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Key lessons from the implementation of an ERP at Pratt & Whitney Canada

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Abstract

This article uses a case study approach to evince the lessons learned from a successful implementation of an ERP system. It points out some strategic, tactic and operational considerations inherent in an ERP implementation that are prerequisites to effective organizational transformation required by a system implementation such as SAP R/3.

At the *strategic level*, top managers established a clear vision of the role of the ERP project in their business model, along with P&WC's strategic priority. They created a feeling of urgency, and precisely determined the scope and scale of the project. Top management then committed substantial resources by allocating sufficient human and financial resources and persevered in backing a structured and disciplined approach to implementation until completion of the project.

At the tactical level, P&WC redesigned its organization with a view to increasing coherence and rigor, at an opportune time. It took on recognized technological partners that used a proven methodology that was meticulously applied. The human aspect was given a preponderant role. Moreover, clear measurement indicators were used to assess progress.

At the operational level, the Change Leadership and Knowledge Transfer teams played a crucial role in this process. The impact of the ERP system on employees was studied extensively and integrated in the action strategies. Change sessions were decentralized within business units. A massive training program was deployed using many of P&WC's own employees as instructors to ensure a better appropriation of the technology. The experience of Pratt & Whitney Canada (P&WC), a large aeronautics company, reconciles both the requirements of a large-scale project and the capacity of an organization to successfully meet the challenges associated with such an implementation. In particular, this experience demonstrates that success is conditional on adequate management of the complex context of an ERP implementation.

Keywords: ERP systems; Change management; Project management

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1. Introduction

Today, the integration of companies' business processes is, if not a necessity, a requirement linked to the reactivity imperative. Organizations' zeal to adopt integrated ERP systems is thus highly justified because these systems are believed to dramatically improve competitiveness. SAP R/3 has emerged as the dominant leader in ERP systems, and is now one of the most widely used tools for optimizing and re-engineering business processes (Cooke and Peterson, 1998; Al-Mashari, Al-Mudimigh, 2003). Siemens (Elliott, 1997) and Lucent Technologies (Francesconi, 1998) for instance, have implemented SAP R/3 to improve the integrity of their supply chain.

Nonetheless, even under ideal circumstances, ERP implementation is fraught with formidable challenges (Motwani et al., 2002). For one, the company must successfully transform its organization within the specified time frame and within budget (Welti, 1999; Weston, 2001). Until recently, the implementation process associated with such systems has been particularly long (Laughlin, 1999). Standish Group found that 90% of ERP implementations end up late or over budget (Umble et al., 2003). In some cases, the implementation time is extended indefinitely, which has negative consequences for both the companies and the morale of their employees (Gupta, 2000; Mabert et al., 2001). Note that this endeavor represents much more than a simple technological implementation in the traditional sense of the term (Austin and Nolan, 1999; Mandal and Gunasekaran, 2002). The organizational change and process re-engineering in ERP projects, the enterprise-wide implications, the high resource commitment, high potential business benefits and risks associated with ERP systems make their implementation a much more complex exercise in innovation and change management than any other advanced manufacturing technology (Kumar et al., 2003). Putting in place an ERP necessitates a transformation that is simultaneously strategic, technological, structural, organizational and social. It is therefore not surprising that many ERP implementations fail (Soh et al., 2000). Mabert et al. (2003) found that even with significant investments in time and resources, a successful outcome is not guaranteed. Radding (1999) argues that when an organization channels millions of dollars into a core business application and re-engineers its business processes around it, the exercise invariably becomes much more than a systems development project.

Implementing ERP systems successfully requires an implementation strategy. Cooke and Peterson (1998) observed that organizations that had no strategic plan for SAP implementation performed poorly 90% of the time compared with those that had a plan. A strategy and a plan, however, should follow systematic consideration of the company's requirements and its ability to manage changes that would be required under the new situation. Companies must carefully define why the ERP system is being implemented and what critical business needs the ERP system will address (Umble et al., 2003). As Mandal and Gunasekaran (2003) affirm: "Such a strategy, either step-to-step or Big Bang, will determine how the related changes can be successfully absorbed at various parts of the organization".

While practitioners and academic scholars (articles and cases studies) provide valuable insights into ERP implementation process issues and key factors that lead to a successful implementation, a more systematic empirical analysis of ERP implementations is essential for understanding the ingredients of successful system implementation, as measured by on-time and on/under-budget performance.

