STRATEGIC LEVEL MS/OR TOOL USAGE IN THE UNITED KINGDOM AND NEW ZEALAND: A COMPARATIVE SURVEY

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MS/OR has traditionally provided modelling support to improve the operational efficiency and effectiveness of organizations. Is there also a role for MS/OR in crafting strategies for the future and supporting strategic decisions? An empirical study of practitioner members of the Operational Research Societies in the United Kingdom and New Zealand was conducted to investigate MS/OR involvement with strategic level decisions. In this paper key results from this comparative survey are presented. Both the levels of MS/OR tool use for a series of 32 core strategic tasks and familiarity with a series of 25 specific tools are outlined and discussed. Significant levels of MS/OR involvement across the spectrum of strategic tasks were found in both countries. Conclusions supporting future MS/OR development of strategic level work are followed by proposals for further research in this important area.

Keywords: Practice of OR, strategic planning, corporate planning, techniques, tools.

1. MS/OR and Strategy?

Management Science/Operations Research (MS/OR) has traditionally been applied to well-structured problems in operational areas (Cyert (1981) and Rosenhead (1989)) such as resource allocation, scheduling, distribution and transportation; providing modelling support to improve efficiency and performance. However, there have been many proposals for increased MS/OR involvement with decision support for top management (Miser (1963), Tomlinson (1974, 1983), Rosenhead (1986), Eilon (1989) and Ormerod (1995)). While the ability of MS/OR to contribute to strategic projects has been advocated by some authors (Tomlinson (1983, 1989), Lesourne (1989), Eilon (1989), Kirkwood (1990) and Ormerod (1995)), others remain sceptical of this linkage (Lawrence (1979), Preedy and Bittlestone (1985), and Fin-

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lay and King (1989)). Surprisingly, major disciplinary reviews in both the United Kingdom (Commission on the Future Practice of Operational Ressearch, 1986) and in the United States (Committee on the Next Decade in Operations Research, 1988) did not address this issue.

Advances in computing capabilities have increased the scope for technological support (Cornford and Doukidis (1991)), and new qualitative tools such as the "soft OR approaches" (Chapman (1992), Finlay and Marples (1991), and Taket and White (1993)) have further extended the potential capabilities of the MS/OR toolkit. Case examples of strategic applications of MS/OR have been reported (Tobin, Rapley and Teather (1980), Ormerod (1995), Tomlinson and Dyson (1983), Tomlinson (1989) and Lootsma (1991)), but limited empirical evidence of strategic level MS/OR was reported in the literature. To begin to fill this gap, a research project was designed to collect evidence of current involvement by MS/OR practitioners who provide strategic level decision support in their organizations. A multi-disciplinary, comparative evaluation was conducted, focussing primarily on tool[1] usage for a series of core strategic tasks by practitioners in both the MS/OR and Strategic Management disciplines. The empirical study was replicated in the United Kingdom and New Zealand.

Tool usage results from the United Kingdom Operational Research Society survey have already been published (Clark and Scott (1995)) and the descriptive results are also available (Clark and Scott (1994)). This paper provides the New Zealand Operational Research Society tool usage results in a comparative summary with the United Kingdom results, to highlight the patterns, trends, similarities and differences in current practice. First, methodological details of the research design will be outlined. Second, the framework of strategic tasks which was developed to provide a structure for the evaluation will be described. The comparative MS/OR tool usage results for each of the strategic tasks and the levels of familiarity with a sample of 25 specified MS/OR tools are presented and discussed. Finally, conclusions are drawn and suggestions for further analysis and research proposed.

2. Research Design

To investigate the role of MS/OR within Strategic Management, a multi-method research design was needed. A postal questionnaire was designed to collect quantitative data on tool usage and tool selection factors (Dillman (1978)), and a series of semi-structured interviews were included to obtain qualitative, explanatory data (Bouchard (1988) and Patton (1990)).

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[1] The term "tool" was used in this project as a generic name for any of the methods, models, techniques, tools, frameworks, methodologies and approaches which provide decision support.

