The Power of Cross-Functional Teams in Driving Total Quality.

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INTRODUCTION

Garrett Canada, a Division of Allied-Signal Aerospace Canada, has been a member of the Canadian aerospace industry for 40 years. It was established in 1952 as a Montreal sales office for AiResearch Company of California. A repair and overhaul facility was established in Toronto in 1956. By 1961 Garrett Canada became a chartered corporate manufacturer of electronic temperature control systems for worldwide sales and distribution. Located in Toronto, Canada, Garrett Canada today has 1000 employees who design and manufacture advanced electronic thermal management systems for aerospace applications. Although Garrett Canada has always been a profitable division with leading market share, the changing and turbulent business environment and globalization of the aerospace industry has created new demands and challenges.

The marketplace is demanding faster introduction of new products, as well as shorter leadtimes for repairs and spares. It was recognised that reducing cycle times for new products and for ongoing production would not only satisfy our customers, it would also enhance our business performance through reduced inventories, lower past due, and more responsiveness to change.

It was evident that drastic step function changes were required if we were to maintain our position as a premier aerospace supplier.

THE CHALLENGE

The challenge was to convert a stable, somewhat slow-paced work environment with strong functional boundaries into a boundaryless world class team functioning in a total quality environment and focused on customer satisfaction.

Complete and uncompromised customer satisfaction has become our driving force, with Total Quality being our engine to continuously improve our processes and increase our speed.

MANAGING THE CHANGE

It was recognized that Total Quality begins at the top. The executive team has been revitalized to ensure that Garrett Canada remains a leader in its Total Quality initiatives. With highly charged leadership, we are on the road to becoming a world class company, able to respond to global competition effectively and profitably.

Building on our strength, energy was focused on revitalizing our key assets "our human resources", since we were addressing the issue of cultural change of the organization.

Our change philosophy was in alignment with our four business priorities:

- Meet our commitments
- Grow our Business
- Develop our People
- Simplify our Processes

Garrett Canada's primary business strategy has been focused on gaining competitive advantage on all three dimensions:

- Quality
- Speed (time)
- Cost

These priorities and business strategy have been stable for several years, and provide an anchor or focal point as we drive the cultural change through the organization. They also complement our Corporate Total Quality training program which focuses on:

- Customer satisfaction
- Process improvement
- People
- Act on fact

The Total Quality training program is being delivered to all Allied-Signal employees during 1992/93, and comprises of a four-day workshop. This training provides an awareness of the need for change, as well as the tools and methodology to execute the change. At Garrett Canada all 1000 employees will complete their training by the middle of 1993. The Total Quality training program is complementing our efforts to redefine the culture and behaviours of Garrett Canada.

IMPLEMENTING TOTAL QUALITY

Referring to the focus points of the Total Quality training program mentioned previously:

a) Customer Satisfaction

In 1991 we launched our Customer Advocate Program designed to provide Executive Management direct exposure to our customers. Key executive staff have been

assigned advocacy responsibilities for specific customers, for which they have to develop relationships with key individuals in their customers' organization such that they can provide valuable business contacts as well as make independent assessments of their customers' satisfaction ratings and feelings.

Metrics are being established for the five or so parameters which each customer deems to be most important to them, and which are indicative of our performance. These parameters are then charted in graph form, and are referred to as "5-Ups". An example of Garrett Canada's 5-Ups is shown below (see Figure 1).

These 5-Up charts are developed for both internal and external customers, and become the measure by which we evaluate our performance, and the measure by which we evaluate the impact of improvements made to our processes and operating methods.

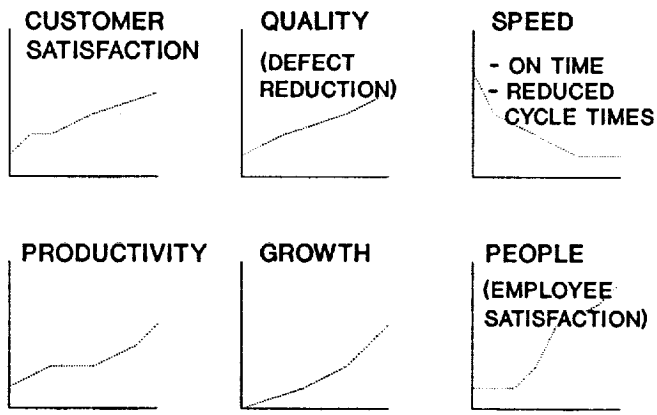

Figure 1 "5-Up" Charts

b) Process Improvement

A fundamental part of the Total Quality training is a nine-step Process Improvement/Problem Solving (PI/PS) Model. This provides a framework for improving the way we work. In the past, we have tended to fix symptoms of problems, with the result that the problem would recur, or worst still, the solution would give rise to a new set of problems. Problem solving has long been the bailiwick of specialist functions who often perform their tasks in isolation from the individuals affected by the problem. However, today's problems are predominantly complex, affecting many company functions. The need, therefore, is for a problem solving process which utilizes the stake holders and key players affecting, or affected by, the problem. This need gives rise to the importance of energizing the workforce to a level of motivation and commitment whereby the traditional bounds of job descriptions, "turf" issues, and Not Invented Here (NIH) syndrome, are no longer a factor. Employees must step beyond those bounds to improve their work processes and resolve problems thereby raising the company performance to a new high. The PI/PS model provides a common approach, consistency and thoroughness of

application which, when combined with our Total Quality training program, results in energized employees.

c) People

During 1991, two way employee communication was given a high priority. The introduction of biweekly INFO newsletters has increased employee awareness of the turbulent environment in which we are operating. The introduction of Special Recognition awards to multi-functional teams was a breakthrough and reinforces teamwork as a way of life at Garrett Canada. Weekly Employee Rap sessions with the president have opened up channels of communications. A Quality Day for key executives and managers encapsulates our determination to make Total Quality "real". Monthly presentations to all management and supervisory staff from the President ensure that business issues, competitive position, and operating results are communicated throughout the organization in a timely manner. The decision to deliver the four-day Total Quality training to each and every employee was made to ensure that all employees developed an understanding of the Total Quality process and the methodology, and were given the opportunity to develop their own capabilities and realize their potential. Training is given to natural work groups whenever possible, and incorporates their current problems as an integral part of the training material.

d) Act on fact

An extensive array of metrics has been introduced which reflect the performance of each function. Using a series of "5-Up Charts", each function, each department, and each individual is able to identify their customers, and the metrics which their customers deem to be important. These 5-Ups form the basis for measurement of progress of improvement, and the goals towards which the company and its constituents strive for. Identification of these 5-Ups, monitoring and follow-up of performance against them is fundamental to the success of our cross-functional teams. A system of metrics based on the flowdown of these 5-Ups was established to measure progress and to direct corrective action when required.

