

**COOPERATION BETWEEN STRANDS OF PRACTICE:  
CHALLENGES AND OPPORTUNITIES  
FOR THE RENEWAL OF OR**

by

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# **Cooperation between strands of practice: challenges and opportunities for the renewal of OR<sup>1</sup>**

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## **Abstract**

Collaboration between OR groups following different “strands of practice”, i.e. adhering to different views about how to conduct OR practice, is difficult. We demonstrate the existence of this problem in two contexts. First, we found several different strands of practice within an independent, entrepreneurial OR firm. Though these strands had the potential to be highly complementary, their co-existence within one firm led to serious tensions and their potential synergy has not yet been realized. When the independent OR firm achieved successful renewal by transforming one of their strands of practice into a new approach to projects, this very success created a new collection of competitive challenges. Second, an independent OR consulting firm working with a client’s internal research group found that the latter’s approach conflicted with its own, resulting in an unsuccessful project. We conclude that the “micro-level” problems of collaboration between individual practitioners and between groups, though largely neglected in the literature, can be serious impediments to success and renewal of OR practice.

*Key words:* consultancy, methodology of OR, practice of OR.

Running title: Cooperation between strands of practice

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<sup>1</sup> An earlier version of this paper was presented during the recent conference on “The Foundations, Development and Success of OR Groups”, organized by Robert Fildes and John Ranyard of the University of Lancaster and sponsored by the British Operational Research Society, on May 20-22, 1996, in Bowness-on-Windermere.

## INTRODUCTION

During a recent conference on “The Foundations, Development and Success of OR Groups”, participants depicted a complex pattern of change in the practice of OR. Instead of calling the change yet another “crisis” or seeing it as the result of “a natural drift” of the profession<sup>1</sup>, its participants (including a number of practitioners and academics who helped frame the debates in the 1970s and 1980s, as well as a new crop of academics and heads of large European and American OR groups) identified a major shift in the environment in which OR is conducted. In the 1960s and 1970s, OR had mainly been conducted through large, internal and centralized OR departments in large organizations (private and public). By the early 1990s however, these traditional clients of OR work had started to restructure their organizations by “downsizing” head offices, decentralizing decision making, and outsourcing work. Sometimes central in-house OR groups were reduced in size, or “privatized”. Sometimes parts of these groups were decentralized in an effort to bring them closer to the internal clients and made part of independent business units, a development also described by Geoffrion.<sup>2</sup>

The net result of this restructuring of large organizations is an emerging network of OR groups. In such a network external entrepreneurial OR groups may conduct projects with central in-house OR groups or with OR groups located in Business Units. Such external groups may also approach clients in large organizations directly. We have observed that groups embodying different competencies and acting in very different roles will have to collaborate in order to integrate their knowledge productively. In particular this is the case when faced with demanding clients with complex and non-routine problems and who want “best practice”. If conducted effectively, such projects may lead (and have led) to the creation of new OR knowledge and the design of new competencies, thus contributing to a continuous process of renewal of OR practice. If, on the other hand, the various OR groups cannot collaborate effectively and learn from each other, or can only do so in a limited fashion, then (i) valuable OR knowledge and competence may remain fragmented, (ii) clients may not draw on “best practice”, (iii) renewal of OR practice may be hampered, and (iv) the role of OR may eventually be taken over by other professions (a serious concern discussed at the Bowness conference). We observed these forces (both positive and negative) at work, finding both renewal and increasing marginalization as results. In this paper we

confine ourselves to two kinds of relations: the collaboration within an entrepreneurial OR firm, and that between an external and an internal group.

Given the scope of the Bowness conference, many participants tended to view OR from a macro perspective. Indeed, surveys tend to be the most commonly used tool in studies of OR practice. While valuable when trying to grasp a broad picture, such a perspective does not shed much light on the dynamics of collaboration *among* OR practitioners. In this paper, we study OR practice at the micro level of individual practitioners, to explore the problems and dynamics of collaboration among OR workers, the difficulties of integrating different competencies, and the effects on the potential for renewal of OR practice. Taking a competence-based view of OR practice, we illustrate at a micro level of practice the kinds of problems an entrepreneurial, external OR firm has experienced over the last ten years. The firm belonged to a set of firms previously studied<sup>3,4</sup> and stood out because several of its senior partners were practicing professors and had developed innovative programs and new ways of conducting OR practice. Their firm had grown from four to eighty members in a decade. We report on collaboration within this external OR group, the difficulties encountered and the challenges its members faced when working together with internal OR and other groups. We use the experience of this external OR `group, captured in several case studies of projects it carried out with varying degrees of success, as a microcosm, as a window on the kinds of problems of collaboration other OR practitioners will likely encounter in the new emerging business environment.

Our analysis of the difficulties of collaboration among OR practitioners in a distributed and differentiated network of competencies builds on earlier research where we reported how entrepreneurial, external OR firms develop rather different strands of OR practice. I.e., when faced with competition and demanding clients, they tended to develop a series of similar projects for different clients that led them to increasingly focus on a particular set of business problems and a particular way of conducting OR. This in turn resulted in specialization based on widely differing competencies.<sup>3</sup> In this paper, we will report on how, within an external, entrepreneurial and innovative OR group, multiple strands of practice emerge over time (each embodying their own way of doing business), how tensions arise between these strands, and how the ensuing organizational dynamics undermine the group's capacity for renewal. We also report on the problems of collaboration in a specific project conducted by this external OR firm with the research department of its client. We analyze these problems in terms of the difficulties encountered by

practitioners working in different strands when trying to integrate their competencies. Finally, we report on how recent changes in the business environment for external OR groups are upping the ante for the practitioners involved by adding new forms of competitive pressure. We conclude that the micro-level problems reported here are serious impediments to the integration of OR knowledge in practice and therefore undermine the renewal of OR practice. Unfortunately, these problems are largely ignored in the literature.