To enable the MS/OR contributions to be evaluated within the context of the Strategic Management paradigm, the research was simultaneously replicated in both disciplines. To provide comparable samples of individuals with interest and expertise in these two disciplines, the practitioner members of the Operational Research and the Strategic Planning/Management Societies in New Zealand and the United Kingdom, were used as the sampling frame.

A comparative study with the United Kingdom was chosen as the professional societies there are large and active; also, this is where many of the newer "soft" MS/OR approaches have been developed. To avoid problems with the small size of the New Zealand populations, census samples were used in New Zealand; all of the Society members who met the residency and practitioner criteria were surveyed between September 1992 and February 1993. Sample statistics for the surveys are summarized in Table 1.

Table 1. Sample statistics for comparative United Kingdom and New Zealand surveys

	MS/OR		Strategic Management	
	UKOR	NZOR	UKSM	NZSM
Responses Received	229	67	179	230
Response Rate	19.1%	67%	14.9%	58%
Usable Responses	177	39	161	138
Usable Response Rate	14.8%	39%	13.4%	35%

These response rates compare favourably with recent survey-based research in the United Kingdom (Doukidis and Paul (1991), Cornford and Doukidis (1991), Greenley and Shipley (1992), and Hall (1992)) and New Zealand (Olson (1991), Coviello (1991), Van der Walt *et al.* (1991), Akoorie and Enderwick (1991), and Hyde, Basnet and Foulds (1995)). The New Zealand response rates are noticeably much higher than the United Kingdom rates. This is explained in part by the proliferation of research in the United Kingdom inundating managers with questionnaires. Another major contributing factor in this project was that individual follow-up was not allowed in the United Kingdom; however, reminders were included in the Society's newsletters to try to increase the response rates. Most of the non-usable returns were from individuals who retained their Society membership, although no longer working directly in the area.

Descriptive statistics were obtained for the sample using the SPSS[X] statistical analysis package (Hedderson (1987)). Frequency results were collated in table and graphical form to identify patterns and trends; mean values were used for interval scale data (Alrech and Settle (1985)). Confirmatory analysis was also used to test relationships between variables (Martin and Bateson (1993)); cross tabulations were used for categorical variables

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and breakdown for interval scale dependent variables (Hedderson (1987)). Non-response bias was tested using chi-square tests of the first and last waves of the responses for key variables (Armstrong and Overton (1977)) and no significant differences were found.

This paper focuses on the tool usage results for the MS/OR respondents from the United Kingdom (UKOR) and New Zealand (NZOR) surveys who indicated direct involvement at the strategic level: 78.5% of the UKOR respondents and 66.7% of the NZOR sample. An overview of the framework of strategic tasks which was developed to provide a structure for this project is described in the next section.

3. Strategic Management Framework

A representative series of core strategic tasks was required to provide a structure for the identification and evaluation of strategic level tool usage. As no definitive list of strategic tasks was available, a Strategic Management framework based on a normative Strategic Management process model was developed for this project (Clark and Scott (1995). Although a simplification, the Strategic Management process model provides a framework for thinking through and understanding the nature and essential elements of Strategic Management (Johnson and Scholes (1989)). It enables a series of core strategic tasks to be defined which are representative of the basic Strategic Management activities; yet summarized in a relatively compact and workable form. This approach has been used previously for theoretical tool evaluations by others within the Strategic Management discipline (Day (1986), Webster, Reif and Bracker (1989) and Dyson (1990)); however, no previous empirical studies have linked tool usage with specific strategic tasks.

