was sort of a bottom up -- that became something that the engineers felt had value-add fairly quickly.

Many agree that the PDP II handbook represents a solid product development process that, if followed, could help the division. A PDP team member said, “I think the process that is in the handbooks is a good one.” How the process is being followed is a different issue, He continues, “...how much of it [The PDP II process] is being followed? I would say less than 50%.” Like other PDP II team members, he also hopes that the experience with PDP II, successful or unsuccessful, will help ELD in the future,

I think, I hope, that we will continue in the direction we are heading and down the road we will look back at this process as an important milestone, but as is I don't think I would consider it a success yet. Maybe you have to go through this painful process no matter what.

### **PDP II Design Team Members**

Some managers that participated on the design team saw things differently. Many felt that before PDP II could produce tangible results it had to change the mind-set of the division, and on that score it was a successful initiative. One PDP II design team member said,

I think it's been reasonably successful....the division as a whole understands at a high level that they need to be moving towards a single process... If nothing else, having one handbook, one high level process...has convinced or educated people to the idea that what George does right in radio design might actually be applicable to Tom over in speed control—a concept which we simply did not have before because we were extremely chimney oriented.

The same manager continues,

...are we getting more efficient? I think so but how much, I'm not sure. In what way, I'm not sure. How specific can I be? I can't be specific at all...We don't have any measurements that we could say, "Okay, in 1990, these things took this long and now they take this long." ... I do have a warm fuzzy feeling that we're better.

Another chief engineer and team member felt that PDP II was a learning experience that ELD had to go through,

...it might have been more important to go through the PDP II process than the process defined by PDP II...from my point of view the issue is this; there's a process people go through to learn and to change...designing and implementing PDP II was a process of change and restructuring and rethinking. It was those things that made a difference versus the fact that we declared victory.

Finally, a member of the PDP II team suggested a different criterion for measuring the success of the initiative,

I was asked repeatedly, "When is PDP II going to be in place?"....What I said was, "When other companies that we consider to be good are coming to us and asking to benchmark our product design or manufacturing process then it will be in place." ...that is starting to happen, so we must be doing something right. How good are we? How close are we? I haven't the slightest idea but other people are starting to visit which tells me that we must be doing something right.

## IX. Problems and Resistance

Even with the all the energy and resources put into the design and roll out PDP II was not universally successful. It certainly did not achieve its goal of a 50% increase in through-put in two years. Further, those that embraced the process experienced many barriers to successful implementation while others never fully accepted it. Participants identified numerous dynamics within the organization that made it difficult for ELD to make such a substantial change.

### **The Resource Dilemma**

#### *Where to Find the Extra Engineers*

PDP II's focus on detailed documentation of customer needs and first past success required that much of the design and engineering work on particular product to be done relatively early in the vehicle cycle. This represented a change from the normal development cycle. The division's general manufacturing manager, explains,

...if you look at our resource allocation on traditional projects, we always start late and don't put people on the projects soon enough...then we load as many people on as it takes...the resource allocation peaks when we launch the project.

PDP II, on the other hand, required people up front. He continues,

We were trying to change [the traditional] mode by putting people up front with the PDP II processes and perhaps reaching a peak at 24 months or so before job one and then diminishing the resources off until there are virtually none left on the project by job one. Well there was a real dilemma because there were not people available to take off of all of these projects that have been developed in the traditional way where you backloaded with resources. By the very nature of the way we run the business...people were all out committed to launches .

The lack of extra resources to make the transition from the old process to PDP II put a particular strain on the supervisors and the middle managers within the division. They were responsible for assigning engineering resources to different tasks, and they were responsible for making sure that products were ready on time and did not hold back an

important product launch. Much of the resistance to PDP II came from these positions. As the initiative leader explains, the problem didn't result from a lack of understanding PDP II,

The thing that was difficult was to win over the hearts and minds of middle level management.... They tend to be the people who are responsible for keeping the business going on a day-to-day basis...there wasn't any problem of conceptual understanding...but when the rubber met the road, the default condition was business as usual.