## THE EMERGENCE OF ENTREPRENEURIAL, EXTERNAL OR GROUPS

Operational Research started as part of a social movement<sup>5</sup> advocating the idea of a management science and as such can be traced back all the way to Frederick Taylor<sup>6</sup> and before<sup>7</sup>. Since its beginnings, it has gone through a life cycle with at least three distinct stages, in each of which OR was practiced in very different client environments and its practitioners were presented with different kinds of challenges. Keys<sup>8</sup> explains these trends in more detail.

The initial model of practice, based on successes in the military sphere during WWII, was that of an autonomously operating “ranger” (with or without a multi-disciplinary team), who had received “a roving brief” from top management to interfere anywhere he saw fit in the organization. With relatively unconstrained access to top management, these practitioners, it was believed, would make the greatest contribution by defining as yet unidentified problems, in which strategy and tactics were often closely interwoven. By 1978 this model, held up by Blackett, Beer and Ackoff, was “a myth based primarily on aspiration”,<sup>9</sup> although, as we shall see later, it continues to have appeal for practitioners up to this day. By 1980, a less heroic and less revolutionary model had emerged. It was recognized that Operational Research had become routinized in bureaucratic organizations. OR was mostly practiced by central, internal OR groups, providing consulting through an on-going program of projects. Such groups were often found in government agencies and a limited set of large, diversified, capital-intensive firms. These groups helped top and middle management to manage a portfolio of businesses through central planning at both the strategic and operational level by trying to balance multiple corporate objectives across businesses and functions<sup>9</sup>.

During the late 1980s and early 1990s large bureaucratic firms, including those with in-house OR groups, engaged in “downsizing”, “delayering”, “restructuring”, and “re-engineering”. Firms began to focus on “core competencies” and to “outsource” work previously carried out by highly trained professionals in corporate staff departments (for instance Information Systems, Operational Research, R&D, Human Resources, and so on). In addition, corporate offices began to provide leadership by articulating a vision and controlling performance through short term financial measures. This made business units less interested in hiring central services or having their own professional services. By the 1990s, three broad trajectories had become visible for central, internal OR groups.<sup>9</sup> First, central OR groups were either closed down or dispersed into the smaller decentralized business units. OR staff are often asked to take on new roles in the management of the business units and the positions they vacate are not filled with OR-trained people. Second, central OR groups such as the National Coal Board OR group are “privatized” or sold to external consulting firms. Finally, some firms like British Airways, American Airlines, Shell, and AT&T operate in industries in which OR is key to competitiveness; here, central internal OR groups do survive and make a distinctive contribution to the core business of the firm.

These developments provide the background for the emergence of external OR groups in the late 1980s and early 1990s; these groups are either identified as OR practices as such or are part of a general consulting firm.<sup>10</sup> The emergence of these groups not only extends OR from central to distributed internal OR groups within a bureaucratic corporate environment, it also adds an *entrepreneurial* component to the practice of OR itself. Although at best under-emphasized so far, we claim (as does Ormerod<sup>11</sup>) this represents a very important part of the future of OR. As we shall see below, one of the critical problems external OR firms face is how to build a competence that allows them to compete while actually conducting projects at the same time. We found<sup>3</sup> that they succeed by carrying out a series of similar projects for different clients, thereby building a “strand of practice”. The broad changes in the practice of OR outlined above are summarized in the taxonomy in the first four columns of Table 1.

## A COMPETENCE-BASED VIEW OF OR; STRANDS OF PRACTICE

Conducting projects as an external rather than an internal OR group introduces a new level of competitive pressure to OR practitioners: how can a group operate and survive (i) when it faces competition from rival OR groups, software houses, and general consulting firms, (ii) when it works for demanding clients who expect “best practice”, and (iii) when it has to address complex, non-routine problems within an agreed time frame?

To address these questions, in the Winter and Spring of 1993, we did a pilot study to generate better descriptions of OR practice. We selected three very successful external, entrepreneurial OR firms in the Netherlands and Belgium (i.e. firms explicitly using OR). We interviewed two senior practitioners in each firm as well as their clients. All but one of the practitioners had a PhD in OR, and four were also part-time academics. Three were co-founders and managing partners in their firms; three were senior project managers. We asked each practitioner to describe a recent challenging but successful project because it is more likely to be etched vividly in the practitioner’s mind and is more likely to have caused them to reflect on the critical assumptions they make.<sup>5</sup> This pilot study led to seven case studies of how OR practitioners conduct projects. A first paper<sup>4</sup> focused on what these projects had in common; a second paper<sup>3</sup> describes the differences between them. Below, we briefly summarize the three main findings of the studies.

First, the practice of the senior practitioners in those firms was significantly different from the widely-held espoused theory of practice, particularly among many academics. The *espoused theory* is the theory that practitioners will typically use to account for their success and it may be remarkably different from the *theory-in-use* constructed on the basis of careful study of their actual practice.<sup>12</sup> The prevailing espoused theory of OR practice is: (i) the situation is entered with an open mind, (ii) an OR technique chosen out of a large repertoire is applied, and (iii) a problem-solving cycle is moved through. This theory is incomplete. The OR projects we studied were much richer and more complex, and the practitioners brought a variety of tightly integrated skills to bear on the problems of the clients.

