Exploring the Everyday Dynamics of Dynamic Capabilities

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Abstract:

The concept of dynamic capabilities is both extremely popular and poorly understood, because researchers approach it from the "outside in." This perspective obscures the social processes through which people enact the capability, and black boxes the dynamics through which they combine exploitation with exploration. We explore the dynamic capability for sustained product innovation from the "inside out." We find that innovative organizations structure everyday work around a conceptual, physical, and temporal space based on the overlap of manufacturing, marketing, and R&D knowledge systems. This structuring of everyday work is the capability, and it becomes *dynamic* because three sets of rules and resources animate it: 1) taking responsibility for the entire process, which provides people with the resource of time; 2) valuing knowledge and expertise, which provides the authority to act; and 3) searching for opportunities, which provides options to address the inevitable surprises of innovation work. These rules and resources invoke routines that enable people to map out innovation work in time, generalize specialized knowledge to make it accessible to others, and keep open a variety of options to solve design problems. We illustrate this new theory and discuss its implications for how managers can actually use their dynamic capabilities.

The concept of dynamic capabilities has attracted considerable attention recently, as researchers seek to explain how firms can deal with fast-changing environments (Henderson & Cockburn 1994; Helfat & Raubitschek 2000). Teece, Pisano & Shuen (1997:516) define dynamic capabilities "…as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments." Most scholars agree that *integrate, build, and reconfigure* are central processes of dynamic capabilities (Leonard 1998; Eisenhardt & Martin 2000). Winter (2000:983) defines organizational capability as a "high-level routine (or system of routines)," adding that it "…confers upon an organization's management a set of decision options for producing significant outputs of a particular type." Thus, dynamic capabilities are organization-wide practices that managers can use deliberately.

However, how managers can use dynamic capabilities has not been adequately explained, because dynamic capabilities tend to be confused with their outcomes (Priem & Butler 2001). "Capability" means potential or the propensity to do certain things, not the things that are done. Capabilities are confused with their outcomes because they are viewed from the "outside-in," which black-boxes the social mechanisms through which people collectively integrate, build, and reconfigure what they know and can do. The outside-in perspective also black-boxes the dynamics themselves. It is established that organizations perform better if they can combine exploratory and exploitative innovation (Rosenkopf & Nerker 2001; Katila & Ahuja 2002), but we do not know how they do so. We do know that many organizations do not stay dynamic, because they fall into local search (Helfat 1994), become mired in past success (Tushman & O'Reilly 1997), or allow temporary work-arounds to "congeal" into ineffective routines (Tyre & Orlikowski 1994). New theory is needed to explain what constitutes dynamic capabilities, and how organizations can combine exploration and exploitation to stay dynamic.

To develop this new theory, we explore a particular dynamic capability from the inside out. We identify the structuring of everyday work that gives people the propensity to routinely integrate, build, and recombine knowledge for sustained product innovation – which includes the propensity to both explore and exploit since sustained innovation refers to streams of new products over time (Tushman & O'Reilly 1997). "Structuring" refers to the recurrent patterns in which people behave in routine situations (Berger & Berger 1970), and reflects Teece et al's (1997:518) definition of routines: "patterns of current practice and learning." Structuring is comprised of rules and resources that people in the organization draw on as they work. Rules and resources structure social interactions by shaping people's attention, priorities, and expectations (Giddens 1979; Orlikowski 2002). According to Tsoukas (1996:15) these rules not only give shape to actions, but also function as "normative constraints, namely as criteria by which [one's] behavior may be guided and assessed."

The result of this research is an empirically grounded theory of the structuring of work that generates the organization-wide propensity to innovate. In fact, we rediscover nearly everything others have claimed to be dynamic capabilities. Our contribution is to define both the capability and its dynamics in terms of the everyday rules and resources that produce them, and to explain how all the various parts work together. Our theory suggests that routines, systems, and/or "best practices" are not, in fact, the dynamic capabilities. Rather, they are the "outer shell" of collective action that enable and propagate a dynamic capability, but they can lapse into mindless procedure if they are not carefully anchored in the rules and resources. Our theory does not resolve all theoretical problems associated with the concept of dynamic capabilities. But it does explain how managers can deliberately use the dynamic capability for sustained innovation, and it provides an explanatory scheme to guide research. Next, we discuss sustained product

innovation to frame our data gathering by outlining activities we will ask people about, and to frame our data analysis by giving a backdrop against which to compare people's narratives.

KNOWLEDGE SYSTEMS AND PROCESSES OF INNOVATION

First, some clarification is necessary. "Best practices" for innovation are also called capabilities – e.g., the capability to know about customers (Day 1993), to build technologies (Leonard 1998), or to use multi-functional teams (Orlikowski 2002). In this study we use the term "capability" to refer *only* to the propensity to integrate, build, and recombine marketing, R&D, and manufacturing knowledge into new products. We recognize that these knowledge sets may be capabilities too, but we call them "knowledge systems" following Helfat & Raubinchek (2000), to distinguish knowledge from the capability of using knowledge for innovation.

Knowledge Systems for Innovation*:* New products are the manifestation of an organization's knowledge (Leonard 1998), so the dynamic capability for sustained product innovation builds heavily on knowledge. Research demonstrates that the more thoroughly people merge knowledge of technological possibilities with knowledge of applications and their contexts, the more successful are their new products (Souder 1987; Dougherty 1990; Clark & Fujimoto 1991; Iansiti 1998). Knowledge for sustained product innovation includes systems of: 1) market understandings, marketing know-how, and selling abilities (e.g., skills discerning trends and how to price and advertise, experience with new customers); 2) product technology understandings (e.g., basic science and engineering disciplines); and 3) manufacturing technology understandings (e.g., plant design and ramp-up, supply chain management, logistics).

All this knowledge exists at multiple levels: from specific products to product families to businesses, and from customer needs to market segments to strategic trends. Innovators need to integrate, build, and recombine this knowledge across levels, not only within levels. At the

project level, innovators create new knowledge about user needs in priority order, develop engineering know-how to produce desired kinds of product performance, and build production facilities for anticipated quality and volume. Each new product must also fit with existing knowledge systems, since no organization can operate plants or R&D separately for each product. The product and the knowledge systems must be flexible enough to enable such unanticipated integration and re-combination. At the same time, by building up each knowledge system people build familiarity with problems, which enhances their abilities to both anticipate and respond quickly to new opportunities.

We can name these categories of knowledge and list best practices for their integration, expansion, and re-combination for innovation (e.g., QFD, concurrent engineering, lead user analysis, platform and portfolio planning, technology roadmapping). But people enact these best practices uniquely for each project, since the knowledge is ambiguous, situated, and complex. Customers often cannot articulate their needs for new products, the needs may be "sticky" or bound up with the context of practice (von Hippel 1994), and unforeseen technical problems often crop up (Iansiti 1998). Knowledge for innovation is thus situated (Lave and Wenger 1991). Innovators understand customers by engaging them in the actual design process (Leonard-Barton 1991); they learn about technologies "by doing" (Rosenberg 1982), or by constructing parts and seeing how they work (Clark & Fujimoto 1991).

These best practices have been widely disseminated, yet studies show that some organizations are able to enact them better than others (Griffin & PDMA 1997). Our first research question concerns why this is so. We ask: *What is the structuring of everyday work that enables people to routinely integrate, re-combine, and build such ambiguous, situated, and complex knowledge into streams of new products over time?*

The Processes of Mutual Adjustment and Mutual Adaptation: Innovation also involves complex social processes of coordination that rely on multi-functional teams, extensive collaboration, champions, boundary spanners, and heavy-weight project management. People's collective ability to explore new opportunities while also exploiting established opportunities would involve some combination of all these processes. From the inside-out, exploitation and exploration are outcomes of two underlying processes: *mutual adjustment* (Thompson 1967; Mintzberg & McHugh 1985), and *mutual adaptation* (Leonard 1998).

