CASE STUDY

Rocketdyne Propulsion and Power

Transformation Through Employee Involvement and Workplace Training: The Challenges of a Changing Business Context

Summary

Who:	Rocketdyne Propulsion and Power United Aerospace and Automobile Workers Local 887
Where:	Canoga Park, California
When:	First visit: January 19, 1999 Second visit: June 21-22, 1999
Why:	Organizational change, funding, and environmental concern
What:	Employment Involvement program

Introduction:

Rocketdyne is a leading producer of rocket engines and related space products facing an increasingly competitive global environment. For Rocketdyne the challenges include a shift from a heavily military focus to a more commercial focus, acquisition by Boeing, environmental and pollution concerns, and developing a lean production work organization system. A vigorous employee involvement program is a defining feature of the Rocketdyne story. However there are ongoing challenges integrating front-line innovation with line leadership and business strategy.

Company Background:

Rocketdyne was established in 1955 as a separate division of North American Aviation, Inc. The company subsequently became part of Rockwell International Corporation and on December 5, 1996 was acquired by the Boeing Company.[1] During its forty-one years of operations, the company has earned a distinguished record for product successes, including the F-1 and J-2 rocket engines for the Apollo 11 Moon Lander.

The Canoga Park facility visited for this case study is a sprawling 430,000 square feet with oversized cone-shaped annealing furnaces, specialized cutting, grinding, and milling machines, and highly specialized, one of a kind rocket parts. During the current manufacturing process, an engine makes a 22 miles journey without ever leaving the facility—which is an additional factor driving the process improvement effort in the organization.

Rocketdyne Canoga Park currently produces a long list of top quality, high technology products including:

- **Space Shuttle Main Engines:** The Space Shuttle uses three of these staged combustion, reuseable liquid hydrogen fueled rocket engines. This is the only operational, reuseable engine designed for human space flight.

- **Space Station Electric Power Systems:** Rocketdyne is responsible for the end-to-end electric power system (EPS) architecture for the International Space Station.

- **Linear Aerospike Engines** for the X-33 Vehicle (the first space vehicle that looks and acts like an airplane).

- **RS-68 engines:** The RS-68 engine (for the Delta IV) is the first new liquid rocket engine to be developed in the United States in

25 years. This is the most powerful liquid-fuel rocket engine ever built.

- **Theater High Altitude Area Defense Systems:** Rocketdyne continues testing of the Divert and Attitude Control System for the Theater High Altitude Area Defense (THAAD) Program.

- **Lasers and Electro-Optics Applications:** Rocketdyne continues to be a major developer of high power lasers.

Summary of Types of Instability:

Rocketdyne is in the process of transition from being primarily military focused to being more commercially focused. The impact of this transition is more easily understood when one recognizes that the company was created to produce rocket engines "in support of national defense and U. S. involvement in space."[2] This transition provides an organizational change backdrop for the other two types of instability: funding shifts and technology change. Further, the facility faces the challenge of the environmental impact of the Santa Susana engine test site that supports Canoga Park production.

The funding shifts currently exercising the most impact at Rocketdyne are also linked to the shift of business from military to commercial. The largest percent of Rocketdyne's business is the space shuttle main engines for the National Aeronautics and Space Administration (NASA). Rocketdyne also produces Delta rockets for the U. S. military. Currently both NASA and the U.S. Military are experiencing budget constraints derived from reduced spending on space exploration, the end of the Cold War, and increasing commercialization of the international space station.

Reacting to these environmental and competitive pressures, Rocketdyne has chosen to search for more commercial business. The goal is to increase sales to the commercial market to 50% of total sales. This means the company faces increasing global competition that will drive advancing technology, cost cutting, and improved quality. Rocketdyne's competitors are Chinese, French, and Russian companies. The Russians have a recognized cost advantage in the high power rocket engine sector of the market.[3]

Since the 1996 Boeing purchase, Rocketdyne has experienced only moderate organizational change. For example, the laser and electrical optics groups are now separate organizations although they are located within the Canoga Park site. Despite many issues surfaced by the business press regarding the Boeing/McDonnell Douglas merger in

1997, Rocketdyne appears to have been somewhat insulated. Employee Involvement and training innovations have not been integrated with parallel efforts at Boeing -- so the change in ownership has caused minimal day-to-day change.