We have chosen to analyze the implementation of SAP R/3 at Pratt & Whitney Canada (P&WC), a large aeronautics company, because this initiative reconciles both the requirements of a large-scale project and the capacity of an organization to successfully carry out the organizational transformation required by the implementation of such a system. The project began in June 1996 and ended in January 1999 (two and a half years) and is recognized as a success story (SAP, 2000; MacInnis, 2002). Through the local chapter of their professional association, two of the authors organized interviews with the P&WC project manager in October 1996 at the start of the project and again in July 1999 when the success of the

project was acclaimed by United Technologies Corporation (UTC), which controls P&WC. The authors were subsequently granted access to much of the documentation produced for this project, both during and after implementation. They could obtain detailed results that were required as evidence of the success of this implementation. All data taken from the main sources were consolidated and linked to create a full picture of the entire implementation process. This article describes the approach followed by P&WC, as well as tactics and techniques used to operationalize its change plan. It provides evidence of the lessons related to this successful implementation of an ERP.

2. Background

P&WC is a Canadian company whose Head Office is located in Longueuil, Quebec, Canada. It belongs to the United Technologies Corporation group, based in Hartford, Connecticut. It designs, develops, manufactures and markets a range of superior quality turboprop, turbofan and turboshaft engines whose power ranges up to 20 000 horsepower. P&WC also provides maintenance and support services, which account for slightly more than half of its revenues.

In 1999 the company controlled about 24% of the highly competitive markets in which it operates. Its competitors included General Electric, Honeywell and Rolls Royce-Allison. For over a decade, P&WC's market has fragmented somewhat, taking on the characteristics of "mass customization" markets, that is markets in which customers are offered products based on individual orders, at costs as low as those of series production (Pine II et al., 1993). To remain competitive, the company multiplied its models of engines and cut production times. It also honed its production processes to be able to design innovative engines adapted to its customers' needs, and deliver these products quickly and reliably. The P&WC executives constantly strive to better respond to an increasingly harsh competitive context (market globalization, increasingly constraining customer requirements) and to maximize the creation of value (improve productivity, service provision and functional efficiency).

With customers in over 180 countries, over a dozen plants in Canada and abroad, and a network of service centers strategically located worldwide, P&WC's customer service requirements dictated that a common information system be put in place. Benoît Durand (1999, p. 7), ERP project manager at the time of the project implementation, reported that, "*implementation of SAP/R3 as such was an ambitious project intended to enable the entire company to fully benefit from the integration possibilities offered by this new technology*".

3. Scope of ERP project

The fundamental objective of the implementation of an ERP system at P&WC was to put in place an information infrastructure (called the Total Enterprise System (TES)), that would foster greater transparency vis-à-vis its customers worldwide, along with greater agility. In particular, P&WC wanted to improve customer response time, reduce work-in-process, increase inventory turnover and increase visibility of inventory and operating costs.

P&WC considered the main enterprise systems available in 1996 for a company of its scope in its industrial sector: Oracle, BAAN, SAP, etc. Each system had its own merits but SAP was considered optimal for the company. The system had succeeded in many implementations and P&WC was already familiar with SAP's organization and approach, given that it had successfully implemented SAP R/2 (1990–1993) as part of its manufacturing resource planning management system (MRP II). As Al-Mashari and Zairi (2000, p. 162) noted, "SAP R/3 itself offers a great opportunity to move from a fragmented, function-based structure that is inefficient, costly, slow and complex, to a process-based structure that is integrated cross-functionally, standardized, customer-focused and competency-centered". SAP R/3 provided P&WC with a global information system, TES, that covers all of the company functions that process customers' orders (see Table 1).

Table 1
Main characteristics of P&WC's TES

SAP components	Financial accounting, controlling Sales and distribution Materials management Production planning Quality management SAP business information warehouse
Hardware platform	Hewlett-Packard
Operating system	HP/UX
Database	Oracle
Number of sites	Five
Implementation	Scope limited to core order-fulfillment cycle
Business Change	Minimal—following go live and rapid stabilization phase, launch of key business-process-improvement initiatives.

Source: Adapted from SAP (2000).

