
Organisation and management of research and development facilities – from cost to profit focus

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Abstract: In this publication we present the main findings of a research project into differences in organisation, management and activities between R&D cost centres, semi-profit centres, profit centres, and independent R&D businesses. First a theoretical framework is presented and then the empirical findings are reported. It is concluded that there are notable differences between cost and profit-oriented R&D structures relating to the degree of freedom in decision making on research management topics, the balance among types of R&D activities, strategy formulation, performance evaluation, marketing and management demands imposed on the capabilities and attitude of the staff. Furthermore, it is observed that *semi*-profit centres have the most challenging task as they are in an invidious middle position: they have to bid for internal projects in order to cover their costs while their freedom to attract external customers or to use a cost plus transfer price is usually limited.

Keywords: Research and Development; R&D management; R&D organisation; R&D businesses; R&D performance measurement.

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Alan Pearson retired in the autumn of 2001 as an active member of the R&D management research community. For many years he had been Professor of R&D Management at the Manchester Business School, manager of the R&D Research Unit at this business school and editor of the journal *R&D Management*. Alan Pearson has a long track record of academic publications on various aspects of R&D management.

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1 Introduction

Over the last two decades, many corporate R&D departments have undergone profound changes in the way they are funded and organised. Some former central R&D departments have been split into decentralised units that are funded by the business unit or division they are linked to [1,2]. Other R&D departments are still organised as a central facility but can no longer count on a largely secured, corporately funded budget. A growing percentage of their funding directly depends upon research contracts with business units within the company which have, at least partly, the freedom to choose between corporate and external R&D organisations; for example, the GE R&D Centre [3]. Other companies have even gone further and not only allow their business units to outsource their R&D projects but also allow, or even require, their R&D centres to do contract research for external customers; for example, Westinghouse [4] and IOCL [5]. These R&D departments thus become more and more responsible for generating their own income through contracting processes in an internal or external market, which means, in accounting terms, that they become (semi-) profit centres instead of expense centres. In the area of public R&D organisations and research associations a similar movement from a more or less secured budget provided by the government and/or by the industry association members towards project based funding according to the customer-contractor principle has already been apparent for some time [1,6]. Isolated examples in respect of industrial commercial R&D organisations have also been reported [7] and there is a long history of R&D consultancy companies.

Although, over time, several authors have noted this trend to move from R&D cost or expense centres towards (semi-) profit centres and independent R&D businesses [1,2,8–10], or report about such a move in their own company [3–5], we have not found *recent systematic* studies into the *consequences of this move for the organisation and management of R&D activities*. The research reported by Hill *et al.* [10] is probably the most recent, but their study is also based on data gathered in the period 1990–1993. Although they conclude that the pattern described by Whittington [1] of central research organisations being transformed into profit centres does not apply to *most* companies in

the European mechanical engineering and food and drink industries, they did find *some* R&D cost centres that were recently transformed into profit centres and were allowed to work for external parties. Furthermore, since 1993 the number of companies selling R&D services has grown and the appearance of technology trading places on the internet (e.g. yet2.com) has made the technology market more transparent. In the UK extramural R&D as a percentage of total industrial R&D rose from 3.2% in 1972 to 15.5% in 1998 or from £27 million to £1.58 billion [11,12]. The increase in contract and independent research technology organisations has grown in parallel with the increasing dependency of companies on external sources of technology such as joint ventures, alliances, licensing and suppliers. This is largely a global phenomenon; for example, between 1995 and 2001 the percentage of companies in Japan, Europe and North America with high reliance on external sources of technology doubled [13]. The pharmaceutical industry in particular has been diversifying their R&D portfolios by relying on external partners to co-develop their products [14]. Therefore, we postulate that the business case for becoming a commercial R&D organisation has strengthened over the last decade, which justifies a new study into this topic.

To fill the above-identified gap in systematic empirical evidence, we started the research project presented in this publication. The field research consisted of semi-structured interviews and case studies of independent R&D businesses, industrial (semi-) R&D profit centres and R&D cost centres in the UK and the Netherlands. In the third section of this publication we will describe in more detail the research methods applied. In Section 4 the findings are discussed and conclusions drawn. However, we start in the next section with a description of the theoretical framework used to collect and analyse the empirical data.

2 Conceptual framework

2.1 R&D responsibility centre types and decentralisation of decision making

Although in the more general business management literature the concept of ‘cost centres’ seems often to be considered as a synonym for centralised decision making and ‘profit centres’ as a synonym for decentralisation, it is clearly pointed out in the narrower management accounting literature that theoretically these are separate issues [15]. Cost and profit centres are accounting concepts, which specify for which financial aspects of a unit’s activities the manager of that unit is held responsible. In cost centres managers are financially accountable for the costs of the inputs they use to produce their outputs; in addition, they are accountable for non-financial performances such as quality and timeliness.

Cost centres are sometimes also referred to as expense centres and are often further divided into ‘engineered expense centres’ for which an optimal relationship between inputs and outputs can be established and ‘discretionary expense centres’ where such a relationship can not be established with a reasonable degree of reliability and where the size of the budget is therefore at the discretion of higher level management [16,17]. Traditionally, industrial R&D laboratories have been classified as discretionary expense centres [16,18,19].