Our emphasis on Quality has not been limited to Engineering or Operations. Administrative functions have undergone significant reorientation to satisfy internal customers. Examples include Training, Human Resource Systems and improved Program Management Tools.

We believe the solution to changing the organization to focus on customer satisfaction in general, and speed in particular, is through the use of cross-functional teams and a combination of:

i) Process Improvement/Problem Solving Model,
ii) Total Quality Training,
iii) Clearly defined stretch goals, and
iv) Management support.

Total Quality efforts are being applied to our whole business process, from customer requirements through product design, supply management, manufacturing and customer support. This paper will focus on two major elements of our business process:

(a) customer requirements and product design - where we have implemented our Integrated Product Development Process to reduce the new product introduction cycle time, and

(b) supply management and manufacturing - where our Total Quality Teams are reducing operational cycle times.

INTEGRATED PRODUCT DEVELOPMENT PROCESS

BACKGROUND

Early in 1991, intense competition resulted in Garrett Canada accepting a new program contract which required us to establish product and engineering cost targets 25% lower than planned - a plan which was already aggressive. Working harder may have achieved a 5-10% savings but we had to find a way to work smarter. To reduce cycle time and corresponding costs we decided we would have to eliminate most of the sequential releases and builds of development hardware configurations. Each version of equipment would have to be as close to right as we could make it on the first pass. We could not tolerate the several rounds of downstream changes caused by factory inputs and misunderstood customer requirements. Our approach was to form teams to address each major area of engineering development, with members from all of the engineering disciplines involved in the design and definition of the new product. As well as project, design, manufacturing, quality assurance, test and customer service engineers, we also incorporated program management, contracts and sales members as appropriate. Our customer and key suppliers were also included in this process. This is the essence of concurrent or simultaneous engineering. We call these teams Design-Build Teams or DBT's. Cost targets for all major system components were established, and criteria were developed which allowed trade-off decisions between non-recurring costs and recurring labour, materials, and relevant overhead. This provided the teams with a more objective tool for design review product-cost decision-making.

GETTING STARTED

We were fortunate that our customer was also deploying their own integrated development process and, as a major supplier, we were invited to attend training courses at their facilities. We sent a small group of our key people to participate. This group became the core of our own project Design-Build Team and training facilitators for subsequent lower level Design-Build Teams.

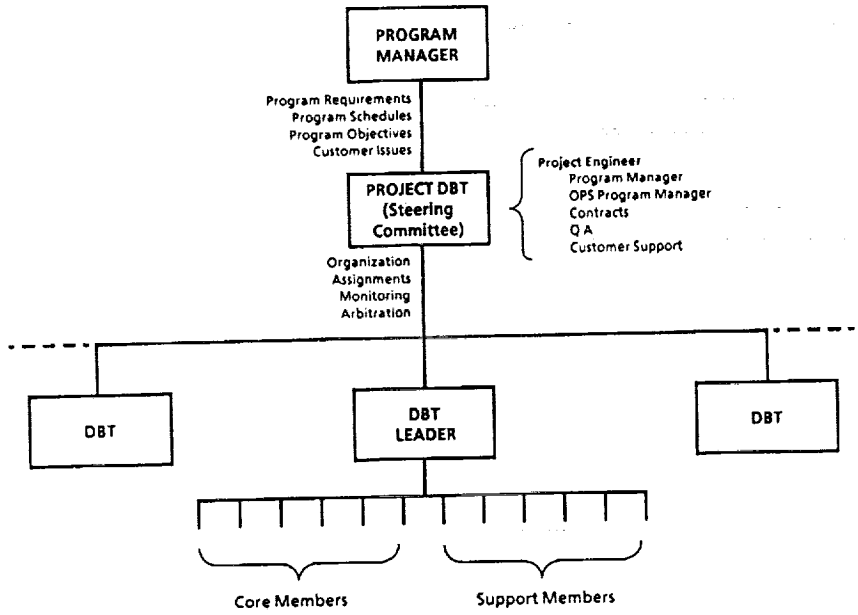

Figure 2 Design-Build Team Structure

Although a smaller project could operate with a single project DBT, the project we addressed involved a significant number of contributors. We divided the project into seven subsidiary DBT's for significant design activities, and assigned appropriate members from cross-functional disciplines. Core members would serve more-or-less full time on these teams, and support members would serve on several DBT's on a part time basis (see Figure 2). Once formed, the teams (both core and support members) were given eight (8) hours of training in two sessions. All teams were trained as a group in the overall process and underlying principles. These included DBT structure, team synergy, building consensus, and project goals. Subsequent to this, each individual team had separate training to help develop their own operating norms and goals (eg. meeting processes, roles and responsibilities, and setting detailed time-phased team goals and objectives).

In this mode of operation, Design-Build Team members operate in a matrix organization (see Figure 3). We are a medium size division which is called upon to support 10 to 20 new product development projects at various stages of completion, and provide continuing support for ongoing production products. This approach provides flexibility and optimum use of our engineering resources. Key to success in this process is the balancing of program and functional responsibilities by the DBT members. The program goals are focused on Cost, Schedule and Customer Specification Compliance. DBT members must also incorporate home department functional initiatives focused on departmental resource planning and strategic directions which address preferred technologies, automation, standardization and reuse. Success in this approach is founded upon training, individual accountability, enlightened, supportive functional managers and an overriding commitment to customer satisfaction.

