**Working Paper No 68/04**

# How centralisation fostered local initiative in EDB4tel: A Case Study Meets Economic Theory

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SNF Project 7881
Økonomisk styring og regulatorisk tilpasning

THE ECONOMICS OF TELECOMMUNICATIONS

This report is one of a series of papers and reports on telecommunication economics published by the Institute for Research in Economics and Business Administration (SNF) as part of its telecommunication economics program. The main focus of the research program is to study the deregulation process of the telecommunication industry, and the economic and organizational consequences of changes in markets, technology and regulation. Being started in 1992, the program is now in its fourth period ending in 2005/2006. The program is financed by Telenor AS.

INSTITUTE FOR RESEARCH IN ECONOMICS AND BUSINESS ADMINISTRATION
BERGEN, AUGUST 2005
ISSN 1503-2140

# How centralisation fostered local initiative in EDB4tel: A Case Study Meets Economic Theory

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*With a case study and a simple mathematical model we show how centralisation can lead to more local initiative. And we argue that we may expect to see more monitoring by the top management, the better the interests of central and local managers are aligned. Both results are contrary to standard theory.*

## 1. Introduction

In current literature, decentralisation is seen as a process through which the principal relinquishes central control in exchange for increased local initiative. A prominent example is Aghion and Tirole (1997:3), who argue that "...the transfer of formal authority to an agent credibly increases the agent's initiative or incentive to acquire information (which in turn reduces the principal's overload); for such a transfer prevents the principal from overruling the agent in those situations." According to Aghion and Tirole, a local manager is motivated by private benefits, and these benefits are maximised if he gets to pick his favourite projects. An informed principal may prefer a different project. But to motivate local initiative, the principal can delegate formal authority, or abstain from becoming informed, to reduce the probability of an intervention. Central control is seen as reducing local initiative.

The starting point of this paper was a longitudinal study of a Norwegian ICT company, EDB4tel (hereafter called 4tel). In this company, centralisation seems to have had the opposite effect. It has fostered local initiative rather than hindering it, although the centralised control in question is very close in nature to the centralised control found in the Aghion-Tirole model. The top management selects projects. But in doing so, they do not only choose among projects within a subunit, they also reallocate resources among the units. Competing for the resources, successful project managers are rewarded and unsuccessful managers are punished. And in 4tel this tournament type effect (Lazear and Rosen 1981) seems to dominate the Aghion-Tirole effect.

In the paper we describe in detail the mechanisms we observed in 4tel. To make the argument precise we develop a simple mathematical model. The model is similar to the one developed by Aghion and Tirole, but its predictions are very different. With the tournament effect dominating, centralised control becomes an efficient way of furthering local initiative. But there is a cost to centralisation also in our model. Local project managers dislike reallocations of resources that do not favour their own unit. They must be compensated for the risk of being transferred to other projects.

Stein (2002) has also studied how the process of resource allocation may affect local initiative, but his model differs from ours in several important ways. While Stein's results are mainly driven by the nature of the communication between the principal and his agents (the verifiability of the data transmitted), there is no such communication in our set up (or in the Aghion-Tirole model). And while Stein studies the internal capital market, we focus on the reallocation of people, leading us to model the unit managers' utility differently.

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An important driver of our results is the way we model the research activities of unit and central managers, which differs markedly from both the model by Stein and the model by Aghion and Tirole. In their models, the tasks performed by the unit managers do not add any value if the top management is fully informed, as the only objective of the research activities performed centrally and locally is to uncover the true value of a series of uncertain possible projects. Our work, on the other hand, reflects that research activities by project teams and top managers tend to be very different in nature.

In our model, the unit managers do proper development work in the research phase, transforming ideas to products; while the top management monitor what technologies are likely to succeed in the market place. Luck plays a key role, as success is highly dependent on contextual factors, like the decisions made by major customers as to what technology platforms they choose to go forward with. In other words, even if the top management is fully informed about the future demand of a particular technology, the benefits of both top managers and unit managers depend critically on the original development work performed in the units. The activities of the principal and her agents have thus become complements, not substitutes.

With this complementarity between central and local activities, we have to also rethink the standard idea in agency theory that central monitoring should increase in the underlying agency problem (Jensen and Meckling, 1976). We argue that central managers may instead increase their monitoring activities the better the interests of central and local managers are aligned. Central monitoring increases the probability of a resource reallocation, which is more valuable when interests are aligned, because the central manager can then expect the local managers to have developed a better product.

The remainder of the paper is structured as follows: First, we describe the study's methodology and empirical setting. The mathematical model is then developed, based on the empirical material gathered at 4tel. In the following two sections, the model is used, in combination with the empirical material from 4tel, to shed light on and discuss two topics: i) the relationship between centralisation and local initiative, and ii) how top management monitoring is related to local disutility associated with effort and reorganisations. We then choose some specific functional forms to derive a closed-form solution and a numerical example. Finally we make some concluding remarks.

## 2. The study

Traditionally, principal-agent research has been dominated by mathematical modelling and hypothetic-deductive studies. This approach has generated important contributions with regard to the transfer of power and responsibility from a principal downwards to an agent (Eisenhardt, 1989). At the same time, it has been pointed out that decentralisation remains "probably the most confused topic in organisation theory" (Mintzberg, 1979:181, see also Hales, 1999), and that the premise and dimensions of principal-agent theory may well be invalid in practice (Worsham et al., 1997).

This paper tries to complement conventional principal-agent research by inducting insight from field-based case data. The study uses a grounded theory approach in which a theoretical model was gradually developed through an iterative process, switching between data collection, coding, and analysis.

At the outset, the focus of the study described in this paper was on strategic control. We wanted to increase our knowledge of strategic work carried out by top management, and we wanted to study how senior managers used different types of control and information systems in order to generate strategic change. During the process of collecting, coding and analysing data, it emerged that the top management's monitoring, and the link between such monitoring and local initiative, did in fact constitute the most important aspect of the managers' work to instigate change. Consequently, we gradually shifted the focus of our research to a description and analysis of this link.