In a *profit centre* a manager is responsible for both the costs of the inputs used and for generating an acceptable amount of revenues with these inputs, the difference between

the two being the profit or loss. For an R&D organisation, being a profit centre would mean that it cannot count on a more or less secured annual budget, but would have to establish prices for its R&D services and sell them via customer-contractor arrangements to internal or external customers in order to generate at least enough revenues to cover the costs. When the revenue responsibility is still ambiguous and the manager's freedom to make business decisions is limited, the terms 'semi-', or 'pseudo-profit centre' or 'hybrid structure' are sometimes used, particularly for internal service units such as R&D [20,21].

As noted above, the type of responsibility centre and the degree of decentralisation are theoretically separate issues. While the responsibility centre type refers to the *responsibilities* of a unit manager, the decentralisation issue refers to the *degree of freedom for managers at lower levels of the organisation to make business decisions* [15]. Total decentralisation means minimum constraints and maximum freedom for these managers. Horngren *et al.* [15] stress that "profit centres can be coupled with a highly centralised organisation, and cost centres can be coupled with a highly decentralised organisation". For example, division managers who are held responsible for making a profit but need to obtain approval from corporate headquarters for every expenditure above a specified, rather low, limit and are forced to do business with other organisational units are clearly restrained in their freedom to make important decisions. On the other hand, managers of cost centres may in some organisations have great latitude on capital expenditures and on where to purchase materials and services.

Notwithstanding these theoretical differences, we in general observe, and in fact from a motivation theory perspective would also expect to observe, an increase in freedom of decision making when the responsibilities of a manager are growing, since it is usually considered unfair if people are held responsible for issues they can hardly control [22–24]. In fact, regardless of the type of responsibility centre, most managers in large organisations will have at least *some* discretion to make decisions but as long as the unit remains a part of a large organisation, its decision making freedom will be limited by one or more corporate constraints to ensure sufficient congruence between the managers' actions and the goals of the organisation as a whole [16,24]. Several authors [16,17,25–29] have identified possible issues for which top managers may impose constraints on the management of a responsibility centre, such as:

- 1 the discretion to negotiate with the financial markets for funding and to chose the unit's financial structure
- 2 decision making on what will be done with a positive cash flow generated by the responsibility centre
- 3 the choice of technological areas and markets in which the centre will be active
- 4 the choice of the types of activities and products to be engaged in and the balance between them
- 5 the choice of the unit's competitive strategy
- 6 the choice of suppliers, business partners and customers
- 7 the determination of the prices charged for the goods or services delivered by the unit

- 8 decision making on the amount and kind of assets and human resources in the organisation
- 9 the discretion to select, remunerate and reward personnel in a self-chosen way
- 10 decision making on all kinds of operational issues like working methods and procedures.

Only managers of *independent businesses* are assumed to have complete freedom in all the areas listed. Managers of *responsibility centres within a company* usually have considerable discretion over operational issues, but the likelihood of interference from the corporate centre is greater with regard to financial and strategic issues. However, the type and amount of interference will also be influenced by the *strategic management style* of top management [26].

2.2 *When to make the R&D organisation a profit centre or an independent business*

The constant challenge for management is to obtain the technology it requires to support strategic objectives as quickly and economically as possible. The dynamic technology, and related business environment mean that the appropriate responsibility centre type and the optimum balance between centralisation and decentralisation, and between internal and external sources of technology are constantly shifting [30]. For example, many large pharmaceutical companies are currently reappraising their R&D structures in an endeavour to improve the rate at which they discover new drugs. Relative size, it seems, gives the big pharmaceutical companies a comparative advantage over small biotech and pharmaceutical companies in the early stages of the research process, when big computers are used to discover interesting targets for new drugs. Scale is also an asset at the final stage of the research process, when drugs have to be tested on a large number of patients and then guided through regulators. However, the big pharmaceutical companies are agonising over the best way to organise R&D management at the intermediate stage when companies try to turn ideas into drugs. Evidence suggesting that small companies are better at drug discovery is causing companies like GlaxoSmithKline (GSK) to consider spinning off its six autonomous research centres that focus on the intermediate stage. Making the research centres totally independent may, GSK speculates, prevent the centres being smothered by being part of a big organisation and allow them to increase their discovery rates [31].

In addition to stage in the R&D process or types of R&D activities, the preferred financial status and organisational structure of a company's R&D seem also to be influenced by its diversification strategy. Whittington [1] found that the companies that were most concentrated on homogeneous core businesses had moved towards hierarchical control (R&D is a cost centre of which the budget is funded and controlled by a business unit or division), whilst more diversified companies had made their R&D laboratories profit centres. This observation is supported by more general studies of diversification that suggest that high performing firms which are diversified in only a few related areas generate an important part of their competitive advantage out of shared and tightly controlled intangible assets such as R&D [27,32]. This implies that companies which are only to a limited degree diversified could best manage their R&D as a cost

centre with limited decision making freedom, whilst more broadly diversified firms could consider managing their R&D facilities on a profit centre basis.