Second, while practitioners we studied readily agreed that their practice was different from the prevailing view and was different to that of other practitioners, none was able to provide a truly coherent

account of his practice. They could do more than they could describe and displayed considerable tacit knowledge.<sup>5</sup>

Third, rather than taking on any kind of project, working from scratch in a client's situation, and selecting one of the many OR techniques available, each practitioner and his/her firm tended to gravitate over time to a certain kind of project, which we have called a "strand of OR practice". Within our sample we identified four distinct strands, each of which constituted a very different way of practicing OR:

- Strand One: an operational researcher practices in different domains (e.g. public transportation route planning, airline maintenance, allocation of space to government agencies), "finds" problems within a client organization, applies a limited repertoire of techniques (such as Linear Programming), and creates systems uniquely suited to the client.
- Strand Two: an operational researcher practices within one domain (and even for one client), develops an intimate knowledge of e.g. the production problems of a large electronics manufacturer, is called in as a troubleshooter, and develops models (e.g. simulation models) to understand the behaviour of the production line.
- Strand Three: an operational researcher focuses on one, very well described problem (such as cutting problems in production processes), finds "all" the clients within an industry with such a problem, and installs the entire system with relatively minor customization.
- Strand Four: an operational researcher works within one, rather narrow domain (such as pension funds) and develops step by step a model for a specific problem (such as the optimal financial structure of a pension fund) by working with multiple clients over time. Each new client contributes to previous development costs and becomes co-developer for the part of the model uniquely suited to his needs.

This emerging specialization and differentiation allows practitioners and their firms to build up specific know-how and an organization-based competence in doing their own particular kind of project. This makes it possible to take on complex assignments in real time requested by demanding clients.

The development of a strand can be traced to particular settings in which firms were founded, the interests of their founders, and the first couple of projects they carried out. The development of a strand through a number of similar projects emerges over time; not every project seems to fit initially. But over time, a strand becomes dominant in the practice of a firm and begins to determine the kinds of projects

the firm goes after, those the firm is likely to get awarded and those it is likely to do better than other firms. In short, the firm has developed a competence for a particular set of problems. The emergence of a strand signifies a process of strategic learning by the firm.<sup>13,14</sup> A strand becomes an emerging strategy<sup>15</sup>, develops into a competence integrating a number of skills, and then becomes a driver for the firm's business strategy that is enacted over time.<sup>16,17</sup> Note that a series of *similar* projects for *different* clients is different from what typical internal, centralized OR groups do when they engage in "a series of interlinking projects [...] better be described as an on-going program of work",<sup>9</sup> in that these interlinking projects constitute *different* projects for the *same* client organization. Even for internal OR groups, Conway<sup>18</sup> observes a wide variety of ways in which individual projects are initiated, ranging from independent initiative by a prospective client to reputation-based inquiries to independent product development and subsequent sales efforts by the OR group. The mechanism by which a group can expect to become involved in new projects is an important consequence of their strand(s) of practice.

#### MULTIPLE SOURCES FOR RENEWAL IN AN EXTERNAL, ENTREPRENEURIAL OR GROUP

If a competence is developed over a series of similar projects, and if the conduct of such projects has a focusing and reinforcing effect, how then do firms renew their practice? One of the firms we studied displayed strategic learning in its projects that pointed to some possible ways of renewal of OR practice, but also displays serious constraints to renewal of practice. This firm, Connor (all names are pseudonyms), had been founded in the mid-1980s by PhD students from a premier, rather theoretical OR program at a Dutch university. The firm now has about 80 staff and is regarded very highly by its clients which include large, internationally operating firms and government agencies. The firm's consultants have an MSc in OR, and several hold a PhD. They are often invited to join the firm after having been identified as "the smartest students in the classroom".

In our original sample of external OR groups Connor stood out in several ways. First, while Connor's first projects were patterned on Strand One, one partner eventually transformed it into the new Strand Four, of co-development with clients. It did not merely develop a new model, it also developed a new way of practicing OR, thus showing a remarkable ability for renewal of OR practice. Second, Strand Four is essentially an entrepreneurial product development strategy that seems particularly viable within

the new client environment of OR. Rather than becoming a kind of a jobber for internal OR groups (the danger inherent in Strand One), or merely replicating a project (the danger inherent in Strand Three), the practitioner is a highly proactive designer of a new offering who keeps creative and business control of his product while co-developing parts with multiple clients. Third, while developing Strand Four, Connor continued to practise Strand One as well, thus creating a repertoire of two very different competencies. If these could draw and build on each other, the firm could have a powerful source for the renewal of practice. Fourth, a key characteristic of Strand Four is that the client is co-developer of the model. In Connor's case, this often turned out to involve an internal OR group. Fifth, the main protagonist of Strand Four within Connor tried to use the approach in an entirely different domain, namely in planning of office space within state government rather than the financial planning of pension funds. Hence, the firm displayed at least three potential sources of renewal: (i) transformation of strands, (ii) multiple strands within this one external OR group, (iii) close collaboration with internal OR groups. We look at each of the three potential renewal processes in the next sections through case descriptions, and identify in each the common problems of integration of practice resulting from practitioners having to collaborate with different, and at times incompatible, strands of OR practice.

#### DEVELOPING A STRAND OF PRACTICE: ESPOUSED THEORY OF STRAND ONE VERSUS THEORY-IN-USE

In the mid 1980s, Connor was founded with the idea that the firm would help clients to address complex business problems that defied intuitive decision making. Mathematical modelling combined with personal computer technology would be the basis for Decision Support Systems that clients would buy and use. During the first five years, Connor's founding partners, in particular Gerald Timman, Joseph Bonniar, and Andrew Boise (all pseudonyms), developed a theory of practice for their firm. In this section we describe how this led to the development of a strand of practice (Strand One), and how its espoused theory began to differ from its theory-in-use. It is the gap between the two that set the stage for innovation, transformation, and renewal by one particular partner (Bonniar), leading to Strand Four.

