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# Surfacing Automation Criteria: A Process Architecture Approach

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## ABSTRACT

This paper describes the outcomes of a case study aimed at surfacing and analyzing decision making criteria used to prioritize process automation initiatives with a view toward engendering a process-centric organization and eventually exposing these processes as services. The study used structured interviews, content analysis, and enterprise process architecture mapping techniques to explore the implicit and explicit logic underlying process automation decisions. The results point to a wide range of decision making criteria involving technology, business and industry characteristics. We discuss the implications of our analysis for future, larger-scale, research projects and describe the potential implications for organizations interested in moving toward a process-oriented enterprise.

## Keywords

Process Automation, Case Study, Decision Making Criteria

## INTRODUCTION

A process-oriented enterprise is one that inherently views its operations and organizing logic as one built around a process architecture, that is, a coherent portfolio of networked assets (Clark and Cameron, 2008). Understanding and exploiting the process architecture of a firm and the inherent coupling between processes and technologies is, therefore, critical for an effort to move towards a process-centric, strategically aligned enterprise. A key aspect of this understanding hinges on the rationales which underlie decisions to automate some processes and not others, and to expose some processes as services and not others, either for direct consumption by customers or as components for creating composite systems of process and/or services (McGovern et al. 2006). Much research in this field is directed at exploring how this may be achieved (see, e.g. Chiu et al. 2008). The *rationale* for this bridge – between processes and technology, as well as services – continues to be explored, for the most part, manually by IT and business managers. Not only does this engender operational, strategic and cultural concerns; the sheer number of processes in a typical organization can itself become a barrier to achieving high standards of strategic, holistic process management.

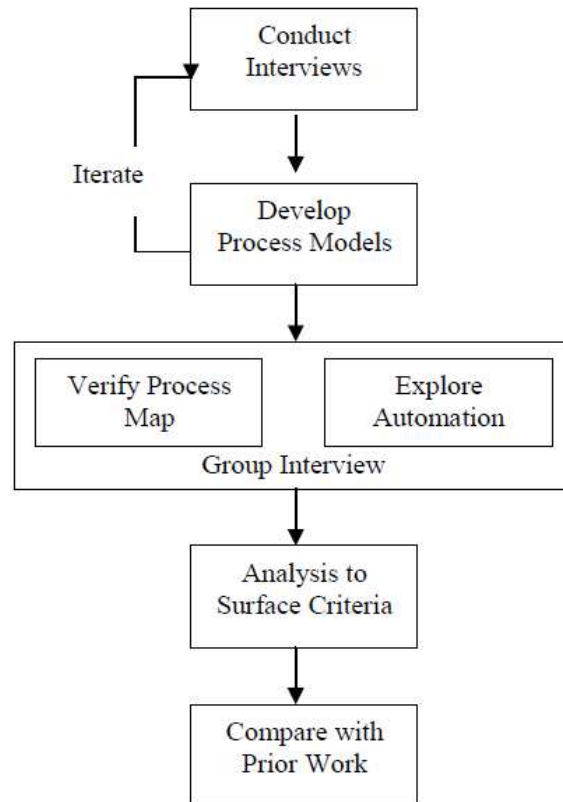
The specific research questions addressed in this study are, therefore, the following: First, what are the criteria that managers implicitly and explicitly use for prioritizing business processes as automation candidates? Second, is it possible to represent a comprehensive, enterprise-wide process architecture and characterize regions or specific locales of automation as a precursor to investigating the rationales for automation decisions? To ensure the feasibility of our approach, the study was designed as an interview-based case study in a small organization, supplemented by the analysis and interpretation of results, followed by mapping our findings against prior, published research outcomes. The choice of the research site was dictated by two predetermined guidelines: (a) a relatively small organization, to allow a complete mapping of the enterprise-wide process architecture, and enable mapping down to a reasonable level of detail; and, (b) a transaction-intensive, service organization, such as a payroll outsourcing company.