Technological change has focused on the company's strategic processes and capabilities. When it acquired Rocketdyne, Boeing invested large amounts of capital for equipment and machines. One example is the $6.9 million in hardware, software, and fiber optics acquired to develop its new Electronic Work Instructions Package (EWIP).[4] One manager told us that "business decisions are based on technology, not price, and technology is seen or evaluated as best value for the product." The facility must identify and drive for a position at the technological edge. Failure to do this in a globally competitive market will result in the loss of new business and the ongoing acquisition or development of new products.

A final source of instability is the potential controversy over environmental concerns about the engine test facility. The 2,700 acre Santa Susana engine test facility is located about a 20-minute drive from Canoga Park among the Santa Susana hills. When the test facility was first created, there were few people living in the area. Now housing developments are creeping closer. People living close to the facility are concerned about air pollution and the noise produced by the testing. Furthermore, Rocketdyne discovered groundwater contamination in 1984. Since then the company has cooperated with environmental regulatory authorities and taken the corrective actions recommended by them. Nonetheless NASA's Office of Inspector General reported that the estimated time to clean up groundwater contamination at the Santa Susana test facility is 40 years.[5]

Summary of Mitigation Strategies:

Two key mechanisms that can help mitigate instability are found in this site – employee involvement and workforce training. Both represent "bottom-up" strategies.

Employee Involvement Program

Among the mitigation strategies that the facility uses to help balance instability are the well developed employee involvement programs and team training. A vigorous employee involvement (EI) program, started in 1990 under the Rockwell ownership, is a key competitive strategy for meeting the challenges of instability. Rocketdyne's EI program and their change process are recognized by the aerospace industry and national media.[6] This leading Employee Involvement program was

spotlighted at the first Lean Aerospace Initiative (LAI)[7] Implementation Workshop in 1997. A joint presentation by Rocketdyne management and UAW Local 887 was favorably received.

Teams are a key component of the Employee Involvement Program. There are more than 120 Employee Involvement (EI) teams and six of these are self-directed work teams. Self-directed team members share the responsibility for goal setting, team performance, task/job completion, problem solving and quality. EI team members are involved in the hiring process and involved with the budgeting process. Each year's budget is decided based on last year's budget. Therefore, information on how they spend the budget is important for the process. One of the team members said , "We made our own arrangement to use a budget surplus and changed the floor setup, cleaned up the order of the machines, and bought new chucks."

The EI program was initially focused on employee empowerment and teamwork at what is termed the "touch" labor level, but now salaried employees are also forming EI teams. As employees gain experience as team leaders they are frequently able to use these skills in filling new management positions –leadership skills instead of technical skills are being given an ever greater weight in being a manager. Integrated product teams (IPT) also participate in EI, with the aim of driving business responsibility down to the team level. The goal for the team is to include cost savings through cycle time reduction, quality improvement, safety, and accountability to goals. The EI program goals are designed to align team level activity with business goals. A joint committee that consists of bargaining unit representatives and management evaluates the success of the program.

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-EI Team Member

The Employee Involvement program was negotiated between the United Auto Workers union (UAW) and the company (Rockwell International) in 1990. The focus of the negotiations was team-based work with established joint national and local employee involvement committees. They developed an employee involvement philosophy (including joint partnership), and started to work on a contractual language (finished in 1993). Their implementation strategy included the appointment of UAW EI facilitators, established partnerships with company facilitators (HR), and the formation of specific local joint committees to establish and benchmark other companies. Under the EI

structure, UAW team leaders are selected by their peers. Team leaders and team managers attend training together where they learn to work as partners in managing the team.[8]

The EI program creates an opportunity to say, "how work is done," introduces more training, and more contact with management and communication with employees. As the EI process allows workers to change their work, issues of trust between managers and workers become important. According to one EI member, “management starts to believe in the workers and they start to understand the final product of EI.”

One of the key elements of the EI program is team decision-making. Teams are expected to take over day-to-day management of their work area. One team member mentioned that, “EI changed things 180 degrees from the past. It is expected that the team should take over day-to-day management. About 90% of the decision is made by the team.” Information sharing, including information on budget is important. Many of the employees mentioned that they were happy about these changes, though with some caution one person said, “at least someone listened,” and another stated “if they don’t use it, at least we had the chance to say it.”