Another manager describes the problem succinctly,

We were saying, "But wait a minute, it's 48 months before job one over here on this other program. We need people on it." People would say, "Sorry, I know it's the right thing to do but what the hell am I going to do, I'm launching this car."

### *Customer Requirements*

Improved definition of customer requirements was a critical component of PDP II.

Without it, the front loaded resource process didn't make sense. However, getting solid customer requirements definition was more difficult than the PDP II design team had anticipated. The initiative leader explains,

...we said, "Well we're going to go out and get this clear specification and understanding for what the customer wants before we start designing it." It turns out that the customers didn't know. ...nobody had ever asked them before ...they said, "Gee beats us, what do you think?" ....if the vehicle product didn't have that discipline, we couldn't artificially instill that discipline at the component level. If the vehicle doesn't have the systems requirements well done, how are you going to get them through the component?

Further, ELD had accepted changes in the customer's requirements in the past. From the customer's point of view that didn't need to change with PDP II. Another team member explains,

You need a good agreement with your customer about what you are really designing....but if you are trying to work this way but the customer is not, you will never break that vicious loop. If you have to accept customer changes at the eleventh hour that force a whole new sequence of product development, you will never fix the process.

Without a solid customer requirements process, getting people to move resources was almost impossible. The initiative leader continues,

The issue is: if I put all my engineers up front then what if something changes? Then I have them all up front and then I still have them all at the backend of the process handling all the changes and then where do you get the advantage? You just front load and backload the project if it actually happens that way.

### *What About Improved Efficiency?*

The resource dilemma was a major limitation to the success of PDP II. However, the main goal of PDP II was to increase the efficiency of the development effort. With the addition

of the new computer tools, the bookshelf, and the other innovations, the resource problem might have been solved by these early efficiency improvements. However, as many participants suggested, this did not happen.

First, the PDP II process required people to follow a sequence of steps. Many of those steps were designed to increase learning between projects. However, on any particular project, particularly if it was under time pressure, these steps could be eliminated. The initiative leader explains,

An engineer might not take the time to document her steps or put the results of a simulation on the bookshelf and because of that she saved engineering time and did her project more efficiently. But in the long run it prevented us from being able to deploy the reusability concepts that we were looking for....there was a lot of push back when it came to following a process that people could look at and say, "Hey, I can do that more efficient by not doing some of these interim steps."

As a result the bookshelf never developed. Other parts of the process suffered from similar problems. Even with the new computer tools, using a disciplined product development process sometimes required more time, particularly in the early going. As a chief engineer and design team member relates,

...we can clearly demonstrate that we can save factors of three, four, five, maybe even ten in designing brackets by using these tools because we no longer use the design, create, break design cycle. Other elements are different, like adding more discipline to the design of software. It was clearly taking more time and more resources because writing the code on the back of an envelope is a lot faster than documenting it. Of course the quality of code went up if you documented it and fixed things that might require rework later, but that only shows up in speed after the fact. It takes you longer initially but overall it takes less time.

#### *Why Not Just Add Resources to the Process?*

The senior leadership of ELD believed that PDP II was critical to the growth and success of the division and many people agree that PDP II's success was limited by ELD's inability to allocate extra resources to the process. Yet, except for a few instances, ELD, even though it was experiencing significant improvement in sales, income, and cash flow, never allocated the engineering resources required to fully make the transition to the new process. The interview participants suggested two main reasons that ELD was never able to make the full commitment to implementing PDP II properly.

First, there was the issue of certainty. Although it was a well designed and thoroughly researched process, properly implementing PDP II was a gamble. It required the leap of faith that the extra expense today would result in a more efficient, leaner development

process. This proposition was difficult for managers to sell to their supervisors, and for ELD to sell to the rest of Ford Motor Company. The initiative leader describes the problem faced by managers,

...taking the risk and spending incremental money that's not in your budget and taking the hit for over running your budget— even though in the long run it would have been the right thing to do—is a difficult thing to do...the budget is something that's easy for your boss to tell you whether or you hit it or not... anybody can hold it up in your face.