Putting in place TES involved replacing about 35 legacy systems, along with the SAP R/2 manufacturing system, used at P&WC since 1993, by a single SAP R/3 system. Implementation of the new system would affect more than 3000 employees in all company departments.

4. Highlights of TES implementation

P&WC adopted a "Big bang" approach to TES implementation. This approach was quite risky because it encompassed all processes simultaneously (Welti, 1999; Davenport, 2000). It called for considerable rigor because it took into consideration the entire P&WC environment, characterized by multi-site activities.[1] On this topic, Davenport (2000, p. 176) notes: "It's simply too difficult to anticipate all of the problems and changes involved in an implementation when everything is changing at once".

The concrete benefits anticipated from the implementation of TES, along with the minimization of associated risks, largely depended on the strategies and implementation practices chosen by P&WC, as suggested by Welti (1999) and Aladwani (2001). Below we will describe the highlights of the implementation approach.

4.1. Major phases of TES implementation

The project duration, i.e. 32 months (from June 1996 to January 1999), was unevenly distributed over five major implementation phases (see Table 2).

In departments across the organization, significant resources were mobilized to manage change and knowledge transfer. In particular, during phases III to V, many resource persons were deployed within several well-structured teams named Project Team, Training Development Team, Change Champions and Power Users.

The planning approach adopted by P&WC was similar to those observed in many other organizations, as reported by Kumar et al. (2003), who investigated critical management issues in ERP implementation projects at 20 organizations. Critical management issues considered were: Constitution of project team; project planning, training, infrastructure development, ongoing project management; quality assurance and stabilization of ERP. Some of these organizations adopted ASAP methodology proposed by SAP. Most ERP implementation projects are structured around phases. Models containing roughly six stages have emerged in the literature (Rajagopal, 2002). As Kumar et al. (2002, p. 160) noted, "All the stage models reported could be clubbed into four broad phases of planning, configuration, testing, and implementation" (see Table 3).

Aside from the project phases, a particular feature of the methodology adopted by P&WC is that it proposed that five project threads "be woven into a cohesive fabric through its five workplans" (ISDS, ERP Methodologies). These threads are discussed in the next section.

4.2. Five integrated threads

As part of its TES implementation approach, the project team rigorously followed the Deloitte & Touche Consulting Group-ICS "FastTrack 4

[1] Plants affected by the ERP implementation were: Longueuil, Mississauga, Halifax, Lethbridge, West Virginia.

Table 2
Five phases of TES project

Phase I: Scoping and planning
From June to December 1996, the P&WC executives focused on defining the *scope* of activities and *planning* their implementation. They took into consideration the strategic objectives, requirements of P&WC customers and best practices (identified through competitive analysis). The processes in place were evaluated to determine those that needed improvement. These considerations helped Management define the scope of the project and resulted in the initial decision to implement SAP R/3 as is, with minimal re-engineering. Specifically, they planned all of the activities related to implementation of the SAP modules. They thus determined the scope of the project both in terms of the necessary resources and the systems to replace.

Phase II: Determining the level of previous reengineering
From January to March 1997, i.e. a three-month period, the P&WC executives defined their vision of the major business processes of the company in line with the targets set (*Visioning & Targeting*). They decided to perform very little process re-engineering during TES implementation.

Phase III: Process redesign
Running from April to September 1997, the third phase was mainly dedicated to redesigning processes in keeping with the executives' vision and with the targets set. Ten processes were affected, which included 47 sub-processes, corresponding to 600 activities. The relatively short duration of this phase (7 months) reflected the P&WC executives' deliberate decision to minimize re-engineering as part of the implementation process.

Phase IV: Configuration
The fourth phase, the longest at 10 months, was dedicated to configuration of the new system. It was during this phase that the main parameters of each SAP module were determined, and that the choice of parameter options related to the new system was clarified.

Phase V: Testing and delivery
The test phase ran from August to December 1998, and included three integration test cycles: An initial cycle related to master file data, a second to static data and a third to dynamic data. During each cycle, the key information technology programs were also tested. The successful test results were then formally accepted by the process managers. The cutover from the old systems to the TES took place on January 4, 1999. Planned from spring 1998 by the start-up committee, this operation constituted a "moment of truth" that was instrumental to the project's success.