The initial idea of the founding partners was not to specialize in certain techniques, domains, or instruments, but rather to meet clients and find out what kinds of problems they had. Hence, they worked on scheduling of maintenance workers in a very large transportation firm, on allocation of office space to agencies of the Dutch Government, on financial asset management by a bank, etc. They represented the prototype for Strand One.<sup>3</sup> Reflections on the conduct of their projects during our interviews revealed they had a clear vision of the design rules they did *not* want to follow:

- “Start big”: designing a comprehensive model from the start grasping the entire complexity of the problem upfront.
- “Move from inside out”: starting with the mathematical representation of the model, “the engine”, instead of with the formulation and design of the user interface.
- “Work from the top down”: creating systems for clients that are imposed on the users without their input and their testing.
- “Outsource software development”: they did not want to act as merely a consulting mathematician; they also wanted to help implement and make operational the systems they had designed.

The partners had learned early on that the approach captured above, and reminiscent of some institutionalized OR, would lead to an effort in which they would try to do “everything” in the first phase of the project, only to be required to scale down the project when confronted with members in the organization. They referred to “the normal people”, for whom “the stuff was too complex”. They had a genuine concern about the implementation and usability of their work. There was idealism and passion, informing entrepreneurial drive.

As a result, the partners settled on a very different approach based on the following design rules, not dissimilar to those of Tobin et al.<sup>19</sup> in their description of the practice at British Airways.

- “Develop a small prototype as soon as possible”: comprising of input and output screens and only a simple “engine”.
- “Move from outside in”: begin with the formulation of the specification and the design of the user interface.

- “Work from the bottom up”: start with the users of the model, and “interactively test the prototype through several rounds”.
- “Develop all the software”: this is a way of creating custom-made systems and of generating additional revenues.

The idea, supported by the clients we spoke to, is that clients have “broad goals”, “don’t know exactly what they want”, ask for proposals from the consultant, “can’t specify upfront” what they want, and expect that “something may pop up”. Therefore they call in a trusted consultant who is flexible, with whom they work informally, and with whom they develop a personal relationship based on trust. The formal contract is usually limited, specifies services for a certain period, is based on “cost-plus” payments, and is extended when sufficient progress is made. This part of the approach is similar to the “roving brief” described earlier. Connor’s partners could operate in this way because they often secured projects through an informal network of alumni of their alma mater, some of whom had become heads of central, internal OR groups.

The consultants described how they begin with a feasibility study and a small project “to create enthusiasm”, “to get the effort off the ground”, and to “show what they can do”. By “launching Version Zero into the organization” early on, they hoped to get feedback from “a broad population”. By doing this a couple of times, by “crawling into the skin of the client”, by listening to the users, by creating something that is useful, they create enthusiasm, sustain interest, and gradually extend the project. As the consultant gets to know the client’s way of working, he may find or frame new projects and get assignments from a quasi-monopolistic position. Connor could then become a kind of externally based internal OR group for the firm. Note that this approach is neither “application of theory or technique” nor “going through a problem-solving cycle”.

### *The theory-in-use; a vicious cycle of marginalization*

By the early 1990s the vulnerability of the firm’s initial approach was becoming clear. One project on maintenance scheduling in a very large transportation company (with some 1,800 employees in the maintenance department alone) provides a good example. Partners Timman and Bonniar mapped out the following vicious cycle of marginalization.

First, they experience a high dependence on personal contacts (former university colleagues or self-proclaimed enthusiasts of OR). Personnel changes lead to the loss of an internal project champion resulting in difficulties conveying the state of the project and its costs and progress to date to new managers who are often not very well versed in OR.

Second, the lack of domain-specific knowledge makes it difficult to continue to sit at the table with top managers, and the latter tend to delegate responsibility for the project downwards. Perhaps the strategy of dealing with the users and the interface also tends to lead more senior managers to delegate the project. This leads to marginalization in the client organization when the consultant is gradually assigned to work with lower-level managers. While senior managers are interested in strategic decision support systems and “what-if” questions, lower-level managers are more focused on tactical and operational problems and are less skilled in abstract thinking and mathematical modeling.

Third, Connor faces competition of domain-specific (OR) firms which makes it difficult to continue their strategy of learning about a domain while getting to know the client. Fourth, lacking domain knowledge and the skills of a software house, Connor tended, at times, to under-estimate the task and to under-bid, sometimes losing financially on the projects. They occasionally had to invest substantial amounts of time in a project on their own account in order to complete it. Fifth, the firm often ended up developing software and faced competition from software firms with modularized approaches and/or standard OR programs. Finally, once the firm had finished a decision support system for strategic decision making, senior managers would sometimes not believe the system’s output and lower-level managers would use the system for tactical decision making.

## TRANSFORMATION AND THE EMERGENCE OF A NEW STRAND, STRAND FOUR

In the midst of experiencing this mismatch between the espoused theory and the theory-in-use of Strand One, one of the partners, Bonniar, was approached by a former university colleague, now head of a small central OR group in a bank. The request was to help develop a decision support system that could analyze dynamic scenarios for changing the financial structure of the bank’s employee pension fund. The internal OR group had already put several man-years into the project, but its head decided to outsource the work to Connor, in part because Connor’s fees were lower than their own. (This reflects the general

trends outlined earlier in this paper.) While Connor did not have specific experience with pension funds, Bonniar himself did have expertise in econometric modeling. He began the project in the vein of Strand One.