Mutual adjustment, according to Thompson (1967), is a kind of coordination that is based on continuous adjustment of the actions by one specialist to the actions of others on a team. Mutual adjustment of a team's activities is almost instantaneous so communication is rapid, direct, and unambiguous. People literally figure out what each is to do and how to work together as they work. Mutual adjustment for sustained product innovation must be an organization-wide propensity that cannot be based on interpersonal familiarity (which is how Thompson explained it). New product teams may include strangers from across the organization (Orlikowski 2002). These strangers must work in parallel (Clark & Fujimoto 1991), which means that engineers are figuring out the design while manufacturing is installing tooling and marketing is preparing distributors. To work in parallel, people must appreciate the constraints of other functions, anticipate others' problems, and be able to shift focus quickly to joint problems.

Knowledge systems themselves also must transform as customers and technologies change. Leonard (1998) calls this process "mutual adaptation," or the reinvention of one system to conform to the new user work environment, and the simultaneous reinvention of the organization to conform to the new system. The process of mutual adaptation requires a revisiting of prior decision points, a reopening of issues that had been resolved, and the

unfreezing of organizational routines, so Leonard argues that it is a spiral of change rather than a cycle. However, the many product teams that are working at any one time in an innovative organization need to mutually adjust even as the knowledge systems they draw on are mutually adapting. Combining mutual adaptation and mutual adjustment is difficult, according to Leonard, because managers often cannot detect when large spirals of change are necessary, since big changes of mutual adaptation often masquerade as a series of small adjustments.

Our second research question concerns how mutual adaptation, which creates new knowledge (exploration), can work in "sync" with mutual adjustment, which applies existing knowledge in new ways (exploitation), and how can managers detect the difference. We ask: *What are the rules and resources that enable people to mutually adjust on new product teams and also mutually adapt knowledge systems, and how do these two processes work together?*

METHODS

Data Gathering: We gathered data to explore our two research questions by interviewing people who worked on new products in a variety of organizations (sample described next). As Mintzberg et al (1976) point out, a good way to find out how people do things is to ask them. The first author carried out all 107 interviews. Managers in each firm were asked to identify people who were working on new products or services. People interviewed had diverse functional expertise and worked from middle to senior managerial levels. Each person was asked to describe how they created new products, whom they worked with and how, what they learned and how, what problems they had, and how they resolved them. These were "ethnographic interviews" (Fielding & Fielding 1984), which actively engaged each person in thinking about innovation and how it unfolded in his organization (vs. barraging people with pre-formulated questions that presume a depersonalized answer). To reduce memory bias, people

were kept grounded in actualities by asking for names, dates, and other details of work. To gain multiple views of the process, at least several people who worked on the same products were interviewed. The interviews lasted 1 to 1 ½ hours, and were done at the interviewee's work site.

These interview data do not reveal actual details of behaviors and interactions, and reflect only what the person chose to reveal or thought was relevant. We also assume that organizations with a track record of effective innovation have the dynamic capability for innovation, but this assumption was not tested. But these data do reveal the kinds of interactions people had, and something about their participation, knowledge, and rationales. Data collection via interviewing also enabled us to gather a large variety of stories about working on product innovation, so we could consider a variety of contingencies and possibilities for the emerging theory.

We deliberately limited sampling to organizations in mature industries that were attempting to improve their innovativeness, to hold the technology and market dynamics roughly equivalent. The theory we develop therefore may not apply to start-ups or high technology firms. The hallmark of grounded theory building is contrast, so within these sampling constraints organizations that ranged in their ability to produce streams of new products or services were included. Including diverse examples of activities in the data help make the concepts developed from them representative (Strauss &Corbin 1998). If we had people's stories only from organizations that innovated easily, we might not see past "best practices" to the structuring of work. People's stories of innovation work in organizations that do not innovate well provided insights into what is not structured and why, and what is and is not part of normal work. These non-innovative stories also highlighted problems that people working in innovative organizations might not mention.

The firms were grouped into non-innovative, moderately innovative, and innovative

abilities, as detailed in Table 1 (all firms are disguised per agreement). Among the non-innovative organizations, all new products developed in the past several years had failed to return even a portion of the costs (Humresco), were way over budget and time (Machco, Shoeco), or the firm had introduced only one new product in the past 5 years (Prodco). The moderately innovative organizations worked in teams and developed incremental new products, but could not innovate outside established product categories. The innovative organizations were publicly acclaimed as "innovative," routinely created new product categories and new synergies across products, and measured all businesses on the proportion of revenues generated by new products, so innovation was actively fostered, not merely espoused.

Insert Table 1 About Here

***Data Analysis Leading to the Grounded Theory**:* Grounded theory building spirals over time between induction, deduction, and hypotheses testing, as researchers iterate from the empirical plane to the conceptual one and back, successively surfacing categories from the data, exploring them theoretically to clarify them, and elaborating then empirically to flesh them out. Grounded theory building is inherently subjective since researchers are interpreting people's experiences, so the analysis requires disciplined questioning of ideas across researchers and events in the data (Bailyn 1977), to continually check alternate possibilities. We followed the specific discipline described by Strauss (1987; Strauss & Corbin 1998), and elaborated by Dougherty (2002): "open coding" (to surface many possible categories), "axial coding" (to hone categories and articulate properties), and "selective coding" (to articulate a core category that integrates others into a theory). Coding is defined as the "... analytical process through which data are fractured, conceptualized, and integrated to form a theory" (Strauss & Corbin 1998:3).

We met once a week for three hours over the course of two months to discuss passages in

the interviews and code ideas about the structuring of innovation work. After each meeting, all researchers wrote up analytic memos and circulated them to the others prior to the next meeting. As well, two researchers separately coded other interviews from the same firm as the one discussed jointly, to look for corroborating, elaborating, or alternate ideas, and circulated memos about these analyses as well. The joint coding sessions forced all of us to articulate, lay open for debate, and get consensus on our own provisional understandings of the structuring of everyday work that we saw in the data. Independent coding sessions helped prevent premature closure in our joint thinking, as each researcher would (re)introduce her own preoccupations and interpretations into the coding process. Once certain categories seemed to surface across the data, we compared instances of them across organizations, to now look past possibly idiosyncratic structuring to find patterns that were common across settings.

Some examples provide a sense of the analysis. We began with the interview with a chief engineer at Prodco (consumer durables), who had worked on Prodco's only innovation in the past five years (Prodco categorized as non-innovative). Preliminary coding included: 1) innovation was unreal and unrelated to regular work (he said innovation was like "never-never land" that did not fit "normal business mode"); 2) functions were separated with little dialogue (he needed special permission to visit plants); 3) he developed his own knowledge for innovation apart from others (he described a new idea that he would not show to marketing formally until it was finished: "Most of the time you can't take an idea to someone high up unless it is reduced…"); 4) a lack of time (constant fire fighting); and 5) a sense of stasis ("we are peddling as fast as we can to get out of trouble…"). The next interview we discussed was with a technology director at Texco (textiles and materials), an innovative organization. Preliminary coding included: 1) innovation work as a kind of space in which they integrated different

technologies ("there are 5 or 6 ways to make fabric, 10 to 15 different raw materials and technologies in manufacturing fabric…"); 2) clear rules for working together; 3) an emphasis on customers ("everyone works with customers"); and 4) a respect for knowledge (he said repeatedly that different people were experts who knew to make the right decisions).

