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Nannette P. Napier

*Georgia Gwinnett College*, [nnapier@ggc.usg.edu](mailto:nnapier@ggc.usg.edu)

Lars Mathiassen

*Georgia State University*, [lmathiassen@gsu.edu](mailto:lmathiassen@gsu.edu)

Dan Robey

*Georgia State University*, [drobey@cis.gsu.edu](mailto:drobey@cis.gsu.edu)

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# From Dichotomy to Ambidexterity: Transcending Traditions in Software Management

**Nannette P. Napier**

School of Science and Technology  
Georgia Gwinnett College  
1000 University Lane  
Lawrenceville, GA 30043  
[nnapier@ggc.usg.edu](mailto:nnapier@ggc.usg.edu)

**Lars Mathiassen**

Center for Process Innovation  
Georgia State University  
35 Broad Street  
Atlanta, GA 30303  
[lmathiassen@gsu.edu](mailto:lmathiassen@gsu.edu)

**Dan Robey**

Computer Information Systems  
Georgia State University  
35 Broad Street  
Atlanta, GA 30303  
[drobey@cis.gsu.edu](mailto:drobey@cis.gsu.edu)

## ABSTRACT

Despite documented best practices and specialized tools, managers continue to face major challenges in software development. While managers are traditionally advised to choose between plan-driven and agile principles, software organizations increasingly face situations in which they need to take advantage of both. There is, however, limited actionable advice on how managers can shape the organizational context to develop such capability. We therefore combine theory on ambidexterity and contextualist inquiry to report from a two-year action research study at *TelSoft*. As a result, we propose a model for how software organizations can become ambidextrous through the processes of diagnosing, visioning, intervening, and practicing and discuss the implications for research and practice into software management.

## Keywords

Software management, ambidexterity, contextualist inquiry, action research

## INTRODUCTION

Despite documented best practices and specialized tools, software organizations struggle to deliver quality software that is on time, within budget, and meets customer requirements (The Standish Group International, 2004). To improve outcomes, software managers are traditionally advised to choose between plan-driven and agile principles. Plan-driven principles emphasize discipline through documentation of milestones, requirements, and designs (Boehm, 2002; Boehm and Turner, 2004). Agile principles emphasize responsiveness and flexibility by giving priority to people and prototypes over processes and documentation (Agile Alliance, 2001; Highsmith and Cockburn, 2001).

In the past, there have been staunch advocates for one strategy over the other. More recently, researchers have started to explore how software firms can overcome this dichotomy and achieve the benefits of both simultaneously (Boehm et al., 2004; Holmberg and Mathiassen, 2001; Lee, DeLone and Espinosa, 2006; Lee, DeLone and Espinosa, 2007; Napier, Mathiassen and Johnson, 2006a; Salo and Abrahamsson, 2005; Vinekar, Slinkman and Nerur, 2006). The integration of such opposing strategies requires, however, software firms to become ambidextrous. Ambidextrous organizations simultaneously pursue contradictory capabilities such as exploration-exploitation (Tushman and O'Reilly III, 1996), alignment-adaptability (Gibson and Birkinshaw, 2004), and flexibility-efficiency (Adler, Goldoftas and Levine, 1999). While studies have begun to provide general empirical support for a positive relationship between ambidexterity and organizational performance (Gibson et al., 2004; He and Wong, 2004), there are at this point no research studies into how software organizations can effectively overcome traditional dichotomies.

Our objective is therefore to explore how software organizations can develop ambidextrous capability to overcome the dichotomy between alignment based on plan-driven principles and adaptability based on agile principles. The research is

framed as a two-year action research study (Mathiassen, 2002; McKay and Marshall, 2001; Susman and Evered, 1978) into practices at *TelSoft*. Adopting action research principles allowed us to get deep and first-hand insight into how ambidexterity was approached and developed over time. Contextualist inquiry (Pettigrew, 1985, 1987) provided a general framing of the study in line with our focus on contextual ambidexterity.