The object of study was 4tel, a corporate producer of software for telecommunications companies. The company was originally a part of the dominant Norwegian telecom company, Telenor, but was made a separate subsidiary of Telenor in May 1998. In 1999 a new listed company, EDB Business Partner, was established through a merger of 4tel, four other IT units within Telenor, and the listed company EDB ASA. Following the merger, EDB Business Partner had a staff of more than 2,000 employees and a turnover in excess of NOK 3 bn. 4tel was one of the group's subsidiaries.

During the study period 4tel employed a staff of approximately 900. The corporation was originally organised around projects (ranging from small-scale projects to projects with a turnover in excess of NOK ½ bn). But a product-oriented organisational hierarchy was introduced at the start of the study period, after which projects were structured in 5 product-oriented divisions and 2 divisions for support activities (see figure 1).

The study involved interviews with the CEO and his deputy, as well as all division heads. These 8 executives constituted the company's top management. In addition, we interviewed 9 managers at the level immediately below the top management, and 4 controllers, or people in controller-like positions. Some of the interviewees we met with more than once, and e-mails and telephone calls were used to tie up loose ends and obtain additional information as necessary. A total of 26 interviews were conducted with representatives of the company. On average, the interviews lasted for 2 hours 8 minutes, ranging from 1.5 to 4 hours.

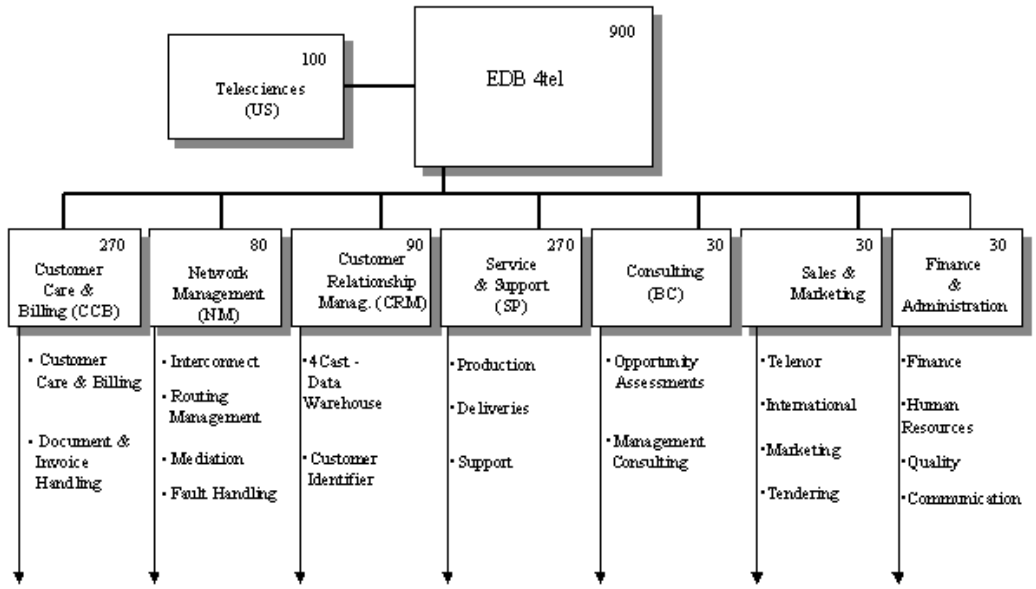


Figure 1. *The organization and products of 4tel.*

The interviews were semi-structured. Two different sets of interview guides were used, one for interviews with managers and another set for interviews with controllers or staff in controller-like positions. Both sets contained open ended questions. Managerial interviews were divided into three sections: section 1 focused on factors of strategic importance to the manager's area of responsibility; section 2 asked questions about the manager's strategic work practices; while section 3 asked what information and control systems that were available to the manager and how he used these systems in his strategic work. The interview guides for controllers and controller-like interviewees asked about organisational structure, products and projects, work flow and the value chain, the control process, and what information the managers used. The controllers and staff in controller-like positions were interviewed before the managers.

During the interviews, the interviewer wrote condensed accounts of the interviewees' answers and narratives. Immediately after each interview, an expanded account was written up, elaborating on the topics in the condensed accounts. Due to the sensitive nature of the questions, no tape recorder was used.

In parallel with the interviews, data was gathered from the company's archives and special attention was given to minutes of management meetings, strategy development and deployment documents, and to all control and evaluation documentation. The relevant annual reports were also studied. In addition, the company web page, two traditional newspapers and one Internet-based newspaper were monitored.

## 3. The model

4tel was a project-oriented organisation, with harsh competition between a large number of projects (at the start of the study period the number of on-going projects had reached three digits). This competition was part of the top management's strategy. The top management had consciously created a situation where the aggregate level of resources required to make all the projects successful by far exceeded the resources available, thus generating pressure and local initiative. The unit managers had to constantly compete for resources, and the top management clearly thought that this competition fostered effort $e_i$ in unit manager $i$.

Successful unit managers would be given the opportunity to continue their projects, normally on a larger scale, through the allocation of manpower ($r_i$ in the model). In some cases, unit managers would be able to recruit such manpower externally. But the need for specific knowledge on Telenor and 4tel, and for expertise in the cross-section between telecommunications and IT, made recruiting extremely challenging in a market with high demand for such competences before and during the IT hype. Consequently, a successful unit manager would normally have manpower transferred from other less successful projects.

Success was important to 4tel's unit managers. Initially, they would enjoy an extensive freedom to initiate and seek out projects based on their own knowledge and preferences. And the extension of an on-going project meant, in most cases, that the unit manager would be allowed to continue using his specialist expertise to refine and spread his ideas; developing his networks, involving internal and external players with an interest in the same ideas. And since this work would be within the unit manager's own field of interest, the extension was of great value to him. The importance of success was further heightened by the fact that a manager's track record would strongly influence his future job opportunities.

