COORDINATION NEGLECT: HOW LAY THEORIES OF ORGANIZING COMPLICATE COORDINATION IN ORGANIZATIONS

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ABSTRACT

We argue that organizations often fail to organize effectively because individuals have lay theories about organizing that lead to coordination neglect. *We unpack the notion of coordination neglect and describe specific cognitive phenomena that underlie it. To solve the coordination problem, organizations must divide a task and then integrate the components. Individuals display shortcomings that may create problems at both stages. First, lay theories often focus more on division of labor than on integration. We discuss evidence that individuals display* partition focus *(i.e. they focus on partitioning the task more than on integration) and* component focus *(i.e. they tend to focus on single components of a tightly interrelated set of capabilities, particularly by investing to create highly specialized components). Second, when individuals attempt to reintegrate a task, they often fail to use a key mechanism for integration: ongoing communication. Individuals exhibit* inadequate communication *because the 'curse of knowledge' makes it difficult to take the perspective of another and communicate effectively. More importantly, because specialists find it especially difficult to communicate with each other, the*

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general problem of communication will often be compounded by insufficient translation.

THE IMPORTANCE OF COORDINATION

Highly motivated individuals often fail in their attempts at organizing. At Xerox during the 1970s, top managers feared that Xerox might falter when business transactions shifted from paper to electronic forms. They were savvy enough to create the group of researchers that invented the first desktop PCs (complete with mouse graphical interface) and easy means of networking them (complete with networked laser printers and e-mail). Then top managers failed continually to organize a structure that could bring the new technologies to the marketplace(Smith & Alexander, 1998). Why? Software developers who are urgently trying to finish a major piece of software frequently organize themselves in ways that actually slow themselves down (Brooks, 1979; DeMarco, 1995). Top managers at the best firms of an era systematically complicated their own jobs by diversifying into other lines of businesses, then floundered when they tried to design organizational structures to repair the complications they created (Chandler, 1963). Front-line workers who are earnestly trying to communicate with each other choose methods of communication that make it even more difficult to organize their efforts (Dougherty, 1992; Bechky, 1999). Even when motivations far exceed the typical range of motivations available in a business setting, highly motivated individuals still fail to organize effectively. During World War II the American Navy was suffering devastating attacks on its convoys by German submarines. It spent months trying to copy the more successful British Navy, willingly borrowing every possible aspect of the British system except for the method of organizing that eventually, much later, allowed them to succeed (Cohen & Gooch, 1990). Why?

The examples above share a common characteristic: Actors were highly motivated to succeed in their task, yet they chose bad ways of organizing their actions. We belabor this point with many examples to raise a curious point; although the social sciences today have much to say about the problem of motivation (which is less of a problem in the examples above), they have less to say about the problem of improper organizing (which is a much more serious problem). In order to accomplish their work, organizations must solve two problems: motivating individuals so that their goals are aligned (the agency problem) and organizing individuals so that their actions are aligned (the coordination problem). Almost all of the founding texts in organization studies emphasize the importance of both problems: agency and coordination

(Barnard, 1938; Simon, 1947; March & Simon, 1958; Burns & Stalker, 1961; Galbraith, 1973). Yet although agency and coordination are both central problems for organizations, in recent years, the agency problem has received far more attention from researchers. Agency theory, a popular topic in both economics and organizational studies, examines how principals can design optimal incentives to align the goals of their employees or agents (Eisenhardt, 1989; Jensen & Meckling, 1976). Although the agency problem has become increasingly popular, the coordination problem has not seen an equivalent rise in popularity, despite the fact that it is equally central for organizations. In fact, in economics, the coordination problem predates the interest in agency (e.g. Marschak & Radner, 1972), yet it has fallen out of favor while the agency problem has become increasingly popular (Milgrom & Roberts, 1992).

In many situations, the agency problem is not the main barrier to organizing. Even when organization members are motivated to work hard, they may find it difficult to coordinate their actions. In organizational research, early researchers recognized this fact and developed studies and theories of organizational design (Thompson, 1967; Woodward, 1965; Perrow, 1967). Now commonly thought of as an 'old' theory, organizational design research has gradually fallen out of favor (Staudenmayer, 1997) albeit with some important exceptions (e.g. Tushman, 1979; Wageman, 1995; Gresov & Drazin, 1997; Crowston, 1997). The little research that is being conducted today typically draws upon the frameworks and concepts put forth by Thompson and others in the 1960s. In fact, Thompson's 1967 book is still the most cited source in organizational design, and its citation count is falling over time (Staudenmayer, 1997).

In this chapter we try to return attention to the coordination problem as a central problem in organizational studies. However, in contrast to the research on organizational design, we explore the coordination problem by exploring the cognitive problems that individuals face when they attempt to coordinate with others. We argue that people have inadequate lay theories of organizing, and that their lay theories hinder them when they attack the problem of coordination. Our level of analysis is the individual and the cognitive processes that individuals use to approach the coordination problem. We argue that when individuals design organizational processes or when they participate in them, they frequently fail to understand that coordination is important and they fail to take steps to minimize the difficulty of coordination. To summarize this hypothesis, we say that individuals exhibit *coordination neglect*.

We do not claim that coordination neglect among individuals will *always* produce coordination failures in organizations. Industries and organizations may provide pre-packaged processes and procedures that can repair the cognitive shortcomings of individuals (Heath, Larrick & Klayman, 1998).

However, if organizations exist in a dynamic environment where they must continually adapt, then individuals within organizations will continually face novel coordination problems that they cannot easily address with pre-packaged solutions. Below, we will present numerous case studies (including those above) that document how coordination neglect produced coordination failures in organizations that were confronting novel situations.

The goal of this chapter is to unpack the notion of coordination neglect and to describe more specific cognitive phenomena that underlie it. However, before we attribute specific problems to coordination neglect, we first need to explain the cognitive approach we are taking. The process of organizing is indeed difficult, and we don't want to take credit for any problem that arises when people try to organize. In the next section, we sharpen the concept of coordination neglect by stipulating what it is and what it is not.

WHAT COORDINATION NEGLECT IS AND IS NOT

In this chapter, we analyze coordination neglect as a cognitive problem that is rooted in the lay theories people use to think about organizing and coordinating with others. People have intuitive, lay theories about many things – social interactions, statistical causality, economic markets (Kahneman, Slovic & Tversky, 1982; Furnham, 1988) – and we suggest they also have lay theories about organization. All theories are incomplete, particularly lay theories, and we are interested in understanding the psychological blind spots in these lay theories that may cause people to neglect to coordinate their actions with others.

In this chapter, we will focus on several facets of coordination neglect, all of which can be located on Fig. 1. In the simplest version of the coordination

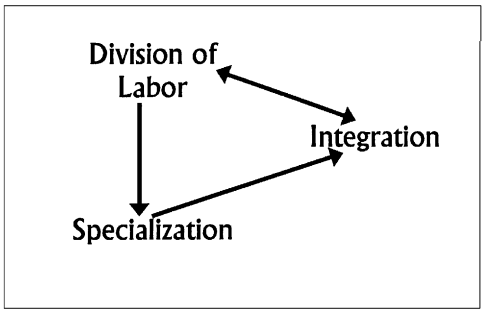

Fig. 1. The Coordination Problem.

problem, an organization divides an overall problem into subtasks and assigns the parts to individuals. We could imagine, for example, an organization that divides the modules of a computer program among programmers with similar skill. Organizations undertake this division of labor because individuals have limited information-processing abilities (Simon, 1962; March & Simon, 1958). Eventually, however, the organization must re-integrate the tasks that it originally divided. In the end, the modules of a computer program must work together as a single program, so the programmers who develop individual modules must integrate their efforts. Thus, the flip-side of division of labor is integration.

The coordination problem becomes especially complicated when organizations divide a task among specialists. Specialization reduces the problem of bounded rationality because individuals can concentrate on a component of the task that meets their unique skills, training, and abilities. Here, we move away from the computer programming example and toward, say, an automobile firm that hires a variety of people with special skills – good transmission engineers to design the transmission, knowledgeable production people to manufacture the car, and effective marketers to sell it. Here, however, the task of integration is even more complicated because the organization must integrate the efforts of specialists who speak different languages and perceive the world in different ways.

Throughout this chapter, we will explore different parts of Fig. 1 that highlight particular problems in the lay theories of individual organizers. However, first it is important for us to distinguish our approach, which depends on flaws in the lay theories of individuals, from other potential approaches. The coordination problem is difficult to solve, so we do not want to accuse people of coordination neglect any time they have difficulty solving this difficult problem.