As general manager, the GM faced similar issue:

Imagine at the end of the year the general manager...going up in front of the president and saying, "We missed our profitability numbers because we spent extra money developing our new design process that won't be fully deployed and rolled out till five years from now but wasn't that a good move?"

A second reason for the difficulty in adding resources to support PDP II was the volume of business that ELD was trying to assimilate. As a manufacturing manager recalls,

We took on more work than there were people to do it. One of the faults of our organization -- and I was a big part of it as anybody else -- is we never said no. You know, someone would come along with a new project and we'd take anything on. We'd do anything for anybody, anytime.

Why, the same manager continues,

...there was tremendous pressure to grow and there was tremendous pressure for new products, new technology and new customers. We were trying to sell very, very aggressively to the outside. So we would get ourselves in situations where we would have a success with an outside customer which translated into a resource problem for the engineers. We typically never said no.

ELD accepted this business because it needed to fill the extra space in the plants. Yet even though they were increasing the volume of projects they were working on, they were increasing the engineering headcount more slowly. How did they think they would accomplish the extra work? Through the efficiencies created by the success of PDP II.

The same manager explains

...we assumed we'd fund it [the extra business] with efficiencies but the efficiencies weren't coming as fast as the needs.... we had a wish list of improvements and those wished for improvements resulting from PDP II or other tools were not rolling through the systems fast enough....it seemed as though we were constantly behind the eight ball in terms of having or being able to manage the resources we had to adequately cover all the projects and expectations that we had out there.

A chief engineer summarizes the resource dilemma and adds a cultural dimension to the issue,

You declare that you are going to be successful, and then you go ahead have your budgets reflect the assumption of success without any contingency for failure, because at Ford we are always successful.

The allocation of resources presented a fundamental problem for PDP II that was never resolved. Resource allocation leads to very deep issues within the culture of Ford. Launching new vehicles simply takes priority over everything else that happens in the company. This emphasis manifests itself in numerous ways. In particular, many people view up front activities as simply less important. As one PDP II participant said,

...as an example, if you are engineer with a project close to job one, say 3 months, and for whatever reason you are not ready to ship your product, that's a very visible and apparent problem. There is no question the project is in trouble and needs attention. Now, if you are thirty months ahead of job one, 2.5 years away, and you are lacking customer definition. You are trying to get the same level of attention, 'I've got to have this or I can't move ahead', there much more of tendency to say 'Come on, quit crying and get on with it'.

### **Resistance to PDP II- Project Management, the Metrics, and the Matrix**

Resource issues were not the only problems faced by PDP II. Many engineers resisted the effort for other reasons.

#### *Project Management and the Process Leaders*

The purpose of instituting disciplined project management was to allow ELD to better manage their resources and to keep closer tabs on projects that might be going off course. Project management required a detailed work plan, some estimate of the duration of each task, and level of resources required to accomplish tasks in that amount of time. Engineers were required to keep detailed records of how their progress compared to the plan, and to update the plan as steps were completed. This process was difficult for engineers to accept.

First, using project management meant more administrative work for the engineers, particularly in the early stage before they were comfortable with the methodology. As one engineer recalled,

Managing the workplan required resources. People had to do their 'normal' work as well as keep track of the work plan. There just weren't enough hours in they day, and the work wasn't going to wait.

The additional administrative effort was not well received by many engineers. The initiative leader recalls,

A lot of the engineers felt that it was no value add and that they should have spent all their time doing engineering and not filling out project worksheets. It's brushed off as bureaucratic...Yes, you can force them to fill out forms and data and all that and then you get a data integrity problem. I mean you can say "I now have all of my program management stuff on line," guess what? None of it means anything.

Of course opinions varied widely from area to area and engineer to engineer.:

It was received all the way from, "Gee its a great tool," to "This is a big pain in the ass and why are you bothering me with it?" ...Those that used it seriously found it very useful. The ones that used it just to get through a report period, probably didn't find it very useful because they didn't use it properly.