As the project progressed, Bonniar began to meet the pension fund managers themselves and got to know their concerns. He got to know the kind of client they were, the specifics of the problem, and the overall context very well. As he began to sense their concerns, he started to proactively invest the time of his firm to stay ahead of their questions. He built a DSS for asset-liability management (or ALM) by integrating skills in econometric modelling, OR techniques, and software development. He generated a solution uniquely fitted to the client. In the end, when the bank balked at the total development costs, Bonniar “swallowed” part of his fee in return for the copyrights of the ALM program.

Bonniar predicted that pension funds of other firms might have similar needs. He began to invest Connor’s time into modularizing the DSS and obtained assignments from several large clients. As the model became more sophisticated, Bonniar began to ask new clients to pay an upfront fee for past efforts. Together, Connor and the client then developed a customized program. Clients in different industries had different human resource policies, reflected in the design of their pension funds. These different demands often translated into additional components of the DSS, and Bonniar took advantage of this. For instance, when the project manager of a large insurance firm which manages the pension funds of many smaller firms, called the asset-side of the model “rather simplistic”, Connor and the client upgraded this part of the model. In addition, because the insurance company staff had to explain the model to the smaller pension funds, they challenged Bonniar to be very explicit about all the assumptions (“the black box” as they called it).

The increasingly entrepreneurial stance of Bonniar, fueled by increasing confidence in his model and his ability to address the concerns of pension fund managers, was critical. Creative control over the design and its entrepreneurial development rested with Bonniar, who began to see clients as co-developers and co-risk takers whose intimate knowledge he needed in order to sustain the program. Bonniar got to know the world of pension funds very well, in his own view, maybe “not enough to manage a fund but well enough to have in-depth discussions with Chief Financial Officers”. At one point, Bonniar began to see how his ALM could be used by large insurance firms which helped smaller pension funds of corporations, and how Connor could customize the model for each of these smaller

clients, thereby creating a stable source of revenues.

Eventually Bonniar began to see how this kind of entrepreneurial OR development was a way out of the vicious cycle of marginalization experienced earlier by Connor. He began to see the development of DSSs for other purposes in the same terms, thereby generalizing his learning about developing a new strand of practicing OR, and creating the beginnings of a virtuous cycle. Bonniar's strand of practice, which we have called Strand Four, became an emergent strategy<sup>15</sup> for Connor, interactively designed and implemented over time through successive assignments, according to the following design rules:

- stay ahead of management's specific concerns by predicting and addressing them;
- get to know the client, the problem and the context in which it emerges;
- start with a small, simple prototype for one client;
- generalize the model by modularization;
- invest time and bear risk, and look for co-developers;
- move from one client to another within a problem domain and become an expert;
- continue to work on components of the model by addressing unique client concerns;
- ask new clients to buy into the project;
- develop individual skills and organization-based competencies through specialization in the domain and its critical problems;
- keep control over the overall development.

#### TENSIONS BETWEEN MULTIPLE STRANDS OF PRACTICE IN AN EXTERNAL OR GROUP

With the emergence of Strand Four, Bonniar believed he had found a solution for Connor's problem of marginalization in clients' organizations, a problem recognized by the other partners as well. However, rather than transforming Connor's entire practice from Strand One with Timman as its main protagonist to Strand Four, several strands of practice continued to exist simultaneously. Tensions cropped up in the firm centering around the questions "what is OR and how to practise it?", "how to allocate resources and how to run a business?", and "what is the firm's business strategy for survival and growth?"

For instance, believing he had developed a much more viable strand of practice, Bonniar started looking for new clients to further develop an office allocation program (to be discussed in more detail in the next section). When Timman turned out to have contacts with a university administration concerned about how to better allocate meeting rooms, Bonniar saw an opportunity. Timman, however, interpreted Bonniar's suggestion as a request "to sell a package", which was incompatible with his strand based on "crawling into the skin of the client" so as to develop projects uniquely fitted to the client's need. As a result he decided not to pursue the suggestion, disappointing Bonniar.

A second source of tension emerged around profitability. Initially, when Bonniar had been investing his own time and that of other consultants in the firm in the ALM system without getting a direct fee, the other partners had questioned the approach. In return, once Bonniar had established a profitable strand, members of his group (but not Bonniar himself) began to question the low profitability of Timman's projects. A third source of tension concerned Bonniar's suggestion that his approach, geared towards helping senior managers tackle strategic problems by using OR, would help the other partners to break out of the cycle of marginalization.

Up to 1995, the three founding partners had been unable to address these questions effectively and the resulting tensions had gradually led to competition between strands. Such dynamics may have important repercussions on the development of new OR practices. An organization emerges that is made up of several strands of OR practice, less and less able to draw on and learn from each other. The firm becomes a repertoire of distinct OR competencies that function as an ecology of groups with a limited learning system.<sup>20</sup> Each strand is based on at times extraordinary competence of individual partners, but is increasingly locked up in itself and sealed off from the others. Groups embodying the strands become engaged in win-lose dynamics. One of the most important consequences is that a firm with a repertoire of isolated competencies will find it much harder to develop new, unique, and competitive strands of practice in the face of a dramatically changing corporate environment. The longer this state of affairs persists, the more difficult it becomes to effectively integrate elements of each strand and to bring them to bear in a new design, uniquely matched to new, emerging opportunities such as Bonniar spotted in the late 1980s.<sup>14,21</sup>

These dynamics also have consequences for the long-term survival of the firm as they could undermine the more traditional business support that the strands of the different partners may give each

other. Mitchell<sup>22</sup> recommends that any OR group should balance rendering short-term assistance and conducting long-term research. The former provides the necessary cash flow, the latter improves the group's long-term sustainability. In the case of Connor, even though the firm's original strand tended not to generate highly profitable projects, it had proved very valuable as a source of access to new domains and clients. The strand practiced by Boise, a stabilized relationship with one firm, was a regular source of income and special knowledge about that one firm and its industry. Moreover, its software expertise had provided an important competence in a lot of projects. The strand practiced by Bonniar acts as a kind of developmental branch, which, if successful, generates stable products that can be used time and again. At a minimum, the strands present a portfolio of businesses, although, as indicated before, this would be an unfortunate and highly reductionistic frame for considering the firm's competence.