For example, in order to argue that coordination neglect is a *cognitive* problem, we must distinguish it from motivational problems such as agency problems. Thus, it is important for us to provide examples where people really would *prefer* to coordinate so that agency problems are not an issue. Engineers and marketers may not talk to each other to coordinate their efforts because they: (1) have more fun interacting with others in their own department or (2) because they don't anticipate how much they need to interact to create a successful product. The first is not coordination neglect, it is an agency problem; an organization could presumably solve it by introducing an incentive scheme that encourages the marketers and engineers to interact. The second is more interesting because it suggests a cognitive limitation. This kind of

cognitive limitation is unlikely to be solved by any of the standard incentive solutions to problems of control or agency.

Furthermore, to document that people are *neglecting* coordination, it is also important that we consider situations where people are *thinking* about how to align action. We are not concerned with situations where systems evolve organically over time in a way that produces hidden interdependencies (Staudenmayer & Desanctis, 1999). In organizations that evolve complicated procedures over time (e.g. consider the process of acquiring parts at a large manufacturing firm), a procedure may span multiple people and departments and it may grow and change over time in spontaneous ways. In organizations, such procedures may be completely revealed only when teams attempt to 'reengineer' them (Hammer & Champy, 1993). Although this kind of hidden interdependency is important, we want to focus on interdependencies that are more obvious. Coordination neglect is clearest when people consciously try to design or alter a process, yet they neglect to consider obvious issues of coordination, e.g. Chandler's (1962) managers who explicitly grappled with how to design their organizational structure.

In order to document coordination neglect, we not only require that people be thinking consciously about coordination, we also require that the act of thinking does not exceed their computational abilities. When we claim that people exhibit coordination neglect, we don't want to reiterate that people have difficulty performing difficult tasks. Herb Simon explained such difficulties many years ago as a product of 'bounded rationality' (Simon, 1947). In order to make the case that people exhibit coordination neglect, we should point out situations where people neglect alternative ways of coordinating that are equally or less cognitively demanding.

In sum, to provide examples of coordination neglect, we should point to situations where people do not coordinate even though they prefer to coordinate, where they are consciously considering how to coordinate, and where there is a means of coordination that does not exceed their computational abilities.

PARTITION FOCUS AND COMPONENT FOCUS

In order to accomplish a complex task, organizations typically divide up the task and assign components of the task to different people. However, whenever the organization divides a complete task into components, the people who perform the component tasks are interdependent and they must integrate their efforts (Thompson, 1967, ch. 5). As Fig. 1 indicates, division of labor compels integration.

In this section, we introduce two related aspects of coordination neglect: partition focus and component focus. *Partition focus* refers to people's tendency to neglect coordination because they focus more on dividing and partitioning the task than on integrating the components they create. People not only focus on partitioning the task into components, they also, when they are trying to diagnose or improve a process, tend to focus on individual components rather than the system as a whole. *Component focus* refers to this tendency for people to focus on components, particularly by investing in components so that specialists can become even stronger. The next two sections explore these aspects of coordination neglect.

Partition Focus

It is completely reasonable for people to divide or partition tasks carefully; this is one half of the equation for success in organizations (Simon, 1962; Lawrence & Lorsch, 1967). However, the other half of the equation for success is integration, and partition focus may cause people to neglect integration. When people partition the world, they may tend to treat small interactions between components as zero when they actually need to invoke a range of mechanisms to integrate the components (March & Simon, 1958).

The most direct evidence of partition focus is provided by situations where people consciously design a process from scratch, for example in the software industry. Coordination is a central issue in software design because software programs, which are constructed in segments or modules by individual programmers, must work seamlessly as a whole. One prominent consultant for the software industry has described the typical process that happens when software designers are given a new project (DeMarco, 1995; DeMarco & Lister, 1997). In a passage directed at team managers, DeMarco describes the typical process of design: "You make a crude division of the whole into five or ten pieces so you can put five or ten design teams to work. That crude division is a design step, but you don't approach it as such . . . That initial crude division is the heart of the design, and since there is no one directly responsible for revisiting its logic, it remains the heart of the design. The result is no design" (p. 251). In software engineering, the division of labor is less successful when there are more interfaces between modules and when the interfaces are more complex. By partitioning the work immediately, rather than thinking through the interfaces and patterns of interdependence among modules, design teams "guarantee the interfaces among people are more complex than they need to be . . . People are forced to interact with more of their teammates in order to get anything done and the interactions are more complex. The result is less

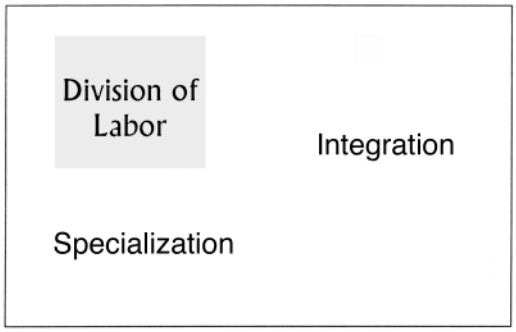

Fig. 2. Partition Focus

possibility of independent work, more telephone tag, more meetings and more frustration" (DeMarco & Lister, 1997, p. 255; Perry, Votta & Staudenmayer, 1994; 1996).

In this example, software engineers partition the project crudely and then proceed immediately into implementation. Unfortunately, this inevitably results in greater integration problems later on because they must continuously loop back and make unanticipated changes to the original inadequate design, a phenomenon that has been documented repeatedly by researchers in software engineering (Kemerer, 1997; Boehm, 1994; Boehm & Papaccio, 1988). To combat this habitual tendency to partition the task prematurely, DeMarco (1995) argues that in a project designed to last a year, no coding should be done until the last two months. According to his recommendation, designers should spend 10 months selecting the right modules by minimizing the coordination that must take place among modules. Coding and testing will then proceed much more smoothly, requiring two months as opposed to 10 or more. Other researchers have pointed out that not all firms can afford the luxury of 10 months of design (Cusumano & Selby, 1995; Yoffie & Cusumano, 1999; Iansiti & Clark, 1994), and have suggested ways of integrating continuously. We argue that all these solutions are essentially cognitive repairs for partition focus in the lay theories of software design teams.

Partition focus runs sufficiently deep that, at times, it has become embodied in the institutional language and planning procedures of the software industry. In one of the most famous books on software design, Frederick Brooks (1979) discusses common flaws that cause large software projects to fail. Brooks is a credible observer of large software projects – he was the 'father' of the very successful System/360 project at IBM; at its time, it was the largest software

project in the computer industry, comparable in size and expenditure to the NASA space program. The first flaw listed by Brooks is institutionalized in the very unit of effort that software managers used to estimate effort in the 50s and 60s: the *man-month*. Brooks notes that "men and months are interchangeable commodities only when a task can be partitioned among many workers with no communication among them." While this may be true of reaping wheat or picking cotton, "it is not even approximately true of systems programming" (p. 16). Brooks regarded this problem as so fundamental he chose it as the title of his book: *The Mythical Man-Month*. Brooks argued that it is counter-productive to focus only on partitioning the task into 'man months' because the different partitions are not interchangeable. Among software programmers, Brooks' warning against partition focus has been generalized in the well-known aphorism: "Bearing a child takes nine months, no matter how many women are assigned".

One general explanation for partition focus is that it simplifies computational costs and saves time. This does not mean that boundedly rational individuals could not calculate a more elaborate set of interactions than they do (indeed DeMarco, 1995, recommends that software managers spend the time to consider such interactions), however 'cognitive misers' might try to shortcut the process. In order to reduce computation costs, people may prefer to categorize ambiguous information into relatively crisp, well-bounded categories (March & Simon, 1958). People may think that it will be easier to plan when they foreclose on a particular way of partitioning the task. Partition focus may be related to a tendency to do what is most well-learned (Staw, Sandelands & Dutton, 1981), particularly in situations where partition focus is enhanced by specialization. Typically, specialists are highly trained in their own specialty but know less about the specialties of others. Furthermore, this specialized training is often exacerbated in organizations by reward systems that inappropriately emphasize individual performance.