Whilst a narrow diversification strategy may provide a positive explanation for having a central R&D organisation in a company, there are also theories that provide more negative arguments as to why some companies prefer to conduct their R&D in a central cost centre. Pisano [33] tested, for example, several hypotheses as to why most pharmaceutical companies did not buy in new biotechnological knowledge from specialised new companies, but preferred to build up this expertise themselves despite the fact that buying-in seemed a more economically rational alternative. Whilst no support was found for hypotheses that this might be due to expected problems with the appropriability, or spill-over to competitors, of intellectual property, or simply because these companies had a habit of doing all R&D internally, the hypothesis that 'small numbers bargaining problems' played a role was supported. This hypothesis, which was derived from transaction costs theory, stated that the pharmaceutical companies were reluctant to buy in because the technologies were very specialist and there were too few suppliers, hence they would become too dependent upon a chosen supplier. This dependency would encourage opportunistic bargaining by the supplier during contract renegotiation cycles or for new contracts. This implies that if (divisions within) companies have *too few alternative suppliers for their R&D*, the option of making R&D an internal profit centre or an independent business does not seem to be viable.

In our empirical research we will research to what extent the above discussed factors, or others, have indeed an impact on the choices made by general management to give R&D managers less or more freedom to make their own decisions and to make them accountable for cost only or also for revenues.

2.3 Managerial and organisational differences between R&D responsibility centre types

Whereas in the previous paragraph we have discussed factors that may influence the financial status of R&D as a cost or as a (semi-) profit centre, or as an independent organisation, we now turn to the possible implications that such a choice may have for the way the R&D centre is organised and managed and the kind of research that is carried out. In a review of the literature reporting about changes experienced in practice when an R&D cost centre was turned into a profit centre, we collected the following list of possible outcomes:

- *entrepreneurship*: from the literature it becomes clear that managers of an R&D profit centre have to behave as entrepreneurs who try to earn a maximum return on their assets. Hence there is an increased interest in generating extra income through licensing of intellectual property and through the creation of spin-off companies [8,34] and in leveraging R&D investments with external funding from government agencies and others [4,34,35].
- *strategic implications*: if an R&D centre not only gets the responsibility at least to sustain itself financially but also has the freedom to work for outside companies, then the centre has to develop its own corporate identity, vision statement and strategic plan [35]. These are no longer (solely) based on the business strategies of

the parent company's divisions or the members of the research associations but should be market-driven and knowledge based [35] and led by economic criteria [1].

- *performance evaluation and reward policies:* in R&D profit centres, a profit oriented R&D management attitude is often not only required from R&D's general management but also from managers and researchers at lower levels in the organisation, where individual performance targets (e.g. an amount of billable hours) are set and incentive pay is linked to performance [1,4,5]. All these new demands on the R&D workforce have, of course, to be counterbalanced somehow by new benefits such as higher salaries [1]. The R&D profit centre of the Indian Organic Chemicals Ltd. (IOCL) also offered a more competitive and comprehensive compensation scheme than when they were a cost centre and put more effort into retaining the researchers by creating an inspiring work environment, providing challenging projects and empowering the researchers [5].
- *performance measurement:* several authors [4,5,8] have noted that the move towards a profit centre approach to R&D management required a more structured approach to project monitoring and management, although Griffith and Pearson [8] also stressed that this is not synonymous with elaborate measurement systems. Rather it means that researchers are given technical, financial and scheduling responsibility for their projects and that critical project information is generated more quickly in order to be able to make any necessary corrections as rapidly as possible. Kerssens-van Drongelen [36] found in her empirical research that R&D profit centres use specific financial metrics to track whether they generate sufficient income, and that decentralised R&D cost centres report a larger number of detailed metrics to their superiors. However, in general, we had to conclude from the literature review that the impact of the responsibility centre type on the usage of performance measurement and the kind of measurements used is not well researched.
- *marketing of the R&D services:* regardless of whether an R&D profit centre still sells its services only within the company or (also) operates on the free market, it has to carry out a new task: marketing of its services to existing and potential customers [1,4,5,8]. Whittington [1] found that the high performing R&D profit centres spent substantially more on marketing than low-performing ones (15-30% of total costs vs. 5-12%). These higher marketing costs have to be recouped by higher fees. At IOCL, the R&D Profit Centre had developed its own long-term marketing plan, including growth objectives, and the researchers were actively marketing their services at conferences and trade shows, in one-to-one meetings with potential customers, through reliable sourcing agents and by showing potential customers around the R&D facilities [5]. Similarly, Whittington [1] concluded that giving marketing responsibility to the researchers themselves appeared to be the best approach. However, Griffith and Pearson [8] also found R&D organisations that had established separate R&D marketing operations. Overall, it seems that the marketing task is definitely an operational implication of acting as a profit centre. Furthermore, the increased customer orientation in R&D (semi-)profit centres also means that technology transfer and customer satisfaction become much more important measures of R&D effectiveness [4,35] and that technology transfer is committed right up to commercial production and even beyond [35].

