# MANAGERIAL AUTHORITY WHEN KNOWLEDGE IS DISTRIBUTED: A KNOWLEDGE GOVERNANCE PERSPECTIVE

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## Abstract

A critical knowledge governance problems concern the consequences the use of the governance mechanism of authority if the knowledge that is essential in a work setting is partially *unknown* to the person who is to exercise authority. Is it possible to rationally direct work and activities under such conditions? Recently, many scholars have given negative answers to this question, arguing that authority relations are becoming strained by the increasingly distributed nature of knowledge in and between firms. We analyze this argument, providing definitions of "authority" and "distributed knowledge." This allows us to show that — while intuitively appealing — the argument that authority cannot be an efficient coordination mechanism in the presence of distributed knowledge is at best problematic. The argument is based on the flawed inference that because the holder of authority is ignorant about some of the knowledge held by employees, he cannot rationally direct them. However, it is correct that the quality of centralized direction (planning, authority) may be compromised by distributed knowledge, leading to choices of other governance mechanisms and structures.

## INTRODUCTION

Much existing thinking on management and authority in organizations implicitly or explicitly makes strong assumptions about the knowledge held by managers. Thus, it is assumed that managers are at least as knowledgeable about relevant tasks as employees; that they can instruct the latter to carry out the tasks, and that they can somehow ascertain whether employees are sufficiently skilled to adequately carry out the task (Grandori, 1997; Sharma, 1997). It is, however, not clear what are the consequences for our understanding of management and authority if the knowledge that is essential in a work setting is partially unknown to the manager, distributed across several employees, and perhaps even — because of its tacit nature — must remain unknown? In particular, how can the manager rationally direct work under such conditions, that is, when he would seem to lack the knowledge required to instruct and monitor employees? Can the use of managerial authority give rise to an effective utilization of the knowledge held individually by employees?

It is quickly seen that although this problem may arguably have been exacerbated by the knowledge conditions that accompany the emergence of the knowledge economy — specifically an increased need to source outside knowledge, rely on knowledge workers and engage in distributed innovation processes—, it is a very general one. It is hinted at, but not analyzed, by writers such as Cyert and March (1963) and Lawrence and Lorsch (1967) in the organization field and Hayek (1973) in political economy. In spite of its apparent relevance (cf. Lessard and Zaheer, 1996), the issue of the knowledge-based limits to management has attracted rather little interest from management theorists (for exceptions, see Mintzberg, 1985; Sharma, 1996; Grandori, 1997; Brusoni, 2005), emerging more indirectly under the guise of the knowledge-based boundaries to the firm (e.g., Kogut and Zander, 1992). Indeed, as Lessard and Zaheer (1996: 513) indicate, the issue is usually sidetracked or at least black-boxed.[1]

The purpose of this chapter is to address a subset of the overall issue, namely the implications of "distributed knowledge" for the use in firms of the authority relation. The notion of distributed knowledge, coined in computer science about two decades ago (Halpern and Moses

[1] They provide strategic management as an example: "In strategy research, the issue of the expertise for strategic decision-making being spread across the firm is often assumed away by focusing exclusively on decision-making by the CEO or the top management team" (Lessard and Zaheer, 1996: 513).

1990), has fast become a household concept in various branches of management and organization studies (e.g., Marengo, 1995; Cohen and Regan, 1996; Tsoukas, 1996; Lessard and Zaheer, 1996; Gherardi, 1999; Coombs and Metcalfe, 2000; Larsen, 2001; Potts, 2001; Spangler and Peters, 2001. For the moment, think of "distributed knowledge" as knowledge that is not possessed by any single mind, but "belongs to" a group of interacting agents, somehow emerges from the aggregation of the (possibly tacit) knowledge elements of the individual agents, and can be mobilized for productive purposes.

Many writers have argued that such distributed knowledge is becoming increasingly important in an innovation-rich, knowledge-based economy. This is because firms increasingly need to rely on a growing number of knowledge specialists, be they employees or outside knowledge agents, such as supplier firms or universities (e.g., Granstrand, Patel and Pavitt, 1997; Hodgson, 1998; Coombs and Metcalfe, 2000; Smith, 2000; Wang and von Tunzelman, 2000; Brusoni, Prencipe and Pavitt, 2001, Orlikowski, 2002; Husted and Michailova, this volume). This tendency is seen as having strong transformative implications for the boundaries of the firm (Coombs and Metcalfe, 2000), as well as for internal organization (Cowen and Parker, 1997; Foss, 1999) — including the use of authority as a mechanism of coordination (Grandori, 1997, 2002).[2]

However, although the concept of distributed knowledge is often invoked, and rather far-reaching claims are made on its behalf, there is little systematic analysis of how distributed knowledge and economic organization relate. Thus, the concept is not clearly defined in the management literature, the causal links from distributed knowledge to economic organization are unclear, and an overall perspective that can frame the discussion is missing. In contrast, we proffer a definition and examine links, focusing on the relation between distributed knowledge and the use of authority in firms. We embed our arguments in the knowledge governance approach (Foss, 2007; Foss, Husted and Michailova, 2008; see also the Introduction to this volume), that is, we examine the alignment between (the characteristics of) knowledge (i.e.,

[2] By "coordination," we mean consistency of plans. By "coordination mechanisms," we refer to those mechanisms that may assure such plan-consistency, such as prices, authority, norms/rules/routines/standards/focal points (i.e., mechanisms that are based on behavioral regularities), consultation and ratiocination (e.g., in games). For an excellent discussion of coordination mechanisms and their implications for organizational theory, see Grandori (2001).

distributed knowledge) and governance mechanisms (i.e., authority) in the context of an overall efficiency perspective.

Here is how we proceed: We begin by taking a closer look at the key constructs of "authority" and "distributed knowledge." We then examine their interplay, focusing particularly of the role of authority as a mechanism of coordination when knowledge is distributed (see also Anna Grandori's chapter in this volume). An outcome of this discussion is that how well authority performs under these conditions depends on what we mean by authority. Thus, while the narrow notions of authority associated with Coase (1937) and Simon (1951) may indeed in certain cases (i.e., for certain specifications of distributed knowledge) be compromised by distributed knowledge, this does not imply that all manifestations of authority break down as mechanisms of coordination when knowledge is distributed. There is accordingly a need for a more fine-grained understanding of types of managerial authority, and we take steps in this direction. We end by exploring the conditions under which authority may be an efficient mechanism of coordination under distributed knowledge, relying on ideas on problem-solving (Simon, 1962, 1973; Nickerson and Zenger, 2004 and their chapter in this volume) and on organizational economics. Thus, in addition to conceptual analysis, this chapter contributes the kind of "feasibility" study recommended by Grandori (2002), that is, a relatively detailed, mainly theoretical, exploration of the working of a specific governance mechanism in the context of those knowledge conditions that are often taken to characterize our emerging knowledge economy.