Training:

Employee involvement builds upon training, employee empowerment and teamwork. A joint Rocketdyne/UAW team designed joint EI Training. Guidelines developed by the joint team include:

- “Require a prerequisite to becoming a team leader to get truly interested candidates
- Team leaders and team managers attend training together to learn partnership and leadership skills
- Entire team (including TL and TM) attend training together to learn basic team skills and techniques
- To promote a Union Company partnership, all training will have both parties facilitating the training
- To gain commitment for the program train floor/shop employees to conduct the training.”

The team and team leader training include a three stage training process:

- Phase I - Team Leader Candidate Class: 16 hours of training in 2~4 hour modules. Training focused on communication skills, leadership skills, problem-solving skills, and decision-making skills.
- Phase II - Team Leader/Team Manager Class: 20 hours of training in 1, 2, and 4-hour modules. Team leaders and Team Managers attend training together to learn partnership and leadership skills.
- Phase III - Team Training Class: 20 hours of training in 4-hour modules.

Other training offered includes 80 hours of numerical control (NC) training for each machinist but there is also training for maintenance and for EI job combos (conflict resolution, etc). Job combos are jobs that combine duties from one or more previously separate sets of tasks. New skills must be acquired by those who perform these combo jobs.

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Some managers mentioned that culture is a check off box after training although there is a culture change under way. One of the value changes described by a manager is that "leadership skills instead of technical skills are important to success." Some of the team members mentioned that the attitude or culture change is also beginning to occur because the teams have been given more responsibility and decision-making capabilities.

All training is delivered jointly by facilitators from the company and the union. The core of all training in the facility is 4000 hours of job combo training. (where training combined 2 jobs together). The state of California has granted a $10-14 per hour subsidy or reimbursement for the facility when it offers this training.

Two further components of interest in the EI include coaching and WINGS. In coaching peers stress team training and try to help people get along and to talk in a better way, WINGS is diversification training -- about dealing with different cultures.

Table

Sources of Instability:
Rocketdyne and Other Aerospace Plants

At this site and others, we conducted an attitude survey to study peoples' views on instability and related topics. The following table features the results on some survey topics for this location and the average results for all others. The survey topics are a variety of instability types, all from three broad sources of stability; changes in funding, changes in technology, and changes in organizational structure. For example, funding instability is reflected in changes in budget allocation for government contracts, internal company budgets and, product demand. These results represent a sample of the views of the entire workforce and must be interpreted from that perspective.

At Rocketdyne three of the instability types were significantly different from the average scores; changes in budget allocations for government contracts, supplier performance, and voluntary turnover. The biggest positive difference was in the scores for changes in external instability as seen in the changes in budgets for government contracts. This reflects accurately Rocketdyne's current efforts to shift toward more commercially focused business and away from a previous emphasis on the military/defense market. This means that a broad cross section of the workforce is very aware of this strategic challenge.

Significant results were found in two areas of internal instability: voluntary turnover and supplier performance. In both cases the scores were significantly and negatively different from the overall scores. Given the current initiative aimed at building team-based work and increasing employee participation plus the high skill levels associated with aerospace work, voluntary turnover would certainly have a negative impact on performance. The facility is already facing a shortage of skilled machinists and scores reflect concerns that were raised about the pace of efforts underway to remedy this shortage. People in this location also have experienced supplier performance issues as a significant source of instability. Clearly this is a subject for further research.

	ROCKETDYNE n=66 (1=never, 2=sometimes, 3=frequently)	AVERAGE OF OTHER PLANTS (4 plants, n=408)	DIFFERENCE
EXTERNAL SOURCES OF INSTABILITY			
Budget Allocations	1.95	1.65	0.31 **
Product Demand	2.05	2.25	-0.20 **
Customer Requirements	2.26	2.26	0.00
Equipment/Technology	1.92	2.16	-0.23 **
Supplier performance	1.59	2.00	-0.40 ***
INTERNAL SOURCES OF INSTABILITY			
Internal budgets	2.06	2.12	-0.06
Voluntary turnover	1.67	1.98	-0.31 ***
Reengineering	1.92	2.05	-0.12
Leadership vision	2.09	2.15	-0.06
Tension/stress around change	2.14	2.14	0.00
Subcontracting out work	1.82	1.72	0.10
In sourcing work	1.47	1.53	-0.06

* .1 level of statistical significance; ** .05 level of statistical significance; *** .01 level of statistical significance

Challenges

For many years the Rocketdyne facility operated in a relatively stable organizational and funding environment, but that has changed. Today, the Defense Department wants to increase the private sector's involvement in military space programs.[9] The EI program is helping to mitigate this shift with the organizational transition but there are some mismatches and conflicts that still exist between managers, engineers, and machinists or touch labor.