- *workforce characteristics*: since an R&D profit centre cannot afford to have capabilities and skills that cannot be profitably marketed, it is frequently noted that researchers have to be more flexible in an R&D profit centre [1]. They must be prepared to move their skills into new areas or develop new ones [1,8]. Whittington [1] also found that established independent R&D businesses sought good generalists with a specialism and a variety of experiences, good communication skills and high levels of commercial awareness in preference to more narrow technical specialists, particularly those with little or no business acumen. To facilitate the transition process, some former R&D cost centres had found it beneficial to bring in new managers from outside with a technical, but not necessarily an R&D background. However, the appointment in one of the case companies studied by Whittington [1] of a manager who had a purely marketing background was not considered to be a success.
- *types of R&D activities*: despite the fact that operating as a profit-oriented independent R&D business often meant more relatively intellectually undemanding short projects *for customers*, Griffith and Pearson [8] found no evidence of a lower work quality. They attributed this to the fact that firstly these R&D businesses were under high competitive pressure and secondly they often initiated their own basic R&D program both for its intellectual stimulation and for the ideas it produced. In Bajpai *et al.* [35] it was noted that the Thapar Centre for Industrial Research & Development (TCIRD), a former central laboratory of the Thapar Group, had in fact more freedom to determine the mix of long range and fundamental research, short-term application research, and services than when they were still a corporate research centre. They also remarked that researchers now have more freedom to come up with research initiatives that are 'close to their heart'. These initiatives are initially sponsored internally and only after a certain level of know-how is acquired do they search for external sponsors. Robb [3] noted a similar dual emphasis at the General Electric R&D Centre: internally there was an increase of freedom and initiative to come up with more new ideas and to do more exploratory research while externally there was an increased emphasis on marketing of R&D to the company businesses. Thus it seems that the common idea that managing an R&D organisation as a profit centre has negative implications for basic and applied research is, at the least, not generally supported.

Overall we conclude that a move from cost centre control to profit centre control seems to imply several new tasks to be carried out by the R&D organisation, more attention towards maximisation of asset value, new opportunities for researchers to increase their income and to work on projects close to their heart, as long as they satisfy the more stringent demands for personal accountability. However, since some of these implications are derived from anecdotal evidence and case-study projects undertaken some considerable time ago, we wanted to study these implications also in our research project.

2.4 Conceptual framework: summary

In Table 1 we have summarised the issues discussed in the conceptual framework and the main topics and assumptions to be examined in our empirical research.

Table 1 The conceptual research framework

<i>Cluster</i>	<i>Focus of attention</i>	<i>Main assumptions derived from literature</i>
Decision-making freedom in the different types of responsibility centres and under different top management control styles	Discretion to decide on: <ol style="list-style-type: none"> 1 use of profits generated by the R&D unit 2 selection of research topics 3 selling R&D services to external customers 4 internal pricing level 5 amount and type of resources employed 6 compensation schemes and rewards 	<ul style="list-style-type: none"> • Independent businesses have full discretion over the issues listed in column 2. • Profit centres have more decision making freedom than semi-profit centres, which in turn have more discretion than cost centres. • The strategic control style of top management will act as an intervening variable on the above-mentioned match between responsibility centre type and decision-making freedom.
Factors influencing the choice of an R&D responsibility centre type	<ul style="list-style-type: none"> • Types/stages of R&D • Degree of diversification • Availability of alternative suppliers • Other contingency factors 	<ul style="list-style-type: none"> • The choice of an R&D responsibility centre type will depend on the types of R&D activities to be carried out. • Companies that are only diversified to a limited degree have R&D cost centres. • R&D profit centres can be found in broadly diversified firms. • If R&D is a (semi-) profit centre, the internal customers (business units) have to have alternative suppliers at their disposal. • Other contingency factors may have an impact of the choice of R&D responsibility type.
Managerial and organisational differences between cost centres, (semi-) profit centres and independent businesses	<ul style="list-style-type: none"> • Entrepreneurship • R&D strategy • Performance evaluation and reward policies • Performance measurement • Marketing activities, including pricing • Workforce characteristics • Types of R&D activities 	<ul style="list-style-type: none"> • Managers of independent R&D businesses and profit centres have to exploit their assets as entrepreneurs. • Managers of independent R&D businesses determine their own strategic direction. • R&D businesses and profit centres have rewards linked to tight performance evaluation procedures at all levels in the organisation. • All types of R&D centres need to measure performance; however, the metrics will be (partly) different. • R&D businesses and (semi-) profit centres have to set up a marketing function within their R&D department. • In an R&D profit centre or business, researchers need to be flexible and to have a general overview. • The amount of time spent on basic and applied research in R&D profit centres and businesses is not lower than in R&D cost centres.