The connection between effort, $e_i$, and resource allocation, $r_i$, varied from project to project in 4tel, and in order to understand this connection, we need to introduce a third variable: luck ($\omega_i$ in the model). In some projects, most factors were controllable by unit managers. In such projects, the degree of success would primarily depend on the unit manager's effort, $e_i$. However, it was more common for the most important factors to be non-controllable. There were a number of reasons for this; unpredictable technological development being an important one. The company supplied software that would enable telecommunication companies to manage their activities, and throughout the study period these companies based their activities on a number of parallel technologies. There were different mobile phone platforms (Nokia, Ericsson, Siemens and others). And although there were established standards for fixed line phones, most people believed that IP based technologies would be replacing existing standards. Furthermore, there was a general belief that such technologies would, some time in the future, merge all forms of communication: mobile and fixed lines, radio and television, as well as different forms of data communication. 4tel's technological challenge was to predict which technologies would come to dominate, and consequently which systems and projects their customers would need.

Important was also the unpredictable structural development of the industry in which 4tel operated. For instance, in early 1999, 4tel's decidedly largest customer, the Norwegian dominant operator Telenor, negotiated a merger with its Swedish equivalent Telia. This merger would have changed the demand for deliveries from 4tel considerably. Telia was a much larger company than Telenor (NOK 49 billion turnover against Telenor's NOK 34 billion in 1999), and there were substantial differences between Telia's and Telenor's systems and technologies. The merger agreement was signed by the CEO of both companies and approved by the parliaments in Sweden and Norway. The implementation of the merger was well on its way in the fall of 1999, and 4tel had incorporated the merger in their strategic plans. It was therefore a shock when political differences over the interpretation of the agreement arose towards the end of 1999, and the entire deal collapsed. The Telenor-Telia merger and the technological developments illustrate how unit managers were at the mercy of external changes. The networks and institutional players surrounding the company were constantly changing, and a number of different technologies might prove

decisive for the company's future competitiveness. Technological battles were never settled solely on technological merit, but through the interaction between technology and structural relations within the industry. Unit managers were thus at the mercy of a number of factors beyond their control; they depended on luck. High effort was necessary, but not a sufficient condition for success: Only if a unit manager had put in considerable effort, developing a good system, and the structural and technological developments were to his benefit, he would emerge with a fully developed quality product customers would buy.

In the interplay between effort ($e$), resource allocation (r) and luck ($\omega$) in 4tel, the top management played a key role. The success of unit manager $i$ depended on the top management knowing that the manager had been lucky, so that he would have manpower allocated from other projects. This allocation rewarded unit managers by increasing the value of the efforts they had put into their projects. The monitoring policy of the top management (called $E$ in the model) was thus important for unit managers as well as the top management.

In 4tel, the monitoring process was facilitated by a wide array of information vehicles. In general, the top management stressed the importance of dialogue with managers, employees, customers, partners, owners, consultants and others, and the CEO emphasised that "obtaining strategically important information is largely a matter of social interaction." In addition, the top management used normal monitoring tools such as accounting systems, project management systems and balanced scorecards, as well as a number of reporting systems and information sources which were embedded in the company's everyday activities. These would include the customer relations management system, requests for proposals from potential customers (these frequently provided information on emerging customer needs and technologies), case reviews (typically, the work undertaken to capture a customer was reviewed), and various reports produced by the individual 4tel units. Furthermore, the top management used tools such as inter- and intranet, and they were informed by journals, external analyses and reports.

The benefits created in 4tel depended on the development of high-quality products (requiring a high $e$), on the unit manager $i$ striking lucky in finding that there was a market for his products once they approached completion (high $\omega$), and on the top management knowing that unit manager $i$ had struck lucky (which again was dependent on $E$), so that the unit would be allocated more resources (r). Consequently, the key variables in 4tel, for the company as well as the unit managers, were $E$, $e$, $r$ and $\omega$. Furthermore, it is important to take account of the top management's monitoring costs, and the unit managers' preferences for resources, their disutility from effort, and their utility from a wage. We will return to these points when developing the model in further detail below.

To illustrate our key points, related to 4tel, we will introduce a number of simplifications. The timing of the model is illustrated in figure 2.

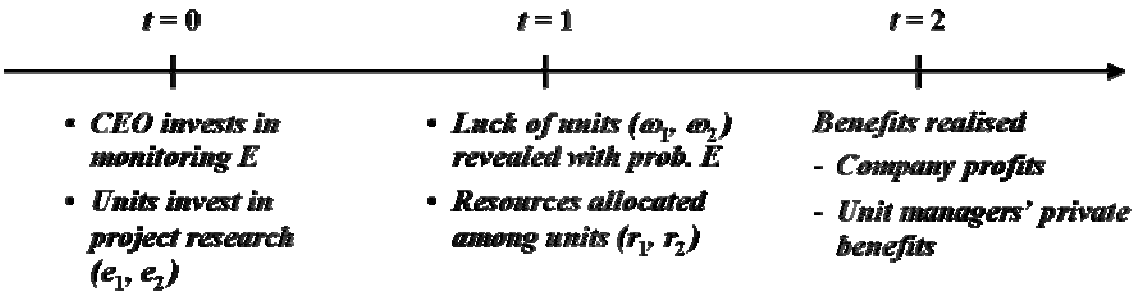


Figure 2. *Timeline.*

To make the model manageable we include only two sub-units ($i \in \{1,2\}$). Each unit has a unit manager who at $t = 0$ invests $e_i$ in project-specific intellectual capital. The investments are unobservable to others. Intellectual capital includes ideas, technologies, competencies and skills that increase the value of the projects in the units.

As exemplified by the Telia merger and 4tel's technological scenario, the success of a unit in 4tel depended also on factors outside the local managers' control, such as market conditions, and luck in finding good ideas and technological solutions. To simplify, we assume that unit $i$ is either in luck, $\omega_i = 1$, or it is a failure, $\omega_i = 0$. And to simplify further, we assume that if one unit is lucky, the other is a failure. Unit 1 is a success (and unit 2 a failure) with probability $p_1$. Extending the model to states of the world where both units are failures, or both units are successes, is straightforward but does not bring any new insights.