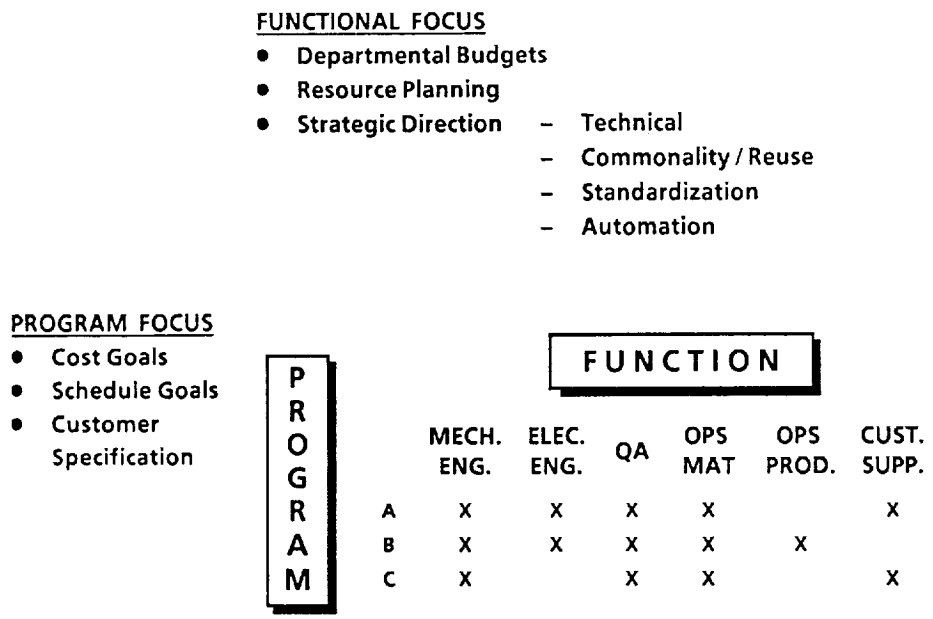

Figure 3 DBT Members have Matrix Responsibilities

EVOLUTION OF THE PROCESS

The Design-Build Teams have been operating for approximately eighteen (18) months. The Pilot Project is on schedule with all major customer milestones met. Development non-recurring costs are tracking the 25% reduction line and the current manufacturing product cost estimate is at 74% of its original value (see Figure 4). Both our customer and suppliers participated jointly in design studies and technical reviews. The program Critical Design Review was successfully completed this spring and the first production prototype units are being fabricated in our manufacturing new product cell - this cell being the result of a Total Quality team effort. Several other projects have also benefited from the manufacturing process reviews and test procedure development conducted in this dedicated facility.