However, there is evidence that partition focus is not produced by environmental rewards, or even by training, but by lay theories. For example, in one experiment, groups of MBA students were given a bag of Lego blocks and were asked to assemble their blocks to match a model (a man with arms, legs, head and torso). They were given a long time to plan the exercise, but their goal was to assemble the model in the least amount of time possible. Teams could do a number of things to speed assembly both by partitioning the task and by integrating it. In terms of partitioning, groups could appoint 'experts' for the different body parts (arms, legs, torso); the individual body part experts could draw a diagram to show how their body part was constructed, and they could develop a specific plan for how to assemble it. In terms of integration, groups

could develop a master diagram of how all the body parts fit together, they could talk about how to integrate the different body parts (e.g. how the arms would attach to the torso), and they could appoint an 'overseer' to guide the assembly process. Regressions showed that each partition and each integration behavior reduced assembly time by approximately the same amount. On the other hand, the partition and integration behaviors were not performed equally often; groups performed about 75% of the possible partitioning behaviors, but only about 50% of a parallel set of integration behaviors (Heath, Jost & Morris, 1999).

The Lego exercise suggests that partition focus is a problem of lay theories because the experimental procedure effectively rules out other potential explanations of coordination problems. The procedure contains no external incentives to create agency problems. There is no a priori specialization that would complicate the task of integration. There are no strong cognitive constraints that would prevent people from thinking through the problems of integration. Finally, in contrast with most coordination situations, the coordination required by this task was obvious and visible; people could see that the arms needed to join the torso, so it was obvious that the person assembling the arms should coordinate with the person assembling the torso. Yet teams often experienced problems at the 'joints' of the model; and such problems occurred simply because team members did not coordinate about how to integrate their subassemblies.

In this section we have considered the simplest version of the coordination problem where people must divide a task among individuals and then integrate the components. The examples from both organizational settings and laboratory work provide evidence that people focus more on partitioning the task than they do on integrating it, and this evidence suggests that partition focus may contribute to coordination neglect.

Component Focus

People focus not only on the process of partitioning a task, but also on the individual partitions or components they create. We will label this tendency as 'component focus' to signal that it is related to partition focus. People exhibit component focus when they try to intervene in an interrelated process by focusing only on one part of the process. When people exhibit component focus, they neglect the interrelationships and interactions among components. In lay theories that exhibit component focus, wholes are not 'the sum of their *parts*', they are a function of *one part*.

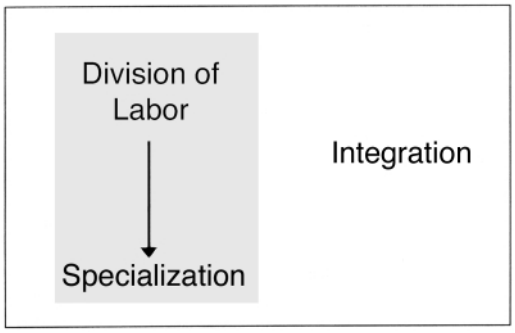

Fig. 3. Component Focus

The division of labor is useful because it allows people to specialize, however specialists often ignore the task of integrating with others. One chief engineer at Ford looked back on his early years and ruefully recalled his narrow view of automobiles during the time he specialized in designing chassis: "When I saw a car driving down the road, all the rest [other than the chassis] disappeared. All I could see were the suspension arms going up and down" (Walton, 1997, p. 73). It is very easy for component focus to become embodied in the structure of the firm. Traditionally, Ford, like other automotive companies, organized around *very narrow* functional specialties, not just 'engineering' but subdivisions of engineering like "chassis, powertrain, electronics, climate control, plastics, and glass" (p. 74). These narrow units did not interact with each other except through the planners who were in charge of a given vehicle. According to one senior engineer, "In the old days, Ford had this attitude, 'You want a car, we'll give you these pieces'." (p. 73).

Component focus is often exacerbated because people focus on enhancing the quality of an individual component by making it more specialized. If people assume that components are the source of competitive advantage (and not the interrelationships among components), then a simple strategy is to get the best 'part' you can. Although specialization is useful, at some point organizations may face tradeoffs between enhancing specialization and promoting integration. Component focus may cause people to neglect coordination through overspecialization.

One example of component focus is found in Xerox's experience with its Xerox PARC unit of computer scientists. In a series of decisions that ranks among the worst business blunders of the 20th century, Xerox created the personal computer in the form we know it today, then failed to commercialize

it. Xerox began well by creating an appropriate group of specialists. It assembled at its Palo Alto Research Center (PARC) the most creative group of computer scientists the computer industry has ever seen. In the 70s, it was well-known in the computer industry that "58 of the top 100 computer scientists in the world" worked at PARC. The common wisdom was somewhat exaggerated since PARC's employment roster never exceeded 50, but the general idea was approximately right because these computer scientists created a working set of networked personal computers that were far ahead of their time (Cringley, 1996). In the late 1970s, an in-house video at Xerox depicted a working computer system that was more than a decade ahead of the industry. A man enters his office, sits at his personal computer, checks his e-mail on a graphical computer interface using a mouse, and prints out a document on a laser printer. The in-house video appeared at least a decade before anyone had considered e-mail, mouses, laser printers or the graphical computer interface (which Steve Jobs later borrowed to make the Macintosh the most successful product at Apple). By 1978, over 1500 of these computers were in active use within Xerox (Smith & Alexander, 1988, p. 202).

In creating PARC, top managers at Xerox recognized the benefits of specialization: they recruited the right cadre of computer scientists, selected the right management team to lead them, and provided an effective campus-style working environment (complete with bean bag chairs). Yet according to Steve Jobs, Xerox "grabbed defeat from the greatest victory in the computer industry. [They] could have owned the entire computer industry today" (Cringley, 1996). Xerox had an extremely advanced personal computer and a sales force with direct access to every major corporation. How could it have failed to become the greatest company of the personal computer revolution?

A book titled *Fumbling the Future* documents a series of mistakes Xerox made in capitalizing on the success of PARC (Smith & Alexander, 1988). Although Xerox successfully created an effective group of specialists, top managers failed to create coordination mechanisms that would integrate the innovations of the specialists into the mainstream business of the company.

For example, because top managers at Xerox consistently focused on specialization, they made disastrous decisions about physical locations, not once, but twice in PARC's history. Throughout Xerox's experience with PARC, coordination suffered because PARC's location on the west coast was so far from Xerox's headquarters on the east coast. When Xerox was first deciding where to locate PARC, some managers argued that coordination would be enhanced if PARC were closer to the rest of Xerox. Jack Goldman, head of research for Xerox and an inside board member, noted in a memo to the CEO that "If the new research center is too isolated from a Xerox environment, the

chances of relevant coupling to Xerox's needs and practices will be severely diminished." In a prescient sentence he said, "one area normally considered as an ideal research environment, Palo Alto, is eliminated because of the absence of any nearby major Xerox facility." But the head of the research lab argued strongly for the Palo Alto location because it was close to the emerging Silicon Valley area and he won the location battle with this argument in favor of specialization (p. 56).

In the second poor location decision later in PARC's career, top management at Xerox had realized that they had failed to commercialize PARC technology, so they created a new group to do so. An outside firm recommended two sites for this new group: the San Francisco Bay area (close to PARC and the rest of Silicon Valley) and Dallas. Xerox chose Dallas. Instead of placing the new group in Silicon Valley next to the PARC researchers with whom it was supposed to coordinate, top managers at Xerox considered it as a unique, specialized component. "An elaborate financial model of a factory in Texas versus one in California conclusively proved, on the basis of labor, transportation, taxes, and other cost indicators, that Dallas would save Xerox money" (p. 162). By considering this group as a 'specialist' in manufacturing, managers chose a location that almost ensured that it would fail in its role to commercialize PARC's technology. The results were predictable: According to the manager of corporate R&D, "Dallas turned out to grow a culture that was completely orthogonal to, and independent of, the digital world in general and PARC in particular" (p. 163).

Xerox emphasized specialization in personnel choices as well. It selected an academic 'specialist' to head the research lab – George Pake, a former provost of Washington University in St. Louis. Although Pake had been an effective university provost, he was ill-equipped to be the chief integrator between PARC and the rest of Xerox. He consistently bungled opportunities to create excitement about PARC's technology within the rest of Xerox because he was too accustomed to an academic style of interaction. When he was appointed to a Xerox-wide strategy committee, Pake was given an ideal forum to proselytize for PARC technology. "Yet from the outset, others noticed that Pake had no commercial instincts . . . [He] spoke awkwardly about business, insisting that the strategy committee reach its conclusions by the 'scientific method' . . . When discussions turned to PARC's technologies, Pake emphasized the work to be accomplished in the laboratory instead of the commercial opportunities that might already exist" (p. 150).