3 Research methodology

Given the limited amount of specific literature on the research topic, we have opted for an iterative theory building process in several cycles [37]. In the first, explorative cycle we conducted 11 only slightly structured interviews with managers and former managers of R&D (semi-) profit and cost centres in the UK and the Netherlands and collected some public information about these organisations. Among the interviewees were a former R&D director who had proposed a management buy-out of his R&D organisation but whose plan had not been accepted by general management, and an R&D manager who had worked in both types of environments and had been in charge of an R&D establishment that made the transition from a cost to a profit centre. Thus he was able to contrast the organisation and management practices in both cost and profit centres. These interviews gave us a feeling of the differences between R&D profit and cost centres, impediments to becoming a profit centre and the issues that have to be addressed when an R&D centre has to be turned into a profit centre.

In parallel with, and inspired by, the interviews we collected and studied the literature summarised in the previous section. Based on both research streams we gradually built a framework for more structured data collection and analysis (see Table 1). This framework has been used in the second, more explanatory cycle of the research project, in which we have conducted four interviews with managers of R&D (semi-)profit centres and one with a manager of an independent R&D business. In advance of the interviews, we sent out a lengthy, semi-structured questionnaire and collected public information about the organisations visited. During the interviews the answers on the questionnaire were discussed and supplemented with company specific questions. In addition, the questionnaire was filled out by two of the previously interviewed managers and by 12 new ones. Thus in total we base our findings upon 19 lengthy questionnaires, plus additional case materials from seven of these organisations. Where relevant, we will also bring in observations from the exploratory interviews with the nine other companies.

The range of organisations included in our sample was quite large. Of the 28 companies involved in our study, six were independent R&D businesses. Three of them were former research associations, two were former government laboratories, and one had been a corporate R&D unit. Furthermore, there were two R&D profit centres, one of which had been a divisional R&D centre and the other a divisional development and pilot production unit. Fourteen R&D centres that participated in our study were still funded and controlled as cost centres, four of them by business units and the other ten by central management. Five corporate R&D centres could be typified as semi-profit centres. Finally one large corporate R&D unit was largely managed as a cost centre, but for a small amount of development projects the semi-profit centre approach applied.

Also with respect to the industries involved, our sample covered a wide spectrum including energy, textiles, environmental research, biotech, water, process industry, chemicals, food, healthcare, footwear, oil and gas, electronics and telecoms.

4 Research findings

4.1 *Decision-making freedom in R&D responsibility centre types*

In the theoretical framework we have listed various areas where R&D organisations may or may not have (some) discretion to make decisions. As expected, the managers of independent R&D businesses included in our study had full discretion over all areas listed, although three remarks should be made in this respect:

- many of the independent R&D businesses have only recently in the 1990s become independent and their managers felt that, although now they do have the freedom to choose the technological areas and markets they want to be active in, they are still constrained by their past history which is often embedded in their current mission statements. However, the recent example of AEA Technology, which is selling one of the core businesses on which it was originally based, shows that over time an independent R&D business can indeed make such decisions [38].
- although managers of independent R&D businesses can themselves in principle determine the general composition and balance of the R&D portfolio in terms of projects and relative amounts of basic research, applied research, development and technical support undertaken, a number of interviewees noted that their decision-making freedom in this respect is constrained by their financial position and the price that they can charge to their customers. If the prices provide high enough profit margins and/or they have sufficient reserves, they themselves have the possibility of investing as much as they deem necessary in basic or applied research in the areas they expect to be relevant for current and future business. If not, then research might suffer because the researchers will all be tied up in commercial development projects which merely exploit the current knowledge base.
- naturally, as in all other kinds of businesses, the discretion of an independent R&D business manager to determine prices is constrained by market forces.

For R&D units that are still part of a larger corporation, we have focused on the decision topics listed in Table 2. Based on the theory outlined, the expectation was that on average cost centre managers would have less decision-making freedom than profit centre managers, but that deviations from this pattern could be possible depending on the strategic management style. Given the limited number of questionnaires, the average scores mentioned in Table 2 have to be interpreted with caution, but in general they seem to confirm these expectations except on the issue of determining research topics. This might be explained by the fact that most of the cost centres had a budget for free research and had more opportunities to insert their own ideas into the yearly research program than the semi-profit centres, most of which had to negotiate contracts on a project-by-project basis. The degree to which the various responsibility centre types are able to influence the work portfolio is also reflected in the average balance in work policies found in each group (see Table 3). Again we see that semi-profit centres mostly carry out what their customers specify.

Table 2 Scores for decentralisation of decision making on the topics mentioned for the three R&D responsibility centre types

<i>decision topic</i>	<i>cost centre (n=9)</i>	<i>semi-profit centre (n=5)</i>	<i>profit centre (n=1)</i>
use of profits generated by the R&D unit	n.a.	2.8	4
selection of research topics	2.8	2.2	4
sell R&D services to external customers	1	1.8	4
internal pricing level	1	1.3	3
amount and type of resources employed	3.3	3.8	4
compensation schemes and rewards	2.8	3	4

Note: measured on a 5-point scale with 1= no discretion and 5= complete freedom; n.a. = not applicable

Table 3 Average distribution of work policies in the different types of R&D organisations

<i>work policy</i>	<i>cost centre</i>	<i>semi-profit centre</i>	<i>profit centre</i>	<i>independent</i>
Customers specify, R&D carries out	67%	76%	35%	18%
R&D develops idea, then finds a sponsor and develops it further	27%	22%	35%	57%
R&D develops a technology or prototype, then 'sells' it to internal or external customer	5%	2%	35%	25%

Note that based on Table 3 the independent R&D businesses have the most influence on their research topics. This might be counter-intuitive to people who still think in the traditional R&D paradigm, but it actually fits with our theoretical framework. This conclusion is corroborated by the average score that managers of independent R&D organisations gave to the question concerning how much discretion they have over the selection of research topics: 4.25 on a five point scale.