Table 3
Main project planning stages

Stage	Major activities
Planning	System planning, benefit analysis (sometime done in chartering phase), project scoping
Configuration	Architecture, configuration, design, building
Testing	User training, product testing
Implementation	Go live, training and documentation

Source: Kumar et al. (2003).

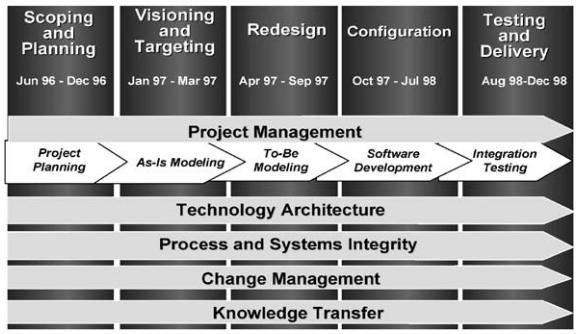

Fig. 1. Project threads.

SAP" methodology. Similarly to ASAP, "Fast-Track 4 SAP" methodology is a proven multi-phase methodology as it has already been used for successful implementation in many organizations (Cafasso, 1995; ISDS, ERP Methodologies). This methodology specifies five threads to ensure the consideration of five key factors throughout the project: Project Management, Technology Architecture, Process and Systems Integrity, Change Management, and Knowledge Transfer (see Fig. 1). Without these threads, a lack of attention to some aspects of these factors might have

hampered the project, notably during integration of all of the business processes or during the adjustment of other company software to the ERP software.

4.3. An impressive project team

The project team comprised seven groups totaling 345 employees in a wide variety of fields and specialties. Four of these groups (172 people) represented the main processes of the company (i.e. sales and distribution, production planning, materials management, finance). Information technology analysts and change managers were two other important groups (168 people). Kumar et al. (2003) found that about 90% of companies usually have strong information technology and functional representation on their implementation teams. The composition of this project team thus conveyed the strong will to ensure the representativeness of the various company functions (Davenport, 2000; Wallace and Kremzar, 2001). Moreover, by forming such a large team, P&WC showed its commitment to ensure employees' ownership of the project and an effective transfer of knowledge and expertise. Al-Mashari and Zairi (2000) report similar cases in companies like Owens Corning, Amoco, Kodak, and Farmland.

4.4. Knowledge transfer through massive training

Training was treated as a knowledge transfer process. Approximately 110 employees from the six most affected departments were trained to become internal trainers. In 1998, P&WC was transformed into a gigantic classroom, the largest training activity in the company's history, directed at more than 3000 employees in nearly all departments. The comprehensive training program was both technical (basic navigation and task training) and business-oriented (processes and tasks). More than 150 manuals were produced to adapt the training to the requirements of diverse participants. P&WC thus effectively prepared and trained its employees. It took the necessary actions to manage appropriation of ERP across the board: Massive involvement of internal resources and external consultants, along with elaborate communication and training processes. Thus, P&WC "created a change readiness in organizational culture" (Bancroft et al., 1998).

5. Results

Both the results of the "go live", corresponding to the "first wave", and those of the "second wave" underline the success of the TES implementation.

5.1. A successful "go live"

In January 1999, TES started up as planned without interruption of business processes and without significant interference with P&WC operations. In the first month, about 3000 calls for assistance were received (regarding passwords, printing, etc.) along with 1800 calls concerning technical difficulties. 1500 of the problems were solved within the first month. In late January, most of the processes had reached an adequate level of stability. In May 1999, the launching of the TES (go live) had been recognized as a great success by the United Technologies Corporation group, parent corporation of Pratt & Whitney, which awarded P&WC the Arthur E. Smith Prize "to crown the exceptional success of the implementation of the largest SAP R/3 system in the aerospace and defense sectors within the Hartford, Connecticut-based UTC group".

The stability of the inventory level between December 1998 and August 1999 was another sign of the success of the TES start-up. During this period, the inventory turnover rate of APM (Aircraft Product Materials) remained steady at between 17.2% and 17.6%.