## AUTHORITY AND DISTRIBUTED KNOWLEDGE: DEBATE AND DEFINITIONS

### Setting the Stage: Distributed Knowledge and Economic Organization

Return to the question with which we began this chapter: How is it possible rationally to govern activities, such as work activities carried out by employees, by means of the authority mechanism when the holder of authority is partially ignorant about some, and potentially much, of the knowledge possessed by the employees, knowledge that may be vital for carrying out the relevant activities?

This question is a subset of a broader question on the role of centralized resource allocation in social systems where the central authority is, to a certain extent, ignorant of knowledge held by

individual agents. In this broader formulation, the question harks back to debate on the viability and efficiency of planned resource allocation on the societal level (i.e., socialism) that raged among academic economists in (particularly) the inter-war period (Lavoie, 1985). Hayek (1945) famously argued that any economy-wide manager — a central planner — would be inherently constrained by the distributed (or "dispersed") and tacit nature of knowledge in the economy. Planning confronted inherent knowledge-based constraints. In fact, Hayek argued, these constraints were binding at such a small scale of economic activity that comprehensive overall management/planning of economy-wide resource allocation would be deeply inefficient. However, he did not provide serious micro-foundations for this argument.

Though little systematic thinking exists on the issue in management, we can see the Hayekian idea popping up in many different contexts. For example, many of Mintzberg's (e.g., 1990) critiques of "design" and "planning" in the strategic management process invoked Hayek-like arguments, such as the notion that emergent strategies would be able to mobilize much more locally held knowledge than a centralized strategy process.

In a different context, Langlois (1995) explicitly links thinking on firm capabilities to Hayekian arguments: Since firms as planned entities are inherently limited in the extent to which they can absorb, process and utilize knowledge — an idea that is reflected in the notion of "capability" — there are knowledge-based limits to the size and scope of firms. Related reasoning can be found in Kogut and Zander (1992), Grant (1996), and other knowledge-based papers that link firm-level knowledge and economic organization. Again, this literature may be criticized for lacking micro-foundations: Because the argument is not systematically rooted in a theory of (individual-level) cognition, it remains unclear why exactly the size and scope of firms are constrained by capabilities.

As a final example consider the increasingly prevalent argument, forcefully put forward by Grandori (2002: 257), that "[d]istributed knowledge causes authority (as a centralized decision-making system) to fail in all its forms." Similar statements can be found in, for example, Minkler (1993), Cowen and Parker (1997), Hodgson (1998), and Radner (2000). The reasoning behind the arguments seems to be as follows. First, it is argued that authority — that is, the right to make decisions which guide the decisions of another person (Coase 1937; Simon 1951, 1991) — presupposes considerable knowledge about the knowledge (and perhaps also the action set) that is

available to those that are being directed. Second, the presence of distributed knowledge means that this condition cannot be fulfilled. Therefore, authority is an inefficient coordination mechanism, and alternative coordination mechanisms (Grandori, 2001) emerge to handle the coordination task implied by distributed knowledge, such as prices (Hayek, 1945; Cowen and Parker, 1997), communication (Garicano, 2000), and norms (Grandori, 1997, 2002).

These examples hopefully suffice to indicate the following: First, scholars from different disciplines and fields put forward arguments that the distributed nature of knowledge in social systems is an independent constraint on the efficiency of planning/central management/authority. In particular, authority is argued to be an inefficient means of coordination under conditions of distributed knowledge. Second, the specific mechanisms through which the distributed'ness of knowledge constrains planning/central management/authority are not identified (the exception is Grandori; see Grandori, 1997). Three, the arguments are implicitly critiques of those organizational theories that place emphasis on the authority relation as the mechanism of coordination that primary characterizes firms, notably transaction cost theories (Coase, 1937; Williamson, 1985) and property rights theory (Hart, 1995, 1996). Finally, it is fair to say that most of those writers who have argued that distributed knowledge is a force that impacts economic organization have generally failed to precisely define what is meant by knowledge being "distributed." Similarly, other key constructs, notably that of "authority," are seldom defined and implicitly taken to be unproblematic. They are not, as we shall see. Thus, in order to assess arguments relating distributed knowledge to authority, we therefore need to look at these two key constructs in some detail.

**Authority**

Organizational theories, drawing on sociology, economics, and psychology, present a huge number of interpretations of authority (e.g., Weber, 1947; Thompson, 1956; Grandori, 2001). This is not the place to present a full review and critical evaluation of the multitude of definitions and ideas regarding the notion of authority. Rather, for the purpose of this chapter, the concepts of authority offered by Herbert Simon (1951, 1991) in two papers, separated by four decades, serve as useful starting points, because they are well known, precise, do not invite confusions with neighbor concepts (e.g., leadership), and are *different*. In fact, we shall them as springboards for developing notions of "Type I" and "Type II Authority."

***Type I Authority.*** Simon (1951) defines authority as obtaining when a "boss" is permitted by a "worker" to select actions, $\mathbf{A}^0 \subset \mathbf{A}$, where $\mathbf{A}$ is the set of the worker's possible behaviors. More or less authority is then defined as making the set $\mathbf{A}^0$ larger or smaller. Simon develops a multi-period, incomplete contracts model with *ex post* governance. In the first period, the prospective worker decides whether to accept employment or not. Both parties know the possible set of actions and their associated expected and real costs and benefits, but none of the parties know which actions will be optimal, given circumstances. In the next period, the relevant circumstances are revealed to the boss. The boss then picks the action that he prefers and directs the worker to that action which — for the latter to accept the assignment — must lie within his or her "zone of acceptance."