If the top management is informed about the luck of the units, they can reallocate resources among them. The top management is fully informed with probability $E$. The probability depends on the top management's investments, $g(E)$. We assume that investments in monitoring and investments by the unit managers are performed simultaneously (and instantaneously). Allowing sequential investments would only strengthen the results, as we will show later.

To sum up so far, the unit managers invest in intellectual capital, developing ideas, technology and competencies. If they are lucky, market conditions and other factors outside their control makes a further development of their ideas possible. The value is enhanced if they are given more resources to help them develop the ideas, which again depends on the top management's monitoring policy.

Without externalities between the units (apart from the reallocation of resources), company benefits from the projects in the two units can be written as

$$(1) \qquad \sum_i \pi\left(e_i, r_i, \omega_i\right).$$

The benefits ($\pi$) increase in effort ($e_i$), resources ($r_i$) and luck ($\omega_i$) in unit $i$. Technologies are identical across units. The function is assumed to be partially concave in its elements, while its cross-derivatives are positive. The positive interaction between effort, resources and luck is critical to the results, and we will discuss this assumption more in the next section. To simplify, $\pi(0,r_i,\omega_i) = \pi(e_i,0,\omega_i) = \pi(e_i,r_i,0) = 0$.

The resources ($r$) could be of financial, physical or human nature. In 4tel people (and of course the money to pay these people) were more important than physical resources (PCs and office space). We restrict therefore our attention to the allocation of human resources across units, and the compensation that we have to pay these people.

For our model to be of interest there must be some frictions (inefficiencies) in the market for human or financial capital. The top management may have an informational advantage

evaluating the skills and competencies of their employees, or they can become informed about the success or failure of a project at a lower cost than outsiders (due to their experience with the technology and their personal relationships with the people involved). The owners of a firm may want to hide success from competitors in order to protect commercial ideas. Recruitment processes are time consuming and costly. There can be significant personal costs associated with moving and making new friends. And company employees may do a better job because they have already developed personal relationships with the people they are to work with, they speak the same language, or they have other firm-specific skills or competencies. A number of these mechanisms were at play at 4tel, but the most prominent one was probably the firm-specific skills amongst employees.

In the model, we assume that frictions are sufficiently severe for the firm never to hire new people at $t = 2$. Furthermore, a successful project is sufficiently profitable for the top management to always keep their employees in the firm for the entire period. We assume that the firm starts at $t = 0$ with two unit managers, one in each unit. At $t = 2$, company benefits are maximised if the manager in the unsuccessful unit is transferred to the successful one (since the profits of the unlucky unit will be zero regardless of its resources). We restrict our attention to the case where an uninformed top manager will choose to abstain from any reallocation between the projects. This is likely to be the preferred strategy of the top manager due to the identical technologies of the two units, the concavity of the benefit functions and the costs associated with resource reallocation.[2]

A unit manager cares about company benefits, allocated resources, disutility from efforts and a monetary wage, $W_i$, in the following additive way:

$$(2) \qquad u_i(\cdot) = \lambda_i \pi(e_i, r_i, \omega_i) + (1-\lambda_i) V(r_i) + U(W_i) - \gamma_i e_i ,$$

where the parameter $\lambda_i \in [0,1]$ indicates the weight the manager puts on company benefits generated in the unit ($\pi$), $V(r_i)$ are the manager's direct benefits from the resources allocated to the unit, $U(W_i)$ are the benefits from a monetary wage and $\gamma_i$ is a measure of effort aversion. The unit manager cares only about his own unit in this model. Allowing the unit manager to care about the benefits generated in other units would not change any of the results (but could weaken the strength of the effects).

Following Aghion and Tirole (1995, 1997) and Stein (2002), we assume that the managers are infinitively risk averse in their monetary income (or that company and private benefits are non-contractible).[3] Say $U(W_i) = W_i$ when the wage is fixed for the entire period ($t = 0$ to $t = 2$) and zero otherwise. In other words, a unit manager is unresponsive to monetary incentives based on for example company benefits. The set-up reflects that 4tel did not use monetary incentives directly to motivate its employees.

The benefits elements in the unit manager's utility function deserve some extra comments. First, we assume that private benefits are proportional to company benefits (as does for example Stein, 2002). Secondly, we assume that the benefits from resource allocation enter the utility function in a concave way (while financial resources enter the utility function in a linear way in Stein 2002); $V(0) = 0$, $V'(r_i) > 0$ and $V''(r_i) < 0$. In other words, if the unit

[2] The alternative strategy would be to promise one of the managers two units of resources when the top manager remains uninformed, so that this unit manager increases his investments at $t = 0$, while the other manager reduces his investments.

[3] Note that there are significant difficulties associated with measuring company benefits in a verifiable way in companies developing new technology, as it takes a long time to generate hard revenues.

manager cared only about resource allocation ($\lambda_i = 0$), he would prefer to get one unit of resources for certain over getting 2 units with 50% probability and 0 otherwise. A unit manager prefers to stay on as unit manager and work with his own project, not risking becoming a subordinate to others. Resource reallocation has a human cost to it, not previously modelled in the literature.