The actual implementation of TES was only the "first wave" of the organizational transformation at P&WC. Usually, the post-project phase triggers operational disturbances that represent hurdles to overcome, and that often result in an inferior level of service to that provided by the former system (Willis and Willis-Brown, 2002). Note that some companies decide to go an extra round of running the ERP and legacy systems in parallel to gain

Table 4
Business benefits

Tangible benefits	Intangible benefits
Realized almost $1 million in savings in year 2000 cost avoidance,	Increased visibility into inventory costs,
Increased productivity by 11% above plan,	Established information backbone to support ongoing change and business-process agility,
Reduced receivables days outstanding by 6% to date (13% planned by 2002),	Established foundation for e-commerce initiatives through mySAP.com,
Achieved return-on-investment (ROI) in 30–40%. range	Achieved capability to generate future reports around flexible KPIs through SAP BW.

Source: Adapted from SAP (2000).

confidence with new systems and avoid risks of business disruption (Mabert et al., 2001).

The smooth start-up of TES enabled the competency centers established by P&WC for the "second wave" to quickly focus on making improvements to their business processes.

5.2. The "second wave"

The "second wave", corresponding to the stabilization period, involved returning to the former levels of productivity, which were measured by key performance indicators. The near absence of major disturbances during this period attests to the quality of the TES project at P&WC and the associated preparations.

Many improvement initiatives had been launched after the start-up of TES,[2] in materials management, production planning, quality and finance. The reduction of production start delays[3] of various subsets constituted one of the significant improvements engendered by the TES. Whereas in late 1999, only 26% of subsets had been put in production within the planned time frames, and half of production start delays were of 10 days or more, in early 2002, P&WC completed 84% of the production of its subsets on time, and less than 2% of subsets had production start delays of more than 10 days.

The TES granted access to real-time information that proved highly useful for both inventory management and purchases. A summary of the benefits resulting from deployment of the TES in early 1999 is shown in Table 4.

According to Benoît Grenier, director of the change leadership and knowledge transfer group (CLKT), improvements scheduled for the first quarter of 1999 were expected to generate benefits with a present value of $10 million over a five-year horizon (SAP, 2000).

6. Lessons from the TES implementation

As Davenport (2000, p. 175) noted "A well-planned and well executed ERP implementation, in conjunction with a good change management program, can create a dramatic turnaround for a company". The successful deployment of SAP R/3 at P&WC clearly illustrates this point. Six key lessons have been learned from this experience in terms of strategic, tactic and operational considerations. The first two strategic lessons regard P&WC's capacity to change and the strategic

[2] In the "second wave," called "SWAP—Second Wave Alignment and Planning" (Deloitte Consulting, 1999), TES competency centers were implemented around the main business processes of the company. These centers were in charge of expanding the capabilities of the system in place, improving business processes and completing the integration of existing systems.

[3] *Production start delay* is one of the KPI (key performance indicators) developed after the launching of the TES by the CORE LOGISTICS GROUP. Using the possibilities of SAP, this group had designed tools to monitor inventory levels, and trained the personnel in charge of identifying means of reducing these levels.

choice of the time for process re-engineering. The third and fourth lessons are at the tactic level: The rigor, discipline and expertise in project management and a culture of results measurement. Finally, for operational appropriation, the fifth and sixth lessons are: Change management and preparation of go live.

6.1. Strategic considerations

Two lessons concern the appropriation of TES at the crucial strategic level.

6.1.1. P&WC's capacity to change

Several factors described in the strategic change literature (Hafsi and Demers, 1998; Aladwani, 2001) fostered the implementation of the ERP system at P&WC. Specifically, the organization's capacity to change when it undertook the TES project exerted propulsive pressure (described by Lewin, 1952) on the organizational system to bring about the change. Of these factors, mounting environmental uncertainty and turbulence increased the pressure for change (Hafsi and Demers, 1998) and thus helped the executives legitimize the change. The favorable attitude to change (Hafsi and Demers, 1998) exhibited by P&WC executives and their openness to employee involvement in change were undoubtedly additional facilitating factors. TES implementation also benefited from a history of prior successful changes (just-in-time, kaizen, etc.). In this sense P&WC is an organization that is far from inert but rather open to change, a favorable condition according to Davenport (2000). In addition, it is evident that the nature of change triggered by TES "fits" with the organization's values: Rigor, efficiency, comparison with best practices, benchmark, etc. P&WC was therefore well equipped to succeed at TES implementation (Hong and Kim, 2002).