4.2 Factors influencing the choice of a responsibility centre type

The first factor proposed in our theoretical framework to have an impact on the choice of a responsibility centre type was the stage or type of R&D activities to be carried out by the R&D centre. In Table 4 we have summarised our findings regarding the types of R&D activities carried out by R&D cost centres, profit centres and independent businesses. The numerous similarities between cost centres and semi-profit centres in portfolio breakdown contradict the assumption that the choice of an R&D responsibility centre type will depend on the types of R&D activities to be carried out, though the small sample size prohibits drawing hard conclusions. When comparing the research portfolio of internal R&D centres and independent R&D businesses, it is noted that apparently product development activities are less often outsourced than process development activities and technical support.

Table 4 Breakdown of the research portfolio in types of R&D

<i>type of R&D</i>	<i>cost centre (n=9)</i>	<i>(semi-) profit (n=6)</i>	<i>independent business (n=3)</i>
basic & applied research	17%	17%	17%
breakthrough NPD	16%	15%	8%
product improvement	39%	31%	14%
process development	10%	14%	26%
technical support	18%	23%	35%

In our theoretical framework, we have further indicated that we would expect companies that are only diversified to a limited degree to manage their R&D as a cost centre with limited decision making freedom, whilst more broadly diversified firms might manage their R&D facilities as a profit centre. However, in our research we did not find support for this. Unfortunately, the sample is too small and the findings too unclear so we cannot reject it either. The companies in our sample that have adopted the (semi-) profit centre concept do not seem to be very diversified, whereas the only company that is rather diversified has actually chosen to break up its central research organisation and to place the remaining parts under the control of the business divisions.

Our data also does not allow us to draw conclusions regarding the third assumption mentioned in the theoretical framework, namely that the choice whether or not to make R&D a (semi-) profit centre would depend on the number of alternative suppliers available to the business units. In the companies in our research with an R&D profit centre, the internal customers are at least to a greater extent allowed to buy R&D services from external parties (average score 3.7 on a 5 point scale (1= no discretion and 5= complete freedom)) than the companies where R&D is a cost centre (average score 2.3). But in the interviews the managers of (semi-)profit centres indicated that in practice their internal customers so far hardly outsourced because the R&D unit was still the best suited supplier in terms of specialised knowledge and skills.

Whereas the support for our theoretical framework is weak, we did find another factor that seems to have an impact on the choice of the R&D responsibility type: the company's (dominant) competitive strategy. Seventy five percent of the companies in our study that adopted the cost price leadership strategy run their R&D as a cost centre, whereas 50% of the companies that pursue a differentiation strategy have moved towards the (semi-) profit centre concept. A possible explanation for this finding could be that cost focused companies consider R&D simply as unavoidable expenses that should be kept to a minimum. In contrast, companies that search for differentiation opportunities consider their R&D unit as a valuable resource that should be exploited. This might be a topic for further research.

4.3 Managerial and organisational differences found between R&D responsibility centre types

In our exploratory and main case interviews, we obtained a good overview of the managerial and organisational consequences when an R&D cost centre is made responsible for profits. Below we list some of our observations:

- *entrepreneurship*: as postulated in the theoretical framework, the R&D managers in the independent R&D businesses had started to act in a more entrepreneurial way. They had become more aware of their assets and discovered that they still had many patents, technologies and products ‘on the shelf’ that could first be exploited before investing heavily in new R&D. Besides such a valuable intangible asset, the management in three of the independent R&D businesses and in one of the profit centres also discovered that they had very valuable tangible assets, namely their land and buildings. In each of these cases this has resulted in the sale or letting of this land and buildings to external companies, creating a mini-business park on their former territory.
- *strategic implications*: the independent businesses perceived an urgent need to develop and deploy their own mission and strategic plan, which is also consistent with the theoretical framework. One of the interviewees noted that for this purpose they were conducting a market analysis using strategic management tools like the BCG matrix. Based on the products/services portfolio that would come out of that process, they would also develop their own technology strategy to guide the selection of research projects that should be financed internally.
- *performance evaluation and reward strategies*: according to many of our independent business and profit centre interviewees, one of the most marked changes in the internal control system when they had been made responsible for profitability was the introduction at all organisational levels of performance appraisal procedures based on measurable targets. Although in the past most of these organisations already had an individual appraisal system and budget variance reporting procedures at the department level, the new approach was considered to be much tighter and it was much more clearly linked to (monetary) rewards. However, it should be noted that in some of the R&D cost centres we also observed a tendency towards more measurable performance targets; these R&D cost centre organisations appear to be following the general trend to link reward systems more tightly to actual performance.
- *performance measurement*: regardless of the type of responsibility centre, in *all* our interview and case organisations performance measurement was a point of particular interest. Nevertheless, based on the observations summarised in Table 5, we conclude that the tendency to measure seems to increase with financial responsibility. The profit centre type has not been included in Table 5 because the organisation that filled out the questionnaire had rather recently become a profit centre and it was still in the process of developing performance measurements. Whereas many metrics at the project team, individual and departmental level were the same for the cost and profit centres and the independent businesses, we also noted differences. In Table 6 we have listed:
 - 1 a few metrics that were typically found to be useful in one or more of the R&D businesses/semi-profit centre
 - 2 a few metrics that were typically found to be useful in one or more cost centres
 - 3 a set of metrics considered useful in both types of R&D organisations.