In some cases, even though the process leader had been assigned to a team to alleviate this burden, supervisors viewed them as resources wasted on a process that wasn't adding much value to begin with. As one process leader recalls his early assignments, "they were basically saying 'Why are you here? I'd rather have an engineer.'"

An additional source of resistance to project management and the process leaders came for another reason. The disciplined use of project management requires reporting when a particular step is behind schedule. Many time engineers did not want to report that they were behind, as a PDP team member explains,

...when you instill project management disciplines it means that you're reporting on your interim progress and sometimes you get behind... A lot of times in engineering exercises there are opportunities to catch up. You're not sure you can catch up so why would you want to report a program in deep [trouble] early on in its lifecycle? ....the net result is that program management had a connotation of reporting bad news that may or may not have been bad news.

This dynamic was compounded by the addition of the process leaders who were sometimes viewed as 'agents' of management whose only purpose was keeping tabs on the engineers and making sure that they were busy. As one process leader recalls,

At first they felt like we were more policemen....the engineers said "You're asking me what my job is...are you saying that because I don't look busy every moment of the day that I should be doing something else?"

This problem was further exacerbated by senior managers who did not respect the aim of project management. Another process leader recalls,

...when I first was a process leader, the executive engineer used to have what I would call 'fighting meetings',...His attitude was we should tell everybody that they're all red [behind schedule], they're all failing, they have to make changes faster....if we don't make changes right now, we're going to shut the whole division down, etc.

However, with time many teams began to view their process leader as a valued member who played an important part in the development process. As one process leader recalls, "...once they realized that we weren't policemen, that we were just trying to help them,...then things got a lot better."

### *Management Adherence to the Process*

Engineers also became frustrated when they perceived that managers were not respecting the time line that the team had developed via project management. A chief engineer describes the problem,

I believe that PM is not an issue in and of itself. The problem with PM is that sometimes management chooses to adhere to it, and sometimes it chooses not to adhere to it....when we set out the disciplines of PDP II we said there it is, its a very disciplined, rigid program, go follow it. Then in the very next breath we would say, "I want you to ignore all that and bring this project home in half the time". That just didn't go down very well.

Pushing some project ahead of schedule created an additional difficulty. As soon as one program was finished ahead of time, the customer started to expect that all projects would be completed that quickly. He continues,

...we started with a 26 month process, but as soon as the customer wanted it in 18 months on one project and we said yes, pretty soon every project was at 18 months, every project was an exception....the credibility of PM was questioned.

### *Metrics*

A second point of resistance to PDP II was around the metrics and objectives. The GM had set a public objective of a fifty percent increase in throughput in two years, and a number of intermediate metrics were also added to the design process. The PDP II design team had struggled with the development of metrics and those difficulties only continued as PDP II was rolled out to the design teams.

The first big problem that arose was lack of definition. Even members of the PDP II design team had a difficult time making The GM's objective operational. As one team member recalls,

We never did get [the GM] to define throughput or improvement, those are the two significant words...We were still operating under the Ford philosophy if you don't understand what the boss said, you don't ask. You wait until you do it wrong and then he'll explain better what he wanted you to do, and you might get lucky, you might do it right.

This lack of clarity was even more confusing for those that worked on the actual development teams. One manager recalls, "The goal was like a big elephant, everybody saw it a little differently." A member of a beta pilot team describes the issue from the engineer's point of view,

... you're trying to reduce your cycle time but you're still working on vehicle time.  
... you want to get your product out in 18 months... but at Ford Motor Company regardless of the fact that you want to reduce your cycle time you're still having to

meet your vehicle time....people can't separate the two....they don't understand why we were trying to get to 18 months... "Well why should we try to meet 18 months, the car doesn't need it until 24 months or 36 months.