To help the reader keep track of the different benefits, we include two tables. Table 1 shows company and unit manager benefits from a lucky unit, depending on what resources the unit is allocated. Table 2 shows the same benefits if the unit is unlucky. Given the resource allocation strategy, some combinations of luck and resource allocation are not relevant, as indicated in the tables.

| | $r_i = 0$ | $r_i = 1$ | $r_i = 2$ |
|---|---|---|---|
| *Company* | not relevant | $\pi(e_i,1,1)$ | $\pi(e_i,2,1)$ |
| *Unit manager* | not relevant | $\lambda_i\pi(e_i,1,1)+(1-\lambda_i)V(1)$ | $\lambda_i\pi(e_i,2,1)+(1-\lambda_i)V(2)$ |

Table 1. *Company and unit manager benefits from a lucky unit.*

| | $r_i = 0$ | $r_i = 1$ | $r_i = 2$ |
|---|---|---|---|
| *Company* | 0 | 0 | not relevant |
| *Unit manager* | 0 | $(1-\lambda_i)V(1)$ | not relevant |

Table 2. *Company and unit manager benefits from an unlucky unit.*

**4. Centralisation and local initiative**

With the top management following the strategy of promising $(r_1, r_2) = (1,1)$ when they remain uniformed, unit manager $i$'s expected utility is given by:

$$\begin{aligned}(3)\quad \mathrm{E}[u_i(\cdot)] &= Ep_i\left[\lambda_i\pi(e_i,2,1)+(1-\lambda_i)V(2)\right]+(1-E)\,p_i\left[\lambda_i\pi(e_i,1,1)+(1-\lambda_i)V(1)\right]\\ &+ E(1-p_i)\left[\lambda_i\pi(e_i,0,0)+(1-\lambda_i)V(0)\right]\\ &+(1-E)(1-p_i)\left[\lambda_i\pi(e_i,1,0)+(1-\lambda_i)V(1)\right]-\gamma_i e_i+W_i\\ &=\lambda_i p_i\left[E\pi(e_i,2,1)+(1-E)\pi(e_i,1,1)\right]+(1-\lambda_i)\left[Ep_iV(2)+(1-E)V(1)\right]-\gamma_i e_i+W_i,\end{aligned}$$

where $W_i$ is a fixed wage. The expression includes the possibilities for (i) informed principal and lucky agent, (ii) uninformed principal and lucky agent, (iii) informed principal and unlucky agent, and (iv) uninformed principal and unlucky agent. We include in (3) also the terms that are equal to zero (cfr. tables 1 and 2).

Observe that the first term in the final expression, the expected private benefits from company profits, is positively related to top management monitoring ($E$), due to the positive interaction between effort and resources. The manager values centralisation because it increases the probability of getting more resources when his unit is lucky, which again affects company profits positively. But the second term, the expected private benefits from resource allocation, is negatively related to top management monitoring ($E$), when $p \leq ½$, due to the concavity assumption. The private costs of being transferred to another unit if you are unlucky dominate the positive effect from getting more resources if you are lucky.

The optimal effort level for a unit manager is given by his first-order condition:

$$(4)\qquad \frac{\partial \mathrm{E}[u_i(\cdot)]}{\partial e_i}=\lambda_i p_i\left[E\pi_1(e_i,2,1)+(1-E)\pi_1(e_i,1,1)\right]-\gamma_i=0,$$

where $\pi_1(\cdot)$ is the first-order derivative with respect to the function's first element. We can now state our first proposition:

*Proposition 1:* Centralisation increases local initiative, when centralisation increases the likelihood of a resource reallocation. Mathematically: $\partial e_i / \partial E > 0$.

*Proof:* With positive interaction between effort and resources, $\pi_1(e_i, 2, 1) > \pi_1(e_i, 1, 1)$. A larger $E$ will thus increase the value of $\partial \mathrm{E}[u_i(\cdot)] / \partial e_i$. For the first-order condition to hold, $e_i$ must increase when $E$ increases, to reduce the value of $\pi_1(\cdot)$.

The critical assumptions driving the result are the positive cross-derivatives in the company benefits function (1). The value of effort must increase in resources and luck, and the value of resources must increase in luck. These assumptions may not always hold in the small, but in the large they seem reasonable. More resources tend to be of greater value in lucky units than in unlucky units. Admittedly, struggling units are sometimes given more resources for a short period to overcome the problems, but a really unsuccessful one will be terminated, as more man hours are of little use if there is no market for the product. Similarly, past efforts in developing a product tends to be of greater value, the luckier the unit is. If there is no demand for the product, past effort is of no value. And, finally, given some luck, past efforts tend to be of more value, the more resources the unit is given to accelerate the development process, experimenting along a series of possible development paths. Although the guidance and coaching of new team members may temporarily slow the process down, more resources tend to cut the time to market, at least if the team leader is allowed to reject team members that are not helping.

Proposition 1 is contrary to what Aghion and Tirole (1997) claim. In their model, local investments are of no value when the top management intervenes because they replace local projects with their own projects. Project research performed by the top management and a local manager are substitutes. But with our set up, centralisation furthers local initiative, because the private benefits that are influenced by local investments increase when the top management reallocates resources. Central and local research activities have become complements.[4]

Proposition 1 reflects the empirical findings at 4tel. Local projects were hardly ever replaced by projects that had been initiated and researched by the top management and their staff. In fact, limited capacity centrally did not allow such a role for the top management at 4tel. Instead they re-allocated resources between projects researched by the units. The Head of Finance and Administration thought of the process in this way:

> ”The thinking is that employees will come up with projects if they’re enthusiastic about them. The management’s role is primarily to select which projects they want to channel resources into”.

In other words, our results differ from the results derived by Aghion and Tirole because we assign the top management different tasks. The project research role of the top managers that is so critical to the results in Aghion and Tirole’s work we ignore, as that role was not important at 4tel. Instead we focus on the resource allocation role of central managers, stressed by 4tel managers but ignored by Aghion and Tirole.

In 4tel, the complementarity of centralisation and local initiative materialised in different ways. One prominent example was the introduction of the product-oriented organisational hierarchy (in addition to the project organisation) in Network Management. Before this organizational change, decisions on resource allocations were to a great extent made by local project managers (cooperating or negotiating with customers and other project managers). After the reorganisation, the managers in the product-oriented organisational hierarchy (see figure 1) took on this role. Consequently, decisions regarding the allocation of resources were now to a greater extent than previously made centrally. The head of Network Management pointed out that this change lead to more local initiative and decision-making:

> ”I feel that today, more decisions are made locally. At the same time, there is more of an organisation-wide thrust which helps back up me and my goals. Each employee is currently part of a group which, to a greater extent than before, shares common interests. The needs, energy and competence of every employee within each group are more focused and forceful, and can be included in discussions and negotiations about future product portfolios, markets, resource distribution, and operative issues”.