A worker's zone of acceptance is defined in Simon as that set of actions where the worker's *expected* costs of carrying out these actions do not exceed the agreed-upon on wage. An important feature of authority is that the authority of a superior is constrained by the acceptance of the subordinate of the authority. "A subordinate may be said to accept authority," Simon (1951: 22) explains, "… whenever he permits his behavior to be guided by a decision reached by another, irrespective of his own judgment as to the merits of that decision."[3] That is, for some of the actions the costs to the worker may exceed the agreed-on wage, but acceptance of authority implies that the worker carries out those actions *irrespectively* of his own cost of doing so.[4] The boss cannot commit to choose actions that maximize total surplus, and even if the worker is able to identify actions that yield a higher total surplus, he must carry out the action that is preferred by the boss. However, the boss never includes in the zone of acceptance those actions where the expected increase in wage to the worker exceeds his expected increase in benefits.

Simon's explanation of authority and the employment relation is quite akin to Coase's (1937). In the presence of uncertainty, Coase argues, contingencies are costly to anticipate and describe in advance, and rather than negotiating on a spot market basis over each contingency as they arise, an employment contract is concluded. The latter is defined as "… one whereby the factor, for a certain remuneration (which may be fixed or fluctuating) agrees to obey the directions of an entrepreneur

[3] In contrast, in a market contract, the parties negotiate *ex ante* about the actions that the agent can take in response to various contingencies so as to fulfill the contract. Thus, the principal's flexibility under market contracting is limited compared to what it would be under authority.

[4] This is what makes the authority different from an agency relation. In the latter, the agent's participation constraint is never violated.

*within certain limits*. The essence of the contract is that it should only state the limits to the powers of the entrepreneur. Within these limits, he can therefore direct the other factors of production" (idem. 242). Simon and Coase's understanding of authority is summarized in the following definition:

> ***Definition (Type I Authority):*** Authority is a decision right that an employer acquires, because he expects to obtain only *ex post* contracting the relevant information that will make it possible for him to pick his preferred actions within a specified subset of actions, which he will then direct the employee to carry out.

In the Simon notion of authority symmetric knowledge/information is consistent with the authority relation. It is sufficient that one contracting party stands to gain more than the other from picking the actions once contingencies materialize, and that the contractors cannot make side-payments that enable them to agree on what is the best choice when contingencies arise. In the Coase notion of authority the employer picks well-defined actions from a set of discrete actions (about which the employer has perfect information). He does this on the basis of knowledge about contingencies that is superior to that of the employee. However, it is key that in either case the employer formally grants *no* discretion with respect to the choice of actions.

***Type II Authority.*** In actuality it is hard to imagine an authority relation where absolutely no discretion is granted to the employee. Even for the most closely monitored and repetitive work, some employee discretion will remain (Knight, 1921). Specifically, in the presence of costs of monitoring, the employer will grant *de facto* discretion to the employee. This already indicates that authority and employee discretion are not mutually exclusive. This was clearly recognized by Simon (1991), four decades four decades after his paper on authority. Simon (1991: 31; our emph.) argues that "[a]uthority in organizations is not used exclusively, *or even mainly*, to command specific actions." Instead, he explains, it is a command that takes the form of a result to be produced, a principle to be applied, or goal constraints, so that "[o]nly the end goal has been supplied by the command, and not the method of reaching it."[5]

***Delegation and authority.*** Two crucial aspects of this understanding of authority should be noted. First, relative to Simon's earlier definition this notion of authority allows for the delegation of discretion. In a sense, this extension brings agency relations in hierarchies inside the orbit of authority relations, because it allows for the possibility that authority may (also) have the function of unilaterally changing the degree of delegation *post* contract agreement (see also Aghion and Tirole, 1997; Baker, Gibbons, and Murphy, 1999). Second, this second, more expansive notion of authority *does not* presuppose that the employer is at least as knowledgeable as the employee about how to best carry out a task. That is, an employer is able to direct or constrain employee actions in ways that benefit him, while allowing the existence of and possible use of knowledge held only by the

[5] In fairness to Simon, it should be noted that the more expansive notion of authority in the 1991 paper can be found already in Simon (1947). Thus, Simon's views of authority did not change between 1951 and 1991. What arguably happened was that Simon in the 1951 paper developed a *formal* model of authority and that tractability of the formal analysis required that a relatively simple concept of authority be employed.

employee. To see how delegation and authority connect, consider the benefits and costs of delegation.

Employers grant discretion to employees for a number of reasons, including economizing with principals' opportunity costs (Salanié, 1997), improving motivation through "empowerment" (Conger and Canungo, 1988), fostering learning by providing more room for local explorative efforts and improving collective decision-making by letting more employees have an influence on decisions (Miller, 1992). Importantly, delegation is also granted in order to make efficient use of distributed knowledge in firms (Jensen and Meckling, 1992).

There is also a cost side to delegation. In Simon (1951), the only restrictions in employment contracts are those that are defined by the agreed upon "zone of acceptance" since actions are all well defined... However, once delegation enters the employment relation the decision rights that are granted to employees are constrained in various ways. This brings a further function of authority into focus, namely to constrain "the method[s] of reaching" an end goal, in Simon's (1991) terminology. Also, top-management keeps ultimate decision rights, so that it, if deemed necessary, can overrule decisions made on the basis of delegated decision rights (Baker, Gibbons, and Murphy, 1999).

There are several reasons why an employer may want to constrain the discretion they delegate to employees. Employees are not full owners or residual claimants on the results of their decisions or do not share all relevant knowledge. Thus, delegation produces spillover effects (i.e., "externalities") that may be harmful to the employer and to overall firm performance.The relevant externalities include, but are by no means limited to, morally hazardous behavior (Holmström, 1979; Holmström and Milgrom, 1991). They also include coordination failures, such as scheduling problems, duplicative efforts (e.g., of information gathering, R&D, etc.), cannibalization of product markets and other instances of decentralized actions being inconsistent with the firm's overall aims, etc. One way to reduce such harmful externalities is to constrain decision rights and monitor their use (Fama and Jensen, 1983; Holmström and Milgrom, 1991). Such monitoring may lead to overruling of decisions made on the basis of delegated rights.