## CASE STUDY

The study was carried out in a payroll outsourcing company based in central Pennsylvania. Payroll outsourcing is, surprisingly, a high growth industry. It is dominated by three major players: ADP, Paychex, and Ceridian Employer Services. These three together have a 44% share of the payroll outsourcing market (IDC 2008). Smaller, regional companies like the one we studied, therefore, primarily operate in regional markets, often filling niche needs of mid-sized and small businesses.

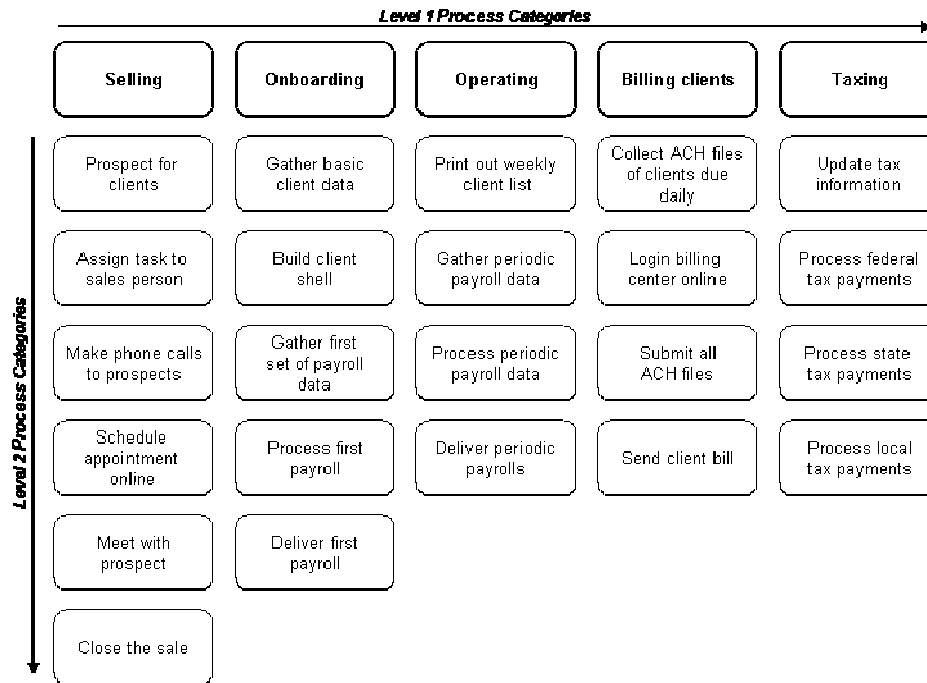
The competition in these regional markets tends to be strong, making automation an important concern. The company we studied was small, and had been in operation for several years, with a client-base of several hundred. Within their region, the organization was considered one of the dominant companies, having captured a large market share by virtue of its longevity and niche position that satisfied the needs of mid-sized businesses at a competitive cost. The following research methodology was followed for the investigation (see Figure 1).