The Strategic Management framework comprises thirty two strategic tasks grouped into three phases (Figure 1). Phase 1, Situation Assessment, involves the evaluation of the current strategic position of the organization and the identification of strategic issues. This is operationalized as the evaluation of fifteen internal organizational resources and features, in conjunction with a review of eleven external environmental influences. The organizational analysis includes evaluation of key features such as the organization's strategy, mission and objectives, as well as nine different types of basic organizational resources. The environmental analysis includes evaluation of Operating Environmental factors (such as the industry, markets, competitors, customers and suppliers), as well as the more general Remote Environmental influences which impact on the organization and its operating environment (including economic trends, technological changes and developments, and social, political influences). Phase 2, Strategic Analysis,

involves three key strategic tasks to identify and select the best strategy for the future. Finally, Phase 3, Strategic Implementation, involves three key tasks which facilitate implementation of the strategy (Johnson and Scholes (1989), Pearce and Robinson (1991), and Wheelen and Hunger (1986)).

4. Strategic Level Tool Usage Results

The proportions of the UKOR and NZOR samples using MS/OR tools to support each of the strategic tasks are summarized in Table 2. As the respondents are not necessarily involved with all of these tasks, these results show the tool users as a proportion of those whose work involves each specific task. In addition, chi-square probability results from significance testing the tool usage proportions are provided. Respondents also indicated the names of tools which they use for each task. A checklist of tools was not provided for this as it would increase the complexity and time required to complete the questionnaire, while also constraining responses to the named subset of tools. The top tools reported for these strategic tasks are summarized in the Appendix; many different approaches were being used, but only the clear "leaders" are listed. The levels of awareness, familiarity and strategic level usage for a series of 25 specified MS/OR tools were also obtained and these results are outlined in Section 5.

4.1. Phase 1: Situation Assessment

First, these results show that MS/OR practitioners in both countries *are* involved with fundamental strategic tasks of Organizational and Environmental analysis, and they *are* using tools to support these Situation Assessment activities. The levels of tool support are quite variable and the UKOR proportions are higher than the NZOR results for most of these Phase I tasks, yet the differences are only significant (at .05 level) for three of the Organizational analysis tasks: evaluating human resources, marketing/distribution and intangibles. The higher levels of involvement with human resources and marketing activities in the United Kingdom may link to the larger size of their organizations.