Early Results are Positive

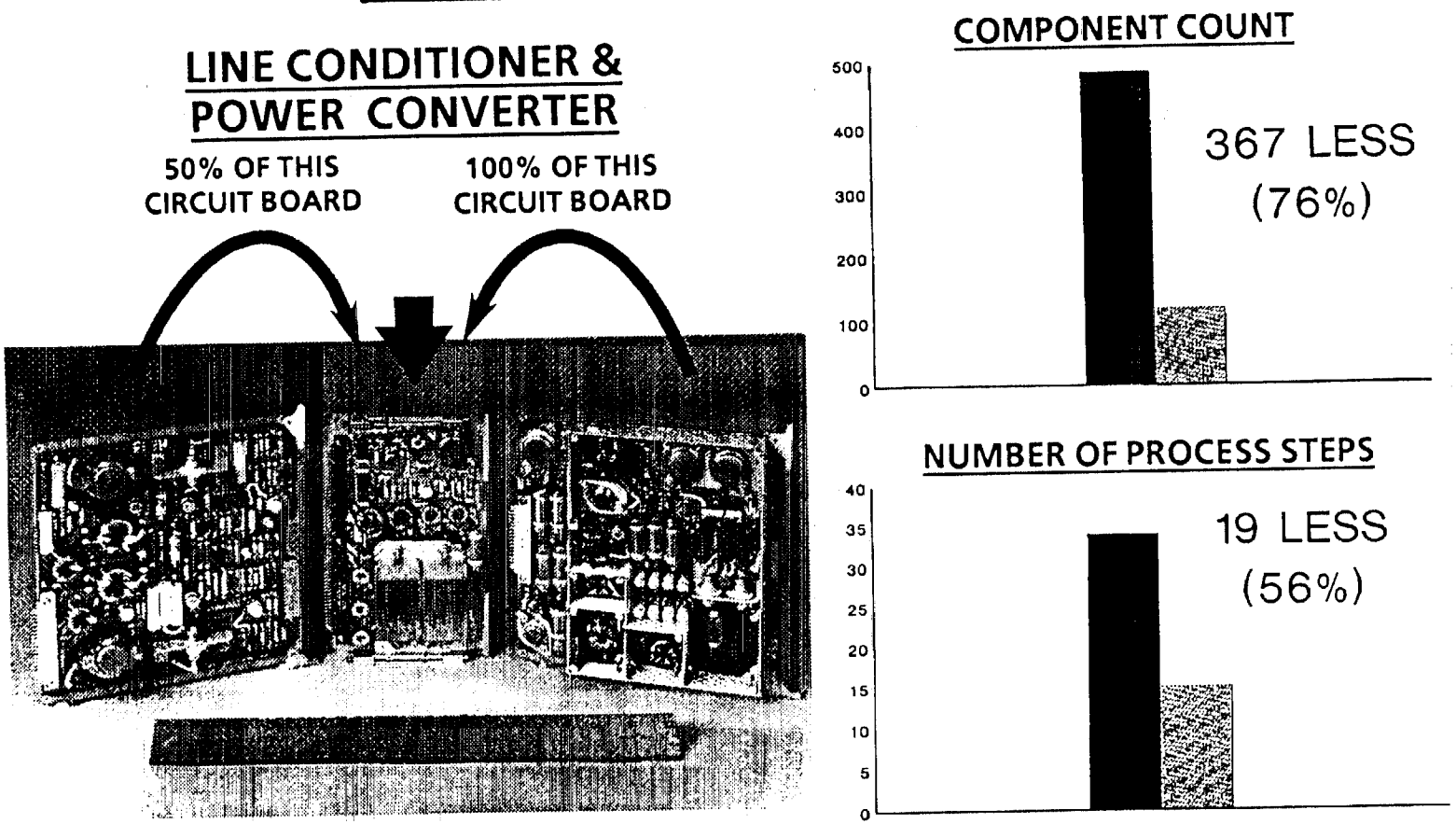

Figure 5 Power Converter Module

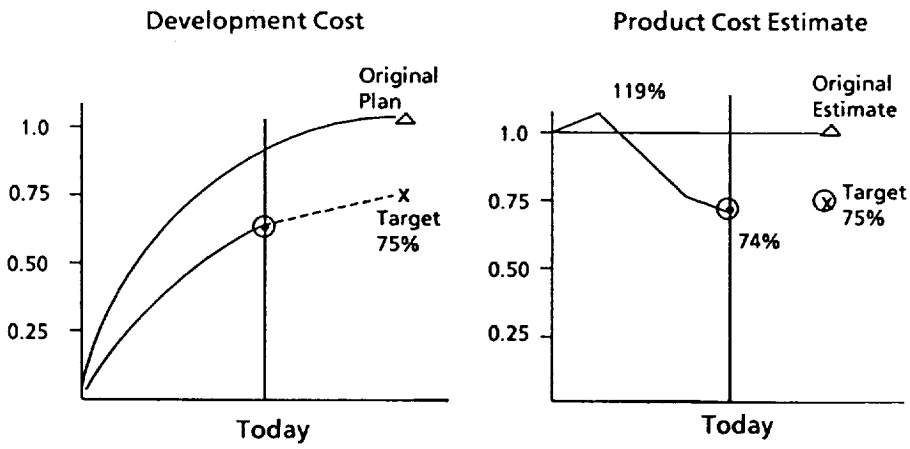

Figure 4 Project Cost Status

One of the early significant results of the approach was achieved by a sub-team which tackled the design of the Power Converter Module and involved the design engineer, a component engineer and purchasing representative as principals. They evolved a power converter design that eliminated one complete printed wiring board assembly, reduced the types and numbers of components required by 76% and manufacturing operations by 56% (see Figure 5). This design approach offered such significant savings that it has been back designed into several other existing products.

As the individual DBT's addressed their tasks, the only common process procedures they had to work with stemmed from their individual basic training. Each group evolved their own operating procedures and design review approaches. The project Design-Build Team Steering Committee provided a level of consistency and forum for the migration of best practices across the several subsidiary DBT's. Not all of the DBT's were equally successful. One team leader and team members changed at their own request due to dissatisfaction with their results and the process, and two other teams merged into a single team. The process was deemed to be of substantial benefit, due to the cost savings indicated by the pilot project, and perhaps more importantly by the fact that ad-hoc "Design-Build Teams" were beginning to perceive benefits and form themselves spontaneously on other development projects.

The evolution of the design-build process was planned following the Deming/Shewart Plan-Do-Check-Act (PDCA) improvement cycle (see Figure 6). As described in the preceding paragraphs the "check" portion of the cycle was indicating that the process was beneficial and the "act" portion of the cycle would require a review of lessons learned, development of formalized process procedures, training and deployment of the process on a division-wide basis.

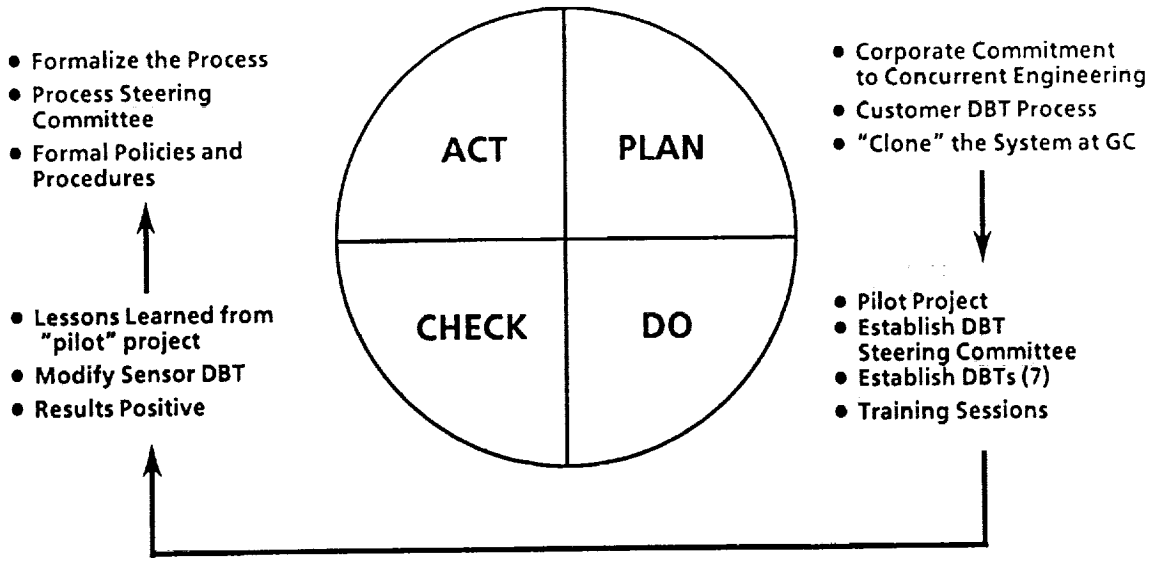

Figure 6 Evolution of the Design Build Team Process

As we began to develop the formal design-build procedures we identified four (4) key components of the process that required specific proceduralization at the division (see Figure 7). First was an overriding policy statement (P&P 6.7) that clearly states and acknowledges Management's Commitment to a team oriented, disciplined approach to new product development. The myth that engineering is an art that cannot be defined by an underlying cooperative process cannot be allowed to persist. Second, the definition, composition, roles and responsibilities of Design-Build Teams (P&P 6.8) are defined, as well as consensus and appeal procedures to prevent deadlock. Third, Management Roles and Responsibilities in the review process are defined and checklists provided (P&P 6.9). The key here is to make these periodic reviews a non-threatening and value-added process. They serve to keep a direct management involvement in the product development process and provide opportunity for recognition of the project team for goals successfully achieved. Finally, the methods for conducting detailed design reviews incorporating lessons learned checklists, and action closure logs were defined (P&P 6.10). These technical reviews are to ensure that product performance and product safety requirements are met, as well as functional department initiatives for design practices, standardization and reuse.