**Figure 1. The Research Approach**



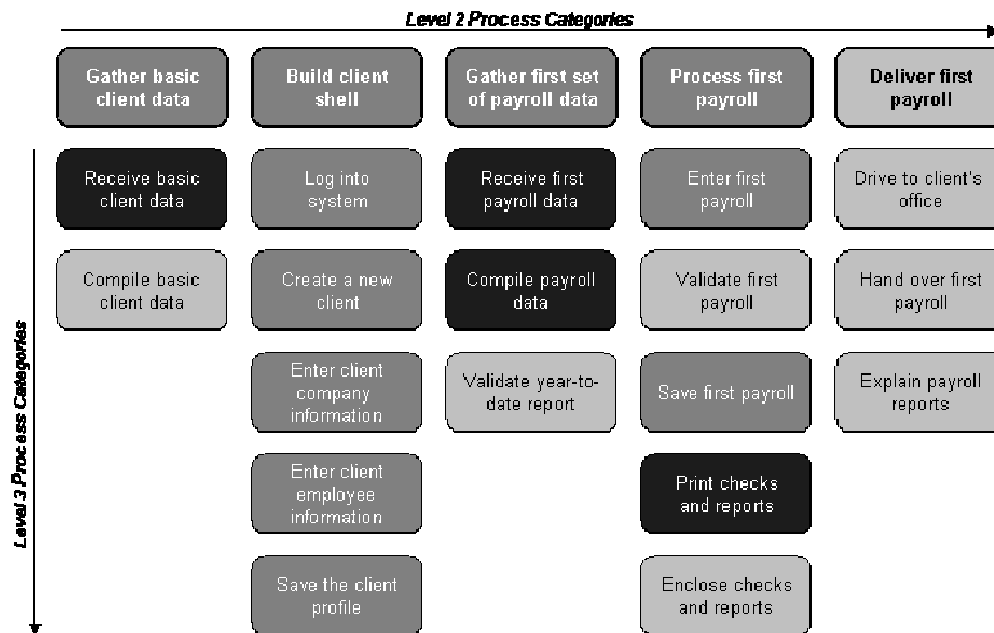
The research strategy broadly resembled an interpretive case study, which began without the encumbrance of a theoretical straightjacket, and ended with comparing the results against prior research, that is, exploring potential theoretical interpretations (Eisenhardt 1989). The outcomes expected were, therefore, to not only expand on prior process automation decision making criteria, but essentially break new ground in this specific area of inquiry. It was also our intention to explore process automation criteria in a manner that could be subjected to further, larger scale, investigations. The first step involved pilot interviews with the top management team to gain a broad understanding of internal and external conditions relating to the firm. Armed with knowledge of the overall organizational structure, culture, business model, and an initial understanding of the environment the firm operated in, structured interviews were conducted with the CEO, the operations manager, and several other employees involved in the day-to-day operations. Examples of employee roles interviewed included the tax manager, a tax clerk, conversion manager, and sales manager, among others. Interview questions focused on task allocation within departments, detailed steps of the work processes, time distribution on various steps, inputs and outputs of each step and process, time schedule for a typical workday, workload, and personal feelings about current work. This was an iterative process that produced the enterprise process architecture (see Figure 2).

Figure 2. Top-level Process Architecture



The next step involved a group interview with the CEO and Operations manager to validate and refine the map, understand the nature of automation for each process and its components, and discover the rationale for automating (or not automating) the processes. Two additional individual interviews were conducted with the conversion manager and the tax manager to ensure that the process architecture map and automation interpretations were accurately represented. Figure 3 shows an sample process, Customer On-boarding, with estimates of automation levels.

Figure 3. Estimates of Process Automation



(Process: Customer On-boarding, Legend: Darker boxes represent greater automation)

The fourth step, data analysis, involved an in-depth analysis of interview notes using a systematic content analysis approach (Krippendorff 2004). Frequency of occurrences, sources and correlations among the text passages were used to corroborate the meanings extracted. Table 1 shows a brief example of content analysis.

**Table 1. Examples of Content Analysis**

<b>Employee Quote</b>	<b>Researcher Interpretation</b>
<i>“We do not automate some processes because our strategy is more of a high-touch approach than our competitors.”</i>	A high-touch approach as a strategic differentiator that means that some processes will not be automated.
<i>“The client’s ability to automate affects our automation decisions.”</i>	Automation may be constrained or encouraged by the business partners’ ability to automate.
<i>“Avoiding automation in this process area is our competitive advantage.”</i>	Automation may open up a market segment to competitors and may, therefore, be withheld.

Using the analysis technique described above several key process automation decision making criteria were identified. (refer to Figures 2 and 3 above). This qualitative research strategy, however, does not claim to be free of bias. These research findings were, therefore, compared, contrasted, and validated against prior work in the final step.

**AUTOMATION CRITERIA IN PRIOR WORK**

The question ‘what can be automated’ has been an enduring theme, and investigated in several contexts. Traditionally, the criteria for automation suitability are tied to the notion of routinization (Saga and Zmud 1993). Routinization refers to several things, including lack of variation and our ability to capture and represent tasks within a process. In contrast, processes that are human-centric, that is, requiring more human skills and behaviors, such as judgment, coordination and complex decision-making are considered less appropriate for automation (Ayachitula et al., 2007). This theme of automation suitability can be traced back almost fifty years, when Fitts first distinguished tasks that “men are better at” and the ones that “machines are better at,” the so-called MABA-MABA principle (Fitts 1951). More recently, Price (2005) has suggested that the Fitts criteria are context-dependent, and therefore may not be ideal for determining automation suitability (Botta & Bahill, 2007).