The situation was equally difficult for the intermediate metrics. As another manager recalls, ...on a day-by-day or week-by-week or month-to-month basis it was very difficult to communicate to the community at large how we're doing versus any of our goals. That in my mind, was a really big inhibitor....sure there are some measures you could take but they're all a little bit mushy, they're not very clear about what kind of progress was really being made.

A second difficulty with 50% improvement objective, and the supporting intermediate objectives, was the sheer magnitude of the goal. Manufacturing had managed to make substantial cycle time reductions in less than four years. However, product design seemed to be a lot more complicated. Many found the objective beyond the realm of possibility, and felt frustrated because they were being asked to accomplish something that simply was not possible. A member of the design team said,

..the thing that I have to say kind of hurt us, [the GM] was adamant that we were going to have a 50% throughput improvement and he wanted to see it in two years. Everybody we talked to, everybody, said that they had been at it between five and eight years and none of them felt that they were there...HP said that in their estimation if we had [made significant progress] in eight to ten years it would be a minor miracle.

Other managers echoed this sentiment, as one said,

...the aggressive objectives were mind boggling, Motorola had an eight year plan to get to six sigma. 50% in two years just seemed like too much...people get depressed when they don't reach their stretch objectives...there was no way for them to attack the objective in a meaningful way,

A final problem plagued the teams trying to achieve the improvement goal: the time delays in reporting were simply too long for the people to use the intermediate metrics to get good feedback about how they were doing. A manager recalls,

...virtually every one of the metrics that we had...would show movement way too slowly for everyone's satisfaction. You know, there are things that you could look at back in history ....But if you're in the midst of the process and you're trying to use that metric to manage the business, it's useless....my general experience with the PDP II metrics was that they were, in the short term, near useless.

In a process where the average project takes over three years, most of the available metrics simply took too long to calculate. Any change made by an engineer did not show up in the metrics until long after that change had been made. A PDP II team member explains,

The cause and effect was a problem. In manufacturing it was at most a couple of weeks before you could see changes. In engineering the cycle time is so long, the measures lose their significance in the minds of the engineer.

The initiative leader summarizes what he felt were both the strengths and weakness of the GM's goal,

...I thought it was useful in terms of trying to describe the level of improvement that we were looking for... picking big numbers like that forces people out of the paradigms that they're in. If you give them numbers of five or ten or even 20, they'll simply assume that can just get better at doing it the way they're doing it today....Once you start showing up with numbers like 50% or a 100% then people start to understand that we're not going to get there from here. We have to do things demonstrably different.

However, he continues,

...from the perspective of 'could people get their hands around it and could people show progress in relationship to the metric', it was a bad metric... I mean we couldn't prove it. We couldn't measure it. We had no baseline on it. It was a very difficult metric to deal with.

## X. Lessons Learned

PDP II had a number of successes and failures. Many of the participants in the initiative felt that although PDP II was by no means perfect, they did learn a number of important lessons through the process.

### **The Role of Senior Leadership**

For his part the GM felt that some of PDP II's short coming were the result of his not having enough time to focus on the initiative. He recalls,

I think on the development side as general manager I didn't spend enough time on it, that's why I was only maybe half way satisfied with it. I didn't dedicate enough time to it like I did the on the manufacturing side, that was a lesson learned.

Other managers, however, noted the GM's support as a key to the accomplishments that PDP II did achieve. A team member recalled recalled,

The key thing about PDP II was that [the GM] drove it from the top. He was an active participant, a champion, and he was willing to set an organization in place, appoint a director whose main task was to push the program, and then call his direct reports to task for not implementing it...He was dead serious about making this work and I think it made a difference.

Another manager noted that The GM's commitment to the initiative never wavered,

[The GM] maintained his commitment. There was an exec in a design area that was reluctant to commit to the initiative. I heard it said that [the GM] finally came up to the guy at an after hours event, put his arm around the guy and explained why this was such a good idea...When the general manager puts his arm around you and tells you what a good idea it is for you to join the team, you do it... [The GM] was doing this a year after PDP II was introduced.