This quote illustrates how the centralisation of project resource allocations gave rise to competition, and shows us how this competitive spirit generated a sharpened sense of focus, better teamwork and improved involvement and local decision-making. The fact that local employees where made more dependent on top management decisions with respect to the matching of company resources to uncontrollable factors generated more local initiative.

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[4] Stein (2002) shows a similar result when information is hard (verifiable). In his model, centralisation increases local initiative when the agent can truthfully communicate the results of her research. Our model does not require this kind of communication. Stein gets the same result as Aghion and Tirole (1997) in the soft information case.

Our result does of course not invalidate the Aghion-Tirole effect in general. What we argue is that our results may dominate with respect to the macro process of picking projects centrally. More centralisation may increase local initiative through resource reallocation in a multi-unit firm. At a micro level, however, with respect to how to go forward with a specific project that has been given resources, more centralisation may reduce local initiative, as in Aghion-Tirole's world. In 4tel, centralisation of the large decisions (resource allocation) seemed, in fact, to be followed by a decentralisation of the small decisions. And, note that the quote indicates that the executive actually saw the process of making small decisions as an integrated part of the local initiative. To show local initiative is to make many small decisions without consulting the top management.

## 5. Top management monitoring activities

Having concluded that centralisation increases local initiative, we must consider whether this is a good thing or not. More local initiative would of course be unattractive if the agency problem was one of overinvestment in one or more tasks. Our single-task set-up rules out overinvestment. But there are surely also other costs associated with centralisation? We consider the two types of costs we found to be most relevant in the case study:

1. For the top management to become informed they must engage in costly activities
2. The unit managers must be compensated for the risk they run of losing resources (being transferred to other projects in the organisation).

To study these two effects we let $E$ be determined endogenously in the model. To simplify, we assume that the units face identical conditions: $p_1 = p_2 = ½$, $\lambda_1 = \lambda_2 = \lambda$ and $\gamma_1 = \gamma_2 = \gamma$, so that $e_1 = e_2 = e$. The expected utility of the top management is then given by:

$$(5) \qquad \mathrm{E}\left[u^{CEO}(\cdot)\right] = E\pi(e,2,1) + (1-E)\pi(e,1,1) - 2W - g(E).$$

Normalising the value of the outside option to zero, the participation constraint for a unit manager is $\mathrm{E}[u_i(\cdot)] = 0$. Solving (3) for W, assuming that the participation constraint is binding, we get

$$(6) \qquad W = \gamma e - \lambda\left[E\pi(e,2,1) + (1-E)\pi(e,1,1)\right]/2 - (1-\lambda)\left[EV(2)/2 + (1-E)V(1)\right].$$

And, substituting for W in (5), we find the marginal returns from top management investments:

$$(7) \qquad \frac{d\mathrm{E}\left[u^{CEO}(\cdot)\right]}{dE} = (1+\lambda)\left[\pi(e,2,1) - \pi(e,1,1)\right] - (1-\lambda)\left[2V(1) - V(2)\right] - g'(E).$$

More top management monitoring increases the likelihood of a reallocation of resources from an unsuccessful unit to a successful one. The first (positive) term includes the direct positive effect on company benefits from better projects, $[\pi(e,2,1) - \pi(e,1,1)]$, and the indirect positive effect though the reduced wage level, $\lambda[\pi(e,2,1) - \pi(e,1,1)]$, as also unit managers value the extra benefits generated in the units from the extra resources they are allocated when they have success. The magnitude of the wage effect depends on the emphasis a unit manager puts on his unit's profits in his utility function.[5] The second (negative) term in (7) is the wage increase necessary to compensate the unit managers for the higher risk of being transferred away from their units, which again depends on the manager's emphasis on this risk and the level of risk aversion he has (the second-order derivative of the V(·) function). The third term is the increase in top management costs.

We observe that for linear top management costs, we get a bang-bang solution, with either $E^* = 0$ (full decentralisation) or $E^* = 1$ (full centralisation). With convex top management costs, we may get an interior solution. Of course, for large marginal costs associated with getting informed, $g'(0)$ large, the top management abstains from monitoring, $E^* = 0$, even with a convex cost function. More interestingly, note that even with $g'(0) = 0$, we are not guaranteed top management monitoring. And, even without any top management monitoring costs at all ($g(E) = 0 \ \forall \ E \in [0,1]$), the top management may abstain from

[5] In a model where a unit manager's emphasis on unit profits is stimulated by linear financial rewards instead of by private benefits, $(1+\lambda)$ in the first term of (7) would have been replaced by 1, but we must then take into account also the risk aversion that the agent may have in the monetary incentives.

monitoring, due to the costs associated with resource reallocations, as perceived by the local managers. On the other hand, if the unit managers do not care about resource reallocations ($\lambda = 1$), the top management will choose to become fully informed, if they can do so at no costs.

We are now ready to state our next two propositions:

*Proposition 2*: We expect to see less central monitoring the greater concerns the employees have about future reorganisations.

Mathematically: (i) $\frac{\partial E}{\partial[1-\lambda]} \leq 0$ and (ii) $\frac{\partial E}{\partial[2V(1)-V(2)]} \leq 0$.

*Proof:* The results follow directly from (7).

In other words, we expect to observe less central monitoring (i) the more weight put on resource allocation, and (ii) the more risk averse the unit managers are with respect to resource allocation.

*Proposition 3*: The more employees enjoy the work they do, the more central monitoring.

Mathematically: $\frac{\partial E}{\partial \gamma} \leq 0$.

*Proof:* From (4) we know that effort, $e$, decreases in the marginal costs of effort, $\gamma$. And in (7) we observe that $[\pi(e,2,1) - \pi(e,1,1)]$ decreases when $e$ decreases, so that $E$ must decrease, if we have an interior solution.