**THEORETICAL BACKGROUND**

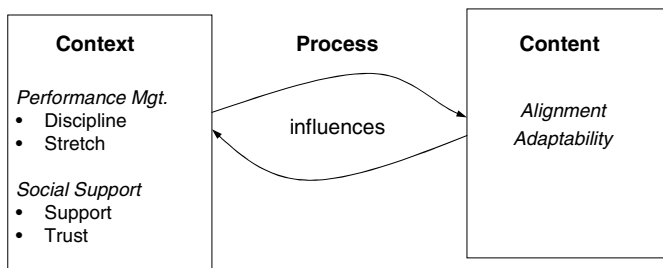
**Contextual Ambidexterity**

In general, ambidexterity refers to the capacity of organizations to manifest opposing characteristics at the same time. In particular, contextual ambidexterity requires simultaneous success at both alignment – the capacity of employees within the business unit to work toward common goal, and adaptability – the capacity of the business unit to change quickly in response to dynamic market conditions (Gibson et al., 2004). This perspective recognizes that the day-to-day activities of individual employees shape and reflect ambidexterity. Therefore, the top management team is charged with creating an organizational context that facilitates ambidextrous practices.

Gibson and Birkinshaw (2004) identify two salient aspects of the organizational context that can be manipulated to increase alignment and adaptability: performance management and social support. Performance management represents systems, processes, and beliefs related to performance objectives set by the organization’s management (Gibson et al., 2004); discipline is an attribute that encourages people to voluntarily meet those objectives whereas stretch is an attribute that encourages people to strive for even more ambitious goals (Ghoshal and Bartlett, 1994). Social support represents systems, processes, and beliefs associated with member relationships (Gibson et al., 2004); trust is an attribute of the organizational context that encourages people to rely on one another whereas support is an attribute that empowers people to lend assistance to others (Ghoshal et al., 1994).

**Contextualist Inquiry**

Contextualist inquiry (Pettigrew, 1985, 1987) focuses on how content, context, and process interact to transform organizations (see Figure 1). *Content* refers to the areas being transformed, in this case, managerial practices at *TelSoft*. *Context* refers to the systems, processes, and beliefs within the organization through which ideas for change have to proceed, in this case, changes to the performance management and social support context. *Process* refers to the actions and interactions between interested parties as they attempt to transform practices, in this case, the actions and interactions related to building alignment and adaptability within *TelSoft*.



**Figure 1: Contextualist Inquiry into Becoming Ambidextrous**

Contextualist inquiry involves process orientation and multiple levels of analysis (Pettigrew, 1985, 1987). Emphasizing the interconnectedness of phenomena in historical, present, and future time, we focus on how past events at *TelSoft* shaped its attempts to build ambidextrous capability and how these events created a basis for moving forward. In addition, we focus on how individuals engaged in project portfolio management, how groups of managers interacted to become ambidextrous, and the wider context of the organization and its interactions with existing and potential customers.

## RESEARCH METHOD

Action researchers use a mixture of research methods such as participant observation, interviews, document analysis, and surveys as they seek to simultaneously contribute to practical problem solving and scientific development (Rapoport, 1970). This makes action research an excellent candidate for studying longitudinal organizational change processes (Pettigrew, 1990). This study is based upon collaborative practice research (Mathiassen, 2002), a particular form of action research that is characterized by strong collaboration between practitioners and researchers to effect change. The dual goal of the research is to improve management practices at *TelSoft* and to contribute to scientific knowledge on ambidextrous software management.

*TelSoft*, a privately held company founded in 1971, customizes geographic information systems (GIS) software for the telecommunications and utility industries. A software unit with approximately 50 members is the focus of our study. *TelSoft* is oriented toward known customers in a niche market; it has high reliance on committed employees who perform many roles within the organization; and it has few resources devoted to innovation (Horvat, Rozman and Györkös, 2000). Although not considered a market leader, *TelSoft* has a reliable customer base consisting of two large customers that drive innovation to their core software products and several hundred smaller customers that use *TelSoft*'s standardized geographic mapping software. Struggling to survive in a competitive environment, *TelSoft* frequently neglected innovation and adaptation, and instead emphasized known customers, products, and services.