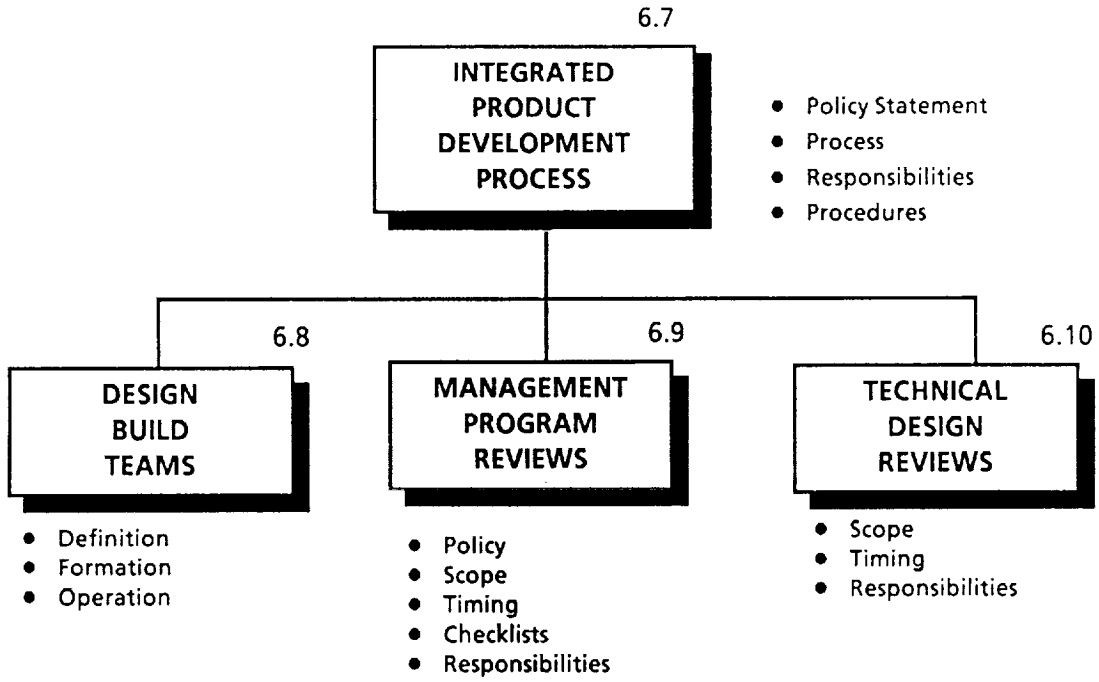

Figure 7 Integrated Product Development Process

LESSONS LEARNED

During the pilot project and evolution of the Design-Build Teams, an integrated Product Development Process Committee was formed and chaired by the Vice President, Engineering. Members included the pilot project Engineering Team Leader, the Program Manager, the Manufacturing Manager of the New Product Module, a Quality Assurance Engineer, and the Director of Design Engineering. This committee met approximately bi-weekly for a period of six (6) months to track the pilot project, interview DBT members, develop policies, procedures, training materials and process deployment plans. The Division President and Executive Staff were briefed periodically on project status, participated in two Management Program Reviews, and key members reviewed and commented upon the policies and procedures as they were developed. The Management Process Committee conducted two half day training sessions on the Design-Build Team process for division mid-management and functional supervisors who would become involved in the DBT approach to new product development.

Prior to division wide deployment of the process, a summary of the Key DBT Lessons Learned at that point was as follows:

- Set Stretch Goals
- Supervisor Support Required
- Follow Up Training Required
- Process Needs formalizing
- Disciplined Adherence To Process Essential
- Strive for Real Consensus
- Rigorous, Critical Reviews Necessary
- Physical Co-Location Helps Mental Co-Location

First is a clear project goal, which represents enough stretch to displace the "Lets work a little harder" paradigm and an openness for new approaches to develop. Support from first line supervisors and middle managers from the functional departments is essential. They feel the most threatened by this process and communication, training and re-enforcement of their importance to the process is critical. The shift of role from "supervisor" to "coach", and the delegation of decision-making to team representatives are difficult challenges which we have to address.

A one-time training effort is not sufficient. The new process requires continuous reinforcement in its early stages. As DBT members change due to employee turnover, reassignments or as the project moves into later stages, this initial training will help refamiliarization. More focused training to address specific team needs must also be provided.

The process must be formalized, documented and deployed across all affected departments. It was useful to solicit input and comments from key department managers during development of the top level command media to assure wide-spread "Buy-In"to the process.

The need for better tools and a higher degree of automation has been identified as a critical success factor. Being planned is implementation of formal Design For Manufacturability and Assembly (DFMA), centralized databases for lessons learned and functional checklists, and Quality Function Deployment (QFD).

Once established, a disciplined adherence to the process must be enforced. Automated tools, routine use of the review process with Lesson-Learned checklists and closed-loop action tracking are important to success. We are maintaining an active process overview committee, and process changes with upgrades are planned so that improvements may be incorporated and a method of removing areas of discontent is available. Real, not apparent consensus is the foundation of the team approach to the design process. The initial fear of "Design by Committee" must be displaced early. A norm of open, honest dialogue with fact based decision making must be established. Rigor and constructive criticism from peers during team meetings, and from management during reviews, is essential to ensure that progress is reported accurately, and that risk assessment and risk avoidance plans are realistic. This rigor reinforces the need for accurate data in order to "act on fact". Out of the IPD process came improved metrics and a better understanding of the numbers, causes and impacts of design changes on the manufacturing process and the installed base.

Role playing and consensus building exercises during initial training were found to be helpful and also the more successful teams were comfortable with rigorous open and critical technical reviews. Shifting the focus to customer satisfaction tends to disarm the inherent

defense mechanisms and sets up a common goal for all team members. This focus also helps to combat the "Abilene Paradox" - in which all members of a team reach agreement to a particular course of action at a team meeting, but individuals in that team would disagree with the course of action when questioned separately.

Finally, team members who were located together benefited from the improved communications. Although it is not possible for all resources to be dedicated and co-located, team meetings and program/technical reviews served to reinforce the "mental" co-location.

WHAT'S NEXT

Teams have been formed to automate and standardize the lessons learned data base and a review discrepancy tracking system. Members of the original pilot project DBT's have been retrained, the next several projects to use the process are scheduled for training and by the end of the year all new product development projects will use the process. Additional training modules to provide improved team dynamics, leadership skills, and support tool introductions are planned (including DFMA, QFD, Design of Experiments).

Better process metrics are being developed. Better tools to help the teams make more informed cost decisions during the design cycle and another PDCA cycle to implement automated DFMA analysis tools has been initiated. The simple four-phase PDCA cycle is now being expanded to follow the Allied-Signal 9 step PI/PS model.

A simplified process guidebook to serve as a reference document in support of the policies and procedures is scheduled to be released in the next few months. The IPD Steering Committee will focus on best practices and continuously feed improvements to the teams. Finally a preplanned process review and command media upgrade will be conducted.