The phrase ‘process automation’ evokes images similar to these prior efforts. For example, process automation may be characterized as automation of each individual task in a workflow (Zhao and Stohr 2001). However, if the dependencies across or among these tasks, such as handing over control or passing along required information are not automated, it may be difficult to argue that the entire process is automated. Another more modern aspect of automation is the addition of an interface to allow exposing the process capability as a service (McGovern et al. 2006). Other automation criteria, therefore, may include process features such as technical characteristics, human factors and strategic alignment (Baker, 2005; Tedre et al., 2006; Parasuraman et al., 2000). For example, strategic alignment may be defined as the alignment with strategic business concerns and organizational critical success factors (Kettinger et al., 1997). Process automation can also entail significant expense. Cost is, therefore, also a critical concern in the automation decision (Botta & Bahill, 2007). Other factors include technology costs and risks related to process re-engineering (Kettinger et al., 1997), technology investment (Abendshien, 2001), and human-machine interaction design (Parasuraman et al., 2000). There are also a large number of commentaries for automation benefits such as accountability and compliance (Manila, 1996), responsiveness to customers (Statton-Smith, 1986; Goldenberg, 1995), and greater control (Kennedy, 1988) that suggests additional criteria. The criteria from prior work can be simply characterized as those aimed at efficiency (see Table 2) and those aimed at other concerns (see Table 3).

**Table 2. Efficiency-oriented Automation Criteria**

<b>Automation Criteria</b>	<b>Source</b>
Need to increase productivity	Buehrer et al. 2005
Need to increase capacity	Adhikari 1995
To negate impact of high labor costs	Lewis 2005
To compensate for lack of labor	Bailey 2005
To free time for strategic pursuits	Rosenthal 2007
To reduce potential errors	Enbysk 2008
To provide timely information	DeMaio et al. 1990
To accelerate flow of information	Richardson 1991
To improve accuracy and precision	Schmidt 1975
To improve communication speed	DeMaio et al. 1990
To improve customer-responsiveness	Goldenberg and Barton, 1995

To improve ongoing connection with customers and suppliers	Captaris 2005
To help with complex and repetitive computation	Richardson 1991
To make output professional	DeMaio et al. 1990
To improve control over processes	Colletti 1988
To improve tracking capabilities	Enbysk 2008
To improve reliability of outcomes	Mark 2005
To improve predictability of outcomes	Richardson 1991

**Table 3. Nonefficiency-oriented Criteria**

<b>Automation Criteria</b>	<b>Source</b>
To coordinate between required roles in the organization	Ayachitula et al. 2007
To reduce the complexity of obtaining information	Ayachitula et al. 2007
To support organizational culture	Baker 2005
To address the potential for operator complacency	Parasuraman et al. 2000
To lower the danger of skill degradation	Parasuraman et al. 2000
To facilitate higher levels of accountability and compliance	Manila 1996
To facilitate the retention of operational knowledge	Captaris 2005
To increase the possibility of employee satisfaction	Goldenberg and Barton 1995
To leverage affordable automation technology	Enbysk 2008
To exploit automation technology that can be easily applied	Enbysk 2008

These summary lists provide a baseline to assess research findings. The assessment involved comparing the automation criteria that surfaced during the case study against those found in prior work to identify areas where earlier research was supported, where it was challenged, and yet others where extensions were necessary.

**FINDINGS**

Based on the content analysis, 26 process automation criteria were derived during the first pass. During subsequent passes, this initial list was compared and contrasted and eventually consolidated into a final list of 18. The final list of criteria is discussed in this section. Although it is possible to classify these along several dimensions, we found the following most useful during this phase: process characteristics, technology features, behavioral and organizational factors, and strategic and environmental factors. A given criterion could, however, have influences from several dimensions. The tables below, therefore, represent broad classifications, where the categorization is not claimed to be crisp or exclusive.