The EI program is moving into the workplace well but still has barriers to overcome. It is necessary to make sure that all the team members are trained, not only hourly workers but also engineers and upper management. As one union official noted, " The contract says that we will do our part, and the membership has done their part, …upper management is not doing their part." The intention of employment involvement is to increase the participation of teams out on the shop floor. Team members learn to control budget, work area issues, and work processes but some managers are unwilling or unable to give up control, so some teams do not have the same level of input.

Ongoing change and the EI program are driving adaptations in the organizational culture. This is also not an easy process. For example, one machinist recounted a story about an incident with the titanium parts wash process. The wash procedure involves dipping a part in a chemical bath that reacts with the metal of the part. A machinist was rotated to the job without completing training. An error occurred when an expensive part was dipped into a chemical bath that caused corrosive damage to the part. The normal procedure when this type of error occurs is outlined in Rule 48 which specifies that if a machinist makes a mistake, he/she is to be written up for the mistake, and must be taken out of that job. As might be imagined, this rule creates little incentive to report mistakes even when they might later cause further problems. Management's attitude in the past has been that mistakes need to be punished. This attitude must shift to one that encourages employees to learn from mistakes and make corrections as needed. Workplace learning and participation often depend on how the parties react to failures as well as successes.

One of the managers said that the change is difficult in a system with 40 years of history in traditional authoritarian relationships. Management still struggles with a mentality that says, "we pay the money and we make the decisions." There is often conflict between new commercially oriented attitudes and older military minded attitudes. Traditional roles as well as traditional attitudes must change. For example, under the new work environment, performance is dependant on the strength of EI team leaders and managers. They must understand that their role is different from the traditional role.

Flexibility also must be part of the machinist's role. For example, under the EI program, the machinist's job may now include inspection.[10] Machinists are also beginning to do some simple maintenance, i.e. changing lights, monitoring lubrication levels, and reducing the amount of certain types of work that regular maintenance workers perform. These changes of jobs and roles can cause conflict between machinists, maintenance workers, and engineers especially when these separations have long been governed by hard won contract language.

The job sharing and rotation efforts are driven by the fact that Rocketdyne and the entire industry are facing a shortage of machinists. Not enough skilled machinists are available nor are there young trainees in apprenticeship or other training programs. The youngest machinist at Rocketdyne is 39. In fact, one of the machinists said to us "I'm young," and he is 43 years old.

One union official expressed his concern that the company views are short term and the management team has not yet discovered how serious the situation really is. A union survey shows that only one area high school teaches machining. A successful effort was made to help the high school acquire updated tools for trades training. The Brown and Sharp Tool Company offered to install machines in the facility to allow on-site training in exchange for access by the machine company. The company said “no.” Many employees at Rocketdyne are in their 50’s and 60’s, while only a few new hires are in their 20’s and 30’s. The union’s concerns for future jobs and skills development do not mesh well with the more short term concerns and profit oriented management activities. One of the union members said that “the managers are not thinking ahead – not enough machinists, not enough skills, and these skills are not being taught in our schools or factories, it’s a dying skill."

Conclusion

Students in the public schools are not learning the skills needed to fill the vacant positions at the Rocketdyne and experienced employees are retiring from the company taking their knowledge and skills out the door when they leave. While the Rocketdyne focus on EI’s process skills such as communication and problem-solving abilities is important, there is less stress on work-based skills. An old mentality is still present which as one person puts it, “we lay people off when the work slows down and we don’t need to worry since other places will provide training for people that we can hire when the work picks up.”

Machinists have to operate specialized machines that require unique skills and experiences. If the company continues its current employment practices, they will soon lose the experienced workers with necessary work-based skills. A SWOT (current strength, current weakness, future opportunity, and future threats) analysis done among groups of workers at the plant show their concerns for this trend. The number one current strength was "the ability of the work force (core competencies, specialized knowledge)” but their number one weakness was "no accountability (accountability is not across the board)."