In sum, Xerox focused on one component of a successful new product introduction: research and development. It created a group of specialists who did, in fact, live up to their billing as the greatest assemblage of computer talent

ever. However, by focusing every feature of PARC around creating a specialized component, top managers at Xerox failed to integrate this specialized component with the other activities like marketing, manufacturing, and finance that were necessary to successfully commercialize the new technology. Although Xerox provides a vivid example of component focus, researchers have documented a similar emphasis on creating groups of specialists in many firms that are trying to commercialize technology (cf., Iansiti, 1995).

Component focus can be found, not only when top managers are trying to create new markets from scratch, but even when they are trying to learn from a successful past model. There is evidence that component focus may blind managers from understanding the sources of their previous success. One such example comes from a brilliant book by David Hounshell & John Smith (1988) that chronicles the history of research and development at Du Pont from 1902 to 1980. During the 1930s, Du Pont had a blockbuster decade, "Quite unexpectedly, [fundamental research] produced neoprene and nylon. Du Pont was successful in commercializing these important discoveries because it already had extensive commercial and technical capabilities in rubber chemicals, organic synthesis, high-pressure reactions, and fibers" (Hounshell & Smith, 1988, p. 596). Du Pont's managers had an opportunity to learn from their successes in nylon and neoprene. What should they have learned, and what, in fact, did they learn?

According to Hounshell & Smith (1988), Du Pont should have learned that success requires a set of integrated capabilities. In the case of nylon, Du Pont's capability in fundamental research was matched by a number of other capabilities that allowed it to develop the product and market it successfully. Du Pont had previously produced rayon, which gave it specific expertise in chemical engineering for artificial fabrics – the ability to scale up a clean, precise laboratory process to an industrial-scale plant (p. 259–73). In its work on rayon, Du Pont found that 25 variables had to be precisely controlled to produce a uniform final product (p. 165). Du Pont also had an unusual capability to manage high-pressure catalytic reactions because of its ammonia business. Although Du Pont's ammonia business was a money-loser if it was considered separately, it produced strong returns when Du Pont made nylon because nylon production required similar high-pressure catalytic reactions (p. 258), an unexpected example of economies of scope. Du Pont also had expertise marketing fabrics to industrial customers; for example, it marketed rayon as a substitute for silk in light fabrics during the fashion boom years after World War I (p. 164–67) and as a basis of tire cords that improved the life of heavy-duty tires (p. 169). In sum, Du Pont's success with nylon was produced

by a range of complementary capabilities and assets spread across the firm (Teece, 1986).

Not surprisingly, Du Pont was pleased with its success in nylon, and dedicated itself to discovering 'new nylons' – proprietary products that would produce the same high rates of return as nylon. Although nylon succeeded because of a wide range of complementary capabilities, when company executives talked about 'new nylons', they did not acknowledge these complex interrelationships. Instead, they primarily focused on one component of their success: fundamental research.

Over the next 30 years, Du Pont, in searching for new nylons, placed greater and greater emphasis on fundamental research. As a consequence, research programs were "pushed away from the company's commercial interests and the nylon model became skewed" (p. 597). While the company's executives believed that fundamental research would produce new nylons, the research department instead produced fundamental research in areas where Du Pont lacked complementary capabilities. The fundamental research group "lost contact with many of the industrial departments and took on the trappings of a high-quality scientific research establishment" (p. 597). During the three decades from 1940 through 1960, Du Pont continued to search for 'new nylons' by investing only in its capability in fundamental research, despite the fact that the company's only two real successes during this period, Orlon and Dacron, took advantage of the same interrelated set of capabilities as nylon: not only fundamental research, but also engineering, manufacturing, and marketing of artificial fabrics. According to the historians, "In developing a mentality of 'new nylons', executives and research managers alike had forgotten why the company had so easily and swiftly developed nylon. The pioneering work on polymers had fitted neatly into the company's existing businesses, technologies, and expertise" (p. 597).

Teece (1986) notes that in order for firms to commercialize an innovation successfully, they must combine fundamental research with other capabilities or assets. Research alone is not enough, firms must integrate it with other capabilities like marketing, competitive manufacturing, and support. According to Teece, firms succeed when they have not one single competency, but when they own a set of assets that are complementary. We interpret Teece's observations as a useful corrective for approaches that primarily emphasize a single core competency (e.g. Hamel & Prahalad, 1990). Such approaches, in their extreme could enhance the kind of component focus exhibited by top managers at Du Pont.

Component focus may be exacerbated because, if people are focusing on only one component at a time, they may preserve the illusion that resources are

being used efficiently. Redundancy conflicts with people's desires to avoid 'waste' (Arkes & Blumer, 1985). One consistent factor in examples of partition focus is that people seem to be trying to use resources to their fullest capacity, whether personnel (DeMarco, 1995; 1997) or other resources (Chandler 1963). In large software projects, "early overstaffing tends to force people into shortcutting the key design activity (to give all those people something to do)" (DeMarco, 1995, p. 260).

This variety of component focus fooled many of the top management teams chronicled by Chandler (1962) in his famous account of the development and diffusion of the multidivisional form. In a number of Chandler's case studies, top managers diversified their product lines in an attempt to create economies of scale in some component of their business: at General Foods, it was an attempt to effectively use their central sales organization (p. 347); at the major oil companies, it was an attempt to use residual petrochemicals from oil refining (p. 361); at meat packing firms, it was an attempt to use their refrigerated distribution network to carry, not only meat, but eggs, milk, and poultry (p. 391). Although these firms sought to create economies by more efficiently using one component of their business, they almost inevitably failed to predict the administrative and coordination costs that they would incur by using the excess resources in this component. The new strategy did not typically increase the total output or size of operations, "but it quickly enlarged the number and complexity of both tactical and strategic administrative decisions" (p. 362). Chandler notes that even "a small amount of diversification in relation to total production" sufficed to create enough complexity to warrant a different structure (p. 362). We argue that many of their problems were produced by component focus. By trying to create economies of scale in one component of their organization, top managers dramatically complicated their job because they failed to anticipate how much they would have to increase coordination to use 'spare' capacity in that component.

Chandler's firms eventually solved their coordination problems by adopting the multidivisional form, but they adopted this solution slowly and only after much internal struggle. It would be fair to argue that such problems might be less likely in today's environment where the multidivisional form is a common solution to the kinds of integration problems that these managers faced. However, the historical example is useful because it points out the problems that may be caused by component focus in other situations where managers confront a novel problem of coordination but do not have automatic access to a prepackaged integration mechanism like the multidivisional form.

In many examples of component focus, managers seem to focus on technology rather than on broader issues of organization. One example of this

occurred in the battle of the Atlantic during World War II. During WWII, the Atlantic Ocean was the site of a protracted struggle between the American and British ships that were trying to keep supplies flowing between the United States and Great Britain and the German submarines that were trying to sink them (Cohen & Gooch, 1990, p. 59–94). During the early stages of this struggle, the Americans were much less effective than the British in combating German subs. According to military historians Cohen and Gooch, the U.S. Navy made "a serious and protracted effort to learn from British experience" (p. 87), but it borrowed only components of the British process, particularly those involving technology (e.g. British ship designs for destroyer escorts or British sonar). On the other hand, it neglected the organizational structure that the British used to integrate the components. The British had a central Intelligence Center with a small staff who collected all incoming information (e.g. decrypted radio intercepts, photographs, prisoner interviews) and communicated this information directly with field commanders (p. 76). Field commanders could then divert their convoys away from German U-boat packs, and could concentrate their scarce escort vehicles on protecting convoys that were most endangered. This centralized operation also allowed the British to test and deploy new tactics to combat subs. Because any combat unit on the ocean might have only one or two chances to engage an enemy submarine, it was important that the combat units use the right tactics the first time (p. 83).

Only after the Navy borrowed many components of British tactics without success did they finally get around to borrowing the organizational mechanisms the British used to integrate their efforts. The U.S. Navy created an unusual military organization, the Tenth Fleet, to command all anti-submarine warfare. It could even override the positions of naval commanders who were not under its direct control. Interestingly, in the initial stages of the war, the Germans had noted the absence of coordination among American forces at sea: "enemy air patrols heavy but not dangerous because of inexperience," "the American airmen see nothing; the destroyers and patrol vessels proceed at too great a speed to intercept U-boats; likewise having caught one they do not follow up with a tough enough depth charge attack" (p. 75). This changed after the Tenth Fleet was created: "In the eighteen months before the creation of the Tenth Fleet, the U.S. Navy sank 36 U-boats. In the six months after, it sank 75" (p. 91).