We define each criterion with a brief description, and map it against the current state of research as supported by prior work (indicated by S), challenging prior work (indicated by C), or new, that is, not noted in prior work (indicated by N). Criteria that belong to the first group, supported by prior work, are not elaborated further. These can be traced to earlier tables (see Tables 2 and 3), and sometimes to general concerns, for example, those related to technology choice. A discussion of the criteria either challenge or extend prior work (the primary contribution of this study) follows the tables.

**Table 4. Strategic and environmental criteria**

<b>Automation Criteria and Description</b>	<b>Map</b>
<i>Firm size</i> (noted in prior work as “Need to increase capacity and productivity”)	S
Compliance with regulations. (noted in prior work as “Need for accountability and compliance”)	S
<i>Increased Market share</i> (noted in prior work as the “Need to increase capacity to handle increased volume”)	S
<i>Competitor’s automation level.</i> Matching the competitors’ automation level may be necessary to gain advantage or to keep current market position.	C
<i>Client’s automation level.</i> For client-facing processes, automation may be constrained or encouraged by the client’s ability to automate (which in turn may be determined by client size)	N
<i>Business Strategy.</i> A high-touch business strategy may mean that few client-facing processes are automated.	N

(Legend: S=supported, C=challenges, and N=New)

The table above shows three criteria that either challenge or extend prior work. Although these may be considered straightforward in hindsight, the strength of this research approach is exactly this: to surface concepts that may have high face

validity but are difficult to uncover. Two of the three new criteria we identified include the automation levels of business partners and competitors. The third points to the overall business strategy followed by the organization. Together, they suggest that the process automation decisions, and, subsequently, the decision to expose capabilities as services, is not independent of the environment (Scott and Davis 2007). Instead, they suggest that the organization should carefully consider these criteria to develop a plan for process automation so that they can be exposed as services that customers can consume and business partners can utilize. In particular, the criterion related to competitors' automation levels was elaborated by the study participants in the following manner (paraphrased): "if we automate this process, then that market segment will be open to competition; since none of our competitors have tried to or managed to automate it, we will not do it either."

**Table 5. Automation technology criteria**

<b>Automation Criteria and Description</b>	<b>Map</b>
<i>Technology quality.</i> Availability of robust technology will lead to greater automation.	S
<i>Technology maturity.</i> Availability of mature technology will lead to greater automation.	S
<i>Technology reliability.</i> Greater reliability of technology will lead to greater automation.	S
<i>Technology ease.</i> Ease of use of automation technology will lead to greater automation.	S
<i>Technology capability.</i> The ability to support the functionality needed will lead to greater automation.	S

(Legend: S=supported, C=challenges, and N=New)

Clearly, none of the criteria in the previous table are surprising. The availability of robust, professionally supported and mature technologies that can be easily used to implement the functionality needed will facilitate greater automation. We note that this is a necessary but not sufficient condition.

**Table 6. Cost and efficiency criteria**

<b>Automation Criteria and Description</b>	<b>Map</b>
<i>Cost savings.</i> (noted in prior work as "Improving productivity as well as labor, material and operating") is a perennial consideration	S
<i>Efficiency.</i> (noted in prior work as the "Need to increase productivity")	S
<i>Automation timing.</i> Difficulties of employees to adjust to new automation based on a history of rapid change and inability to maintain performance on the learning curve..	N

(Legend: S=supported, C=challenges, and N=New)

The criteria grouped under cost and efficiency are also relatively straightforward. The last criterion, related to timing of automation, although it points to a known concern, suggests an interesting premise. Much discussion about moving from manual processes to automated ones with the intent of translating these into services neglects the conventional wisdom about the continuing importance of people, and changes that will be needed within the organization if the automation is to succeed. This criterion points to the timing of automation. For the organization we studied, this was a significant concern that they repeatedly described as (paraphrased): "our automation works because we were able to build it into our business model right from the beginning. It allowed us to compete effectively against existing businesses."