There is a gap about content of work between management and skilled workers. This reflects a gap between instability and mitigating strategies. The EI program at Rocketdyne has survived the acquisition by Boeing. It is still a very active program, but recognition of EI activity is limited at the plant level. Continuation of the EI program will contribute to a smooth transition from Rockwell International to Boeing, as well as helping to meet the challenges of a shift from military focus to commercial focus and international competition. The

program will have a greater impact with increased links to business strategy.

Effective functioning of the EI program is necessary to align team level activity with aggregate business goals. In order to improve this process, improving communication skills, information sharing amongst teams and an attitude change of the managers and team members is important, but also the EI program has to stress that its bringing market (internal and external customer) information into the EI process. Rocketdyne is now faced with organizational and cultural change issues of technologies and market competition. If the EI program is intended to bring customer needs into the process, then the program should be evaluated by judging the level of the customer satisfaction. This will bring market pressure into the system and this pressure will influence the employee's attitude/morale and the culture of organization.

Endnotes

[1] From Boeing Backgrounder information sheet available at www.boeingmedia.com

[2] From Boeing Backgrounder information sheet available at www.boeingmedia.com

[3] Ashley, S. (1998). Bringing launch costs down to earth. Mechanical Engineering, 120 (10), Fortune, November 8, 1999, The Economist (1999) Asia: A divine lift-off for China, Nov 27.

[4] Chase, N. (1998). Paperless manufacturing pays off. Quality, 37 (11), 46-47.

[5] IG-98-024, Cost Sharing for Santa Susana Field Laboratory Cleanup Activities. NASA, Washington DC.

[6] Fortune, November 8, 1999.

[7] The Lean Aerospace Initiative (LAI) was formally launched in 1993 and has evolved over time. LAI is a research partnership among the U.S. Air Force, labor unions, aerospace industry, and the Massachusetts Institute of Technology (MIT).

[8] RD and UAW Employee Involvement Program outline presented Feb. 1998.

[9] Willingham, S. (1999). Pentagon space program woos suppliers. National Defense 84 (553).

[10] Machinist jobs went to milling or general machinists, pdm (higher grade of 17) at Palmdale they created general machinist and they can pretty much run each thing.

Teaching Notes

It is people who are the heart of new work systems – establishing stability and then driving continuous improvement. The Labor Aerospace Research Agenda (LARA) at MIT is committed to furthering our understanding of the human and institutional aspects of these new work systems, especially as they relate to broader issues of employment and vitality in the aerospace industry. Toward this end, LARA is pleased to announce a new series of case studies. These case studies were written by a MIT-based research team and were developed in conjunction with representatives from each of the sites, with the help of representatives of the United Auto Workers and the International Association of Machinists.

These case studies are designed for use by union leaders, managers, trainers, college and university educators, and others interested in fostering constructive dialogue about the current dilemmas, challenges, and innovations in and around employment matters in the aerospace industry. These cases can be used in a classroom setting, in small discussion groups, or by individuals as thought starters.

This case study was prepared as an example of the challenges of instability in the aerospace industry. It was written as a basis for dialogue and learning, not as an illustration of either effective or ineffective actions. There may be many possible answers to these questions. They are designed to foster constructive dialogue and action on these very challenging issues.

Potential Discussion Questions

The following questions may serve as a starting point for further discussion.

- What do you see as the strengths and limitations of Rocketdyne's approach to training and skills development – with its focus on employee involvement and teams as the core of the process?

- What are the implications of workers getting some of their training from outside educational providers and of workers getting training when they are laid off?

- Is there evidence of a sense of urgency around an industry skills shortage? What would need to take place for there to be a higher level of intensity around training?

- For continual success the case study suggests that the EI program needs to be linked to business strategy. How can this be accomplished?

- What are the consequences of salaried employees gaining experience as team leaders and moving into management positions?

- Are leadership skills being valued more than technical skills and what does this mean to the company and it's competitiveness?

- Do you think that Rule-48 is a barrier to learning? If so, what do you recommend as an alternative?

Takashi Inaba and Betty Jo Barrett prepared this case with editorial and design input from Susan Cass, John Verbos and other members of the LARA team. This case study is an example of the challenges of instability in the aerospace industry and was written as a basis for dialogue and learning – not as an illustration of either effective or ineffective actions.