At the time our study began in 2004, *TelSoft* was experiencing severe issues with their main customers: software releases were frequently shipped late, ran over budget, and contained deviations from agreed upon requirements. These issues prompted management to focus on process innovation supported by this action research project. Several innovation projects were initiated and have been the focus of other research (Napier et al., 2006a; Napier, Mathiassen and Johnson, 2006b); however, this study focuses on the efforts that occurred to innovate project portfolio management, i.e., the systematic management of the company's projects in order to decide which projects should be added or removed as well as the relative priority of projects within that portfolio (De Reyck, Grushka-Cockayne, Lockett, Calderini, Moura and Sloper, 2005; Markowitz, 1952; McFarlan, 1981). In software firms like *TelSoft*, project portfolio management is a core management activity requiring ongoing assessment of existing projects and new business opportunities (Clark and Wheelwright, 1992; Hobday, 2000).

Data collection occurred in four phases: diagnosing, visioning, intervening, and practicing as summarized in Table 1. Data analysis proceeded across project phases and informed activity in subsequent phases. To address the question of ambidexterity, we coded data reflecting the concepts of performance management, social support, alignment, and adaptability (Gibson and Birkinshaw (2004). Following a strategy of temporal bracketing (Langley, 1999), we analyzed coded data within each phase and extracted the organizational practices that balanced alignment and adaptability. Subsequently, we conducted an analysis across phases to identify the mechanisms that caused ambidexterity to increase or decrease.

## RESULTS

Ambidextrous project portfolio management involves balancing alignment (mainly monitoring existing projects based on plan-driven principles) with adaptability (mainly identifying new projects based on agile principles). In the following, we assess how the action research project transformed project portfolio management as summarized in Table 2.

### Diagnosis Phase

**Context.** During the diagnosis phase, *TelSoft* employees were not disciplined in managing projects and they did not stretch themselves to reach beyond stated objectives. Instead, poor performance management was exhibited in three major ways. First, each project manager had considerable autonomy, and there were no rewards for either project failure or success. As a result, project outcomes varied considerably. For instance, the *TelSoft* project manager for one major client prioritized high quality over controlling cost, scope, and time. His projects therefore frequently missed deadlines and exceeded budgets. Long-time project managers faced no threat of being replaced, and developers had limited opportunities for promotions or increased responsibilities. Financial incentives were not given for exemplary performance, resulting in low morale among employees who had not received a raise in three years. Second, there was no process for allocating scarce talent across projects to ensure the company's profitability. *TelSoft* had four key engineers who had to be spread across three projects. *TelSoft* privileged requests from major clients over requests from internal customers which jeopardized the productivity of the company as a whole. Finally, *TelSoft* did not facilitate or encourage employee training and development.

Phase	Start Date	Trigger	Data Sources
Diagnosing	10/2004	Began diagnosis of software practices at <i>TelSoft</i>	22 Interviews <ul style="list-style-type: none"> <li>• Software development group</li> <li>• Internal customers</li> <li>• External customers</li> </ul> 2 Workshops <ul style="list-style-type: none"> <li>• Software development group</li> <li>• Internal customers</li> </ul> Diagnosing report
Visioning	6/14/2005	Steering Committee commits to eighteen month improvement initiative	3 SCG Planning meetings <ul style="list-style-type: none"> <li>• Meeting notes and minutes</li> <li>• Project plan and fixed agenda</li> </ul> 2 SCG Meetings <ul style="list-style-type: none"> <li>• Transcription of meetings</li> <li>• Reason for being and software strategy</li> <li>• Current project reviews</li> <li>• Business case assessment</li> </ul>
Intervening	11/2/2005	SCG Meeting #3: First complete review of Current Projects and Business Opportunities	7 SCG Meetings <ul style="list-style-type: none"> <li>• Transcription of meetings</li> <li>• Reason for being and software strategy</li> <li>• Current project reviews</li> <li>• Business opportunities list</li> <li>• Customer account reviews</li> </ul>
Practicing	8/9/2006	SCG Meeting #10: Smooth operation of meetings. Meetings used to facilitate decision making and take action.	6 SCG Meetings <ul style="list-style-type: none"> <li>• Transcription of meetings</li> <li>• Reason for being and software strategy</li> <li>• Current project reviews</li> <li>• Business opportunities list</li> <li>• Customer account reviews</li> </ul> 10 Assessment Interviews