## **Metrics**

Many involved in PDP II mentioned that the process of developing metrics could have been improved. A design team member recalls,

The whole metrics process was frustrating to say the least. However there was a reciprocal frustration of the manufacturing side. Finally we just decided to do it. We weren't sure that the metrics were the right ones, but we just decided to do the best we could, and it helped...It was much harder to convince engineers that we needed metrics. I think as a group they don't like to be measured. It was very frustrating...It was also very difficult in manufacturing, but in manufacturing the goal was made operational immediately. People were given a job and they had to deliver....we never really got to that point in PDP II.

He continues

I would have locked people in a room until they agreed upon a small set of metrics that they could all live with. We just fought the metrics time and time again. When you don't have good metrics, you don't have a good feedback mechanism.

Another manager had a different opinion,

...some of the [metrics] that we were trying to use for PDP II were worse than none at all because people used time worrying about them and they didn't mean anything when they got done... they were useless...I think we need to look at the objective and the measurables and decide if the measurables help to drive the process in the near term or not and if they don't, we shouldn't use them.

## **Who Should be Involved**

There was also a strong feeling that the PDP II design team had not made enough of an attempt to capture the thoughts of the engineering community. The initiative leader explains,

...we should have had more of the line guys participating, from their perspective it was this group of academics that went off into a closet, developed a new process that really didn't emulate the real world or how they did products, etc. ... getting more involvement from them[line engineers] and maybe replacing some of their people with contractors or something while they were involved would have aided the deployment significantly.

Another manager concurs,

In PDP II too many staff people got involved. We brought in a special team that was going to fix things, and they spent an enormous amount of time off on the side working on this. PDP II was not viewed as a mainstream activity...If we had said 'product development guys you have six months and we have to have a new way of doing business' we might have made more progress.

The lack of engineer involvement manifested itself in a number of ways. First, many engineers felt divorced from the process. Second, many engineers felt that PDP II missed many of the elements that they believed were critical to the development process. A member of the alpha pilot team recalls,

...it seems like with PDP II they forgot some of the basics, for example, teams work better when they sit together...I was working on this project for two years before the team was moved together in one location. They were always making promises, but they kept putting it off, 3 months, 9 months at a time...it was very frustrating.

A process leader who had worked on a number of PDP II projects explains the consequence of not having the engineers involved in the process,

[The Handbook] only depicted the process down to the department manager or supervisor level. The engineers never really changed. The low level guys -- the guys who did the actual work never really changed but the people above them were expecting major changes in performance. It's like we took a Volkswagen and now we put a Porsche engine in it but we left the little donut tires on and it's still not going any faster, what's the problem?

### **Dealing with the Customer**

Many also felt that further improvements in the development process would be difficult until ELD had changed the way it deals with its vehicle program customers. A PDP II design team member said,

Part of the engineering role has to be to say to the customer "I hear you, but it is now too late, I can not provide a quality product in this little time." We are not very good at that here. We all play right into that mentality. The customer says "I know you can make this change you have done it before". We have to say no to the customer some times, and I don't believe that contrary to giving the customer what she wants, its giving her proper advice.

Many engineers concurred with the evaluation, a member of the beta project said,

...if they [management] want a better process, then they should define the product and then leave us alone...I think almost every engineer would say, if you want us to produce more work, you have to give us hard definition of the product before the detailed design.

While another said, "...when people are asking for late changes, the quality of event has to suffer, but people don't seem to recognize the relation between the two."

### **Difficulty of Change**

A key learning shared by many people involved in the initiative was a recognition of the difficulty of what they were trying to accomplish. One manager recalls,

I think perhaps we were optimistic in terms of our ability to roll it out and get it fully implemented in a relatively short time frame.

Another continued,

Things of this nature are considerably more difficult than you might think...pick and choose your issues wisely... Doing a major process change in two years is impossible...you need a big time commitment on the part of the managers and the

participants. My big lesson was do not underestimate the amount of attention required by an effort like this.