Gooch and Cohen argue that many military historians who have tried to explain the early failure of American submarine warfare, have suffered from the same kind of component focus as the U.S. Navy. According to Gooch and Cohen, many historians have blamed either a single individual (the commander in chief of the U.S. Fleet) or a single cause like the absence of a coastal

blackout or of convoy support, or a 'single-problem' such as a missing piece of technology that may have turned the tide (radar, more destroyers, etc.). However, Gooch and Cohen argue that none of these components is sufficient to explain American failures. For example, American success did not increase even after the coastal blackout was imposed in 1942; and before the reorganization disseminated effective tactics, the Americans failed even when destroyers were available and they actually spotted a U-boat (p. 79). In this case, sophisticated historians joined the sophisticated military personnel in WWII in their vulnerability to component focus.

Component focus on technology can also be seen in other organizations. For example, General Motors engaged in the famous NUMMI joint venture with Toyota, hoping they would be able to borrow some applications of technology for their other factories. Instead they were confronted by relatively low-tech machinery, but a new system for how workers interacted with each other and integrated their actions. GM failed to understand or capitalize on this different style of coordinating on the factory floor (Keller, 1989, pp. 124–144).

In the product development literature, Marco Iansiti and others (1993; 1995; Iansiti & Clark, 1994) have argued that ineffective development teams are 'element focused' while effective ones are 'system focused'. Iansiti notes that most development processes in traditional companies are sequential and element-focused. Basic researchers explore a new concept and hand it off to other scientists; these scientists elaborate the concept until they discover a new application, then they hand it off to engineers and manufacturing people; the engineers and manufacturing people prototype and produce the new product . . . This linear approach by element focused firms "tends to compartmentalize specific knowledge" (Iansiti, 1993, p. 138). In contrast, system-focused companies form a core group of managers, scientists, and engineers early in the process, and this integration team modifies and adapts the new concepts from fundamental research so that they mesh with the current capabilities of the company. Iansiti shows that systems focus is much more effective than element focus: system-focused companies solved 77% of major problems early on, while element-focused companies, which were not as attuned to integration, solved only 40% (Iansiti, 1993, see also Henderson & Clark, 1990).

Some modern organizational theorists have likewise criticized earlier scholars for component focus on technology. For example, Perrow (1984) conducted a famous analysis where he argued that some technologies are so complex that they inevitably lead to 'normal accidents'. Weick & Roberts (1993) argue that Perrow focused too much on technology rather than on the dynamics of social coordination: "We suspect that normal accidents represent a breakdown of social processes and comprehension rather than a failure of

technology. Inadequate comprehension can be traced to flawed [shared] mind rather than flawed equipment" (p. 378).

In part, component focus may represent overgeneralizations of theories of organizing that are plausible in a more sophisticated form. As people learn rules, they frequently generalize rules too much before they learn the appropriate exceptions (Anderson, 1995). When lay theorists of organizing are confronted with an unfamiliar situation, they may take basic principles of organizing, like the value of specialization, and overextrapolate them. Because an organization must eventually coordinate the actions of specialists, it should not encourage specialization past a certain point, yet when managers focus only on a component of the broader organization (such as auto engineers on the chassis, Xerox managers with PARC, or Du Pont managers with 'fundamental' R&D), they may enhance specialization in a way that detracts from coordination.

Summary: Partition focus and Component Focus

In this section, we have argued that people exhibit coordination neglect, in part, because of partition focus and component focus. People focus on the division of labor rather than on the equally important process of integration, and when they try to intervene in an ongoing process of coordination, they tend to focus on specialized components of the process rather than attending to the interrelationships as a whole.

In a clever paper, Weick & Roberts (1993) argue that in order to coordinate effectively, people must do so with heed: "carefully, critically, consistently, purposefully, attentively, studiously, vigilantly, conscientiously" (p. 361). "Heedless performance . . . is a failure to see, to take note of, to be attentive to" (p. 362). Weick and Roberts are quite correct to emphasize that it is important to understand and manage attention, but the examples above seem to indicate, not that people are inattentive, but that they neglect to pay attention to the right things. People's lay theories lead them to heed some things (division of labor, components, specialization) while simultaneously remaining heedless of others (integration, the importance of complementary capabilities).

INADEQUATE COMMUNICATION AND INSUFFICIENT TRANSLATION

Organizations can integrate their efforts in many ways (March & Simon, 1958; Thompson, 1967); they may establish routines or rules that standardize the action of different units or they may establish plans or schedules that govern the

actions of independent units. But the most important means for units to integrate, particularly in complex or uncertain environments, is for them to communicate with each other on an ongoing basis. According to March & Simon (1958), 'the greater the efficiency of communication within the organization, the greater the tolerance for interdependence' (p. 183).

In this section, we examine how coordination neglect may be enhanced because individuals fail to take advantage of this key mechanism for integration. Although good communication is fundamental to integration, we argue that people often exhibit coordination neglect because of inadequate communication and insufficient translation. *Inadequate communication* is likely because a number of psychological processes make it difficult for individuals to take the perspective of another when they are trying to communicate. However, these standard problems of communication are compounded in organizations because specialists must communicate with other specialists who speak different languages. If organization members don't anticipate the need to translate across specialists, then *insufficient translation* will compound the basic problems of inadequate communication. Together, both processes may cause people to fail to integrate their efforts and may result in coordination neglect.

Inadequate Communication

Because organizations are filled with constrained information processors, communication will always be incomplete. Organizations develop filters that allow them to identify the most crucial information in the complex stream of information that enters from the outside world and flows through the

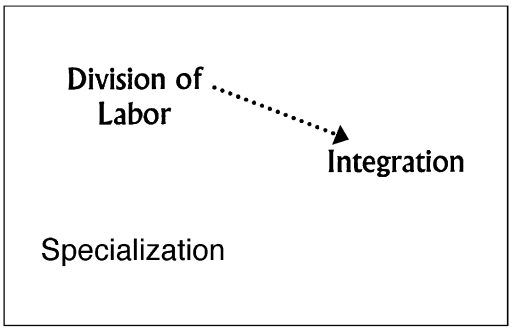

Fig. 4. Inadequate Communication

organization (March & Simon, 1958; Arrow, 1974; Daft & Weick, 1984). However, communication, although incomplete, need not be inadequate. Recall that the British Navy during World War II created a successful submarine warfare unit, but it did so only after it failed in a similar task during World War I. In the successful WWII unit, analysts collected information and communicated it directly with field commanders at sea; they could not only communicate 'hard intelligence' about the location and activity of enemy units, they could also use their judgment to communicate 'working fictions' about possible movements and tactics (Cohen & Gooch, 1990, p. 77). Interestingly, this successful Intelligence Center structure was developed only after Britain failed to capitalize on their 'brilliant cryptanalysts' during WWI because of inadequate communication. In WWI, the cryptanalysts were "cut off from non-cryptologic sources of intelligence, allowed to communicate only with the Admiralty in London rather than operational commanders at sea, and discouraged by admirals from offering educated hypotheses about likely enemy behavior" (p. 77). In one spectacular failure, the British Navy failed to cripple the exposed German Fleet at the Battle of Jutland precisely because these organizational barriers prevented the Navy from adequately integrating and communicating information. By WWII, the British Navy arranged an organizational structure and procedures that allowed it to communicate more adequately.

Evidence indicates that managers systematically underestimate the importance of communication when they are planning important tasks. Recall Brook's (1979) famous book on software design, *The Mythical Man-Month*. In his list of the common flaws in large software projects, one major flaw relates to situations where managers underestimate the importance and difficulty of communication. Brooks observes that when a project falls behind, managers tend to add people to the project in hopes of delivering it more quickly. Unfortunately, this tactic compounds the difficulty of communication. When engineers are added to a project, two kinds of communication automatically increase. First, the existing engineers must communicate with new engineers to train them. Every new engineer must understand something about the technology, the project's goals, the overall strategy, and the work plan. This slows down the project because the existing engineers, who should be producing code, instead spend their time training new ones. Second, the pattern of communication becomes more complicated because the new engineers must be integrated into existing communication flows. Brooks argues that because software involves complex interrelationships, the project quickly loses more time by increasing communication costs than it reduces time by partitioning tasks among more people. This argument has been enshrined in the software

industry as 'Brook's Law': "Adding people to a late software project makes it later."

In the American automobile industry, it took half a century for managers to realize that design times are cut in half when you make communication easier by putting functional representatives on a single cross-functional team in the same location. In the 1980s, research found that Japanese manufacturers routinely beat American firms in terms of both cycle time and quality; this prompted a large scale study of the world-wide auto industry attempted to understand the reasons behind this difference (Womack & Jones, 1996; Wheelwright & Clark, 1992). Numerous studies contributed to this research effort, and, in general, they attributed a large part of the Japanese success to relatively simple structures and communications practices (e.g. forming a cross-functional team and locating them in a single site). The results have since been replicated in other industries and settings (Ancona & Caldwell, 1992; Brown & Eisenhardt, 1995; Eisenhardt & Tabrizi, 1995).