The highest levels of tool support in both countries reflect the traditional MS/OR domain: analysis of production/operations issues and financial resources. Substantial MS/OR involvement with the Organizational Analysis tasks of evaluating strategy and objectives is a very interesting finding as these are certainly not regarded as traditional MS/OR areas or tasks.
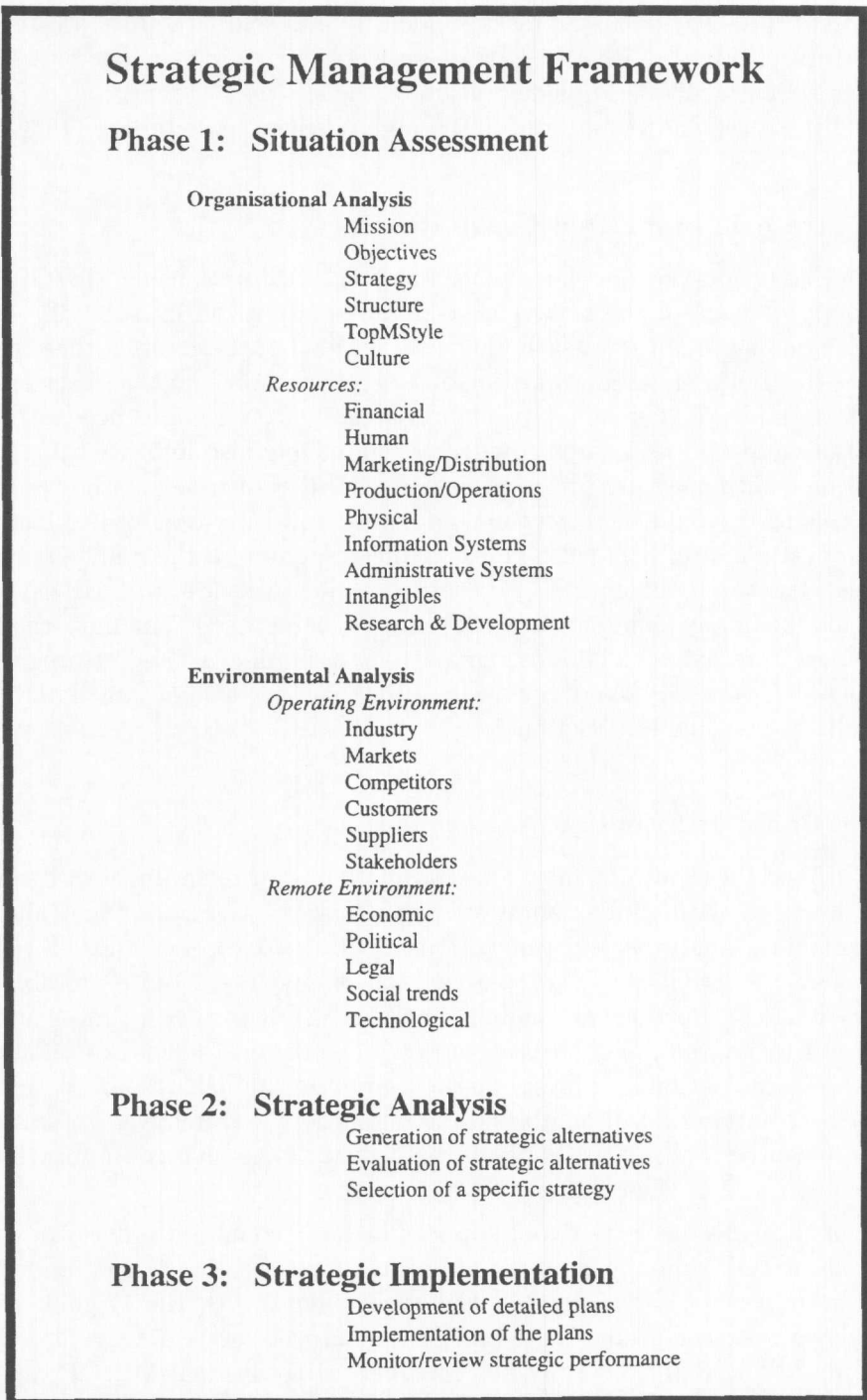
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Strategic Management Framework

Phase 1: Situation Assessment

Organisational Analysis
Mission
Objectives
Strategy
Structure
TopMStyle
Culture
Resources:
Financial
Human
Marketing/Distribution
Production/Operations
Physical
Information Systems
Administrative Systems
Intangibles
Research & Development

Environmental Analysis
Operating Environment:
Industry
Markets
Competitors
Customers
Suppliers
Stakeholders
Remote Environment:
Economic
Political
Legal
Social trends
Technological

Phase 2: Strategic Analysis
Generation of strategic alternatives
Evaluation of strategic alternatives
Selection of a specific strategy

Phase 3: Strategic Implementation
Development of detailed plans
Implementation of the plans
Monitor/review strategic performance

Figure 1. Strategic Management framework

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Table 2. Comparison of United Kingdom and New Zealand
strategic tool usage proportions

Strategic Task	UKOR %	NZOR %	Chi Square Probability
Phase 1: Situation Assessment			
Organisational Analysis			
Mission	16.1	12.0	.602
Objectives	25.0	24.0	.916
Strategy	44.2	32.0	.259
Structure	16.7	12.0	.560
TopMStyle	8.1	0	.142
Culture	7.3	0	.165
Resources:			
Financial	47.7	48.0	.978
Human	34.8	12.0	.024*
Marketing/Distribution	46.6	24.0	.037*
Production/Operations	57.7	68.0	.337
Physical	38.3	36.0	.830
Information Systems	32.8	25.0	.450
Administrative Systems	16.8	8.0	.265
Intangibles	2.5	12.0	.030*
Research & Development	19.2	29.2	.271
Environmental Analysis			
Operating Environment:			
Industry	19.1	12.5	.441
Markets	32.6	29.2	.740
Competitors	29.6	16.7	.191
Customers	37.3	36.0	.901
Suppliers	16.2	20.8	.574
Stakeholders	8.7	4.2	.450
Remote Environment:			
Economic	29.2	24.0	.595
Political	15.5	12.0	.659
Legal	8.7	0	.117
Social trends	19.2	16.7	.768
Technological	19.2	16.7	.768
Phase 2: Strategic Analysis			
Generation of strategic alternatives	40.9	40.0	.930
Evaluation of strategic alternatives	68.4	73.1	.635
Selection of a specific strategy	45.7	57.7	.281
Phase 3: Strategic Implementation			
Development of detailed plans	24.6	20.0	.620
Implementation of the plans	21.2	29.2	.390
Monitor/review strategic performance	35.1	30.4	.663