We next coded interviews with others in these companies to flesh out common issues in each and to compare. We realized that Prodco people defined technology in terms of products, while Texco people defined products in terms of technologies. The contrasts also brought out issues that were absent: Texco people described their technologies at length, often with charts or graphs, whereas Prodco people never did; Prodco people never discussed recombining knowledge, whereas Texco people never discussed sequential hand-offs. We also coded interviews from other companies to look for general manifestations of patterns. People in moderately innovative firms provided insights into the underlying rules, because these firms had recently changed. For example, people described: 1) breaking down departmental barriers by developing a common literacy; 2) building respect for others' expertise by not requiring departments to do specific things but instead highlighting "what we are all trying to do;" and 3), an underlying shift in thinking such as valuing technology for its own sake.

The theory emerged when we found a similar structuring of everyday innovation work that invoked the integration, building, and recombination of knowledge for innovation – which we call the capability, and a contrasting structuring that inhibited these processes. We also found three sets of rules and resources – which we call the dynamics, that animate the structuring of everyday work by enabling mutual adjustment and mutual adaptation, again with contrasting rules and resources that inhibited change. In the next section, we first summarize our theory, and then detail the capability and the three dynamics that animate it.

FINDINGS

Overview of the Theory

Our theory answers our two research questions by describing the structuring of everyday work that that comprises the capability for sustained innovation, and the rules and resources through which people continually create this capability, which we label the dynamics. We separate the two in order to conceptually clarify each part, although the capability does not exist apart from the dynamics that animate it. We also find that systems, routines, or best practices that others claim to be dynamic capabilities (Leonard 1998, Teece et. al., 1997; Eisenhardt and Martin 2000) in fact are not. Instead, they are the outer shell of collective behavior that give managers access to the structures that do constitute the dynamic capability, but this access works only if the routines are anchored in these inner structures.

In innovative organizations, *everyone's* work is structured around "what we can do" to provide "what customers want." Product innovation is understood *not* as the province of any one function or level, but as a common activity to which all contribute, and as part of doing business. The knowledge systems of manufacturing, marketing, and R&D intersect to create an integrative space for innovation work that is at once conceptual, physical, and temporal. This space is conceptually denoted by continued strategic articulation of "what we can do" for customers. This space is also physical and temporal, since people work together in the same context at the same time. Everyone does his or her work in the light of all knowledge systems, so everyone can visualize both the product concepts and a way to bring these concepts into reality. This structuring of everyday work is the capability for sustained innovation. People in non-innovative organizations have no shared conceptual, physical, or temporal space, so no one can see the whole product or a common way for creating it.

The capability for sustained innovation is *dynamic* because three sets of rules and resources create the organization-wide propensity for mutual adjustment and mutual adaptation. These dynamics are: 1) taking responsibility for the entire process, which provides people with the resource of time; 2) valuing knowledge and expertise, which provides people with the resource of authority to act; and 3) searching for opportunities, which provides people with the resource of options for dealing with the inevitable surprises of innovation work. These rules and resources create the propensity for mutual adjustment by invoking everyday project routines that map out innovation work over time, make specialized knowledge accessible to others, and keep open a variety of options to solve design problems. They create the propensity for mutual adaptation by invoking similar strategic routines that enable senior managers to map out and thus recognize when transformation is needed, to see what kinds of transformations should be made, and to experiment with possibilities to make those shifts.

In the next two sections, we show that these simple structures directly order everyday work so that sustained product innovation is routine and sensible. These rules and resources give managers the "tools that manipulate resources" (Eisenhardt & Martin 2000), as well as the "decision options for producing significant outputs…" (Winter 2000). Managers deliberately "use" these rules and resources by keeping strategic and tactical routines implemented, refreshed, and changed outright as needed, as we illustrate. We also show that the absence of these rules and resources produces local search, rigidity, and premature "congealing," because people have no time, little control, and few alternatives. Without underlying innovative rules and resources, managerial systems, routines, or best practices cannot produce sustained innovation.

The Structuring of Everyday Work – Moving Pieces

First, let us explore the 'moving pieces' that come together to create the capability for

innovation. Figure 1 depicts how everyday innovation work is structured in the innovative, moderately innovative, and non-innovative organizations in our study. Each of the traditional functional departments – manufacturing, marketing, and R&D – is a knowledge system represented by the ovals. In innovative organizations (top of figure), the three knowledge systems are 'moving pieces,' so innovation work consists of their *intersection*, not simply their combination. Innovation work is structured so that all participants are involved throughout the process, so all inhabit the same conceptual, physical, and temporal space. Each knowledge system is understood to exist for innovation (not for itself) so building up each one widens the intersection (in the figure, the oval representing each knowledge system expand on all sides). Since innovation is shared, "encroachment" as functions expand their functionalities is not a concern. In fact, the overlap of functions strengthens the sense of a shared process: since participants share the same conceptual space they can shape their activities to facilitate integration and reconfiguration across functional boundaries.

Insert figure 1 about here

In somewhat innovative organizations, R&D acts as a bridge between marketing and manufacturing so that there are some shared spaces, and adjacent functions are in contact. This overlap facilitates some integration, allows people to make some sense of the expansion of knowledge in other areas, and allows for some recombinative options. However, no comprehensive view of the new product or the process of innovation exists, which is why these organizations struggle to innovate outside of familiar product categories. In non-innovative companies (bottom of Figure 1), different parts of the innovation process happen at different times and in different places. This Balkanized structuring of work means that recombinations are possible only within a function, that people have no sense of what others do, which impedes

integration, and that any expansion of one function is likely to be out of sync with the others and thus viewed as a transgression on another's territory.

First, in innovative organizations the "space" of innovation is conceptualized concretely as developing and maintaining ways to satisfy customer needs, as this market researcher suggests:

> *Innovation basically becomes more from a product concept -- identify user needs and your capability and say what can you do to meet the need. (market research, Compco)*

Innovation is clearly regarded as a part of everyday work life – it occurs when what a company can do is linked with what a customer wants. This space is mobile, however, because competitors move in or customers change. For example, a Compco engineer said that a competitor had already developed a certain technology, so they were creating alternates; a Texco technology director said that their customers were "constantly trying to engineer us out," so his group continually created new products to lower costs or improve functionality.

The mobile space for innovation is physical as well as conceptual. Employees are encouraged to move between different sites as they work on a product. People may not be co-located over the entire cycle, but several members of the multi-functional team share a common physical space from time to time. For example, some visit customers jointly, the project manager sends "our quality guys" to visit with customers' quality people, and a product engineer moves to a plant for a week to work with the process engineer. These joint enactments invoke the shared, situated learning that keeps a common understanding of the product and the development process salient. And because the physical space is shared, it is easier to develop a shared conceptual space, as suggested by these comments:

> *Our people are in the labs every day. We [marketing] visit them, since I guess paper is more transportable than Bunsen burners (marketing executive, Chemco).*

> *I said to marketing: You have to take two engineers with you even if they are baggage, whenever you go [to the customer]. (engineer, Compco)*

Connecting in time is also an important element of creating the shared space for innovation. Different units work on the same new product at the same time. "Stage overlapping" not only reduces lead time, but also increases the opportunities for intensive communication (Clark & Fujimoto 1991), as this engineer suggests:

> *We are trying to get all interfaces defined, literally, and all decisions for development made on the same schedule, so it can all come together. (engineer, Compco)*

Working collectively does not require lots of extra time because it is how everyday work is structured. In contrast, in non-innovative organizations people from different departments are actually forbidden from sharing physical space. According to the chief engineer at Prodco: "The plants are like little kingdoms. You have to get special permission to go visit them." The practices at somewhat innovative organizations lie in-between these two extremes. While there is interaction, it is not extensive:

> *It starts with a relationship between myself and the factory manager and the technologist. And the technologists have a good rapport with the factory. It is not perfect but they spend a lot of time interacting. (R&D, Foodco)*

Managers from non-innovative companies also repeatedly comment on the time-related frustrations brought about by the linear process of innovation, since they do not share the same time. For example:

> *Their [marketing's] timeframes are different. I am sure it is reasonable in their minds but not to us (engineer, Prodco).*

Table 2 provides more examples of the conceptually, physically, and temporally shared space of work at innovative organizations, contrasted with that at moderately and non-innovative companies. This capability does not exist apart from dynamics that animate it and keep it mobile over time, so that "what we can do" in R&D and manufacturing continues to intersect with market opportunities, or what customers want to have done. We describe these dynamics next.