Although the experience of the American auto industry suggests that practising managers may sometimes neglect the importance of adequate communication, perhaps academic researchers sometimes do so as well. Hinds & Kiesler (1995) note that although hierarchy and informal networks have always existed side by side, researchers and managers have historically emphasized the structural and operational significance of hierarchy, while downplaying informal networks as 'ad hoc' linkages that are created through accidents of physical proximity, personal history, or demographic similarity. "When informal networks were seen as 'the grapevine'—unplanned, personal, and casual – neither managers nor researchers viewed them as integral to formal organization or crucial to accomplishing work" (p. 388).

Why is communication incomplete? One barrier to adequate communication is that we must be able to take the perspective of others and understand what we need to communicate to them. In psychology, there is a great deal of evidence that people find this kind of perspective-taking to be difficult. For example, children who are asked to direct another person around a landscape, will assume that the listener sees the landscape exactly like they do, even if their listener is in a different place (Piaget & Inhelder, 1967). Yet this phenomenon is not limited to children. When adults in an experimental market were given private information about the value of an experimental object in other markets, they found it impossible to ignore this information even though the value of the object in the experiment was determined by the people who were interacting in their own market (Camerer, Loewenstein & Weber, 1989). Here, adults lost money because they found it impossible to ignore their private information. In

this study, the researchers labeled their phenomenon, the 'curse of knowledge' – people could not abandon their own perspective even though they should have been highly motivated to do so.

Because people suffer from the curse of knowledge and have difficulty taking another's perspective, they also underestimate how easy it would be to communicate their knowledge to the other party (Keysar, 1994; Hinds, 1999). In a striking demonstration of this, Newton (1990) asked people to participate in an experiment in one of two roles: 'tappers' and 'listeners'. 'Tappers' received a list of 25 well-known songs and they were asked to tap out the rhythm of one of the songs; listeners tried to identify the song based solely on the taps. Note that this design induces dramatic differences in the perspective and information of the two participants. Although listeners heard only a series of disconnected taps, the tappers, according to their own reports, 'heard' the lyrics and complete musical accompaniment as they banged out the rhythm of their song. This inside information made it hard for the tappers to anticipate the states of their listeners. Although the tappers tapped out 120 songs during the experiments, listeners only identified 3 (a rate of 2.5%). Tappers, however, incorrectly predicted that listeners would identify 50%.

In the experiment above, the curse of knowledge makes communication inadequate because people have a complete picture of what they intend to convey, and this complete picture blinds them to gaps in the information they actually convey to others. An engineer on a disk drive project described this kind of communication problem on a new product team: "There were a lot of specs, but these were only detailed conceptually. They wanted 'something like this'. As a result the specs get interpreted widely. You end up delivering something they didn't ask for . . . I was working with one or two people at the customer organization, then they showed our design to fourteen others who said: 'Oh My God! We didn't want that'!!" (Dougherty, 1992, p. 189). In general, this kind of problem is exacerbated by experience and expertise (Hinds, 1999).

Allen (1977) followed multiple R&D teams who were working to develop new high-technology products for sophisticated customers using a matched-pair design. The teams that performed better were more consistent about communicating. Lower performers were more 'irregular' about consulting internal colleagues and in the middle of the project they "virtually cut off contact with colleagues outside their project team." Allen notes that the high performers stayed in in closer touch with organizational colleagues throughout the project, and thus "obtained the necessary information to prevent problems from getting too far out of control" (p. 103–104). Recent research in network

theory by Burt (1997), Krackhardt (1996), and others re-emphasizes the value of entrepreneurial networks for individuals and groups.

The problem of communication in organizations is much more formidable than the normal problem of communication between two people. When two individuals are communicating face to face, they can use a number of strategies to repair breakdowns in communication as they occur (Clark, 1996). Communication in organizations is a more formidable problem because it requires individuals to communicate through formats (e.g. specifications, blueprints, memos or budgets) that are relatively impoverished and that separate the people who are communicating by time and space. Top managers are particularly likely to fall prey to inadequate communication because their inside information and their expertise in business may make them particularly prone to the curse of knowledge; furthermore, they are isolated by structural and social distance from feedback that might prompt them to repair inadequate communication (Heath & Walston, 2000).

The problem of inadequate communication will be particularly difficult to overcome when knowledge is tacit. Von Hippel (1990) notes that information is often 'sticky'; hard to understand and interpret away from the specific, applied context where it arose. For example, one production manager may have difficulty telling another production manager at a different plant why their new production line is successful because success may depend on a number of subtle aspects of layout, staffing, and process flow that are hard to notice and verbalize. Interestingly however, von Hippel implies that people can overcome the problem of sticky information if they become aware of how much their knowledge depends on a specific context. We interpret this to mean that information is sticky and communication inadequate, in part, because of the kinds of cognitive problems we have considered in this section.

Agency misattributions. Communication is often inadequate in organizations because people attribute coordination problems, not to inadequate communication, but to inadequate motivation on the part of their communication partner. This may lead people to stop communicating prematurely because they think their partner is not motivated to coordinate with them.

Recall the distinction earlier in this chapter between the two tasks of organizations: aligning goals and aligning actions. The first is the agency problem, the second is the coordination problem. We suggest that while both problems are important in organizations, people are likely to interpret coordination problems as agency problems, what we label an *agency misattribution*. It is harder to imagine someone having different knowledge than different motivations (Klayman, Loewenstein, Heath & Hsee, 1999). If the

curse of knowledge leads people to believe that they are communicating something obvious to the other person (recall the tapping game), then when a listener fails to understand the 'obvious' message, the communicator may be less likely to assume the other person has different information (a communication problem) than different motivations (an agency problem). Indeed, even in situations where differences in knowledge are obvious, like the tapping game described above, people often attribute coordination failure to agency problems. In one variant of the tapping game, when listeners failed to understand the song tapped by the tapper, over 40% of tappers accused their listeners of "not working very hard" to understand the song. When tappers confronted a coordination failure, they failed to recognize the difficulty of the task (because of the curse of knowledge) and instead accused their listeners of lack of effort; a classic agency misattribution (Morris, Heath & Jost, 1999).

Interestingly, one could argue not only organizational participants, but also organizational theorists are subject to agency misattributions. Indeed, examples of potential agency misattributions can be found on both sides of the political/theoretical spectrum. On the side of the spectrum that assumes individuals rationally pursue their own self-interest, economists have spent much more time pursuing the agency problem than considering the equally important problem of coordination (Milgrom & Roberts, 1992). On the opposite side of the spectrum, the human relations school has made a career arguing that non-monetary factors are important sources of motivations, yet it was famously embarrassed to find that job satisfaction didn't predict job performance (Iaffaldono & Murchinsky, 1985; Staw, 1986). Instead, performance is more determined by coordination mechanisms like organizational routines and procedures (Herman, 1973; Bhagat, 1982; Staw, 1986). Here, the human relations school engaged in a kind of agency misattribution because it assumed that performance problems were driven by dissatisfaction (an agency problem) rather than organizational routines and procedures (a coordination problem). These examples suggest that agency misattributions do not depend on a particular theory of human motivation – whether intrinsic or extrinsic. However, they do require people to emphasize motivational issues over the knowledge-based issues associated with coordination.

If agency misattributions play an important role in preventing effective communication, it may be particularly important that organizations use techniques like physical location to bring different departments together. By locating people together, people not only gain more opportunities to communicate, they may also become more willing to communicate because they may be less likely to engage in agency misattributions and assume that coordination failures signal a lack of motivation by their partner. Rich, face-to-

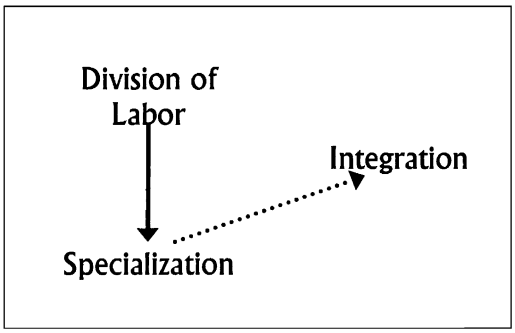

Fig. 5. Insufficient Translation

face communication may be particularly important in establishing trust (Daft & Lengel, 1984; 1986). If we are communicating with another person who has very different knowledge than we do, then we may need to see the puzzled expressions on their face to understand their questions are motivated by ignorance rather than spite, ill feelings, or petty resistance.