Notes:

* $p < .05$
** $p < .01$
*** $p < .001$

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The levels of tool support for the Environmental Analysis tasks are lower than many of the Organizational Analysis tasks as significant proportions of the MS/OR practitioners are not currently involved with any of these areas. However, the potential ability of MS/OR to contribute to the evaluation of these Operating and Remote Environmental areas is captured by these results. The highest levels of tool support in the Environmental Analysis areas were the fundamental tasks of evaluating customers and markets. Evaluating competitors and economic trends also feature as strategic tasks with substantial MS/OR modelling support. Industry analysis, demographic trends and technological changes are additional strategic application areas for MS/OR in the future.

Tools which were frequently mentioned to support these strategic tasks include quantitative approaches such as Spreadsheet Modelling, Simulation, Forecasting, Financial Modelling, Linear Programming, and Statistics. Qualitative approaches which featured in the top tool sets of some specific tasks were Brainstorming, Heuristics, Porter's Five Forces and Soft Systems analysis.

Recognizing that these are strategic level tasks, and that they include a broad range of non-traditional areas for MS/OR, these findings are both interesting and surprising. More differences between the countries could have been expected based on factors such as scale. Yet the high similarity between the sample proportions in both countries provides corroborating evidence of strategic practice and future potential application areas. Taken overall, the results demonstrate the diversity of potential strategic application areas for MS/OR practitioners and MS/OR tools, and signal the ability and preparedness to move out of conventional settings.

4.2. Phase 2: Strategic Analysis

There are significant levels of MS/OR involvement in both countries for all three of the Strategic Analysis tasks; all of these sample proportions are over 40%. Furthermore, the same pattern of very similar results in both countries is confirmed, as no statistically significant differences were found. The use of tools to evaluate alternative strategies is the Strategic Analysis task with the highest level of involvement by the MS/OR practitioners. With sample proportions of 68.4% in the United Kingdom and 73.1% in New Zealand, this was the 'top' strategic task in this project. MS/OR tool use for strategy selection is also comparatively high and a surprising number of practitioners are using tools to assist with the generation of alternative strategies. These results provide compelling evidence that the traditional MS/OR role of developing models to investigate alternative systems or options is equally applicable at the strategic level.

The most commonly reported tools for these Strategic Analysis tasks in both countries were Spreadsheet Modelling and Simulation. Other approaches which were frequently reported include Cost Benefit Analysis, Delphi, financial approaches such as calculating Net Present Values, as well as traditional Mathematical Programming, SAS and In-house modelling.

4.3. Phase 3: Strategic Implementation

The levels of tool usage for the three Strategic Implementation tasks range between 20% and 35%; these are much lower proportions than the top tasks from the Situation Assessment and Strategic Analysis phases. Nevertheless, the results signal that *some* MS/OR practitioners *are* involved with each of these strategic tasks. The same pattern of similarity was found in both countries, with no statistically significant differences in tool usage proportions. However, 65-70% of these samples are not involved with tools for any of these Strategic Implementation tasks. These comparatively low results appear to reflect the sample composition of modelling/analysts who often provide inputs for strategic decision making, rather than being part of the Strategic Implementation process. In addition, there are other projects which do not reach the Implementation stage, including exploratory feasibility studies, and cases in which the decision is made *not* to proceed with a particular strategic project. As a discipline MS/OR, could be expected to play a major role in this Strategic Management Phase which deals with "operationalizing the strategy". However, as Dantzig (1995) suggests, the secret to unleashing MS/OR potential is to ensure active involvement in both design *and* execution of critical activities.