**Table 1: Data Sources by Project Phases**

The level of trust and support that existed in relationships at *TelSoft* reveals both strong and weak elements of the social support context. *TelSoft's* VP of Software had worked with several of his direct reports for over 15 years and a friendly, comfortable relationship existed. When cost overruns and blown schedules occurred, the VP's displeasure was tempered by a belief that managers were committed to doing the best job they could. *TelSoft's* management team also had strong customer relationships, allowing customer requests to guide innovation projects. Although the major customers appreciated *TelSoft's* responsiveness to their requests, they also wanted *TelSoft* to be more proactive in product innovation.

*TelSoft's* management team was uncomfortable with how the Division President set direction for product innovations. The VP of Software claimed that the Division President operated based upon hunches, reacting to events emotionally or intuitively. As a result, company-sponsored product innovations were often not aligned well with the market.

**Content.** *TelSoft's* capability for alignment was evident. Employees rallied behind some project managers to ensure the completion of assigned work, although the strength of alignment varied across project managers. *TelSoft* continued to select projects reactively and lacked a shared long-term product strategy. In this way, *TelSoft* lacked adaptability. *TelSoft* employees focused on known products and were reluctant to invest their effort in new directions. There were no systems in place for assessing products and improving them. Although *TelSoft* quickly responded to customer requests, it had a dismal track record when it came to responding to market dynamics.

## Visioning Phase

A new Division President arrived June 2005 and approved money for innovating software processes, including project portfolio management. The research team and VP of Software created a detailed plan for a software coordination group (SCG). The SCG group would meet monthly and follow a fixed agenda covering current projects, business opportunities, improvement initiatives, and strategy. The SCG would consist of four *TelSoft* employees: Division President, Vice President (VP) of Software, Development Manager, and Product Manager. In November 2005, a kick-off meeting was held to ensure that each member understood his role in the group and to allow refinements to the initial agenda.

**Process.** Three important events occurred during the visioning phase. First, the SCG clarified the company's mission, targeted markets, and operating policies. Following the agility principles of the sense-and-respond model (Haeckel, 1995, 1999), the SCG collaborated with the CEO to create a "reason for being" and a software strategy. Nine specific policies contained in the software strategy were contributed by members from all levels of the organization. Policies included requiring approval of the quality assurance department before delivering official releases, and managing each development project with a two-phase approach that separated requirements and development activities. Collectively, the reason for being, software strategy, and policies became known as *TelSoft's* software charter.

Second, the SCG agreed to use key performance indicators (KPIs) for assessing current projects. The VP of Software reinstated the practice of weekly status reports from all project managers. The Development Manager assumed responsibility for collecting the information and distributing it to SCG team members before each meeting.

Third, the SCG began reviewing new business opportunities. The Product Manager prepared a template for justifying investments based on cost-benefit analysis. During the first two meetings, he used this template to present two proposals for enhancing *TelSoft's* existing product line. While this was a step in the right direction, both proposals represented uncontroversial ideas that already enjoyed broad support by the other SCG members.

**Context.** The visioning phase saw some improvements to performance management, specifically in the desire to become more disciplined about monitoring and tracking the company's performance objectives. The SCG was committed to the idea of using reliable project information to facilitate project portfolio management. They wanted to use KPI monitoring as an "early warning system" which would provide time for corrective actions. They also hoped tracking KPIs would inspire project managers to improve. However, contextual factors prevented *TelSoft* from realizing these benefits. The biggest problem was that information supplied by project managers was frequently in an unsuitable format, incomplete, or submitted too late. The SCG tolerated these information quality issues and did not hold the project managers accountable.

Another problem involved the market intelligence underlying business cases. When the SCG members asked questions during his presentation, the Product Manager admitted that he lacked supporting evidence for many of his assumptions. At one point the VP of Software called the estimates in the business case "outrageous." Despite such problems, the group decided to pursue one of the opportunities presented.