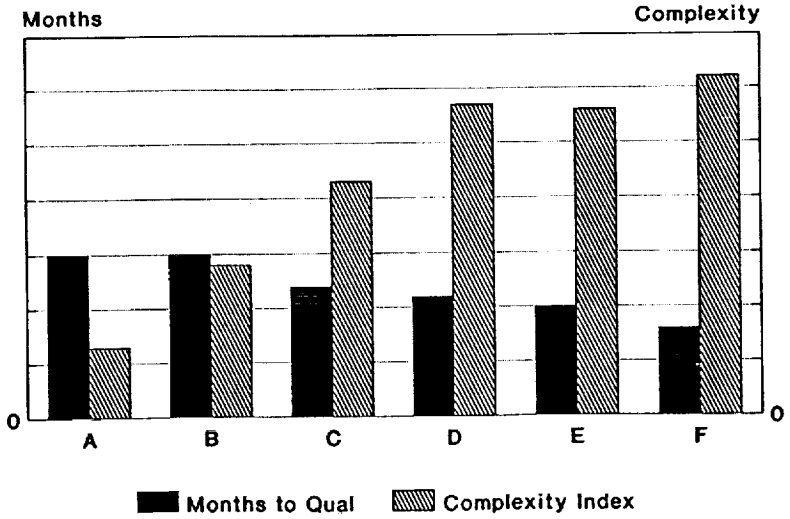

Figure 8 Cycle Time vs Complexity

SUMMARY

At Garrett Canada an integrated new product development process has been implemented which captures the power inherent in multi-functional Design-Build Teams. Customer and supplier representatives have also participated and relationships have been strengthened. Results to date are showing specific reductions in product and development costs in excess of 25%; and new product development cycle times are being reduced even though the product complexity is increasing (see Figure 8). Additionally, design and test approaches have evolved from these teams which have offered additional savings for non-related projects. During the development of this new process a Deming/Shewart PDCA cycle was followed which is now serving as a model as we address other division critical operating processes.

Getting the product designed "right the first time" is only half of the battle for improved cycle times and business performance. We also had to address the procurement and manufacturing cycles and the provision of high quality products so that we could satisfy our customers' needs and expectations.

CYCLE TIME REDUCTION THROUGH TOTAL QUALITY TEAMS

BACKGROUND

Traditional order-to-delivery cycle times in the aerospace electronics industry are measured in months, resulting from long material procurement leadtimes and long manufacturing cycles. These long cycle times result in increased investment in inventories, and reduced flexibility and responsiveness to change in product or schedule.

Improving material supply and manufacturing cycle times will enhance competitive advantage through reduced inventories, lower quality defects, increased responsiveness to changes, lower operation costs, and better customer focus (see Figure 9).

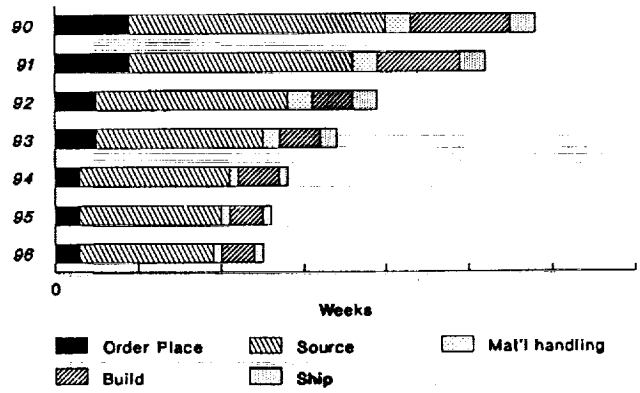

Figure 9 Operations Cycle Time Reduction

Specialist support functions have traditionally driven improvements in operational efficiency; but such efforts have failed to achieve the full potential of the synergy which results from involving all employees in the improvement initiatives.

Garrett Canada has developed and implemented a number of cross-functional Total Quality teams deployed to improve cycle times through the order-to-delivery process.

ORGANIZATION

The company organization is in the process of being redefined where necessary to focus on Customer Satisfaction through reduced cycle times. Traditional hierarchical organizations are characterized by slowness, bureaucracy, functional silos, and individualism. Changing the structure of the company is fundamental to achieving a fast, responsive organization. The company reorganization included delayering supervisory and management levels (see Figure 10), consolidating near-duplicate functions, and eliminating non-value added work and this reorganization process is continuing.

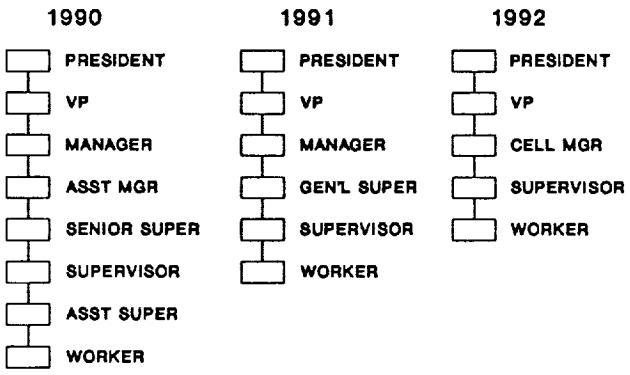

Figure 10 Organizational Restructuring For Speed

Simplifying the organization is resulting in lower costs, shortened cycle times, improved levels of quality, improved communication, better customer service, and last but not least, improved employee morale.

CREATING THE TEAMS

a) The Operations Managers (8) became a steering group to coordinate the overall TQ team efforts, with the need to avoid duplication or overlap of team efforts, and the need for the teams to achieve tangible results.

b) Successful teams require a management mentor to act as a coach who provides encouragement, and runs interference when the team reaches a roadblock beyond their control.

c) Another key element of a successful team is a clear understanding of commonly defined stretch goals and expectations. This is achieved through assigning a draft problem statement to the team, followed by a review of the team's final definition of the problem which they are to solve.

d) Teams are formed from "natural work groups" - those individuals who would naturally be formed to solve a problem or improve a process - they may consist of members of only one department, or may comprise of representatives from several departments or several company functions. The team membership rarely changes until the team's problems is resolved (ie. membership does not rotate).

e) The team leader is identified by the Operations Management Steering Group, as an individual who has a significant stakeholding in resolving the problem, who has the commitment and drive to see the problem resolved, and who has the necessary people-skills to lead a team. The team leader works with his Management mentor to identify the team members needed to solve the problem.

f) Once formed, a team is provided with basic Total Quality training on objective/goal setting, problem solving and team interaction. This team interaction includes establishing team member responsibilities and defining a code of conduct and team norms. During this training, emphasis is placed on the need to solve the root causes of the problem and not simply to fix the symptoms, and to demonstrate a basis for action. This is achieved through the use of the 9-step PI/PS model, and the use of ambitious but achievable schedules for completion of the team task.

g) Finally it is made clear to the team that they have the responsibility and authority to resolve the problem - they are empowered by Management. Support from the Management mentor and the whole company Management team reinforces this empowerment on a regular basis, and builds commitment of individual team members.