The tools which were most frequently reported by the MS/OR practitioners to support these Strategic Implementation tasks include Project Management, Spreadsheet Modelling, Simulation and customized In-house models.

5. Tool Familiarity

A sample of 25 MS/OR tools was used to investigate the levels of awareness, familiarity and usage of tools in both countries. Table 3 summarizes the UKOR and NZOR sample proportions for the four categories of increasing familiarity: (1) don't know, (2) know about, (3) know well enough to apply, and (4) have used; superscripts 1-5 are used to show the highest rankings for each sample. Note these MS/OR respondents are all involved with support of strategic decisions which include "major decisions associated with determining the overall direction and future of an organization, including developing and implementing strategies".

From this set of MS/OR tools, Spreadsheet Modelling is the approach which is universally applied; this is consistent with the results in the previous section and signals the increasingly significant role that a general technological support tool can play for strategic, as well as operational, decision support. There were five other tools which have been used by significant proportions of the respondents from both countries: these include Simulation and Forecasting which are commonly applied to a wide range of strategic tasks; and basic approaches for financial evaluation (Cost Benefit Analysis), project implementation (Project Management) and resource allocation (Mathematical Programming). These tools are all general approaches which provide a structure for evaluation of content, rather than focussing on the modelling process.

Table 3. Comparison of United Kingdom and New Zealand
tool familiarity proportions

Tool	"Have Used" %		"Can Apply" %		"KnowAbout" %		"Don't Know" %	
	UKOR	NZOR	UKOR	NZOR	UKOR	NZOR	UKOR	NZOR
Analytical Hierarchy Process	4.0	0	2.4	4.3	13.5	17.4	80.2[2]	78.3[3=]
Cognitive Mapping	6.3	4.3	14.3	0	41.3[5]	17.4	38.1	78.3[3=]
Corporate Models	24.1	20.8	14.3	12.5	31.6	17.4	30.1	54.2
Cost Benefit Models	45.1	70.8[3=]	27.1[4]	16.7	21.8	12.5	6.0	0
Critical Success Factors	19.1	20.8	13.7	12.5	23.7	33.3	43.5	33.3
Decision Analysis	22.0	21.7	33.9[2]	34.8[2]	32.3	34.8	11.8	8.7
Decision Support Systems	42.6	21.7	14.0	8.7	31.0	52.2[2]	12.4	17.4
Delphi	10.7	16.7	11.5	16.7	33.6	37.5	44.3	29.2
Expert Systems	19.2	8.3	16.9	25.0	57.7[1]	54.2[1]	6.2	12.5
Forecasting	62.2[3]	75.0[2]	25.2	16.7	10.4	8.3	2.2	0
Game Theory	10.9	4.2	22.5	25.0	53.5[2]	50.0[3]	12.6	20.8
Heuristics	34.6	26.1	16.5	30.4	36.2	43.5[4]	52.4	0
Influence Diagrams	13.5	9.1	13.5	13.6	20.6	27.3	52.4	50.0
Inventory Modelling	30.5	20.8	25.2	45.8[1]	27.5	33.3	16.8	0
Math Programming (incl. LP)	49.2[5]	62.5	34.8[1]	25.0	14.4	8.3	1.5	4.2
Multiple Criteria D. Making	18.9	12.5	17.3	16.7	43.3[4]	41.7[5]	20.5	29.2
Process Improve(incl PDCA)	7.3	21.7	3.3	4.3	8.9	13.0	80.5[1]	60.9
Project Management	49.6[4]	66.7[5]	30.8[3]	20.8	11.3	8.3	8.3	4.2
Robustness Analysis	10.3	13.6	7.9	4.5	27.0	22.7	54.8[5]	59.1
Simulation	71.3[2]	70.8[3=]	16.2	16.7	11.0	8.3	1.5	4.2
Soft Systems Methodology	10.4	4.5	17.6	4.5	48.0[3]	13.6	24.0	77.3[5]
Spreadsheet Modelling	83.7[1]	91.7[1]	8.9	0	6.7	8.3	0.7	0
Strategic Choice/AIDA	3.2	0	8.0	4.3	21.6	4.3	67.2[4]	91.3[2]
SODA	3.2	0	7.1	4.3	22.2	0	67.5[3]	95.7[1]
System Dynamics	11.7	4.2	9.4	12.5	39.1	29.2	39.8	54.2