Insufficient Translation

Consider the earliest account of the dilemmas of specialization and integration in large organizations:

> And the whole earth was of one language, and of one speech. [. . . And the people] said, let us build a city and a tower, whose top may reach unto heaven; and let us make us a name. And the LORD came down to see the city and the tower, which the children of men builded. And the LORD said, . . . let us go down and confound their language that they may not understand one another's speech. So the LORD scattered them abroad upon the face of all the earth: and they did not build the city. Therefore the name of that place is called Babel; because the LORD did there confound the language of all the earth, and from thence did the LORD scatter them abroad upon the face of all the earth.
>
> Genesis 11: 1–9

In the traditional theological interpretation, the story of Babel is about the perils of hubris. However, it can also be read as a parable about the communication difficulties introduced by division of labor and specialization. Whenever organizations undertake a sufficiently large task (e.g. building a large tower), they must partition it into components. However, when a task is partitioned to form groups of specialists, each group of specialists tends to develop a different language. As organizations become sufficiently specialized, the specialists do "not understand one another's speech." Partitioning a task

leads to Babelization, and if the Babbelings are not translated sufficiently, integration fails. In this section, we suggest that people will exhibit coordination neglect, not only because of inadequate communication, but also because of insufficient translation.

The organizational literature has long recognized the potential problems of specialization. In the classic study by Dearborne & Simon (1958), a group of business executives were given a complex case study about a failing company. It was easy to predict how executives would assess the 'core problem' in the case based on their functional background: the finance executives saw a financial problem, the marketing executives saw a marketing problem, and the production executives saw a production problem. Thus specialists see the world in different ways and stress different content. Although the potential problems of coordinating specialists are well-described in the organizational literature, our question is whether lay theories acknowledge these problems and allow people to overcome them through sufficient translation.

Some authors have been skeptical about whether people will always recognize the problems of translation. Translation was a central feature of Allen's (1977) study of gatekeepers in engineering firms. He notes that translation problems are especially difficult to identify in organizations, "Anyone who does not speak French knows his deficiency, but very often we think we know what someone from another organization is saying when in fact our understanding is very different" (p. 139). According to Allen, the 'principal contribution' of gatekeepers is translation, they convert information "into terms that are relevant and understandable for the members of their organization" (p. 166). In his book, Allen devotes separate chapters to the basic communication problem (Chapter 5, The Importance of Communication Within the Laboratory) and to the translation problem (Chapter 6, Communications Among [Sub-] Organizations), yet in Chapter 7, he puzzles over the fact that both of these problems are rarely solved, "Given the obvious benefits of internal consulting, it is puzzling that it is so infrequently used" (p. 183).

Specialization would not create such serious problems if people only realized they need to work differently to translate across specialist boundaries. However, there is evidence that specialists, rather than understanding the translation problem, respond to integration issues by reasserting the same strategies that made them specialists in the first place. For example, specialists often develop symbols that can convey large amounts of information in a compact way (e.g. abbreviations, technical language, blueprints, the numerical summaries of accounting systems; March & Simon, 1958). Unfortunately, when specialists adopt these abstract symbols they often assume that they are equally meaningful for other parts of the organization. Bechky (1999) studied

a manufacturing firm that designed and built the complicated pieces of machinery that are used to produce silicon chips; this firm's competitive advantage in the market depended on its capabilities in clever engineering and precision manufacturing. Not surprisingly, the engineers and the manufacturing people spoke very different languages. When engineers tried to communicate with the assemblers, they communicated in ways that reinforced the translation problem. For example, in an attempt to communicate better with the assemblers, the engineers endeavored to make their engineering drawings as comprehensible as possible: to "add intelligence to the drawing" (p. 83). However, the assemblers in the production area did not share the specialized training that allowed the engineers to read the drawings. Assemblers 'mistrusted' the drawings (p. 68). Bechky implies that this was a problem of inadequate translation. "The drawing was clear to the [engineers] who created it, because they worked in the context of engineering drawings all the time . . . However, assemblers lacked this knowledge" (p. 68).

Indeed, because engineers could not abandon their perspectives, they often compounded the problem of translation. Engineers made their drawings 'increasingly elaborate' in the hope that this would 'clarify' the production process for the assemblers. "This drove them to greater abstraction in the documentation, which caused further communication problems . . ." (p. 94). Here, the engineers behaved a little like the American tourist who tries to translate his or her ideas in a foreign country by repeating the same English phrase at a louder volume. The interesting part of the process was that the engineers often neglected to use other means of translation that would have been simpler. Bechky (1999) notes that the physical machine was the most effective translation device. It was 'the lowest common denominator' so it worked "most effectively and quickly to resolve misunderstandings" when individuals from different departments were trying to communicate. One assembler noted that, "If we do it from the engineering drawing we can get confused and make mistakes. Looking at [a physical machine] is easier and better" (p. 83). Yet even though the physical machine improved translation, the firm anointed the abstract engineering drawing as the 'privileged' form of communication (p. 93). Bechky's careful study as well as other studies in the literature (e.g. Henderson, 1991) suggest that people may sometimes neglect appropriate boundary objects because they fail to recognize the importance of translation.

If people neglect the importance of translation, they may also undervalue people who act as translators by spanning boundaries among groups within an organization or outside. Anecdotes suggest that organizations often sack the wrong people during mergers (Economist, January 9, 1999) – perhaps because

the first people who are fired during downsizings are those who are not clear members of one department or another (i.e. the very people who are probably bridging gaps between departments). For example, Dougherty & Bowman (1995) found that downsizing hindered strategic problem solving because it broke the networks of informal relationships that innovators use to work out strategic problems – to acquire support and resources for new initiatives and to translate the innovation into terms that will be accepted by senior managers.

Although the examples above indicate that the translation problem is important, there is evidence that even sophisticated observers of organizations may underestimate the difficulty of translation. Lawrence & Lorsch (1967), who devoted much of their book to the problems of integration, critiqued earlier organizational theorists for not realizing the inevitability of translation problems. According to Lawrence & Lorsch (1967), the 'major failing' of the classical writers on organizations was that they did not recognize that partitioning the organization into departments would lead each department to "develop specialized working styles and mental processes," a process they called 'differentiation' (i.e. "not just the simple fact of partition and specialized knowledge," but fundamental "differences in attitude and behavior," p. 9). They argued that differentiation would make it impossible for an organization to coordinate itself using the simple coordination mechanisms recommended by classical writers (primarily hierarchy). If Lawrence and Lorsch are correct, then the problems of translation are not obvious even to many experts who are thinking carefully about organizations.

Emotional barriers to translation across specialists. To this point, the idea of translation has been considered at a fairly rational level. If people have trouble communicating, it is because they don't think to give all the information to another person, or because they translate insufficiently from one specialist's language to another. However, this rational approach is insufficient to understand the complete dynamics of communication and translation because it ignores an important *emotional* component of the communication process. Communication requires trust because both parties must assume that the other is making good-faith efforts to coordinate (Grice, 1975; Clark, 1996). Here it is useful to recall our earlier discussion of agency misattributions, because if people are subject to agency misattributions, then they are likely to assume that translation problems are a sign that the other person, with whom they are trying to coordinate, is operating in 'bad faith'.

Agency misattributions are quite likely when specialists communicate. Specialists may be somewhat suspicious of others' motives to begin with because they come from different groups with distinctive backgrounds,

preferences, and language. Research in social psychology on 'minimal groups' has shown that dividing a group based on even trivial distinctions (e.g. liking abstract art by Klee vs. Kandinsky) has surprisingly quick effects on group dynamics; people allocate more resources to their own group, talk up the qualities of their own group, and denigrate those of the other group (Tajfel, 1970; Brewer, 1979). The minimal group experiments provide empirical parables about how easy it is to produce ethnocentrism and emotional conflict, but in organizations, differences among groups are anything but minimal. When specialists try to coordinate with each other, their suspicions about others may enhance agency misattributions; causing them to attribute integration problems to bad motives by the other party. True, group dynamics may produce real agency problems, but we predict that specialization may make groups suspicious of one another's motives even in situations where the different groups are actually quite motivated to work toward the same goal.

Consistent with the idea that agency misattributions are common among specialists, Lawrence & Lorsch (1967) noted that people "personalize the conflicts that arise with representatives of other organizational units. Of course they know logically that an organization needs different kinds of specialists, but they forget the full meaning of this when they run into a particular person who is 'impossible to work with'. Then they all too readily turn to an explanation based on personality traits that writes off the individual as an oddball and justifies them in withdrawing from the conflict or forcing it" (p. 217).