Insert table 2 about here

The Everyday Dynamics of Innovation

Table 3 outlines the three sets of rules and resources that together animate the capability for innovation, thus making it dynamic: everyone takes responsibility for the full cycle of product innovation and product life, which provides people with time; everyone values knowledge and its potential over any particular manifestation of them, which provides people with control and the authority to act; and everyone is looking for opportunities, which provides people with actionable options for dealing with the inevitable surprises that crop up in innovation. These rules and resources were constantly mentioned in innovative companies, but absent from non-innovative ones. They are organization-wide frameworks or enabling beliefs that become the context for everyday action. People create the capability for innovation described above by drawing on these particular rules and resources.

Insert Table 3 about here

The rules and resources create the propensity for long-term mutual adaptation by supporting the strategic routines outlined in the second row of Table 3 – to track, get to, and fill in the emerging space of innovation. Taking responsibility for the entire process supports routines for tracking the emerging space of innovation. Because everyone feels responsible for the whole process, senior managers can use strategic mapping routines to look for large cycles of change, and to make new functionalities sensible. At Texco, senior managers meet every six months with business heads to discuss where the businesses are going over the next three years, and Chemco managers implemented organization-wide "pacing projects" to leverage new technologies across units. Valuing knowledge for its own sake supports routines for generalizing knowledge, so managers can also see what knowledge is needed to keep the firm in that

emerging space. Generalizing enables strategic managers to see beyond existing businesses and knowledge systems, to "what we know" collectively, and thus to see how to develop this knowledge to keep the organization in the moving space of innovation. Managers use routines such as platform evolution planning and lead user analysis to figure out how to transform knowledge systems so that the space for innovation outlined above continues to exist. Searching for opportunities supports routines for experimenting with new knowledge, such as probing and learning (Lynn, Marone, & Paulson 1996), "surfing" (Quinn 2000) or "living at the edge of chaos" (Brown & Eisenhardt 1997). With these routines, managers can fill out the innovative space by enacting a variety of options and opening up a number of possible paths.

These rules and resources also create an organization-wide propensity for mutual adjustment so that numerous project teams can come together, work, and disband easily, using the routines outlined in the third row of Table 3. Because everybody takes responsibility for the full process of innovation at the project level too, process mapping that presents a holistic picture of the process is sensible (it does not become a bureaucratic abstraction). Valuing knowledge supports the routine practice of generalizing one's specialty knowledge to communicate with people in other areas. Precisely because people value knowledge, they want to make it accessible to as many as possible. Because everybody is constantly looking for new opportunities, there are plenty of design options that can be considered for any given problem that arises in any given new product process. New product teams put off the design "freeze" until almost market launch, which enhances the chances for success (Ianseti 1998).

In the next three subsections we illustrate the rules and resources by columns in Table 3, to explain how mutual adaptation works with mutual adjustment. Our theory is that mutual adaptation and mutual adjustment arise from the same rule and resource, so both reflect a similar

experience of work. Managers still have to manage, but the common ground of structuring gives them a foundation for developing specific structures for especially challenging links. For example, they can now assign a special task force to oversee the transition of new products into new production facilities, or establish temporary reporting relationships to keep specific priorities salient, or implement process management tools to help line up diverse activities.

Mapping Organizational and Project Innovation Processes In the Context of a Shared Responsibility for Innovation: The first rule for innovation gives everyone the responsibility for the whole process of creating value in the organization. This responsibility is viewed as something that is carried throughout the life of a product, not something that is handed off from one person or group to another. Since people are responsible for what their knowledge systems and their own expertise contribute to the project throughout the life of the project, their contribution is not important in one stage and nonexistent in another. A manager expresses an expectation that people know what their contribution will be, what to do, and when to do it:

> *The development engineer will continue to support these for a period of time, still be the expert. And his counterpart in manufacturing will have the same burden of responsibility. The engineer will nurse it in and their two lines cross, and somewhere down the line the colleague on the team in manufacturing has more customer contact. This kind of thing goes on throughout the company. (technology manager, Texco).*

This simple way of working gives people the resource of time in two ways. First, this technology manager does not have to directly supervise his staff by assigning activities to people at specific times, or spend time monitoring other functions to make sure they are "doing the right thing," or continually negotiate objectives and criteria. Instead, he has time to look for new technologies to support the business's strategy since he can rely on the rule of taking full responsibility. Second, people working on projects have more time to develop their own contributions, because they can expect others to pitch in as necessary, as this comment suggests:

They pair up a technician with a customer to make sure the customers are getting the right stuff. This is not rocket science. Making sure the width of the fabric is consistent with the width of the customer's machine – if their machine can run only fabric that is 65 inches and the fabric is 70 inches, it won't work. The developer knows to check. (technology manager, Texco)

The rule of taking responsibility for the whole process of innovation allows people to 'see' the space of innovation that exists apart from any one function or level. As Table 3 suggests, this rule and resource underpin strategic routines for mapping out the evolution of businesses and knowledge systems, which in turn enable managers to track the emerging space of innovation strategically. The technology manager of a particular business thinks about delivering different kinds of material to customers based on his portfolio mapping of the business, while corporate manufacturing thinks about keeping plants loaded based on routines for updating facilities that might produce new materials, and corporate R&D uses technology roadmapping to anticipate completely new materials based on input from technology directors in all the businesses. Because everyone is mindful of the whole process, people are aware of what they as a business, a function, or a firm can do and cannot do, so they can see emerging needs.

The rule of responsibility for the whole process also enables people from different functions to mutually adjust as they work together on projects. Projects are structured so that all participants are simultaneously involved with innovation; no sign-offs leave functions outside of the innovation process for long periods of time. However, since the simultaneity of different development phases does introduce complexities, people in innovative companies use process mapping to manage innovation. They rely heavily on stage gate processes that conceptually frame innovation, making the sequence of events, milestones, and the resources required with every step clear to all within projects. Integration is facilitated by the fact that all functional groups focus on the same stage at the same time. In fact, Iansiti (1998) regards a stage-gated approach as

essential for integration. The process map therefore supports the creative recombination, expansion, and integration of knowledge systems for new products.

However, in non-innovative organizations there is no rule of shared responsibility for the whole of product innovation. Responsibility is separate and is handed off from one group to another, which reduces perspective and the ability to see longer-term needs. The result is that functions often find themselves with too little time to expand their own knowledge to solve particular problems, which forces dramatic last-minute crises, or very limited or hidden innovation. In fact, people in non-innovative organizations repeatedly mentioned of lack of time, which led us to realize that joint responsibility creates time as a resource, while its absence eliminates time. The resource of time is best illustrated by its absence:

> *Usually there is a request by marketing for a given season two or three years out, but we came up with the XYZ idea ahead of time. If we didn't have it ahead of time, it wouldn't be ready, but if we showed it to them [marketing] upfront, they would have said we don't know about that. (technology manager, Shoeco)*

Without systematic, organization-wide strategic mapping, she develops technologies on an ad hoc basis and in secret, to be ready for anticipated demands. She cannot count on marketing to appreciate how her new ideas might provide functionality for future opportunities, or even to give her enough time to develop these new possibilities.