In addition to the Design-Build Product Development Teams already discussed, we currently have thirty (30) TQ Teams chartered to improve processes throughout the operations activities. These teams include:

Linear Shipments	A team with participation from Operations, Engineering, Contracts, Quality, Program Management and Accounting meet daily to resolve critical issues impacting shipments.
Quality Ownership	A team was formed within manufacturing to dramatically alter employee attitudes towards quality and drive significant improvements in both process and products.
Concurrent Design	Teams were formed to fundamentally change the working relationship between Design Engineering, Operations, Quality Assurance, Suppliers and Customer Support.
Dimensional Issues	Teams were formed from Engineering, Operations, Quality and Suppliers to aggressively eliminate delays caused by dimensional issues and product design resulting in radical shift in the design concept.

Solder Defects	Team formed to dramatically drive down rejects off the wave soldering machine (see Figure 11).
Past Due	Team formed to virtually eliminate controllable past due shipments (see Figure 12).
Growth	A program-specific team formed to slash delivery times and win the order in a new business area (see Figure 13).
Factory Redesign	A natural work team formed to design their own dedicated work cell for a specific customer product line.
Critical Items	A team of Management representatives from each function was formed to identify critical items affecting short-term operating performance. Meeting on a daily basis, this team is able to cut through bureaucracy and quickly initiate change.

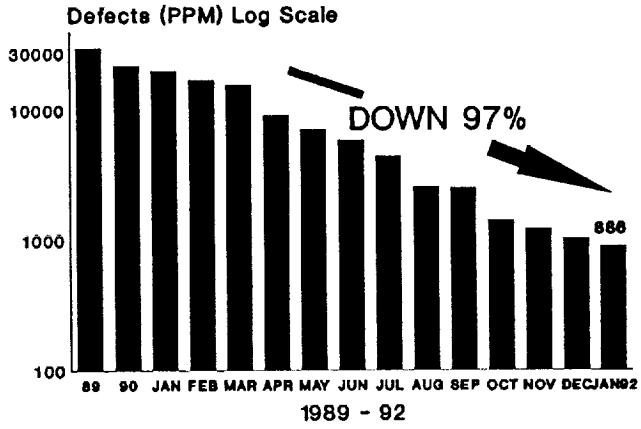

Figure 11 Solder Defect Reduction

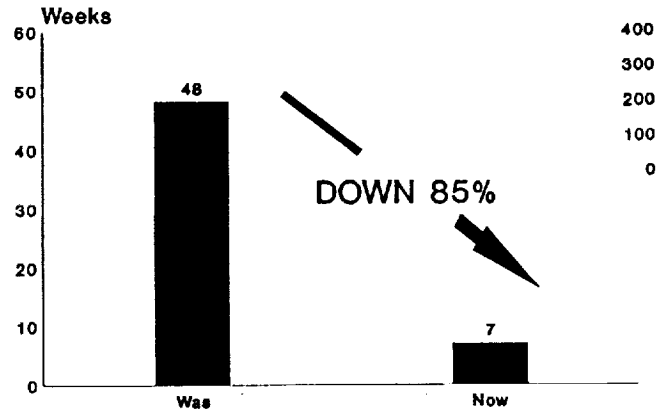

Figure 13 Manufacturing Delivery Time

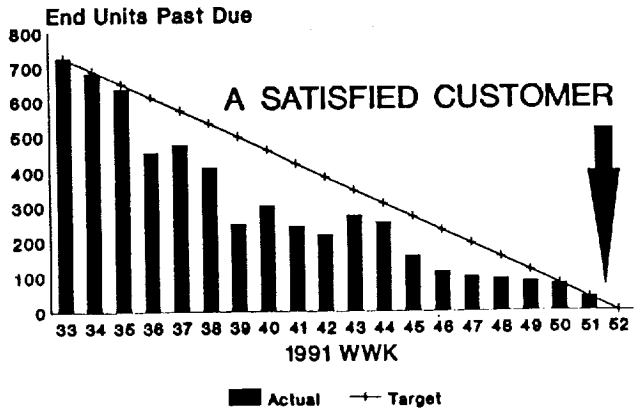

Figure 12 Units Past Due

RESULTS

We have moved the "yardsticks" forward. Our critical success factors are simple. Set stable priorities and develop our Human resources. Significant accomplishment through the use of cross functional teamwork have payed substantial dividends. We are reaping the benefits of a "greenfield" approach to redesigning our factory without the short term cost and time penalties associated with such a strategy. Some of our key accomplishments are listed below:

Increased factory sales per operations employee by 46%

Delayered organization by 2 levels

Reduced wave soldering defect levels from 20,000 PPM to less than 1000 PPM

Reduced Past Due
Total past due slashed from 42 days to 13 days in 5 months
One major customer's past due reduced to Zero

Reduced one program lead time from 10 Months to 38 days (potential business opportunity $16M)

Reduced Controller lead times by 25%

Increased Burn-in Yield from 80% to over 90% while Reducing test labour by 80% through automated test

Reduced defects by 20% through Quality Ownership program (at the same time reducing Inspection census by 16)

Reduced one program shipset cost by 26%

Increased Outgoing Shipments linearity from 52% to 86%

Saved 9% on $20M through supplier partnering and purchase economies

Over 20% of our vendors are now Certified Vendors

Increased the amount of materials received from Certified Vendors/Source Inspected to over 30%

Eliminated all work in process stops due to dimensional issues

LESSONS LEARNED

a) Utilize ground won by others

In the area of external orientation, key employees visited other ASAC divisions to counter the "not invented here" culture. We have benchmarked our performance against other Allied-Signal Divisions including AiResearch Los Angeles Division - Software processes; Allied-Signal Engine Controls Division - Quality Function Deployment process; AiResearch Tucson Division - Cost/schedule control.