## MULTIPLE STRANDS OF PRACTICE WHEN INTERNAL AND EXTERNAL OR GROUPS COLLABORATE

As we outlined in the introduction to this paper, collaboration between external and internal OR groups is becoming a critical feature in the emerging configuration of OR work. As we have seen, many of Connor's projects were obtained through working with central, internal OR groups. In the previous section, we showed how integrating distinct strands of practice within one firm led to various problems. It should not come as a surprise, then, that collaboration across firm boundaries, in this case between an external OR firm and an internal group, also poses significant challenges. In this section, we explain how Connor's fundamental approach to OR projects clashed with that of a client's internal research group.

We saw above how Bonniar was able to transform the firm's traditional approach in a series of projects, across multiple clients, thereby creating an entrepreneurial development program while developing the ALM product. The emerging success of his new approach led Bonniar to see that the lessons he learned in one domain could be carried over to another domain he was already working in; through a project for the Consulting and Research Department of the National Real Estate Management Service. With government cutbacks in agencies' employment and budgets, the request was to design a decision support system that would allow regional planners of the Service to more effectively allocate existing office buildings among agencies.

Bonniar began to see that a model co-developed with the Service's research department could also be used with large corporations which were often beginning to cut back too. In doing so, he ran into a problem that may be emblematic of the issues that will emerge if OR is going to be practised in a decentralized and distributed network of OR practitioners -- i.e. an incompatibility between different strands of practice for conducting OR.

Based on prior experience with using OR, the head of the internal group had framed the problem of allocating buildings to agencies as a linear programming problem. Bonniar had been impressed by his reasoning, and even more when he found out that others in the group (i) were also "very smart", (ii) had sophisticated knowledge about the allocation problem they were facing, (iii) did not "merely talk" but were prepared to take action, and (iv) had already identified 23 decision criteria to be optimized through the model. The relationship between the client and Connor was similar to previous projects -- great mutual respect and trust. However, this first project did not work out because the regional planners of the Service, the intended users of the model, did not adopt it and Connor, as Bonniar explained, could "not shove it down their throats" despite numerous training sessions. Then, when a large ministry moved into a new building, the same logic of space allocation between agencies was now used for space allocation within an agency with the intent to eliminate the "bargaining" and "nagging" typically involved. Because Bonniar was "already sitting at the table", he received this new assignment. After a while, the project manager of the internal group was surprised to learn that no feasible solution existed for what he began to see as a political problem. Connor practitioners focused for a long time on developing and testing the algorithm rather than developing a user interface. In the end they missed the deadline to be of use in the Ministry's move. Once the model was finished, however, others in the agency balked at what the project manager called "a too objective allocation of space".

Reflecting on the failure to get the project accepted, Bonniar stated he had become aware afterwards that working through the Central Research Department had inadvertently changed the way Connor developed the project. Because the Department had come up with the problem, the model and the criteria, *it* had become the client rather than the regional planners. Taken in by their problem framing and following their approach, Bonniar mentioned how, in dealing with them, he felt like "you were pretending you can do what you say", and there was "less emphasis on prototyping". Most importantly, he wondered "do I dare to send something into the organization which I know to be incomplete and upon

which they may frown?” Given the Research Department’s sophisticated knowledge, Bonniar had not dared to follow Connor’s usual approach. Moreover, as Bonniar had seen the potential for the development of a multiple client project, he had kept on investing time that would not be covered by the client. (However, without new clients, the project would not become profitable.) Finally, as indicated in the previous section, when Bonniar asked his partner, Timman, to use the model with a university real estate office for allocating meeting rooms, Timman balked at “selling the program”.

The research of Fildes and Ranyard<sup>9</sup> and our own points to a new future of OR practice, i.e. a distributed network in the form of central internal OR groups, decentralized internal OR groups, external groups specialized in OR, and general consulting firms (see also Ormerod<sup>10</sup>). Cooperation between these groups and the integration of their knowledge for specific projects across different strands becomes critically important for the renewal of OR practice. Our micro-level study indicates that this cooperation may not be easy, and that problems of cooperation between different strands may represent an under-reported if not unrecognized problem.

While consulting is generally framed in terms of *either* an internal *or* external group, we think that it may be more likely in the future that the two need to cooperate. However, this route is fraught with problems (such as those illustrated above). First, many of Connor’s projects have been obtained through former university colleagues or other OR champions working in internal OR groups. Changes in personnel tend to affect OR projects disproportionately because management support tends to evaporate. Second, the entrepreneurial strand developed by Bonniar only became possible when he gained direct access to senior management through the first project and began to contact senior management directly for subsequent projects. Third, in the case of the ministry, it was the internal Research Department with its OR knowledge that became a barrier for Bonniar to ground the project with the regional planners. Bonniar felt forced to accept the Research Department’s more institutionalized approach to OR. In view of these kinds of problems, Bonniar vowed never to work *through* a central, internal OR group again. His comments are reminiscent of Argyris’s<sup>23</sup> observation about organizational development professionals, another staff group in large firms, whom he frequently experienced as presenting a barrier to creating effective organizational change programs.