This suggests a rationale for authority that is rather different from the one associated with Type I Authority but consistent with Simon (1991) — namely, to *delegate and constrain*

*discretion*.[6] For example, the right to use an asset in certain ways may be delegated; however, it is understood that this right does not entail the right to use the asset in the service of a competitor firm, nor may the asset be used in a way that management perceives as being damaging to the firm. It is also understood that breaking this understanding will be sanctioned.[7] Defining constraints also implies the rights to veto decisions made on the basis of delegated rights, and to withdraw delegated decision rights (this may be seen as a special case of constraining rights). Employees may have different benefits and costs depending on the particular delegation and constraining of discretion. As in Type I Authority an agreed-upon "zone of acceptable delegation and constraining" limits the way in which authority can be exercised. As under Type I Authority the employer only includes actions where his expected benefits exceed his expected costs in terms of increased compensation to the employee. Given the above, we may put forward a second definition of authority:

> **Definition (Type II Authority):** *Authority is a decision right that an employer acquires, because he expects to obtain only ex post contracting the relevant information that enable him to delegate discretion to employees and constraining such discretion in ways preferred by him and within a specified subset of actions.*

In this definition, the holder of authority makes choices from a set of alternative possibilities of delegation. He does not necessarily have complete information about the actions available to the employee given the level of delegation and constraints he chooses. As we shall argue this directly means that Type II Authority can make efficient use of distributed knowledge. However, clarifying the latter notion still remains.

**Defining Distributed Knowledge**

During the last decade or so the notion of distributed knowledge has been used with increasing frequency as a catchy description of the knowledge conditions in which modern firms

[6] The rather considerable literature on delegation in organizations (e.g., Galbraith, 1974; Fama and Jensen, 1983; Jensen and Meckling, 1992) does not explain why delegation should be associated with the exercise of authority. Part of the reason may lie in the static nature of the analysis: All costs and benefits associated with delegation are given (hence, optimum delegation is known immediately to decision-makers), and there is no role for authority, except than perhaps monitoring the use of delegated decision rights.

[7] Multi-tasking considerations (Holmström and Milgrom, 1991) also suggest a basic reason why decision rights may be constrained; thus, agents' attempts to carry out activities that are easily measured and therefore directly rewarded at the expense of harder to measure, but necessary activities may lead to the former ones being curtailed.

increasingly find themselves.[8] Thus, in the strategy field, Tsoukas (1996) conceptualized the firm as a distributed knowledge system, Granstrand, Patel and Pavitt (1997) documented the increasing extent to which the knowledge bases controlled by major technology-intensive corporations are distributed, and Lessard and Zaheer (1996) discussed the implications of distributed knowledge for the strategy-making process. Hutchins (1995) and Gherardi (1999) discussed implications for organizational learning, Cohen and Regan (1996) applied the notion to technology management, Foss (1999) discussed implications for the modern economics of organization, and Larsen (2001) discussed the context in the context of knowledge-intensive service firms.

This scholarly activity may reflect reality. Thus, many writers argue that distributed knowledge conditions have become increasingly important in modern competitive conditions, as firms to a larger extent need to access an expanding set of external knowledge sources (Coombs and Metcalfe, 2000; Smith, 2000; Arora and Gambardella, 1994), and increasingly need to rely on specialist knowledge controlled and accumulated by specialist employees (Miles et al., 1997). Of course, there is nothing new *per se* in the notion that knowledge for productive purposes may be distributed; indeed, it is a necessary consequence of the combination of the division of labor and bounded rationality (Hayek, 1945, 1973; March and Simon, 1958; Arora and Gambardella, 1994). Rather, what is being asserted by a number of authors seems to be that there are significant discontinuities in the evolution of distributed knowledge, so that the distributed character of knowledge has strongly increased during the last decades. Thus, Granstrand, Patel and Pavitt (1997) document the significantly increasing extent to which firms organize in-house distributed technological knowledge, drawn from a growing number of underlying technological disciplines. Wang and von Tunzelman (2000) emphasize that not only are the number of disciplines that firms draw on expanding, it is also the case that these disciplines themselves evolve in terms of their depth and specialization; firms' sourcing of technological knowledge reflects this. Although the construct thus seems to ring a bell in a number of contexts, the above contributions are not entirely forthcoming with respect to precise definitions.

[8] To our knowledge, the term originates with Halpern and Moses (1990). However, the basic idea has a much longer pre-history, not only in the logic of knowledge, but also in economics and political philosophy (e.g., Hayek, 1945, 1973).

Distributed knowledge is a member of a set of concepts that relate to the different ways in which knowledge may "belong" to a group of agents. Two other examples of this kind of concepts are the game theory notion of "common knowledge" and "shared knowledge." An event is common knowledge among a group of players if each player knows it, each one knows that the other players know it, each player knows that other players know that the other players know it and so on (Aumann, 1976).[9] Shared knowledge differs from common knowledge by not requiring that each agent knows that the other agents know, etc. Thus, there is shared knowledge of a fact if each agent knows this fact, but does not know that the other agents know it.

If common knowledge lies at one end of the spectrum, distributed knowledge lies at the other end. Loosely, knowledge is distributed when a set of agents knows something no single agent (completely) knows. Thus, the notions that firms (Tsoukas, 1996) or whole economies (Hayek, 1945, 1973) are distributed knowledge systems mean that the set of agents comprising these entities somehow can be said to collectively possess knowledge that no single agent possesses. Note that this does not amount to asserting the existence of mysterious supra-individual "collective minds." Knowledge still ultimately resides in the heads of individuals; however, when this knowledge is combined and "aggregated" in certain ways, it means that considered as a system, a set of agents possesses knowledge that they do not possess if separated.

To add a slightly formal touch to this, consider the following definition based on epistemic logic (Hintikka, 1962):

> **Definition (Distributed Knowledge):** *If $K_i p_i$ means that agent i knows proposition i, a set of n agents has distributed knowledge of a proposition q (i.e., Dq) when: $K_1 p_1 \wedge K_2 p_2 \wedge \ldots \wedge K_n p_n \Rightarrow Dq,\ q \neq p_i,\ \forall i$.*[10]

For example, Jack knows that p is the case and Jill knows that p implies y, but neither know that y is the case. However, if Jack and Jill's knowledge states are "added" there is a sense, which is more than metaphorical, in which they may know that y is the case (Gerbrandy, 1998: 53). The information that y is the case is present in the system comprising Jack and Jill, but in a distributed form. The definition is clearly open to some interpretation. At one extreme, Jack and Jill may

[9] Common knowledge is a core assumption in contract theory, including agency theory (Salanié 1997).