In Operations, we participated in the Canadian multi-industry Manufacturing Visits Program involving over 50 companies to learn how others are dealing with competitiveness challenges.

On the international front, 3 key Directors/VP's toured the U.S, Europe and Japan to view how world class operations are meeting the challenges of the nineties.

We will continue to benchmark our performance and learn from the best - both inside Allied-Signal and outside the corporation. As a result of our efforts to date, the number of "agents of change" is more than adequate to sustain the momentum for cultural change in all areas of Garrett Canada.

b) Team formation/effectiveness

The normal team cycle of "form - storm - norm - perform" can be improved through the use of TQ Leadership Training. The "form","storm" and "norm" effort can be drastically reduced through the use of effective training and a common approach to team norms and PI/PS models; everyone speaks a common language and has a common understanding of the tools.

c) Symptoms vs root cause

In the past, we have spent a lot of effort fixing symptoms - only to have the problem recur later - or to create a new problem. The PI/PS model used by Allied-Signal applies considerable effort to defining the problem, and to identifying the team players necessary to resolve the problem. With management support and effort, a clear definition of the problem can be established and the team is then better able to resolve the root causes.

d)"What you measure is what you get!", and "What gets measured gets improved!"

Meaningful metrics are fundamental to the improvement process. Metrics are the facts on which we act. They establish the basis for problem identification and for evaluation of alternative solutions. They provide the feedback to measure the effectiveness of process changes. They provide the foundation for performance evaluation of departments and individuals. Most importantly, they provide the touchstone of our customers needs and expectations. Garrett Canada's system of metrics is continually reviewed to ensure that they reflect the changing needs and expectations of our internal and external customers.

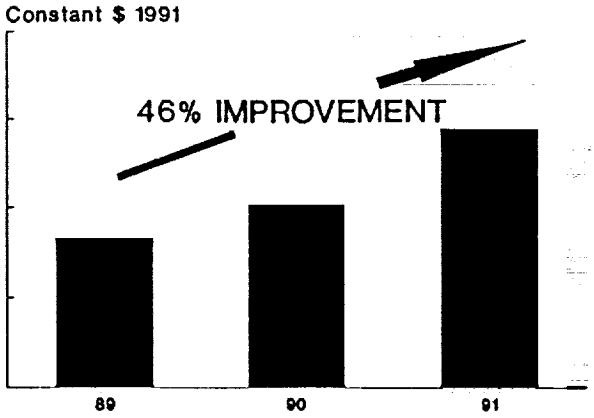

Figure 15 Factory Sales/Ops Employee

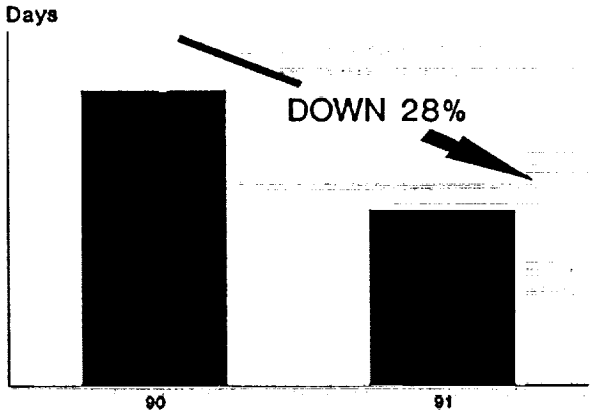

Figure 16 Manufacturing Inventories

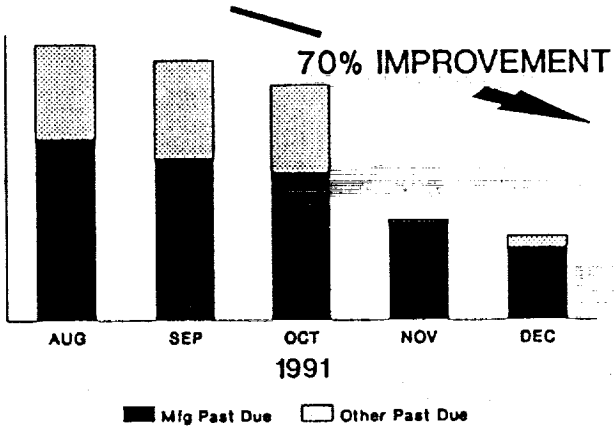

Figure 17 Total Past Due

THE FUTURE

As Total Quality becomes embedded in our behaviours, there will be more TQ Teams chartered to improve our processes. This will require formal policies and procedures which establish guidelines for obtaining a Team Charter, and for Problem Screening and Prioritization.

Recognition and reward systems such as "gainsharing" are being evaluated to reinforce effective teamwork.

As we look towards self-directed work teams, changes in middle management's role will need review, as their role evolves into one of a coach rather than a traditional manager.

CONCLUSION

The improvements in cycle times achieved through our Cross-Functional Teams and our Integrated Product Development Process translate directly into improved business performance and product and service quality. Factory Sales per Operations Employee is up 46%(see Figure 15), Manufacturing Inventories are down 28% (see Figure 16), Past Due is down 70% (see Figure 17), typical cycle times are down 25%, and quality levels are higher.

Our quality is best measured through the eyes of the customer and by the customer's confidence in us and our people. The best indicators to attest to this high confidence is the authority to accept product on their behalf:

> Department of Transport Canada has authorized nine Garrett inspectors to sign Certificates of Airworthiness.
>
> Boeing has authorized three source inspectors.
>
> General Dynamics Ft. Worth and Land Systems have each authorized two source inspectors.
>
> Garrett Canada won the prestigious Northrop Gold Key Award. This is the first time this award has been granted outside the United States.

Also worthy of mention, the Canadian Government has recognized Garrett Canada's commitment to customer satisfaction and improvement by awarding Garrett Canada with a Certificate of Merit for the Canadian Awards for Business Excellence (a Canadian award system equivalent to the Malcolm Baldridge Award).

Cross-functional teams and the Integrated Product Development Process are yielding significant improvements in business results for Garrett Canada, along with improved customer satisfaction and enhanced employee morale.

We will continue to tap the enormous potential of our employees as we travel on our never ending journey of continuous improvement.

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