**Table 7. Process characteristics criteria**

<b>Automation Criteria and Description</b>	<b>Map</b>
<i>Process computability.</i> (Similar to the factor noted in prior work as "Help with complex and repetitive processes")	S
<i>Electronic data availability.</i> (noted in prior work as "Complexity of obtaining information")	S
<i>Availability of trained and trainable workers.</i> Availability of workers that are trained in technology or are trainable makes automation more likely.	C
<i>Retaining high-touch.</i> The more valued human touch is in a process, the less necessary to automate it.	C

(Legend: S=supported, C=challenges, and N=New)

The final category of automation criteria described above is related to process characteristics. The first two criteria in this category are supported by prior research. The final two criteria present interesting challenges to assertions made in prior work. Continuing the theme of the importance of people (from the previous set), the third criterion suggests that automation does not necessarily eliminate the need for people. The organization in this study emphasized that (paraphrased): "process automation does not necessarily result in eliminating work roles; instead, it requires a more capable workforce that can work with the automated process." For process-centric organizations such as payroll outsourcing businesses (such as the organization investigated in this case study), the traditional criterion of eliminating the need for labor via process automation is, then, replaced by a more nuanced understanding of hiring a more capable workforce that can carry out a more effective

socio-technical process. The final criterion, related to retaining high-touch activities, actively works against several other criteria, sometimes arguing for less productivity for senior employees. For the organization we studied, this was particularly true for the “customer on-boarding process” (paraphrased): “although the later stages of the process could be fully automated, these were intentionally retained as a manual process because it allowed senior employees from the organization to connect with our clients.”

In addition to the list enumerated in tables 4 through 7, these findings also allude to criteria that did not surface explicitly from participant feedback, but which prior research has highlighted. This observation is consistent with the known limitations of a single case study, which is unlikely to provide a comprehensive set. While the efficiency-related criteria (see Table 2) were evident upon closer examination, though not explicitly articulated by the study participants, other known criteria were entirely missing from the data. Significant among these were two criteria: (a) coordination among roles, and (b) knowledge retention and adverse effects of skill degradation. It is possible that the nature of the present organization (a payroll outsourcing company) we investigated, which has several processes that are controlled by a single employee, may have influenced the research outcomes and limited feedback on select criteria identified in prior work. The other criterion, knowledge retention and skill degradation, was reflected in an oblique manner, that is, in the availability of trained and trainable workers. For the processes that were uncovered in this organization (see Figure 1 earlier), the business model and the skills of the staff may have influenced these findings. In the next section, we discuss potential next steps for research and implications for practice.

## CONCLUDING REMARKS

The automation decision making criteria that surfaced in this study, for a small organization that operates in a transaction-intensive, service-focused environment, provide a good starting point for discussions related to bringing together fragmented lessons from prior work. The research process proved useful for surfacing rationales for process automation without the influence of prior work. The findings point to several criteria that were supported in prior work, and others that challenged and extended prior work. One significant conclusion from the analysis is that despite of five decades of investigations related to automation decisions, the established wisdom may not yet be translated to everyday practice, nor does it suggest that the debate is settled.

For researchers studying the linkage between technology and processes, and as a consequence, criteria for automation; the study points to a few possible extensions. First, the nature of this research, a case study, comes with the usual caveats of a single case, and warnings about generalizability. On the other hand, it demonstrates that case studies can be useful to challenge and extend established wisdom. Additional case studies are, therefore, likely to be useful. Second, a potential extension to this work will be Delphi studies. This technique can surface and rank several criteria. Zhao and Stohr (2001) lament the lack of significant research in this arena, connecting organizational understanding or work and workflow automation. The work we have reported represents a first step in understanding this linkage and provides several opportunities for extension following the pointers from Zhao and Stohr (2001).

We conclude by pointing to the key contribution of this work. We have demonstrated that it is feasible to conduct investigations of automation criteria to understand which processes can be automated. Although prior work suggests several criteria, they are fragmented across academic disciplines. The case study method we have followed allows bringing these criteria together and comparing them against the rationales expressed by managers. The results point to the potential for larger studies, and an approach that can benefit managers interested in systematically moving to a process-centric, or even service-oriented enterprise perspective.

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