[10] $p_i$ could be interpreted as a vector of propositions. Thus, we are not asserting that each agent only knows one thing.

both be completely ignorant about the knowledge controlled by the other party.[11] At the other extreme, there is considerable, but not complete,[12] knowledge overlap ($p_i$ may be close in some sense to $p_j$), but it is still the case that no single agent knows q. (An implication is that distributed knowledge is consistent with asymmetric information). Between the extremes are different degrees of overlap between individual knowledge elements. Note that as a special, but very important, case, it is not inconsistent with the definition to have agent i knowing that if the various knowledge of all the other agents are "added" in some activity, this will result in a beneficial outcome, even though he does not know any of these knowledge states, and may not even know the precise nature of the beneficial outcome.

**Distributed Knowledge as a Challenge to Authority?**

In a paper that is quite forthcoming about the relation between authority and distributed knowledge, Grandori (1997: 35) argued that

> … whatever its basis, authority is a feasible governance mechanism only if information and competence relevant to solving economic action problems can be transferred to and handled by a single actor, a positive "zone of acceptance" exists, the actions of other supervised actors are observable, and if the system is not as large as to incur an overwhelming communication channel overload and control losses.

Thus, Grandori nicely outline the reasons why distributed knowledge may challenge authority. Specifically, authority is challenged as a "feasible governance mechanism" for three reasons: Under distributed knowledge,

> 1) the employer does not possess full knowledge of the employee's action set (i.e., the actions that he can take when uncertainty is resolved), so that the employee can take actions about which the manager has no knowledge;
>
> 2) the employee is better informed than the employer with respect to how certain actions should (optimally) be carried out; and

[11] Sometimes such an interpretation is made of the "competitive equilibrium" model in economics: Although knowledge of technologies and preferences is private, all this knowledge is utilized in the best possible way, so that the knowledge of how to bring about an allocation of resources with superior welfare properties is distributed in the economy (Makowski and Ostroy, 2001).

[12] If knowledge overlap is complete, the agents will also know or be able to infer q (if they have perfect rationality/perfect reasoning assumptions and/or the knowledge elements and how they connect is easy to comprehend).

3) the employer does not know which actions should optimally be chosen from the action set in response to contingencies (because he lacks information on contingencies).

The ignorance on the part of the employer that is implied by 1) to 3) implies that authority cannot be employed as an efficient mechanism of coordination.

While intuitively appealing, this argument is problematic, and may be a *non sequitur*. The reasons are these: first, the scope conditions of the argument seem unclear clear. We have argued that there are (at least) two meaningful notions of managerial authority (Type I and Type II). Does the argument apply to both notions of authority, or only two one of them (and then which one?)? Second, the argument is based on an inference that seems flawed, namely that because the holder of authority is ignorant about some of the knowledge held by employees, he just cannot rationally direct them. But in actuality managers are constantly engaged in directing employees whose knowledge in a number of dimensions is superior to theirs. Managers are often quite successful in this. The reason is that one can very well possess the knowledge that somebody else's knowledge may be productively used in a certain activity, even though one doesn't possess that knowledge oneself. Knight (1921) called this faculty "judgment" and argued that management is first and foremost about exercising judgment over worker capabilities.

As we shall argue, the problem is therefore not that matching authority and distributed knowledge is always and inherently inefficient. It is not. Rather, what needs to be examined is *how* distributed knowledge constrains the efficient exercise of authority. The issue is, in other words, not one of whether a governance mechanism is inherently inefficient, but about choices between governance mechanisms.

## ALIGNING DISTRIBUTED KNOWLEDGE AND TYPE I AUTHORITY

### An Example

To focus things, consider a contract situation between Jack and Jill. Knowledge in this situation is distributed, because while Jill has knowledge of some of elements and Jack has knowledge of other elements that are relevant to their contractual relation, their respective knowledge is not overlapping.

Specifically, Jack can execute two different actions, y and z. Because of specialization only Jack is capable of carrying out the actions. The two actions can solve coordination problems in

the contract situations. The costs and benefit of these actions depend on the contingencies (p, b, q) that arise with certain probabilities during the contractual relationship. See Table 1. The numbers in the cells show the expected benefit to the employer (Jill) from an action given a particular contingency and the expected costs to Jack of carrying out the actions under the three different contingencies.

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***Insert Table 1 Here***

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The things that Jack and Jill can know and which are of relevance to their contractual relation (i.e., the "knowledge elements") are 1) the actions available to Jack; 2) the costs and benefits of carrying out these actions (i.e., the implications of [p, b, q] on the choice between y and z); 3) the different ways in which the actions can be carried out; 4) their associated costs and benefits; 5) the type of contingencies that can arise (p, b, q); 6) the probability that these contingencies arise; and 7) the actual contingencies that have emerged. The coordination problem then consists of combining these knowledge elements in such a way that Jack chooses those actions that match the relevant contingencies in a value maximizing manner (given the various constraints that may exist).

In a perfect world with symmetric information, complete contingent contracts and/or with costless re-negotiation and contract enforcement, the problem would be easily solved, and all the value-maximizing actions would be chosen to match whatever contingency emerges. Recall that in Simon (1951), the assumption in a contracting situation as the one sketched above is that of symmetric information between the contracting parties on all relevant elements; however, the execution of the contract is characterized by uncertainty with respect to which one of the already identified contingencies arise during the contract execution phase. High contracting costs makes it too costly to re-negotiate as the contingencies emerge, and a third party cannot enforce a promise by the employer to choose only actions that maximize total surplus. Thus, the choice according to Simon is therefore between a market contract in which Jill and Jack contract on one of the known actions to be carried out independently of what contingency emerges, or an employment contract where the employer (Jill) choose actions as contingencies emerge, that is, exercise Type I Authority.

Given the specifications in Table 1, Jill will pick action y if contingency b emerges and action z if contingency p or q emerges. Given the assumed probabilities, the expected benefit to Jill of having authority is 112 and the expected cost to Jack 32, which is also the minimum flat wage he accepts for actions within this zone of acceptance (given that his opportunity costs are zero). The expected surplus from the authority relation is 80. In a market contract Jack and Jill would contract on y and the surplus would be 70. Thus, in a situation of symmetric information Jack and Jill strike an employment contract in which Jack executes y or z depending on the benefit of these actions to Jill given the observed contingencies.

**Contracting Under Distributed Knowledge**

In the present context, knowledge is distributed when Jack and Jill have different sets of information on any of the above factors of importance to the contract. Will authority in the Type I sense be efficient under these conditions?