One consequence of these discontinuities in the innovation process is that people seem unable to mentally map out the innovation steps, and have to actually *do* them before they can assess the feasibility of an idea:

> *We built a couple of prototypes and over lunch break during a meeting, we brought them [marketing] out to see the product. Now we will get with production and see if it is feasible, durable. It is an enhancement, a styling enhancement that we have not commercialized yet, and we are not aware if it has possibilities. (engineer, Prodco)*

Because the process of innovation is neither mapped nor shared, people are constantly in

reactive mode, which in fact takes more time. A sequential process, in the words of Clark and Fujimoto, "imposes a greater problem-solving burden on downstream processes" (1991: 211). The system of sequential sign-offs makes it impossible to integrate activities, and both building and recombination are constrained by the existing functional knowledge. Table 4 contains more illustrations of these contrasting rules and resources.

Insert Table 4 about here

Generalizing Organizational and Project Knowledge in a Context Where* Knowing *is a Central Task: While the first set of rules and resources supports routines for tracking the space of innovation as it evolves, the second supports routines for getting to that space and for keeping it open. Innovative companies are governed by the rule that knowledge itself matters, and that knowing is a central task for everybody in the organization. This rule keeps people collectively conscious of what they know and how they know, so building up knowledge systems, honing expertise, and applying expertise competently are all routine activities. The resources are control and authority to act, which arise from expertise. People are not only allowed to apply their expertise to the whole innovation process, they are expected to, which helps them become practiced at being a competent expert.

This quote shows that the people in the organization are responsible for knowing, and also that they are authorized to act as they see fit:

> *If the team finds a new customer or an existing customer or a new need, they are experienced enough to know whether this is the right technology or not for that need. (technology mgr, Texco)*

This rule also fosters a respect for knowing and learning, including a respect for the people and what they know. A constant theme is that people are respected and their knowledge is valued, and they are expected to know:

> *The best product developer has some respect for what we are capable of doing in manufacturing. (marketing, Chemco)*

This rule supports routines of generalization that keep specialized knowledge widely accessible, strategically as well as tactically. Even though people keep developing deep expertise, they can stay clear of overly technical details when working together because they are skilled with high-level conceptual frameworks. This generalizing can take place visually, for example through charts, matrices or models, or verbally, where categorization and enumeration become important. Generalizing is a conscious and deliberate attempt to counter the tendency for more deeply held knowledge to be inarticulate, as Suchman explains:

> The problem is rather that just to the extent that some form of activity is a fundamental aspect of a person's practice, they would never think of mentioning it to you. It becomes, quite literally, *unremarkable* to them (Suchman 1996:409).

Because generalization frames knowledge in such a way that it can be more easily shared with other people, it is a driver in the expansion of knowledge. For example, one Texco manager laid out for the interviewer a simple chart of their technologies:

> *Here are all the ways we manufacture yarn, sixteen different ways. And then all the products. The matrix shows where we do it and can we use it. We also have a matrix for weaving, finishing and coating. Look in here [on the coating matrix]. What the hell is XYZ [pointing to a word in the middle of the list]? Well, it is a way of finishing, and this shows we are not using it anywhere. (Technology manager, Texco)*

This simple generalization illustrates what they know, what knowledge they may be at risk of losing, and how Texco can stay in the emerging space of innovation strategically, by pointing out particular kinds of new knowledge to adapt in manufacturing.

The role of the strategic manager is partially defined as taking charge of prompting knowledge and learning:

> *My biggest job is to put the right people in the right spots and if we have a deficiency to fill in the gaps. (technology mgr, Texco)*

Whoever comes up with an idea tries it. We get the right people and give them the tools and tell them what we are trying to accomplish. (technology mgr, Chemco)

Generalizing is very important within projects too, since it provides people with the ability to translate knowledge into an accessible form for people with other technical and functional backgrounds. Generalizing also presupposes an awareness of one's own capabilities and an awareness of what other project participants know and can do, which heightens the awareness of all available knowledge within a project. The "intensive communication" Clark & Fujimoto (1991:245) describe that takes place within innovative companies obtains, we suggest, because of the rule of valuing knowledge, and its routines of generalizing provide the propensity for a "common language and a common methodology."

In non-innovative organizations people are not expected to know, only to *do* – or to produce a product. There is no expectation that others will appreciate less than fully specified ideas or even make a reasonable attempt to do so, since knowledge for its own sake is not valued. So, rather than continually articulate possibilities and question options, people develop innovative knowledge apart from others. The chief engineer at Prodco was asked if he found it useful to involve marketing and manufacturing in his innovation work. His answer:

I know the party line is yes, but the answer is no. You need people who have insights into what is possible, and feasible, and then you bounce the ideas off marketing and manufacturing – it is informal. (engineer, Prodco)

This engineer does not believe he can count on his colleagues in other departments to understand what he is trying to do. As a result, processes only implicitly embody knowledge; there is not an explicit respect for what other people know or an appreciation for learning:

They [marketing] think there is a technology tree out there and it has all the technology growing on it and all we have to do is go and pick off something. It takes development and trial and error and many prototypes. (technology, Shoeco)

This lack of respect for knowledge and for what people know outside of one's own

function makes it impossible for these organizations to recognize and use their knowledge for innovation. People do not expect others to shape their knowledge to fit the collective task, or to use their expertise competently for the project. The result is that people focus on the outcomes of innovation work, specific products, rather than on ongoing innovation. This structuring narrows down people's understanding of everyday work to current products and expertise, rather than open it up to flows over time. Since knowledge is not generalized – indeed, not discussed – in terms of underlying potential, people have no shared sense for possibilities of integration, expansion, or recombination of knowledge. Because participants only really know their own sphere of specialty, the number and quality of possible recombinations is reduced. Likewise, when knowledge is only personal and specialized, integration is very hard to achieve.

The lack of respect for knowledge and knowing reinforces people's inability to deploy their expertise for innovation, so they do not have control over the innovation or the authority to act. Instead, people concentrate on preventing others from doing things that may make their work more difficult. Table 4 has additional contrasts of this rule and resource, and their absence.

Spiraling Across Cycles of Adaptation, in a Context of Constantly Looking for New Opportunities: The third rule is to constantly search for new opportunities. The constant search yields a large number of options from which to systematically choose innovations at all levels, from new technological capacities to alternate ways of solving a particular design problem. Constantly looking for new opportunities encompasses the idea of constantly innovating, and this creates an organization in which the people are used to innovation – they are used to change. As one manager said, the "chaos is that we are constantly innovating" but the organization can handle it because, "we are all used to it" (technology, Texco). This rule provides people with the vital resource of having ways to deal with the inevitable surprises of innovation ready at hand, since

various possibilities that might fit a particular case are likely to have already been tried out.

This rule and resource support routines for filling in and keeping open the space for innovation, but it works with the other two sets in Table 3. For example, manufacturing follows its strategic routines for tracking the emerging space for innovation by examining its abilities to improve customer satisfaction and delivery time. They develop this overall know-how by working directly on specific innovation projects, so as new business opportunities arise, they are likely to have requisite production abilities in place, at least for experimentation. And since the abilities are already in place, albeit perhaps just one line in one plant, they already have a sense for the possibilities of plant scale-up, supply chain transformation, and shifts in customer relations. They can make the decision to launch an entire new business, or not, based on this everyday sense. The mutual adaptation of entire knowledge systems to create new businesses is eminently sensible, because everyone is mindful of the whole process, is well aware of the organization's knowledge, and actively searches for opportunities, thus continually enacting and situating the knowledge.

Because decisions are taken on the basis of the promise of the entire system, no techniques are assessed in isolation, and a wide variety of possibilities are available for experts to consider. During this spiraling process of mutual adaptation, there is a constant movement between generalized and specialized knowledge. Generalized knowledge is necessary to create a wide awareness of available options, but specialized knowledge is needed to assess the systemic impact of a specific option. Yet in order to explain to other participants what the systemic constraints or opportunities of that option are, knowledge must again be generalized. This combined deep knowledge of a discipline and breadth of understanding of how the discipline interacts with others is termed a T-shaped combination of skills (Iansiti, 1998). The innovative companies are organized in a way to support the development of organization-wide T-shaped

skills so that they reside not only in individuals, but are institutionalized.