There was also improvement to the social support context, particularly in the new Division President's approach to strategic planning. The software charter was created collaboratively and shared within the organization. The commitment to the action research project showed a willingness to break with tradition and consider alternative ways of thinking. With respect to product innovation, the Division President wanted anyone within the organization to be able to suggest new business possibilities and referred to the Product Manager as the "gatekeeper of opportunities". Generally, the SCG members were open to direction, criticism, and new ways of thinking from the researchers.

**Content.** During the visioning phase, alignment was increased among SCG members through the creation of systems for defining, debating, and modifying performance against business objectives. The software strategy and reason for being were explicit, shared understandings of criteria for assessing product innovations. The fixed agenda documented important areas to be discussed each month. Agreement on KPIs specified key business objectives to the project managers at *TelSoft*. Although beliefs were changing among members of the SCG, it was too early to tell whether others outside the SCG would adapt their behavior based upon these systems. With respect to adaptability, the SCG struggled to think radically about new markets. In fact, the business cases proposed were largely targeting traditional markets. Yet, commitment to monthly SCG meetings and openness to ideas from the researchers were promising signs that changes to adaptability could take place.

## Intervening Phase

The intervening phase began in January 2006, the first meeting in which the Development Manager provided data about current projects using the KPIs. The key characteristic of this phase was the SCG's uncertainty in interpreting information

that was brought to its meetings. This uncertainty continued through July 2006, at which point the group began to base decisions more confidently on the data presented.

**Process.** The SCG spent substantial time extending practices initiated during the visioning phase. The software charter was communicated to employees through workshops and to external customers through a letter from the Division President. Project managers began reporting KPIs on time; however, data tracking performance were not always accurate. In response, the VP of Software developed a tool to retrieve data from the time tracking system automatically. In addition, instead of presenting detailed business cases justifying a specific software innovation, the Product Manager reported on the list of sales leads being pursued and the status of those leads.

The SCG also introduced periodic customer account reviews as an important new practice. In these reviews, the project managers reflected on the performance of recent releases, identified open issues, and talked about future business opportunities. These formal reviews held project managers accountable to the new Division President. At the same time, attending the SCG meetings allowed project managers to learn about the SCG and the importance of KPI data.

**Context.** During the intervening phase, project managers were held more accountable for project performance, and feedback was used to improve performance. The VP of Software enforced the discipline of weekly written status reports and instituted periodic oral customer account reviews. One noticeable feature during this phase was that the SCG members began to use data to identify troubled projects. Some project managers reported their projects were “going smoothly” even though evidence suggested otherwise. In these cases, the VP of Software accepted responsibility for following up with project managers.

As monthly KPI reports continued to show that most projects missed deadlines and went over budget, *TelSoft*'s project managers were urged to stretch themselves to meet project goals. Also, more pressure was placed on project managers to provide reliable project information, which in turn revealed problems with the social support context. Gathering project information required people throughout the organization to work together. Project managers created overall plans; the development coordinator scheduled developers for specific tasks; developers provided status against those plans; and project managers adjusted plans. Project managers complained that developers did not provide appropriate estimates. For their part, project managers did not always adjust plans to reflect what was learned as requirements solidified. Overall, this lack of coordination and communication among project managers, the development coordinator, and developers caused confusion and prevented progress. Other social support problems reduced project performance. Projects remained open and incurred costs long after development work was complete.

**Content.** During the intervening phase, *TelSoft* was more successful with adaptability, as they tried new tactics to attract potential customers. They purchased a new contact management system to track sales leads and pursue customers outside traditional markets. Breaking with the tradition of responding to customer requests, *TelSoft* managers proactively planned to revive an earlier product that had failed. This product vision was shared with one of the major customers for feedback on attractive features. Although the potential for financial sponsorship was uncertain, *TelSoft* managers felt this exercise would provide useful insights.

### Practicing Phase

The practicing phase began in August 2006 and ended February 2007, when the research collaboration ended. During this phase, the SCG focused on practicing project portfolio management as developed over the previous phases. Also, toward the end of the phase, we interviewed several employees about the impact of the initiative as well as the effectiveness of the SCG.