When the unit managers do not find project research very costly (on the margin), investment elasticity is high and top management monitoring and the following reallocation of resources is a very effective incentive mechanism. While with more costly local research, top management monitoring is not so effective incentive-wise, and the $t = 2$ extra benefits from reallocations are not sufficient to justify the top management monitoring costs and the extra wage the top management would have to pay the unit managers, to compensate them for the disutility associated with expected reallocations.

In sum, propositions 2 and 3 postulate that the better top management and unit manager interests are aligned (small $\gamma$ and large $\lambda$), the more top management monitoring we would expect to observe. This is the opposite of Aghion and Tirole's model (1997), in which the principal invests less when the agency problem is reduced. The result is also contrary to standard agency theory, where the principal's efforts are of little value when the agent does a good job. Again the results come down to the fact that in our model the investments of the agents and the principal are complements, not substitutes.

The propositions can be illustrated with a team working in Bodø, more than 1200 km away from the head office. The unit developed something which after a while was named agent-technology. The project had been initiated in Bodø, and the team was extremely keen on continuing the development work, which they found to be exceptionally interesting. In other words, in our model ($1-\lambda$) was large for this unit, pulling in the direction of less monitoring, as the private costs associated with a reallocation would be high. These costs were further increased by the fact that a geographical reallocation would be costly to the people involved.

High monitoring costs, high $g'(E)$ in the model, seemed to pull in the same direction. The geographical separation made informal communication between the team and the top management less frequent and not so rich. But more important was probably the nature of the work performed in Bodø, which the top management found to be complex and difficult

to understand.[6]

And, as expected from this discussion and proposition 2, the monitoring of the Bodø unit was much less intense than the monitoring of other units in the company:

> "..nobody really understood what the group was working on, and we felt we had no control over them" (Head of Network Management, commenting on the interaction between 4tel's top management and the team in Bodø).

However, the lower monitoring intensity did not seem to give less local initiative in Bodø as expected by proposition 1 if you see the centralisation effect in isolation. On the contrary, the Bodø people were extremely dedicated to their task; the effort level *e* was high. In the model this can be explained by low private costs associated with the work, a small $\gamma$. With the high interest the project team members showed in the technology they were working on, their effort level would be close to maximum regardless of the incentives associated with the resource reallocation process. So, although a small $\gamma$ in isolation tends to increase central monitoring (proposition 3), for the Bodø unit this effect was dominated by the proposition 2 effect and the direct extra top management costs associated with the monitoring of this particular unit.

In the model we have assumed simultaneous investments by the top management and the unit managers. If we allow sequential investments, with the unit managers observing the top management investments before they decide on their own effort level, the central monitoring and the local effort will both increase:

*Proposition 4*: The investments by the top management in monitoring and the investments by the local managers in project research are both larger with sequential investments than with simultaneous investments.

*Proof:* The expression for the marginal returns from top management investments *E* must now take into consideration the direct effects on unit manager investments *e*:

$$(8)\qquad \frac{d\mathrm{E}\left[u^{CEO}(\cdot)\right]}{dE} = (1+\lambda)\left[\pi(e,2,1)-\pi(e,1,1)\right]-(1-\lambda)\left[2V(1)-V(2)\right]-g'(E) + \left[E\pi_1(e,2,1)+(1-E)\pi_1(e,1,1)\right]\frac{de}{dE},$$

where the last term is reformulated, using the unit manager's first-order condition in (4), from the following expression:

$$(9)\qquad \left[\left\{E\pi_1(e,2,1)+(1-E)\pi_1(e,1,1)\right\}\left\{1+\lambda\right\}-2\gamma\right]\frac{de}{dE}$$

The last term in (8) is extra compared to (7), and the term must be positive, hence *E* must increase to satisfy the first-order condition of an interior solution, compared to the case with simultaneous investments.

Allowing sequential investments is equivalent to letting top management commit to a monitoring policy. Committing to a monitoring policy can be done by for example establishing reporting routines, hiring staff (or letting staff go), or credibly promising not to

[6] The Bodø team used IP technology to collect data about telecom traffic. A small example illustrates the complexity of this task: In 1999, 4tel's most important customer, Telenor, delivered 18.7 bn minutes over 3.1 million telephone lines (wired networks). The challenge facing the group was to develop a product capable of collecting data from the wide array of technologies, networks and databases that was required for transmitting this traffic. Gradually, it became apparent that the group was up to the task: The agent technology was successful and was considered strategically important to 4tel's future growth.

monitor (based on reputation effects). As proposition 4 shows, allowing sequential investments does not change our results qualitatively.

**6. Numerical example**

To derive a closed-form solution to the problem, we assume square root benefit functions:

$$\pi(\cdot) = \sqrt{er\omega} \text{ and } V(\cdot) = \sqrt{r},$$

and a quadratic top management cost function: $g(E) = E^2/2$. It is straight-forward to now derive the following expressions for optimal unit manager investments ($e$) and top-management investments ($E$):

$$(10) \qquad e = \frac{1}{4}\left(\frac{\lambda p}{\gamma}\right)^2 \left[1+\left(\sqrt{2}-1\right)E\right]^2 \text{ and}$$

$$(11) \qquad E = \frac{\lambda(1+\lambda)\left(\sqrt{2}-1\right)-4\gamma(1-\lambda)\left(2-\sqrt{2}\right)}{4\gamma-\lambda(1+\lambda)\left(\sqrt{2}-1\right)^2},$$

given an interior solution. (10) shows how local initiative ($e$) is positively related to the top management monitoring ($E$), as stated in proposition 1.

To illustrate proposition 2, we plot the top management monitoring ($E$) as a function of the emphasis put on company benefits ($\lambda$), see figure 3. As $E$ is the probability of becoming fully informed, it is bounded by 0 and 1.