Table 5 What is measured in each type of responsibility centre

<i>responsibility centre type</i>	<i>project team performance measured</i>	<i>R&D process performance measured</i>	<i>R&D department's performance measured</i>	<i>R&D sub-departments' /discipline groups' performance measured</i>	<i>performance of individual researchers measured</i>
cost centre (n=9)	33%	22%	33%	11%	78%
semi-profit centre (n=5)	80%	60%	80%	60%	60%
independent business (n=4)	50%	0%	50%	75%	100%

Note: percentages mean: 'x % of responsibility centres type A regularly measure this performance'

Table 6 Typical metrics found useful in R&D cost centres, profit centres and independent businesses

<i>metrics typically found to be useful in independent R&D businesses and profit centres</i>	<i>metrics typically found to be useful in all R&D organisations</i>	<i>metrics typically found to be useful in R&D cost centres</i>
<ul style="list-style-type: none"> • turnover and profits in last period • exposure= (cumulative accrued costs ÷ expected year costs) x 365 days • number of billable hours realised in last period • size of the forward workload • number of bids sent out • hit rate on project bids • % of sales from new customers 	<ul style="list-style-type: none"> • actual costs ÷ budgeted cost • actual time spent ÷ planned schedule • customer satisfaction scores on a project evaluation questionnaire • % of profits generated by products or based on technologies/knowledge developed over the last 3 – 5 years • % of projects considered to be successful • number of milestones met • income from licensing and sale of patents • scores on employee satisfaction survey 	<ul style="list-style-type: none"> • the part of the company's annual profits that is attributive to R&D ÷ annual R&D investments • internal customers' assessment of the % of initially agreed research objectives that have been completed in the last period

Note: these metrics are usually compared with earlier periods

- *marketing of R&D services*: as expected, starting up marketing activities was one of the new responsibilities of the independent R&D businesses. At one of the newly independent R&D businesses that participated in our study they had hired new people with consultancy experience since many researchers had difficulties in marketing their services. Furthermore, a substantial part of the existing workforce was sent to a bidding or a marketing course. In the BU of the middle manager interviewed in this organisation, each small product group of between one and eight

people had its own product manager who spent about 50% of his/her time on marketing and sales, and 50% on projects in order to keep in touch with the services they sold. Two other R&D businesses worked with account managers. Also an interviewee in an R&D profit centre indicated that their marketing effort to both internal and external customers was substantial and still growing.

One of the issues in marketing is, of course, the pricing of the services. As indicated in Table 2, on average the R&D (semi-) profit centres had only limited freedom in setting their internal prices. In Table 7 we have summarised the pricing practices found in our sample companies for *internal* transactions, which shows a gradual shift from cost oriented transfer prices to market prices. For *external* transactions almost all of the profit-oriented R&D organisations researched used market prices, except for two semi-profit centres that only had a limited amount of external sales. They used cost based prices.

Table 7 Transfer prices used for internal transactions

<i>transfer pricing method</i>	<i>cost centre (n=9)</i>	<i>semi-profit (n=5)</i>	<i>profit centre (n=2)</i>	<i>independent business (n=4)</i>
no transfer price	44%			
marginal cost	22%	20%		
full cost	11%	60%		25%
full cost plus		20%	50%	
market price			50%	50%
negotiated price	33%			25%

- *workforce characteristics*: the expected necessity to have a staff that is market-oriented and that has a flexible mindset, willing to switch to other types of activities or other technological areas if required by the market, was confirmed by our R&D business interviewees.
- *types of R&D activities*: while in principle the management of the independent R&D businesses, and in some cases also the business unit managers within these R&D businesses, could determine the mix of R&D activities and areas to work on, this freedom was constrained by their ability to gain a sufficient margin on their services in the market. This was found to be especially difficult in the start-up phase, which may partly explain the fact that in two of the independent R&D businesses the amount of research and development activities dropped dramatically in the first years in favour of more near-market activities such as engineering, consulting, measurement and testing. However, in one of them, the internal investments in R&D went up again after a few years. Based on the quantitative finding in our research (see Table 4), we may also conclude that on average all types of R&D organisations spend roughly the same percentage of their R&D budget on basic and applied research, and overall the figures for cost- and (semi-)profit centres are quite similar. The main difference between independent R&D businesses and the rest is that they do relatively less product development and more process development and technical support.