Consider first distributed knowledge about the actual or expected cost to the employee of the different actions under different contingencies (i.e., factor 2) above). If Jack is informed about his own cost of actions, but Jill is not, Jack can misrepresent the real costs in order to influence the sharing of the surplus. Such strategic misrepresenting can, of course, also happen in market contracts and there are no systematic differences in incentives to do so depending on the type of contract. Jack's misrepresentation of costs may influence what actions Jill wants to include in the zone of acceptance, if she is to assume the role of employer. For this reason Jill may prefer a market contract rather than the employment contract she would have preferred in a setting of symmetric information.[13]

If there is distributed knowledge concerning the probability of a contingency, and Jill is the informed party, she can use this information strategically in both market and employment contract to extract a greater share of the surplus. Thus, Jill can misrepresent the probability of a contingency that make her choose actions that are costly to Jack. However, she does not stand to gain from misrepresenting beyond what makes Jack accept the same zone of acceptance as he would have accepted in a setting of symmetric information.

[13] The same conclusion can be drawn if employees (agents) can act in a morally hazardous manner and choose to exert less effort in the actions they choose or that are chosen by the employer. The employment law often grants employers more rights to monitor the employee than is the case with a market contract. For that reason moral hazard may influence the choice of contract.

The consequences of distributed knowledge for the choice between employment and market contracts are more difficult to track if there is asymmetric information about the actions (y and z) available to Jack and if this information is obtained by Jack *post* contracting. Consider the situation in which Jill does not know that y is a solution to the coordination problem when contingency b arises. If she enters an employment contract, she picks y if contingency q arises and z in all other cases. Her surplus from entering that contract compared to the market contract (i.e., choosing z in all cases) is the difference between the wage and the created value from choosing y if contingency q arises — which may not be sufficient to make her choose the employment contract. Jack may not have incentives to inform Jill of these actions *post* contracting, since he is not interested in revealing actions where his costs are higher than the agreed upon fixed wage. Jack will not inform Jill about y as a contract solution should contingency q arise, but would do so should contingency p arise. However, neither the "employee" in a market contract has incentives to inform the "employer" on actions that imply large costs relative to the payment for the job. Thus, if the employee obtains information about actions *post* contracting (and this is expected by the employer), it can positively influence the use of employment contracts and authority only if the employer is able to take advantage of emergent actions where the costs to the employee are less than the agreed-upon wage without renegotiations.

Finally, the employment contract is always efficient compared to the market contract if there is symmetric information on the actions and factors that effect costs and benefits to the parties of entering the contract, but Jill is in a better position to observe what contingency materialize. A different situation obtains if Jill can observe the contingencies (p, b, q), but only Jack has the information on the actions available and on the costs and benefits of these actions. In that case, Jack must be given discretion to make efficient use of the information.

From the above discussion, it may seem that the efficiency gain from using an employment contract compared to a market contract can be ascribed to the employer being more sensitive to the choice of actions compared to the employee when it is too costly for an employer to credibly enforce a promise to select only actions that maximize joint output. The latter situation arises in one-period games when some information about the actual contingencies and/or the actions and their associated costs and benefits are not available to third parties (e.g. courts) allowing them to

enforce the promise. However, for the employment contract to be efficient, the employee must be able to commit to carry out actions that are not in his interest. How can that happen? For an employee to credible commit to authority, a third party must refuse to interfere with the contract execution during execution stages. This non-interference from a third party supports the use of authority in contracting relations (Williamson, 1993), and is efficient when contractual incompleteness arises because of asymmetrical information between an enforcing third party and the contracting parties. Moreover, courts allow employers to sanction employees who do not obey the authority of the employer. Courts can observe if an employee refuses to carry out any actions. In that case courts enforce authority by allowing the employer to cancel the contract and they may also sanction the breach of the promised acceptance of authority. Thus, accepting authority implies that the employee must carry out those actions that are preferred by the employer even when the costs exceed his payment for the particular action.

## ALIGNING DISTRIBUTED KNOWLEDGE AND TYPE II AUTHORITY

### Delegation and Type II Authority

Recall that Type II Authority implies that the employee has been delegated rights to make decisions that influence the contracting parties' welfare. Employees to whom such discretion has been granted may be remunerated by fixed wages or by some kind of incentive arrangement. However, as the vast body of agency theory shows, a well designed incentive contract makes the agent act in the interest of the principal, even in the presence of asymmetric information concerning the agent's actions (Holmström, 1979). In fact, incentive contracts can be used to allow the agent to choose actions including actions that may be unknown to the principal and based on knowledge that is not possessed by the agent.[14] Supplier contracts may exemplify this. For that reason we compare two incentive contracts, a market contract and an employment contract.

Continuing with the example, assume that *post* contracting, Jack becomes informed about high-yielding, low-cost actions that are available to him. Jill knows that such actions may emerge. In such a setting, consider a market contract in which a bonus payment is agreed upon,

[14] However, current formal models of agency does not allow for this.

such that Jack signs the contract. Jack can now freely interpret what contingencies has emerged and choose actions in order to maximize his benefit from the contract. However, he has incentives to interpret contingencies in a manner that allow him to choose the least costly actions, and do so at the expense of Jill. For example, if (in Table 1) contingency q emerges, Jack can claim that it is really contingency p, and choose action z instead of Jill's preferred action y. The observed result will be 100. If there is asymmetric information between courts and the contracting parties regarding what contingencies have emerged, the promise may appear to be fulfilled according to legal standard, and Jack can get away with his cheating.

If instead Jill has the authority to interpret the contingencies, Jack has incentives to choose those actions that create the greatest surplus, given the contingency (and provided that the incentive compatibility constraint is met). The consequence of the asymmetric information between courts and contracting parties is that in the market contract setting there are more instances where incentive compatibility *cannot* be reached compared to an employment contract. For that reason the use of authority interpreted as the right to define the contingency may be more widespread with the use of incentive schemes.

**Type II Authority When Knowledge Becomes More Distributed**

As many writers have pointed out the distributed nature of knowledge in social systems (from economies to firms) is closely related to, and partly prompted by, specialization (Hayek, 1945; Arora and Gambardella, 1994). Specialization allows us to effectively handle more and more complex productive tasks of any kind, provided that individual actions are somehow aggregated to a coordinated set of actions. This coordination can take place through markets (negotiations among independent agents) or through the use of Type I and Type II authority. However, as economists have rediscovered (e.g., Romer, 1986), specialization is an ongoing process. So far, we have argued that authority may be efficient in handling a certain level of specialization and distribution of knowledge within a well defined problem; will it also be efficient if specialization and the attendant distribution of knowledge are increased (e.g., Coombs and Metcalfe, 2000; Smith, 2000; Arora and Gambardella, 1994)?