Senior business managers in innovative organizations use exploration to develop business strategies, as this marketing director at Chemco suggests:

> *My view is that to be a different kind of company, we need to exploit internal competencies, by looking at existing customers, that is level 1. Level 2, which is where we are now, is to work on emerging value. I want to move to level 3, which is creating value. These are the sources of innovation I talked about… The first is reconfiguring, adjusting, re-engineering, working in the white spaces. (marketing, Chemco)*

He diagnoses where he thinks they are now, and maps out various kinds of explorations he hopes the business takes. This way of thinking would underpin routines for "surfing" (Quinn 2000), or "probing and learning" (Lynn et al 1996) because it makes these routines sensible. A project manager at Chemco describes the constant influx of new ideas in manufacturing as normal:

> *You can't be in a plant without seeing a lot of new products. There is a constant flow of them. Some manufacturing people look at new products negatively because they do cause problems, but there is a mindset here at Chemco that this is my problem today but this will be our bread and butter in three years. The constant flow of innovation hurts their financials but innovation is an expectation, and most people in manufacturing accept it. There are enough people on both sides to help out. (technology, Chemco)*

The rules that everyone will pitch in and that knowledge itself is valuable are evident as well, and support the rule of constantly searching for new opportunities.

At the project level, this rule supports the routine of quickly exploring various possibilities. For example, at Compco, people working on a very new kind machine together developed the possible attributes that the market researcher would test, working from a much larger, jointly developed list of possibilities:

> *You need agreement on the attributes that you are going to test. We joined together engineers, product managers, and we decided on fifteen attributes. Our first cut was 90 attributes; this was connected to the development of the product idea. (Market research, Compco).*

The rule of always looking for new opportunities enables the weeding out of alternatives,

so that particular problems in design can be explored and solved systematically by matching capabilities to needs. Iansiti (1993:141) describes the "weeding of alternatives":

> The integration team began selecting the most promising of the various new techniques and worked on combining the elements into one technical concept. They investigated several possible technical concepts in parallel […] As the integration team learned more about the systemic effects of the various alternatives, some were dropped, others postponed for future generations, and others refined and kept for future study.

This "spiraling" process requires the systematic assessment and elimination of many options so that only the single best option remains. The choice is fluid and only gradually firms.

Perhaps the most obvious characteristic that describes non-innovative organizations is that as a whole they do not actively look for new opportunities. Instead, they may make it very difficult for new opportunities to be considered. As one project manager describes:

> *You hit a wall sometimes trying to get new ideas through that are outside the paradigm. They like to see things done the old way. Transco was very successful for a lot of years. This is an extremely conservative company. If we have an idea of cutting costs that doesn't fit with what we like to do, it can't get through. (market mgr, Transco)*

The non-innovative organizations also depict innovation as an ideal state – something that is different from the everyday reality, affirming that looking for new opportunities is not normal either. For example, one engineer said: "The ability to innovate is in people, it is not a procedure. It is like the masked avenger, it is disguised during the normal business mode" (technology, Prodco). He also said that the time he spent in a special venture unit "was like being in never-never land. It was totally separate from the organization."

People working on projects in innovative organizations have the vital resource of being able to consider various options and to hold the design open. People in non-innovative organizations do not have this resource, so their work is more like a player trying to hit bull's eye with a single dart. For example:

> *Since we run a big [transportation] network, it is hard to pilot test. We have to train*

50,000 operators. Once we decide to go, we go. (marketing, Transco)

In addition to the paucity of options in non-innovative organizations, the sequential process requires one functional set of techniques and technologies to be finalized before being handed to the next function, thus fundamentally limiting the extent of possible integration. Non-innovative companies lack both the ability to generate multiple options for innovation and the supporting capability of choosing between options in a systematic way. Table 4 provides additional illustrations of this rule and resource, with contrasting illustrations of its absence.

DISCUSSION

We began this analysis with the observation that the concept of "dynamic capabilities" is very popular, because it helps theorists and managers deal with fast changing environments – or at least to think about dealing with them. However, we also pointed out that theorists cannot explain how to use dynamic capabilities because we have not explained what dynamic capabilities are, nor how they are created and maintained. To fill this gap, we developed an empirically grounded theory that describes the structuring of everyday work for sustained product innovation, which we call the capability, and three sets of rules and resources that animate this capability, which we call the dynamics. We did not confirm a theory, only created one, and the theory we created is limited by the data and analyses used. We give our answer to the question of how managers can use the particular dynamic capability we examined, and then suggest additional research to overcome the limits of this analysis, and to advance theory for dynamic capabilities in general.

As we noted in the introduction and illustrated in our development of the theory, we found just about everything others have already said are part of dynamic capabilities, so this study is certainly consistent with existing research. Our theory, however, is that the dynamic capability for innovation is comprised of a particular structuring of everyday work that is animated by three

particular sets of social rules and resources. This dynamic capability for innovation is enabled by an "outer shell" of specific routines that foster process mapping, knowledge generalization, and opportunity search. Managers "use" the dynamic capability indirectly, by shaping, selecting, and implementing these supporting routines. We think that the rules and resources must be anchored in strategic and project-specific routines, so that participants can get a more immediate sense of why they matter and how to enact them. Without the routines, the rules and resources may become abstractions that are too inarticulate for people to understand how they apply to the innovative process. But without the rules and resources, the routines can lapse into bureaucratic requirements that hinder more than help innovation. The mutually reinforcing interaction between the rules and resources with these routines is essential.

Therefore, if managers are to use the dynamic capability for sustained innovation, they first need to be mindful of the capability and dynamics, since the purpose of routines is to keep these underlying structures effective. We showed that some organizations could not innovate systematically, relying instead on ad hoc efforts. We argued that their inability to innovate arose directly from how they structured everyday work (innovation activities separated conceptually, physically and temporally, supported by rules that responsibilities are also separate, that knowledge is pushed into the background so the product outcomes are all that is salient, and that opportunities are not explored). This inability is not caused by path dependency, institutional order, or some mysterious environmental force, at least not directly, but rather by how managers organize work. The non-innovative organizations had implemented "best practices" for innovation (e.g., most espoused multi-functional teams, customer orientation, building "core competences"). But these routines had little effect, we suggest, because the structuring of everyday work was not transformed to a conceptual, physical, and temporal shared space.

People in the innovative organizations we studied do their work in light of all three knowledge systems, so they can integrate, expand, and recombine knowledge into new products, new product families, new abilities and processes, and new businesses, *because* doing so is literally part of everyone's job. Since the space for innovation is created by the intersection of functions, these knowledge systems must be managed in terms of their contributions to innovation, not as "silos" or separate functions. Three sets of rules and resources animate this everyday space of innovation work, which is how an organization's capability for innovation can remain dynamic. People take responsibility for the entire process because they can control their own time and see how to get the time to complete their part. People value knowledge because they are authorized to use their expertise as they see fit. People keep looking for opportunities because they can use these opportunities to accomplish their work. These resources are not controlled or doled out by management but instead are available directly to people doing work.

These rules and resources are consistent with research that emphasizes innovative, entrepreneurial, and/or learning cultures and systems. However, we find no astonishing proclivity for risk-taking, no mystical culture of entrepreneurship, no amazing leadership skills – just a few simple rules and resources. Our findings specify how the everyday work of so many people in large organizations can "become" entrepreneurial or risk-taking when viewed from the outside in. People know what is expected of them and what to expect of others. When they attend meetings, create plans, calculate costs, figure out criteria, and otherwise go about everyday work, they have a common ground for negotiating collective action in particular situations.