5 Conclusions and discussion

In this publication we have presented the major findings of our research project into the differences in organisation, management and activities between R&D cost centres, R&D profit centres and independent R&D businesses. In this final section we summarise the most important managerial conclusions that can be drawn from these findings, although we admit that, given the limited sample, these conclusions are not empirically generalisable. We conclude the section with some suggestions for further research.

Based on the scores given in the questionnaires, we first of all conclude that, except for the decision relating to which research topics to work on – over which R&D cost centres managers had slightly more discretion than R&D semi-profit centre managers – R&D cost centre managers are more constrained in their decision making than their colleagues in ‘profit’ oriented R&D units. However, the interviews revealed that even the management of the independent businesses felt themselves constrained to some extent, namely by the market, by possible shareholders, and by some legacies from the past. By acting as an entrepreneur who ‘makes his assets sweat’, these general business constraints are managed.

Secondly, taking both decision-making freedom and responsibilities into account, we tend to conclude that managers and researchers in *semi*-profit centres have the most challenging task; although they have some more decision-making freedom on most management issues than their counterparts in R&D cost centres, their financial responsibilities, and hence their financial risks, are much larger whilst their authority to handle these risks is limited. In essence the semi-profit centre managers are in an invidious middle position: they have to bid for every project – sometimes in competition with external suppliers – in order to cover their costs, whilst their own freedom to attract external customers, or to use a cost plus transfer price is usually limited. Our findings suggest that the semi-profit centre should only be countenanced as a short-term transitional arrangement. Management concerns that R&D contract work for external customers risks the potential loss of proprietary R&D knowledge are frequently unjustified and neglect the learning value of such work. Contract work can also be a very flexible and powerful means of managing R&D capacity so as to balance the peaks and troughs in internal demand and thereby retain expertise at no financial cost.

Our third set of conclusions relates to the operational differences between the R&D cost centres and ‘profit’ oriented R&D organisations. Within the R&D organisations studied we have observed several of these differences. R&D managers who will have to make the shift from cost to profit orientation may use these findings to set the agenda for their change management plan. These differences were:

- Strategic planning: whereas R&D cost centres closely cooperated with the internal customers to select a project portfolio that aligned with the strategic plans of these customers, the managers of the independent R&D businesses and of the R&D profit centre were free to develop their own mission and strategic plan, which they had done on a large scale. These plans were explicitly communicated within the organisation. Semi-profit centres largely resembled cost centres in this respect: they had to follow the strategies of their internal customers and to build up their portfolio based on the projects negotiated with their (mainly internal) customers.

- In profit-oriented organisations not only had the top management profit responsibility, but this responsibility was also delegated down to the lowest level of the organisation.
- The independent R&D businesses had implemented performance evaluation procedures at all organisational levels with both financial and strategic performance indicators that were perceived to be much clearer and much tighter than when they were still a cost centre.
- Although there was a common set of metrics that was considered useful by both cost centres and independent businesses, there also seemed to be metrics that are specific to each of them. Furthermore, independent R&D businesses and profit centres measured at more levels, on average, than R&D cost centres.
- An important new task in profit-oriented R&D organisations appeared to be marketing and sales. Instead of setting up a specialised marketing unit within the organisation the researched companies preferred to spread this task over several people within the organisation who also had operational responsibilities.
- Managers of R&D (semi-)profit centres used to a large extent cost plus or market price transfer prices for their internal transactions in order to be able to fulfil their profit responsibility and to compensate for the greater risks they faced.
- A move from cost to profit centre generally required the staff to become more customer-oriented, more flexible and more accountable. Since these requirements did not suit everyone, the transition into a profit centre often initially led to a reduction in staff in the companies studied.

Our study also raised several issues that may be worth examining in more depth. First, we found that the balance between different types of R&D in cost -and (semi-) profit centres was roughly the same. Independent R&D businesses also spent on average a similar percentage of their budget on basic and applied research, but they spent a markedly lower percentage on product development activities and more on process development and technical support. This might indeed be a general characteristic of independent R&D businesses, but it could also be caused by the size of and biases in our sample. Thus, this seems an interesting area for further research.

Other topics for further research can be derived from our analysis of possible factors impacting on the choice of a responsibility centre type, since we did not find support for the contingency influences hypothesised in our theoretical framework (i.e. the degree of diversification and the availability of alternative R&D services suppliers). Whilst this may be due to our limited and selective sample, it could also be that these general contingency relationships do not apply to R&D responsibility centres. Furthermore, the link found between the company's *competitive strategy* and the type of R&D responsibility centre suggests a further area for fertile inquiry.

Finally, in this study we have mainly focused on how, in general, R&D organisations with a certain responsibility profile are managed. Although this has generated interesting insights, we acknowledge that it will be even more valuable to know which organisational design choices have the highest impact on R&D and company *performance*. This again remains an area for further research.

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