6.1.2. The right time for process re-engineering

The P&WC executives decided to implement the basic SAP R/3 system by replacing the SAP R/2 system in place since 1993 along with 35 legacy systems. Re-engineering aimed at adapting processes to best practices of SAP R/3 was deferred to the "second wave". Management knew it needed to make a clear decision, in the sense that: "The first question a company wishing to introduce SAP R/3 will ask is: What would be the best way of going about it – First introduce the software or first re-engineer the business processes?" (Dolmetsch, and Österle, 1998, p. 3). By deciding to implement SAP R/3 *as is*, with minimal re-engineering, P&WC made a clear decision to defer process re-engineering. Intended to reduce risk, this decision corresponded to a relatively conservative position compared with the two extreme base strategies for implementing integrated systems as described by Dolmetsch and Österle (1998) namely:

- *Process-oriented approach*: a company first re-engineers its business processes and then introduces SAP R/3 accordingly,
- *Information system-oriented approach*: a company emphasizes the swift introduction of e.g. SAP R/3, on the basis of existing processes without systematically analyzing and possibly re-engineering them beforehand.

In some cases, however, the companies re-engineer their processes in parallel with ERP implementation, which takes more time than expected (Keller and Teufel, 1998; Mabert et al., 2001). Al-Mashari and Zairi (2000) argue that "the decision as to when business process re-engineering should take place in SAP R/3 implementation is highly dependent on the business situation, the motivations for choosing SAP, and the magnitude of improvement desired by the organization". From this standpoint, the strategic option adopted by P&WC is very advantageous: "*After go live we were able to undertake major re-engineering initiatives. We could significantly seek out benefits, because we no longer needed to implement other applications in our supply chain*" (Durand, 1999, p. 7).

Similar to companies that have taken the fullest advantage of the implementation of their integrated system (Davenport, 1998; Welti, 1999), P&WC had envisioned the change from the organizational and strategic standpoints from the outset.

6.2. Tactical considerations

The next two lessons concern appropriation at the tactical level. Based on the decision to re-engineer at the right time for transformation of the organization, two other lessons help facilitate this transition.

6.2.1. Rigor, discipline and expertise in project management

Many ERP analysts have underscored the importance of project management and planning for successful implementation (Davenport, 2000). P&WC's experience in implementing SAP R/3 highlights a major element of top management's contribution to the success of the TES project: Adoption of a complete and proven methodology to plan and coordinate deployment of all of the resources required, along with rigorous discipline during the implementation of the plans.

This methodology provided internal project managers and external consultants with a valuable tool to control a large-scale project intended to modify the habits of thousands of workers. Implementation was consistent with the global vision of the company. The methodology allowed the company to avoid numerous pitfalls, in particular those described by Davenport (1998, p. 123): "If a company rushes to install an enterprise system without first having a clear understanding of the business implications, the dream of integration can quickly turn into a nightmare". Like good majors in a modern army, the Project Team at P&WC proved to be able to apply this methodology to efficiently carry out a vast set of activities that involve various teams (see Fig. 2).

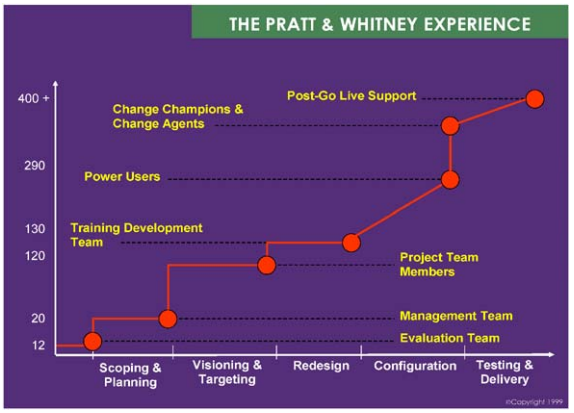

Fig. 2. Number of people involved.

The involvement of such a large number of stakeholders, ranging from 12 to over 400 (along with nearly 45 external consultants) depending on the project phase, resulted in an efficient transfer of expertise from consultants to the organization and its employees that appropriated the technology and its implications.

The process was underpinned by a solid structure of players and an active role by Management, which imposed the same discipline during the change per se as it did during application of the methodology. In keeping with Kotter's model (Kotter, 1995), the P&WC management manifested a feeling of urgency regarding the implementation during Phase I and created a hard core of individuals that were able to see the project to completion. Management thus integrated the project in its vision, which it communicated effectively.