Managers "use" this dynamic capability for innovation indirectly, by facilitating, shaping, and manipulating routines for process mapping, generalizing to keep knowledge sharable, and spiraling among options to solve specific innovation problems. Here, strategic managers have

hard work to do in selecting and implementing those procedures, processes, and techniques that would best keep the dynamic capability operative. This part of our theory leads directly to more research, since exactly which best practices are appropriate for which competitive conditions, how often they can be changed, and how congruent they must be are likely to be contingent.

Our theory is based on mature organizations, so the particular routines we found may only fit similar organizations. Studies of other industries can confirm or refute our basic theory, and also determine contingencies. For example, is generalizing to keep knowledge valuable and accessible crucial in biotech or professional service industries? We think so, but expect that the generalization routines would differ from those found in our manufacturing firms. As well, how can the rule of taking responsibility for the entire development process fit in high technology firms that emphasize "technology push"? Our theory suggests that these organizations might have a diminished capability for innovation because their purview is narrowed (i.e., less market and operations knowledge emphasized or appreciated). Such an hypothesis would both test our particular theory and push forward general theory by exploring specific mechanisms. Finally, our theory presumes some coupling between the outer shell of routines and the inter structuring of work, perhaps because we studied big manufacturing firms. The very presence and degree of this coupling is also an empirical question.

Our theory also raises issues for more general discussion. We focused on just one dynamic capability, and do not think that the same structuring underpins all capabilities. Rather than lump together all sorts of activities under "dynamic capabilities," we propose that research examine whether or not organizations can possess all capabilities, or might these capabilities conflict with each other? Another question is to examine the conditions under which exploration and exploitation cannot be combined. Our theory explains how the spirals of mutual adaptation and

mutual adjustment flow together, but at what point would the "common ground" be too diffuse? Finally, we argued that organizations do not innovate effectively because their everyday work is structured to prevent it. We also argued that rigidity, simplification, local search, and similar predilections are not inherent in the human condition, but are the direct outcomes of this structuring of work. This too is an interesting research question.

In conclusion, we propose a theory for dynamic capabilities that is focused on a particular set of activities, and explains the propensity to engage in those activities systematically, or across a large organization, based on the structuring of everyday work. Our theory pulls together various ideas in the literature by suggesting a particular set of relations among social rules and resources and the routines that enable them. These rules and resources create a social fabric out of which innovation can flow, but the routines keep the rules and resources sensible and indeed sharable. If nothing else, our theory shows that the social mechanisms of organizational capabilities can indeed be observed. They need not be assumed, imagined, or ignored.

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Figure 1: The Capability for Sustained product Innovation

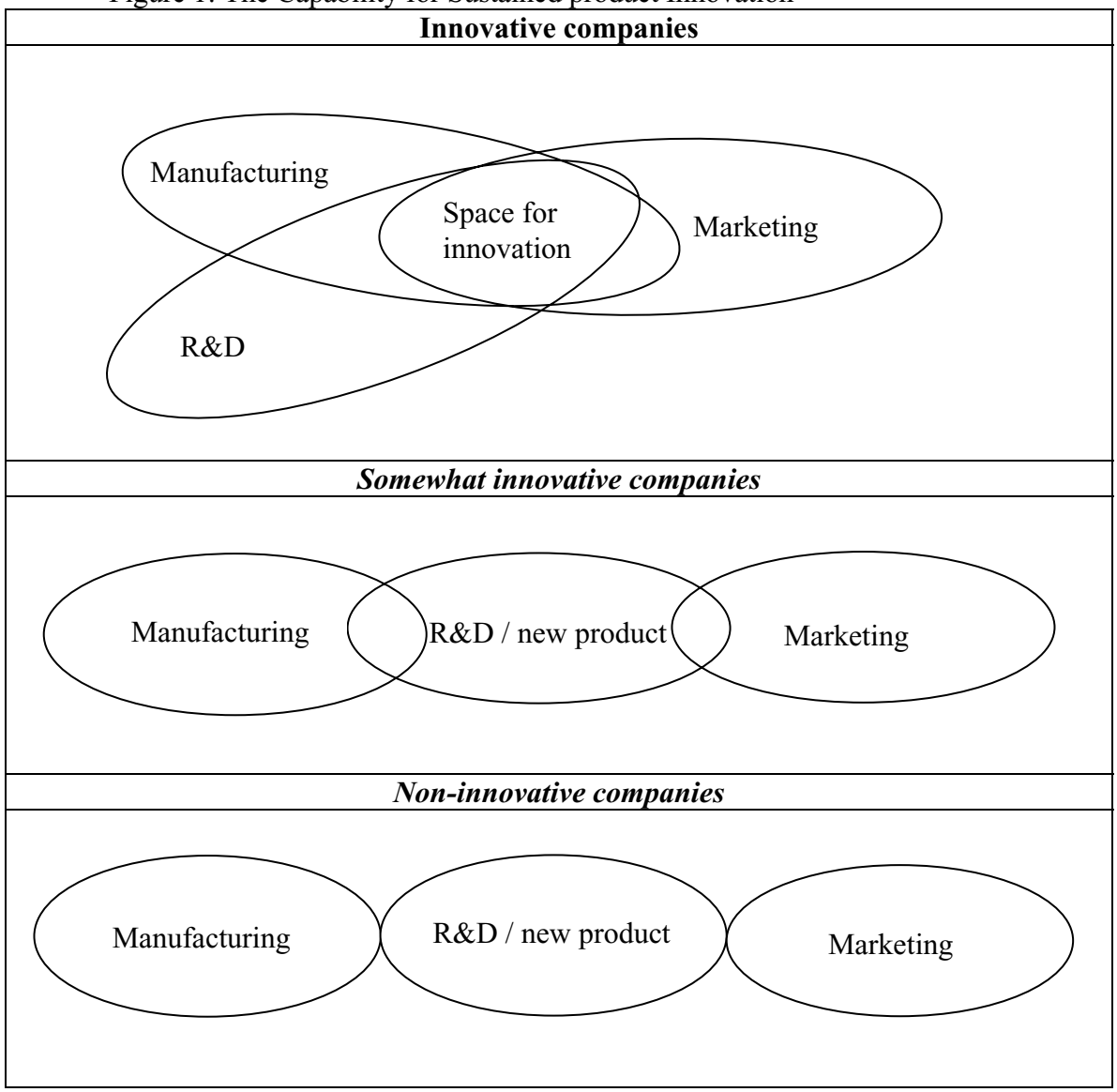

TABLE 1: Organizations, Number of People Interviewed, Innovation Category		
Organizations	**People Interviewed**	**Category of Innovation Capability**
Chemco: 110 year old specialty chemicals	4	Highly innovative (widely recognized in press and scholarly study for innovative capabilities; measures all businesses on % of revenues from new products; continually upgrades procedures, structures to support innovation)
Texco: textiles, 130 years old	6	Highly innovative (received national award for innovativeness; measures all businesses on % of revenues from new products continually upgrades procedures, structures to support innovation)
Comco: office and electronic equip, 50 years old	3	Moderately innovative (recent major restructuring to enhance organization-wide innovation; corroborated by mgt article accounts)
Foodco: processed foods, 30 years old	11	Moderately innovative (others at firm said this bus. unit most innovative; have reduced innovation product cycle from 3 years to 6 months with many successes; however those interviewed said are still stuck in product category.)
Humresco: services in human resources; 55 years old	21	Non-innovative (head of task force on NPD said all innovations in past 3 years lost money; corroborated by others)
Machco: industrial machinery; 120 years old	30	Non-innovative (all 4 recent innovations in business unit very late, over budget; corroborated by 2 other researchers at site)
Transco: shipping; 100 years old	9	Non-innovative (all product mgrs said firm not good at NPD; have always copied competitors rather than lead industry)
Prodco: consumer durables; 130 yrs old	6	Non-innovative (only one new product in 5 years; others changes appearance only)
Phoneco: telecom; 90 years old	8	Non-innovative (benchmarking study showed firm too slow, lacks processes for NPD)
Shoeco: women's shoes; 30 years old	9	Non to moderately innovative (changes underway, consultant said firm is bad at NPD)