## UPPING THE ANTE: SUSTAINING STRAND FOUR IN A DYNAMIC ENVIRONMENT

It will be clear from our description that OR practitioners engaged in the renewal of OR practice face formidable odds. We have illustrated (i) the transforming of a strand of practice, (ii) the problem of collaboration between multiple strands within one external OR group, and (iii) the problem of collaboration between internal and external OR groups when working in different strands. Each of these sets of problems may produce considerable tension and conflicts which practitioners find extremely hard to resolve. We now look at a case where renewal was successfully achieved (Bonniar's Strand Four), only to see that this very success led to yet another set of challenges, those of an increasingly competitive environment and of coaching of new practitioners.

### *A dynamic external environment*

The ALM system had become a real product with accompanying services within Connor and an exemplar for learning a new strategy. However, the change in the world of pension funds and the opportunities it provided had not remained unnoticed and led to a number of new problems for Connor:

- Severe competition: other much larger international consulting and financial services firms had entered this new market with far less sophisticated programs but better marketing resources and often much tighter relations based on historical ties with the potential clients.
- The direction of further development: should Bonniar focus on constantly upgrading the model (and for instance include derivatives) and should it be custom-made for large pension funds and mutual funds or should he focus on smaller pension funds and milk the program, hoping to develop another product?
- Big pension funds were increasingly demanding that if the consultant developed and sold a new feature, they wanted royalties.
- International financial services firms tried to acquire Connor and when he did not accept, Bonniar feared they might try to hire his best people.

In addition, while Bonniar had learned that this new strand of practice could be used to develop strategic decision support systems in other domains, he had noticed in the 1990s that larger firms had cut

their research budgets, and managers were less willing to engage in these kind of development projects because of the perceived risks. (Fildes and Ranyard mention a similar problem for internal OR groups.) In addition, firms had become less willing to have consultants learn about a domain at their expense. They increasingly expected prior experience with these kinds of projects and selected the best firm available within that more limited set. These developments could prevent Bonniar from following his development approach in other domains. This raises the strategic question of how to capitalize on economies of scope and scale. Can small- or medium-sized OR-based consulting firms survive in this competitive climate, or need they become part of much larger general management consulting firms? The present trend in consolidation and the acquisition of large internal OR groups in the UK by Cap Gemini may point in the latter direction.

### *Dynamics within the new strand*

In order to further develop the ALM program, Bonniar was faced with several challenges in managing the development of his new strand. First, until mid-1995 the firm tended to recruit the “smartest students in the classroom”. These students quickly grasped the technical and economic intricacies of the ALM model, but could these technically competent developers have discussions with Chief Financial Officers of firms listed on the Amsterdam Stock Exchange? Bonniar, once such a smart student himself, had gone through a long process of learning how to do this. How could new recruits learn to do what he did, and how could he help them? Moreover, some OR students who were perhaps less versed in technical matters had a feel for marketing and sales. Could these two groups accept each other and work together?

Second, could these smart developers acquire the breadth of experience that Bonniar himself had gained over the years through a variety of projects, that would allow them to develop the model further and deeper, and even embark on similar projects in new domains? Would they be innovators? Third, Bonniar noticed that many of his developers would not ask for help when they experienced difficulties. In a culture in which “being the smartest” and solving one’s own problems was highly valued, asking for help did not come easily. And when these developers would encounter obstacles, they would initially deny it when asked, until the problems became too obvious. Bonniar sensed there was a need for more coaching on his part but he had not been able to address this problem effectively.

Fourth, there was also a need for more accountability and better project management. For this reason, Bonniar had appointed a senior project manager, allowing himself to focus on coaching junior developers. However, the developers quickly spotted that the project manager was less versed in OR than they were, branded him as a “task boss”, sabotaged his efforts to get information, and wondered why Bonniar himself was not acting as the head of the firm. Eventually, the project manager resigned in frustration. Hence, after some five years of developing Strand Four, Bonniar faced a nested set of problems related to the transfer of deep experience and sustaining the innovative drive of his group. These were the kinds of problems that drained his energy.

## THE CHALLENGE OF RENEWAL OF OR PRACTICE AND LEARNING ACROSS STRANDS OF PRACTICE

We began our paper by describing a change in the organized practice of OR from “institutional” OR, conducted in centralized, internal OR groups in large organizations, to more decentralized (but still internal) OR groups combined with the emergence of external OR groups (be they specialized OR groups or more general consulting firms). We pointed out that this was a major shift and that very little is known about how OR is practiced in what we have called “entrepreneurial” OR groups.

Our research showed us that (i) among external groups, there are significant differences in the way OR was practiced; (ii) even within external groups, OR is practiced in different ways; and (iii) OR, as practiced in entrepreneurial firms, may differ in important ways from institutionalized OR practiced in internal OR groups. While our sample was limited in size and confined to a relatively small geographical area, we believe our findings can be generalized into working hypotheses because we worked with some of the very best practitioner-academics we could find, and because the patterns and dilemmas of OR practice which we found are not dissimilar to the findings of other studies of the conduct of professional work in organized settings (see e.g. Schön<sup>5</sup> on a range of professions including architecture, psychotherapy, town planning, product development, and management; Argyris<sup>23</sup> on external management consultants; Overmeer<sup>24,14</sup> on real estate development; Mintzberg<sup>25</sup> on strategic planning).