6.2.2. A culture of results measurement

P&WC's project management incorporated not only results-oriented but also results measurement. From the outset, the objectives set were operational and measurable, defined as follows: Improve customer response time, reduce work-in process, increase inventory turnover and cut inventory and operating costs. The results-oriented culture was omnipresent. Often, project teams do not take the time or make the effort to measure concrete results. However, Kotter (1995) insists on the importance of consolidating progress, emphasizing the link between new behaviors and results. Schaffer and Thomson (1992) advance that "the best change programs are those that begin with results", as opposed to programs whose change management is oriented toward actions or programs. P&WC implemented change management oriented on results by applying measurable and pertinent indicators.

6.3. Operational considerations

The last two lessons regard operational appropriation. "End-users" are considered pivotal to successful implementation.

6.3.1. Change management: An uncompromising necessity

It is impossible to successfully transform an organization by deploying ERP without an approach to support change (Al-Mashari and Zairi, 2000; Welti, 1999). At P&WC, this approach entailed the introduction of a structure dedicated to change management. This structure included three levels (change champions, change agents and power users), together with change consultants that acted as staff for change champions and agents. Change champions had to establish a network of Change Agents, and were responsible for successfully implementing the new SAP-enabled business processes in their respective organizations. They then reported the progress to the Implementation Committee and the Steering Committee. Change agents were instructed to understand and communicate required changes in his/her area, and to plan and coordinate local area change management activities. In addition, they reported progress to their Change Champion. These tasks were temporally assigned during the project to employees from the various change areas that had been identified by the change leadership and knowledge transfer group (CLKT).

Directly related to the implementation committee, the change agents appointed within various organizational entities played a pivotal role in the change management process, specifically by encouraging change and identifying and disseminating expected employee behaviors, removing obstacles (Kotter, 1995) and ensuring follow-up. They were supported by four external change management consultants and close to 125 expert users (power users) originating from various company departments, that were thus well represented. The number of change management resources reflects P&WC's uncompromising commitment to involve human resources (see Fig. 3) in the transformation project.

In addition to the massive training activities (110 trainers, 3000 users, 150 manuals), many innovative tools were developed to raise employee awareness before the training: Change sessions (regarding foreseeable difficulties, local action plans, review of business processes), follow-up sessions, communication and feedback plans, follow-up teams, readiness assessment, employee feedback forums, etc.

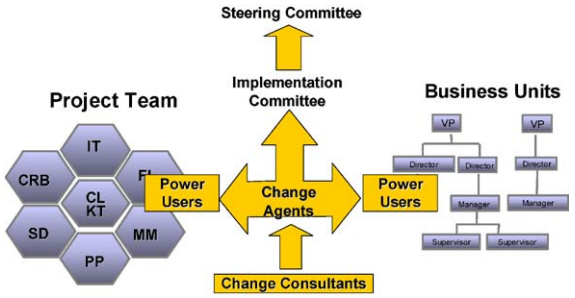

Fig. 3. Change management reporting structure.

6.3.2. A well planned and well orchestrated "go live"

The meticulous planning of the "go live", along with the extent of the resources deployed to assist users at the time of TES startup, are noteworthy. A Business Operations Cutover committee had been formed in March 1998. Composed of 18 key middle managers from many business units, their mandate was to prepare the supply chain for startup and to minimize the potential disadvantages of the launching of the TES on company operations. The startup committee left nothing to chance. They systematically prepared all aspects of the go live from the adjustment of production plans to the development of procedure manuals. They dedicated particular efforts to preventing problems by conducting an intensive test series and by supplying assistance to users at the time of startup of the new system.

Seven validation exercises were staged, largely under the direction of expert users. Three of the exercises were end-to-end, covering the data for one month of activities. At the time of startup, user assistance was of crucial importance because the plants had to function at full capacity throughout the first quarter. Assistance was provided by an imposing network of support teams available seven days a week, 18 hours per day during startup, and on call at all times. This network included a core of 245 people organized into teams, which were present in all departments and on all sites. With such a dense network,

P&WC could be certain of a smooth startup of its TES.