**Process.** During the practicing phase, the SCG continued to meet and became an integral part of the management structure at *TelSoft*. There were several areas of improvement: the VP of Software took more ownership of meetings with less interaction from the researchers; the software charter was posted to the company's website and shared face-to-face with management representatives from major clients; and a new procedure for conducting post-project reviews was created. Furthermore, the Division President and CEO agreed to continue working with the research team for another year to develop the project management capabilities of selected employees. Not all changes were positive, however. During this phase, *TelSoft* experienced loss of market intelligence when one of its two sales people resigned. The poor quality of metrics during current project reviews also persisted.

**Context.** The practicing phase was characterized by more critical discussions and questioning during project reviews, again trying to use the metrics to make decisions. There was an increased emphasis on holding project managers accountable. The group realized that KPI reports were not the early warning system they had imagined; projects still were over budget and delayed. However, the managers wanted to consider more systematically why these failures occurred in the past and how they could be avoided in the future.

**Content.** Alignment among SCG members continued to grow. The software charter made non-SCG members aware of the company’s strategic direction. However, there remained opportunities for working more coherently across levels of the organization. Adaptability was sustained through the business opportunity reviews, and *TelSoft* decided to invest resources in training project managers.

CONSTRUCT	PROCESS			
	Diagnosis	Visioning	Intervening	Practicing
CONTEXT: Performance Management	Low	Some improvement	Major improvement	Neutral
CONTEXT: Social Support	Mixed	Some improvement	Some setbacks	Some improvement
CONTENT: Alignment	Mixed	Neutral	Neutral	Major improvement
CONTENT: Adaptability	Low	Neutral	Some improvement	Some improvement

**Table 2: Becoming Ambidextrous at *TelSoft***

**DISCUSSION**

In the spirit of building theory from process data and case study research (Eisenhardt, 1989; Eisenhardt and Graebner, 2007; Langley, 1999), we propose a four-phase model for building ambidextrous software management capability in Table 2. The model incorporates contextualist inquiry’s two-dimensional approach by focusing on the vertical interaction between content and context and the horizontal unfolding of the change process across four phases. At *TelSoft*, managers first dealt with contextual issues (social support and performance management) before realizing improvements to content (alignment and adaptability). In fact, the main emphasis during the visioning phase was not on improving ambidexterity per se, but rather on transforming the context to better facilitate ambidexterity. The visioning phase focused on creating shared beliefs among SCG members with respect to performance management and social support through exercises such as creating a reason-for-being statement, and crafting a software strategy with specific policies. Actions during the intervening phase also concentrated on transforming context, this time yielding some improvements in adaptability. Finally, the practicing phase saw changes to both context and content. Given that nearly ten months passed before impacts on alignment and adaptability became visible suggests that becoming ambidextrous is a long-term process requiring managerial patience.

Our findings have important implications for research into software management. The results from *TelSoft* suggest that it is possible to overcome the traditional dichotomy between plan-driven and agile principles by developing contextual ambidexterity. At *TelSoft*, these efforts focused on project portfolio management and bridged individual, project, and organizational levels. *TelSoft* benefited from combining concepts from contextual ambidexterity and contextual inquiry (see Figure 1 and Table 2).

Future research could overcome three limitations of this study: the single-case design that does not allow for comparisons across contrasting contexts; the narrow focus on project portfolio management that does not consider insights across different innovation initiatives; and our restricted conceptualization of organizational context relying on Gibson and Birkinshaw (2004). Future research could enrich theory by inducing different aspects of organizational context that influence the process of becoming ambidextrous to transcend traditional dichotomies within software management.

Our findings also have implications for practicing software managers seeking to create ambidextrous practices. Our analysis of the change process indicates the value of structuring such efforts into discrete phases within which various aspects of context and content receive emphasis. For example, we discovered the importance of addressing contextual issues early so that the proper conditions (social support, heightened performance management) for improving other capabilities are established. Over time, managers should anticipate such shifts between improvements in context and content. The experiences from *TelSoft* also suggest that software managers seeking to overcome the traditional dichotomy between plan-



driven and agile principles should focus on practices that transcend the boundaries of single software projects and engage stakeholders representing management, software development, sales, and customers. Project portfolio management proved to be a suitable place to start, because it directly relates to current project performance as well as to investments in future opportunities.

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