Increasing specialization is likely to result in more *interdependencies* among the actions of different agent (Thompson, 1967), and to some agents specializing in problem-solving. For example, Jill knows that contingency b implies that Jack should carry out y and Will should carry

out v, whereas contingency q implies that Will must never carry out v. Jane knows what contingencies emerge, but not the implications of these contingencies, and Jack and Will know the actions available to them. In such a setting, Jill acts as a problem-solver or "coordinator," possessing the knowledge that *if* Jack, Will's and Jane's knowledge sets are somehow aggregated, this will result in their having, as a "system," a knowledge that none of them possesses individually and that this system of knowledge is needed in order to make efficient choices. Thus, although Jill-the-coordinator may still be ignorant in an important sense about the knowledge controlled by Jack, Will and Jane, she does not suffer from complete ignorance; there is some, possibly very modest, knowledge overlap. Jill may therefore be able to pass judgement on the overall abilities of Jack, Will and Jane, and, in particular, about how actions based on their knowledge may be coordinated. In other words, it is quite possible to have knowledge of types of interdependencies between actions based on different knowledge elements without possessing much knowledge of the actual interdependencies or the actions themselves (see also Spangler and Peters, 2001).[15]

**Problem Definitions and the Continuing Need for Authority**

The question then is whether there is a link between authority and such expert "coordination knowledge." If the expert has all the knowledge needed to create a perfect decomposition and there is no need to adapt his decision on how to decompose the problem, there is no need for the expert to hold authority. The expert may simply sell his knowledge on how problems should be decomposed or on what actions to choose given different types of contingencies (cf. Coase, 1937).[16] However, in actual practice, the design of a problem

[15] An illustration of the notion that "systemic" knowledge can be had without necessarily having (much) knowledge of individual knowledge elements may be found in the theory and practice of software development. Thus, Parnas (1972) develops the notion of "information hiding," that is, the desirability in software development (particularly in big projects) of literally hiding information in decomposed modules and so bring interdependencies down to the absolute minimum. Individual programmers ideally (!) should have very little idea about what is going on in the other modules. The development effort is thus of a distributed nature. However, in order to coordinate the actions of individual programmers a system has to be designed. In the case of software development someone must create an architecture, interfaces and standards that define the limits within which software programmers are allowed to choose among actions (i.e., types of code). An expert may possess knowledge of the structure of the software programming problem that enables him to define a decomposition of the overall development problem without being cognizant about much of what goes on in individual modules.

[16] Market exists for expert advice, although such advice as an economic good suffers from the well known problems in connection with markets for information.

architecture (Simon, 1962), including interfaces and standards, is very much a trial-and-error learning process (e.g., Staudenmeyer and Cusumano 1998), a process of what Egidi (1992) aptly calls "conjectural decomposition": A decomposition is tried out, whether "online" or "offline," a response is received, feeding back into a new conjecture, etc. Major product development projects that involve the problem-solving efforts of highly interdependent teams with distributed knowledge are usually based on such recurrent conjectural decomposition. Recent examples include the Boeing 777 development effort as well as Microsoft Windows (Cusumano 1997).

Such recurrent conjectural decomposition appears to be an activity that predominantly takes place within firms rather than within market relations: Firms formulate and change business plans and strategies; markets don't. Innovation, an iterative process if there is one, tends to take place in firms as interdependencies between the various resources and assets increase. The reason, we argue is that firm organization enables the use of the authority mechanism which is a low-cost way of governing recurrent conjectural decomposition.[17]

***Governing the definition of problems***. A first step in the creation of problem architectures is the decomposition of the problem (see Heimann, Nickerson, and Zenger, this volume). This requires that the problem has been *made* well-defined. For example, a strategic opportunity must be defined and made concrete by refining the business proposition and delineating its application. Authority is an efficient governance mechanism for promoting these processes (see also Nickerson and Zenger, 2004). Moreover, the way in which problems gets defined and the kind of constraints that are chosen will to some extent influence whether problems can be fully decomposed, nearly decomposed or not decomposed at all (Foss and Foss, 2006). This has implications for the need for authority in managing residual interdependencies, specifically for the understanding of Type II Authority.

Simon (1973: 186) forcefully argues that virtually all problems presented to problem solvers are, from the outset, "… best regarded as ill structured problems. They become well structured problems only in the process of being prepared for the problem solvers. It is not

[17] For the expert on system creation to acquire authority in a setting of recurrent adaptation, the expert must be the part who is most sensitive to decisions such as choices among different way of decomposing the problem, identification of what contingencies (unexpected interdependencies between modules) has emerged and what action (new decompositions) to take. Moreover, the system creator must have more information on important aspects of these decisions compared to a third party (courts), such that authority of Type II becomes the efficient way of organizing the system designing (cf. Simon, 1951).

exaggerating much to say that there are no well structured problems, only ill-structured problems that have been formalized for problem solvers." Thus, well-structured problems are outcomes of deliberate problem-defining processes. Defining a problem requires that *constraints* are imposed on it. Simon (1973) provides several examples of problems (relating to shipbuilding and building a house) that are initially extremely ill-structured, but which through the imposition of constraints *become* well-structured. A key point in his discussion is that initial choices of constraints define the major interdependencies in the problem-solving effort; in the sense that these constraints define what are the (first levels of) sub-problems and the relations between these. Not all constraints can be defined initially, and new constraints (around new sub-problems) arise endogenously in the process. The necessity of iteration between sub-problems and succeeding design changes, follow from the impossibility of getting the decomposition right initially (cf. Simon 1973: 191).[18] This provides a continued role for deliberate problem-solving, and the use of authority in defining problem and creating architectures (Nickerson and Zenger, 2004).[19]

***Governing interdependencies by means of authority***. However, there may also be an ongoing role of authority once the problem is well defined and the corresponding architecture has emerged. Nickerson and Zenger (2004) assume that problems are *given,* and that the main problem is to organize the search for solutions. That is, a problem architecture has been identified which defines the patterns of interaction that are needed to resolve the remaining interdependencies between sub-problems in order for the system to adapt to changes.