We believe that the study of OR practice needs to be taken very seriously. While others have reported about different roles within an OR project (e.g. Eilon<sup>26</sup>) and about different stances to practice,

to our knowledge, the idea that there are remarkably different strands of OR practice, informed by different theories of practice (Argyris and Schön<sup>12</sup>) is new. Equally important is the view that an OR practice is developed over time, can be viewed as competence-based and is informed by a set of design rules for the further development of the strand. Moreover, we have demonstrated how a strand of OR practice is transformed over time in response to an unintended mismatch (the vicious cycle), and how this constitutes important individual learning on the part of the practitioner and strategic learning on the part of the firm. In addition, we demonstrated that within an (external) OR group, the emergence of several strands of practice can lead to tensions and conflicts, making work across strands and integration of strands into new strands to match new opportunities a non-trivial task that requires another kind of organizational learning (“double loop organizational learning” in which practitioners are able to reflect critically on the theory of practice they bring to bear). Finally, it is unlikely that the movement toward downsizing and outsourcing will continue much further; in fact, some evidence suggests that firms may have gone too far and, rather than merely eliminating “fat”, have actually “cut into the muscle”. Some senior managers are now reconsidering the trimming and some firms are “upsizing” (*The Economist*, June 8th, 1996). Examples of growing internal OR groups exist in e.g. firms engaged in financial planning or yield management. Therefore, within a network of distributed OR competencies and differentiated roles (Schön<sup>5</sup>) among various internal and external groups, that same learning also has to occur in the relationship between external and internal OR groups, between OR groups in different business units of the same firm, and most likely also (though not the focus of this paper) between OR practitioners and other professionals claiming expertise in similar domains.

We are now able to project our view of OR practice into the future and extend the framework we provided earlier in this paper. Clients will increasingly seek best practice and since no one group may have all that is needed, it is not unreasonable to expect a close collaboration between distributed competencies operating in different roles. The core problem requiring most attention will shift to integrating multiple competencies, including non-OR ones. Projects will be undertaken by the temporary bundling and then unbundling of multiple competencies, geared towards unique, one-of-a-kind projects closely linked to the competitive position of the firm (see the last column in Table 1).

The core of this paper is about how different competencies in OR work together and how collaboration is not a given within one firm or between an internal and an external firm. In fact, we

suspect that much talk in the past, in particular the insistence by more academically-based ORers, about the OR method as being the application of techniques and the moving through a problem-solving cycle, has in fact prevented an acknowledgment of the richness, the complexities, and dilemmas of OR in action. The corollary of such a neglect is that it has prevented attention being focussed on the problems of cooperation between operational researchers who practice different strands.

Our aim in this paper is to suggest that the study of OR practice is critically important for the profession as it is increasingly conducted in distributed networks of competencies in which OR practitioners may operate in differentiated roles. This is not only because novice practitioners need to develop a better sense of what it takes to become a competent practitioner, they also need to learn to cooperate effectively with those practising OR differently, even within their own firm. Acknowledgment of those differences, of the non-trivial problem in working together and of talking across the boundaries of one's strand, may not only be a source of renewal of OR practice within an external group. It will also facilitate the cooperation across organizational boundaries between internal and external groups, as well as make it possible to have productive discussions with other professionals that lay claim on the domain OR sees as its own. It is tempting to respond from a defensive posture and view those professions as intruders, or as para-professionals (Abbott<sup>27</sup>). However, if operational researchers could learn to integrate different OR competencies more effectively, they could then use this experience to embark on projects that require the integration of OR-based competence with that of other professions and create solutions uniquely matched to the client's problems. If operational researchers could lead the way here, and skilfully collaborate with other professionals in addressing vexing client problems, they may give a whole new meaning to the idea of "operational" in operational research; perhaps, we should then speak of "co-operational research".

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**Table 1: Changing models of organized Operational Research practice**

Notes: (i) the periods are approximate and tend to overlap, (ii) in case of the first stage, it is difficult to distinguish between “espoused” theory and what was *actually* practiced, in particular after civilian organizations tried to replicate military successes.

| <b>Attributes of the practice of OR</b> | <b>Revolutionary stage<br/>(1940-1955)</b>                                  | <b>Institutionalized stage<br/>(1955-1985)</b>                 | <b>Entrepreneurial stage<br/>(1985-1990s)</b>  | <b>Network of distributed competencies and differentiated roles<br/>(beyond 1995)</b> |
|---|---|--|--|---|
| charter                                 | <i>roving brief and unlimited access to top management</i>                  | <i>earn access</i>   | <i>survive as an entrepreneurial activity</i>  | <i>seek the best practices</i>  |
| way of practicing                       | <i>autonomous rangers with or without a multi-disciplinary team</i>         | <i>internal, central OR groups</i>                             | <i>decentralized internal, and external OR groups</i>                                | <i>collaboration between distributed competencies and differentiated roles</i>        |
| problem requiring most attention        | <i>framing unidentified practical problems to which OR could contribute</i> | <i>implementation of OR findings and systems</i>               | <i>building competence</i>   | <i>integration of multiple competencies, including non-OR</i>                         |
| relationship between projects           | <i>individual projects</i>  | <i>on-going program of interlinked projects for one client</i> | <i>a series of similar projects, a strand, for multiple clients</i>                  | <i>bundling and unbundling of multi-competence project teams</i>                      |
| kinds of projects                       | <i>strategy and tactics interwoven in one project</i>                       | <i>tactical projects</i>                                       | <i>strategic as well as tactical projects, or projects that have both components</i> | <i>unique, one-of-a-kind projects</i>   |