Table 2:
Structuring of Everyday Work as a Conceptual, Physical, and Temporal Shared Space Vs. Partial Structuring and Absent Structuring

Innovative companies	**Somewhat innovative companies:**	**Non-innovative companies:**
A shared view of innovation	**Somewhat shared view of innovation**	**No shared view of innovation**
It may take 6 months to learn a technology, so you can't have different groups doing different phases of development (Tech., Chemco) The upside of cross-functional teaming is letting the manufacturing guy know what is going on. Before, he would show up and run an experiment, and no one would know what to expect. (Mkting, Chemco)	We work very closely with marketing and we are involved in product design panels, and research, and we are often there with focus groups. … It is a collaborative thing. To some extent we involve the factory but not enough. (R&D, Foodco) In Product development we know what marketing wants, and production knows what they want – no new nozzles, nothing hand done. We are in the middle. (R&D, Foodco)	All products start with a new product request… a simple form that identifies the customer, performance goals… it is all filled out by marketing. We in Research go through and see what it takes to satisfy the request. (Tech., Prodco) This is me in the middle [he moved things around on table with one in middle to represent Design, and three others called Marketing, Sales, and Engineering each at 90 degrees]. I never go out to any of the points. (Designer, Shoeco)
Physically Shared space	**Some shared space**	**Separate territories**
I took two chemists plus a manufacturing and a research guy with me to XYZ customer. (Technology, Texco) We have marketers in the lab. It sure helps communication. (Tech, Chemco)	We would like to be more involved in terms of more customer contact. […]We do not want to work in a vacuum. We would like to know the frozen foods managers, plus the buyer. Those relationships are typically with Marketing. (Manuf, Foodco)	The plants are like little kingdoms. You have to get special permission to go visit them. (tech., Prodco) Other advanced concept groups send people abroad to work with factories but not us. (Tech., Shoeco)
Shared timeline	**Timeline somewhat shared**	**Timeline allocated between separate functions**
This product redid the process. Before, certain parts of the product development team wanted research before they would do product goals or test pieces of research. This was parallel processing rather than linear. (Mkting, Compco) Manufacturing people who are experts are involved in the beginning of the process. There is no toss over the wall after development... (Mkting, Techco)	If we [manufacturing] are not involved early on, you already have a product with momentum, and if manufacturing has severe constraints, then manufacturing has to figure out how to solve them. (Manuf, Foodco) They [marketing] may focus on the rollouts, products that are new for them and the customers, but were developed 6 to 8 months ago. To me these are old. (R&D, Foodco)	At today's meeting Strategic Planning suggested that all my products be reworked by February. (Mkting, Transco) We have more being asked of us than we can possibly accomplish. We make choices on what we will do (tech., Prodco)

Table 3: The Dynamics of the Capability for Sustained Innovation			
Dynamic	**Mapping Organizational and Project Innovation in the context of a Shared Responsibility**	**Generalizing Organizational and Project Knowledge in a Context Where Knowing is Central Task for all**	**Spiraling Across Cycles of Change, in a Context of Constantly Looking for New Opportunities**
Rules and Resources	**Rule:** Responsibility for innovation carried through entire development cycle, not handed off **Resource:** gives individuals time to get work done	**Rule**: Knowledge valued for own sake, awareness of, respect for own and other's knowledge; **Resource:** gives individuals control over their own contribution and authorizes each to act as expert	**Rule:** Active search for opportunities; **Resource:** gives individuals many workable options exist to solve innovation problems
Strategic Routines Supporting Mutual Adaptation	**Process Mapping of business evolution** to track evolving space of innovation strategically: enables people to see where space is going and what "we need to know." Routines: technology roadmapping, six sigma, concurrent engineering, strategic prioritizing	**Generalizing knowledge systems** to get into space of innovation strategically: enables people to keep open space by highlighting knowledge that is needed; Routines: platform planning, lead user strategic development, value mapping	**Spiraling among experiments** to enact space of innovation: enables people to fill out space by trying alternate paths and contrasting various experiments; Routines: probing and learning, patching, moving charters
Tactical Routines Supporting Mutual Adjustment	**Process mapping of innovation project**, to situate work in particular innovation space: to provide holistic picture of project level activities and what to do by whom Routines: phase review, QFD, concept articulation processes	**Generalizing one's own knowledge**, a practiced skill at steeping back and presenting gown knowledge in a way that makes sense to others, comes from a shared sense of value creation	**Spiraling locally among options**, shifting and rethinking connections, have whole in mind and can then figure out various possibilities

Table 4:
Illustrations of the Three Dynamics of Innovation Vs. Partially Present and Absent

Innovative companies	**Somewhat innovative companies**	**Non-innovative companies**
All share responsibility – Routines of Process mapping	**Limited overlap of Responsibility – Linear map**	**Responsibility handed off – no process mapping**
[Showing a chart with the phase review process] Here are the things we need to do step by step. Here this is the hurdle to get into the plant. (tech., Compco) We have a five-step process, with what each person is doing in each phase. Then we have a preliminary marketing plan, and we test it back and forth ten times. (Mkting, Chemco)	We are forced to put numbers in to meet the figures. We knew it would not happen in three years, but we said three, so I built capacity for three. (Manuf., Foodco) We do not go into the gory details of equipment design because they wouldn't like it, and they do not go into the gory details on the nuances of flavors, because we won't like it. We focus on the business and the timeline. (Manuf, Foodco)	The focus of priority setting has been what can we do to come out with next January. It will not be a very innovative new product. It is a struggle to get beyond that. (Mkting, Prodco) Just about everything we do is a direct response to some business plan, a new product request from marketing. We look at it and establish what are the real costs, the technical challenges.. (Tech., Prodco)
Valuing Knowledge -- Routines of Generalizing to Support Sharing	**Sharing of some generalized knowledge**	**Knowledge specialized and not shared**
Our customers are very simple. To them value is making or saving money. There are three elements to that: how long does the product last, what are the processing costs, and what is the labor to use the product. (Mkting, Chemco) We can make lots of different topographies [so] do we try the topography or change what goes into the minerals or resins, or adjust the finishing process itself.. (Tech, Chemco)	The constraints could be and are the structure of the ingredient and how to dispense it. For example, there may be somebody who thinks we can dispense this ingredient automatically but there isn't any way, or the equipment would not work here, or we can't do it. (Manuf, Foodco)	I am doing a presentation on it next week. I thought that up to now everything was OK.. .but now I have heard that public affairs will come to the meeting and rebut everything I will say. Now I have to come up statements to support my side. I work against my own people. (Mkting, Transco) We had found a niche and applied skills to that niche. Later on the skill didn't matter any more, only the niche. We have held onto a small skill aspect. They should be a foundation, but the business focus took us away. (Designer, Shoeco)
Multiple options generated and rigorously screened	**Some options generated and superficially screened**	**Few options generated and poorly screened**
I was assigned to look into [problem with load in a plant] further… We sent out an invitation to all the business managers… and I presented the process. In a company with many technologies, not everyone understands all of them. If you pick one and totally explore it with a captive audience a lot gets learned. We ended up with six new project possibilities and two clicked. (Tech., Texco)	With the concepts we get the recipes together. We get six to eight recipes; Marketing might want four. (R&D, Foodco) Marketing chose this design, and at the time we thought it was six of one, and a half dozen of the other. We went with it because we thought the risk was the same and the capital cost was the same. (Manuf., Foodco)	They look for technology that is very specific to the products (Tech., Prodco) We have a lot of young people who are anchored in operations and who have very good ideas about how to do things. But they are afraid they will lose their jobs… (mkt mgt, Transco)