Consider the instance where the identification and gradual definition of a business opportunity has resulted in the creation of an organization that is designed to produce and sell various goods. Adaptations within the organization require that agents adapt their actions to newly discovered contingencies (Williamson, 1996), implement actions not previously

[18] The following quotation from a software developer is illustrative: A lot of time people don't realize that they are dependent on something. It's just not obvious. For example, you don't realize that you have a dependency because you are not familiar with that part of the code. Or a dependency just sort of materializes out of thin air because of a need and is tracked informally. Or instances where the solution to one dependency creates problems for a third party. The real problems arise with the hidden interdependencies – the ones that no one thought about pop up at the last minute" (quoted by Staudenmeyer and Cusumano 1998: 18-19). The developer goes on to stress the need for carefully managing the process of iteration.

[19] Given the uncertain nature of the process, the process of decomposition will almost certainly be one of trial and error (Egidi 2002). Grandori (1997: 37) notes that it has been "well-documented" in organization studies that "… authority is not very effective in managing uncertainty." The arguments developed here imply rather the opposite.

recognized as solutions to problems, or restructure the system as they learn more about the interdependencies involved in the ongoing problem solving. These are settings in which according to our previous discussion Type I or II Authority may be efficient, and the exercise of authority may take the form of orders, the creation of job descriptions (sub-divisions of tasks), delegating and constraining rights to further subdivide sub-problems, and establish information linkages and/or incentives that will allow actions taken on the bases of distributed knowledge to be aggregated in way that minimize negative externalities.

The constraining, planning and direction that is needed — and therefore the need for authority — depend on *how* the business opportunity has been defined and decomposed, in particular what is the nature of the relevant interdependencies. If the problem has been defined and decomposed in a way such that only *sequential interdependencies* (Thompson, 1967) remain between sub-problems, adaptation to unexpected contingencies requires information to travel in one direction to ensure adaptation and agreements on adaptation only needs to be reached between agents engaged in adjacent activities, because that is where externalities emerge. Modular production systems exemplify this (Langlois, 2002). The coordination may take place through, for example, prices, routines, standards, the use of kanban methods, or through the use of authority of Type I or II. What choice of governance mechanism (and structure) is made depends on the determinants that are highlighted in organizational economics, notably whether the parties have made complementary investments and the degree of enforceability of the incomplete contract governing the relationship.

If problem identification and decomposition create a system where the remaining interdependencies are *reciprocal* (Thompson, 1967), these can be handled by means of communication between members of teams dealing with the relevant sub-problems. Possible disagreements may be handled by outside arbitration or by the use of authority. However, when nearly decomposable problems contain very different kinds of reciprocal interdependencies between sub-problems, the costs of mutual adaptation through consultation (i.e., lateral communication) and/or negotiations among agents may be very high. Increased specialization and the resulting distributed knowledge may leads to the choice of an authority-based governance of the adaptation process. A central agent who specializes in recognizing contingencies and in knowing the consequences can reduce re-negotiation costs and will acquire authority depending

on the specifics of the contracting situation (contractual incompleteness and enforceability, cf. Hart [1995] and Williamson [1996]). As more interdependencies arise between knowledge elements of different kinds, the margin at which authority become costly in terms of increased mistakes may soon be reached. However, due to the nature of the numerous interdependencies market contracting may not be the efficient solution. In such instances, it may instead be efficient to redefine the problem and create an architecture, in which many of the complex interdependencies are transformed to sequential interdependencies and where market contracting becomes efficient. However, such a redefinition of the problem may require the use of authority. In product development, the re-definition of product development problems and the creation of modular or nearly modular systems exemplify the way in which system designers can reduce costs of market contracting for some transactions, thus reducing the scope of transactions for which authority must be applied. Thus, an important function of Type II Authority is to define problems and to redefine sub-problems, such that at the margin the costs of making use of market contracts relative to authority is reduced (Langlois, 2002).

## CONCLUDING DISCUSSION

Knowledge governance concerns the deployment of administrative machinery and other designable features of organization in order to steer processes of knowledge utilization, sharing, integration, and building in desired directions, that is, toward their efficient levels (Foss, 2007; chapter 1, this volume). This chapter has focused on the utilization of knowledge (Hayek, 1945; Garicano, 2000). Specifically, we have raised the issue of whether knowledge that is distributed is misaligned with the governance mechanism of authority in terms of efficiently utilizing that knowledge (this is how we interpret those management writers who claim that authority relations become strained under the impact of knowledge for productive purposes becoming increasingly distributed).

Overall, the conclusion of this chapter is that there is no apparent contradiction between the use of authority and the existence of distributed knowledge. This conclusion seems to be at odds with Hayek's famous claim that distributed knowledge puts binding constraints on the size of an economic system for which central planning is feasible (Hayek, 1935, 1945). However, two observations seems important to the argument. First, the introduction of Type II authority allows for some degree of decentralization in the use of distributed knowledge and thus expands the

binding constraints on "central planning" as a feasible mode. Second, Hayek's argument refers to the decline in the quality of planning and direction as more economic activities are subsumed under a central planner. Thus, it is not a matter of whether or not authority can be used at all, but at what *scale* it becomes inefficient *relative* to market contracting; that is, the issue is comparative-institutional (Williamson, 1985). The strong emphasis on the marginal limitation to the use of authority is also present in Coase's (1937) analysis of the boundaries of the firm. At some point, he argues, the costs of managerial mistakes offset the costs of using markets as means of coordinating. Accordingly we should also examine the influence of increasingly distributed knowledge on the effective scale at which authority of Type I and II can be applied. However, this goes beyond the present work, the aim of which has been to contribute conceptually to the discussion of important notions that characterize much contemporary discussion of governance in the emerging knowledge economy, and to specifically argue that authority may very well be consistent with efficient governance under distributed knowledge conditions.

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**TABLE 1:** ***Contracting Between Jack and Jill***

| **CONTINGENCIES AND THEIR PROBABILITIES** | | | | |
|---|---|---|---|---|
| | | **Contingency p (p= .2)** | **Contingency b (p=.6)** | **Contingency q (p=.2)** |
| **ACTIONS** | **Y** | Expected benefit: 6<br>Expected cost : 6 | Expected benefit: 60<br>Expected cost: 12 | Expected benefit: 32<br>Expected cost: 10 |
| | **Z** | Expected benefit: 20<br>Expected cost: 10 | Expected benefit: 48<br>Expected cost: 7 | Expected benefit : 20<br>Expected cost: 2,2 |