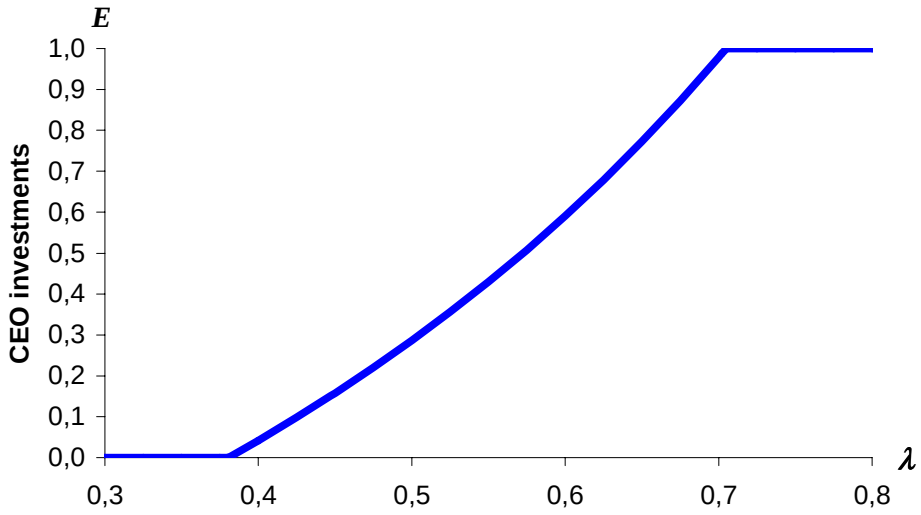
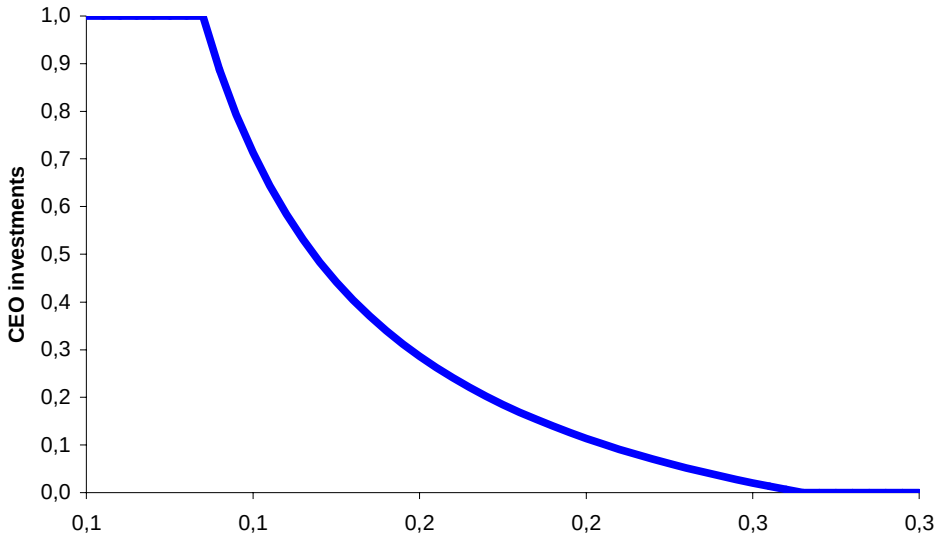



Figure 3. *Top management monitoring (E) as a function of the weight unit managers put on company benefits ($\lambda$)*[7].

Similarly, we can illustrate proposition 3, by showing how top management monitoring ($E$) depends on unit managers' marginal costs from effort ($\gamma$), see figure 4.

[7] Identical unit managers face identical conditions: $\lambda_1 = \lambda_2 = \lambda$, $p_1 = p_1 = 0.5$ and $\gamma_1 = \gamma_2 = 0.25$.




Figur 4. T*op management monitoring (E) as a function of unit manager marginal effort costs (γ)*[8].

With sequential investments, top management monitoring increases to:

$$(12) \qquad E' = \frac{\lambda(2+\lambda)\left(\sqrt{2}-1\right)-4\gamma(1-\lambda)\left(2-\sqrt{2}\right)}{4\gamma-\lambda(2+\lambda)\left(\sqrt{2}-1\right)^2},$$

where $(1 + \lambda)$ in (11) is replaced by $(2 + \lambda)$ both in the denominator and the numerator. The investments by both the top management and the unit managers have increased, as stated in proposition 4.

[8] Identical unit managers face identical conditions: $\lambda_1 = \lambda_2 = 0.5$, $p_1 = p_1 = 0.5$ and $\gamma_1 = \gamma_2 = \gamma$.

## 7. Concluding remarks

We have shown that to increase central monitoring may stimulate local initiative, when the monitoring increases the chances of resource reallocation. And we may get more centralisation the better the interests of the principal and the agents are aligned. Both results are contrary to the predictions found in Aghion and Tirole (1997). But although the results are conflicting when it comes to the project selection process performed by central manager, we believe that the results derived by Aghion and Tirole are more valid when it comes to other types of decisions. For smaller decisions, regarding how to go forward with a specific project, we also believe more decentralisation will increase the agent's initiative, as found in Liberti (2003).

The results are driven by the fact that central and local activities are complements and not substitutes in our model. The local managers and their people do development work on specific technologies, while the central managers monitor the general technology development and the competitive forces in the industry. Consequently, the work of the agents adds value also when the principal is fully informed.

Of course, our model is simple and partial. For example, centralisation may also affect the parameters which are exogenously given in our model, such as the perceived costs associated with extra effort and the tendency to suboptimise, caring about personal preferences and not company benefits. There are for example indications in our material that the introduction of a product-oriented hierarchy in Network Management, which meant more centralisation, also generated greater work satisfaction (smaller $\gamma$) and increased focus on the organisation's objectives (larger $\lambda$).

To separate and follow up every effect is impossible in a paper like this. We have focused on the mechanisms we believe to have been the most important ones in our case study. But based on our experience, these mechanisms are relevant also for other companies, especially in high-technology industries, where the success of product development efforts depend critically on technology developed in parallel by other organisations.

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