One researcher who has studied new product introductions argues that although outsiders may believe agency problems contribute to new product failures, they are not, in fact, very common: "From the outside looking in, one can see the conventional stereotypes for each department: technical people never settle on a design, field people are short term, manufacturing people always say no, and planning people are conceptual. But from the inside looking out, each thought world is truly concerned with the successful development of the product, and each has an important insight into the product or market that is essential to a new product's development" (Dougherty, 1992, p. 191). However, although each department is motivated to develop the product, the departments may fail to coordinate because they translate their goals and expectations insufficiently. "Technical people, for example, expect field people to tell them exactly what customers want in the design. Field people, however, cannot identify these 'specs' because [they think] product innovation involves meeting shifts in customer needs, so they expect technical people to produce alternative designs quickly" (p. 189). Agency misattributions may lead team members to ignore the translation problem because they assume the other party has the wrong incentives. According to Dougherty, differences in specialization

can preclude optimal integration "by producing severe frustrations and withdrawals into separate thought worlds." If people suffer from agency misattributions they are unlikely to take the time to address such translation problems because they assume the other person is not truly motivated to cooperate.

Summary: Inadequate Communication and Insufficient Translation

Although organizations can integrate their efforts in many ways, the most important mechanism of integration, particularly in complex or uncertain environments, is for units to communicate with each other on an ongoing basis (March & Simon, 1958; Thompson, 1967). In this section we have discussed two problems that may hinder individuals from taking advantage of this integration mechanism: inadequate communication and insufficient translation.

Communication is difficult in general. People are prone to the curse of knowledge which makes it difficult for them to take another person's perspective well enough to communicate adequately. In face-to-face conversations, people have a variety of means of repairing instances of inadequate communication, but in organizations, where much communication takes place across time between individuals who do not interact face-to-face, the problems of inadequate communication become more significant (DeSanctis, Staudenmayer & Wong, 1999).

Organizations complicate the basic problem of communication, because they require people to communicate across differentiated groups of specialists. Thus, if people translate insufficiently across specialized languages or 'thought worlds', coordination will be further hindered. The problems of communication and translation are magnified because differentiation and specialization may leave people suspicious of one another so that they are more likely to make agency misattributions when they encounter coordination problems; attributing problems not, as they should, to lack of communication, but instead to misaligned motivations.

UNDERSTANDING COORDINATION NEGLECT

In this chapter, we have argued that people in organizations often exhibit coordination neglect. Even when they desire to coordinate with others, when they are thinking actively about the problem, and when coordination does not

exceed their computational abilities, people may have blind spots that make them likely to fail in their coordination attempts. In the paper, we have focused on two different aspects of coordination neglect:

(1) *Partition focus and component focus*. People focus on the process of partitioning a task more than the process of integration and they tend to focus on individual components when they try to diagnose problems or intervene to provide a solution.
(2) *Inadequate communication and insufficient translation*. People do not communicate adequately in general and they fail to realize the additional problems of translating across differentiated specialists.

Although the figures in this paper indicate how both sets of problems arise from the basic process of division of labor in organizations, it is possible to think of these two sets of problems operating in a two-stage temporal sequence. In the first stage, an organization must plan the division of labor along with any integration mechanisms it deems necessary. In the second stage, the organization must integrate its efforts in an ongoing basis. Presumably, if people make errors in one stage they can offset them with superior performance in the other; effective planning may reduce some of the demands of implementation, and skilled implementation may overcome some of the problems of inadequate planning. Yet the evidence above suggests that organizations will experience predictable problems in both stages.

The examples in this chapter suggest that coordination neglect plays a role in many important decisions. Individuals indeed have gaps in their lay theories of organizing. Note, however, that these gaps are seen even in managers and scholars who are quite sophisticated about the problems of organizing. This observation is consistent with research in individual decision making that has suggested that any bias that can be documented in naive individuals can also be documented, in a more subtle form, in experts (Kahneman, Slovic & Tversky, 1982). It is interesting that many examples of partition focus or inadequate communication are found with sophisticated managers in otherwise successful companies. Even sophisticated organizational theorists have neglected these problems at times (e.g. see critiques of the organizational literature by Lawrence & Lorsch, 1967; Cohen & Gooch, 1990; Weick & Roberts, 1993; Hinds & Kiesler, 1995). Such examples suggest that the problem of coordination neglect is not trivial, particularly whenever people encounter problems that are, to them at least, novel (Chandler, 1963; Brooks, 1979; DeMarco, 1997).

Bad (and Good) Ways of Repairing Coordination Neglect

While we have emphasized the problem of coordination neglect, we also want to highlight that organizations may create other problems if they adopt overly simple cognitive repairs for coordination neglect. For example, if organizations attempted to repair partition focus or component focus by decreasing the division of labor, they could easily create other problems such as lack of requisite variety or expertise (Weick, 1983; Nemeth & Staw, 1989). Similarly, people may overemphasize the ability of hierarchy to coordinate complex processes. In group situations, students typically want to simplify coordination by 'appointing a leader'. Hierarchy appeals to our fascination with people as the source of action (Weber, Rottenstreich, Camerer & Knez, 1999; Meindl, Erlich & Dukerich, 1985), but it is likely to be ineffective in complex, uncertain environments (Lawrence & Lorsch, 1967; Hinds & Kiesler, 1995).

It's clear that organizations can over-apply the lessons they learn about individual shortcomings. For example, thanks to the research attention on the benefits of cross-functional teams, many organizations have tried to repair inadequate communication by using team meetings as a generic repair for every coordination problem. However, more communication is not always better. Many managers in firms today complain of the length and frequency of meetings (which interfere with their ability to get their own functional work done) (Perlow, 1995; Staudenmayer, 1997).

In fact, thoughtful organizations solve problems of coordination by integrating the efforts of their members in ways other than direct communication. For example, software teams sometimes enforce integration by using special processes that force integration among separate workers. In some firms, software teams do a nightly 'build' to put together the modules for the entire program (Staudenmayer, 1997; Cusumano & Selby, 1995). Individual developers can decide whether or not to submit an updated version of their module to the nightly build, but if they do so, they must take care that their module doesn't 'break the build', i.e. produce problems for a module other than their own, causing the overall program to crash. In this procedure, individual programmers are not forced to communicate with others to ensure that their module doesn't break the build, yet they are prompted to test their code and to anticipate what problems they may create for other modules when they change their own.

As another source of repairs for coordination neglect, Tom Malone of MIT and a group of colleagues have developed a process to suggest alternative ways of solving coordination problems (Malone et al, 1999). They collect examples

of how different organizations perform similar processes of coordination, and organize these examples in an on-line 'process handbook'. They analyze processes at various levels of abstraction, so they capture both the details of the specific processes as well as the 'deep structure' of their similarities. As a result, managers can explicitly represent the similarities and differences among related processes and they can more easily generate alternatives to solve a particular coordination problem.

Although there is ample evidence of coordination neglect, organizations that attempt to repair coordination problems in an ad hoc way may find that their would-be repairs create additional difficulties. There are solutions to these problems, but they will require careful attention to the underlying requirements of integration and to overcoming the cognitive barriers we have identified.

Extensions

On a lighter note, perhaps the most extreme evidence for coordination neglect is provided by conspiracy theories. In the typical conspiracy theory, a diverse set of military, industrial, and government agencies coordinate seamlessly over long periods of time despite organizational and geographic barriers. Extreme versions of conspiracy theories feature coordination across planets and species (a serious neglect of translation problems). If individuals fully understood the difficulty of coordination, it seems unlikely that they would be quite so facile in assuming the level of coordination present in the typical conspiracy theory.

Conspiracy theories also play a role in the day-to-day analysis of sophisticated experts. In Robert Jervis' (1976) brilliant book on the psychology of international relations, he devotes a set of chapters to 'Common Misperceptions' in international relations. The first of these chapters is entitled 'Perceptions of Centralization' (pp. 319–342). According to Jervis, a common misperception is to see the behavior of others as "more centralized, planned, and coordinated than it is" (p. 319). For example, during World War II, "many observers believed the German fifth column [espionage force] was largely responsible for the Allies' difficulty in mobilizing and the swift German victories . . . Later investigation showed that the fifth columnists had done very little and that the incidents attributed to them were caused by Allied disorganization" (Jervis, 1976, p. 322–323).

Such examples suggest that coordination neglect, even in its most extreme forms, may play an active role in how we approach and interpret the coordination problem in organizations.

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