According to Motwani et al. (2002, p. 94), "… incremental, bureaucratic, strategy led cautious implementation process backed with cultural readiness, and careful change management are factors that contribute to successful ERP implementations". As we can see in the above lessons, many of these features were present in P&WC's SET implementation project.

7. Discussion and conclusion

To successfully implement an operation of such complexity, P&WC adopted a model that reflects the recommended approach to organizational transformation (Al-Mashari and Zairi, 2000; Hong and Kim, 2002; Rajagopal, 2002). The success of this project was contingent on the *appropriation of ERP at three levels*: *Strategic, tactical and operational* (Bernier et al., 2003).

It is quite evident that at the *strategic level*, the Pratt & Whitney managers established a clear vision of the role of the TES project in their business model, along with its strategic priority. They affirmed the legitimacy of the project, created a feeling of urgency (Kotter, 1995), and precisely determined the scope and scale of the project. In this context, the top management of P&WC understood that substantial resources, indispensable for implementation, must be allocated. It therefore freed and mobilized a sufficient number of human resources. The quantity of human and financial resources allocated to this project and the integration of the project in corporate strategy are remarkable. Without this firm commitment and unflinching support from top management of P&WC, the project could not have succeeded. These strategic conditions played a determining role in the orientation of the TES project and its successful implementation.

Regarding *appropriation of the TES project at the tactical level*, defined as the capacity of the organization to reconceptualize its business processes to take into account the technological potential while preserving the integrity of the value added processes that make up its expertise, P&WC redesigned its organization with a view to increased coherence and rigor, at an opportune time (second wave). It took on recognized technological partners that use proven methodology (FastTrack 4 SAP). Processes were then redesigned in keeping with management's vision, in line with the targets identified. The change scenario was clear: The objectives and orientations were identified by top management at P&WC, the five-phased methodology had to be rigorously followed, and the human aspect played a preponderant role. Moreover, clear measurement indicators allowed evaluation of progress.

Appropriation at the operational level was made possible by mastery of human issues, critical in all change projects of this scale (Mabert et al., 2001; Motwani et al., 2002). The Change Leadership and Knowledge Transfer teams played crucial roles in this process, roles that recognized in the literature, but that are often given scant consideration in concrete implementation. The system model drew on the competencies of 3000 recipients or end users (people affected by implementation of the TES system), in all Canadian departments and plants. The expected behaviors of employees were defined and clearly communicated as Kotter (1995) suggests. With the employees' collaboration, each change agent examined the impact foreseen in their unit along with the potential challenges related to advantages and disadvantages of work processes, roles and responsibilities, skills required and workload. The impact of the system on employees was therefore studied extensively and integrated in the action strategies, which were highly operational and close to the action. The change management strategy mobilized the troops by decentralizing change sessions within the business units, where information can circulate directly between individuals and where modifications in roles and structures are addressed and taken into account at the lowest level. The strategy also entailed centralizing deployment of a massive training effort, while safeguarding the hierarchical responsibility for competencies development.

This tripartite appropriation also reflects the various strategic, managerial, and operational factors described by Al-Mashari and Zairi

(2000), that can help an organization achieve an optimal outcome from SAP R/3 systems.

During the project, the duration was extended to 32 months. Part of this delay was due to the production objectives that were set for summer 1998. Due to high demand, most plants were running at near full capacity. However, a readiness audit showed that the organization was not ready enough to implement SET without risking a decrease in production level. This risk was considered unacceptable by upper management. Thus the "go-live" was postponed until early 1999. This created a "window of opportunity" for project managers (Tyre and Orlikowski, 1994), which they used to redirect the resources that were devoted to the "go-live" in the summer of 1998 towards enhancing power users' training during fall 1998 and to fine-tuning the planning of the "go-live", as seen in the Section 6.3.2.

To summarize, it is quite apparent that the success of P&WC's startup of SAP R/3 results from a constant and shared effort by all stakeholders. P&WC fostered appropriation at three levels: Strategic, functional and operational during the implementation of SAP by placing priority on change management, clear orientation of top management, mobilization of all managers, an impressive quantity of internal resources, supplemented by external resources, and a formidable training andofSvope13'owe;LvaL/3/jSkeying1Y%uYMuctolder/'xfi/w;Lvo/13L'zavo/1w9uvsucces3wjxfresu/13Sjfi;w

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