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The "Can Apply" category was included to distinguish between those tools which are *actually* used and those which are *well known*, but *not applied*, for whatever reasons. The top three tools here are general approaches which are primarily quantitative: traditional MS/OR techniques for resource allocation (Mathematical Programming), evaluating options (Decision Analysis), and project planning (Project Management). In the NZOR sample, Inventory Modelling was also very highly rated in this category. All of these approaches can potentially be applied without any additional training.

The "Know About" category is for the tools which respondents have heard about, but do not know well enough to apply or use currently by themselves. The approaches which were highly ranked here are mostly "newer" approaches which have been developed/promoted through the 1980s. For example, technological tools such as Expert Systems and Decision Support Systems, qualitative process approaches including Soft Systems and Cognitive Mapping, and specialist tools such as Game Theory and Multiple Criteria Decision Making.

For twelve of the MS/OR tools specified, significant proportions of both samples indicated that they "Don't Know" anything about them. Although there are some large country specific variations in the sample proportions, the overall pattern is quite similar - most of the tools which appear to be "unknown" are quite qualitative approaches. As with the previous category, many of these have been developed and promoted in the 1980s, rather than being "classical" MS/OR techniques. This result is very interesting as it raises all sorts of general questions about the promotion of new tools, and specific questions about the promotion and performance of these particular approaches. For the purposes of this project, focussing on strategic applications of MS/OR, the lack of widespread knowledge of the "soft OR" approaches is also a significant finding. These tools can be used for strategic level issues and problems, but to be able to apply them requires considerable expertise. It was surprising to find that even the approaches which have been developed and/or promoted in the United Kingdom, are not known by significant proportions of the UKOR sample. For example, the Strategic Options Development and Analysis (SODA) Methodology and the Strategic Choice approach were both developed in the UK and have been promoted there in seminars, conferences and journals, yet two-thirds of this UKOR sample (and over 90% of the NZOR smaple) do not know about them. Cognitive Mapping and Soft Systems Methodology are more widely known in the United Kingdom, but they are still relatively "unknown". These findings are of concern and signal the need for further investigation, by the professional societies, of the effectiveness of the promotion of "soft OR" tools.

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6. Conclusions and Further Research

This paper provides new empirical evidence of the involvement of MS/OR practitioners from the United Kingdom and New Zealand with strategic level decision support in their organizations. The findings are significant as they demonstrate the ability of MS/OR to contribute at the strategic level by providing modelling support for the complete range of core strategic tasks. This is gratifying given the desire to enhance the role of MS/OR.

Striking similarity in the levels of tool support for the strategic tasks in both countries was confirmed by statistical testing. Although the percentage of tool users is quite low for some of the strategic tasks, they signal potential areas for MS/OR contribution and involvement in the future; these need to be monitored for their critical success factors. Moreover, the results demonstrate the diversity of strategic application areas for MS/OR practitioners and MS/OR tools, giving encouragement to move into these areas.

The highest levels of tool support were found in the Strategic Analysis phase (evaluating alternative strategies), and in the Phase 1: Organizational Analysis (evaluating financial resources and the production/operations area). Results for the Strategic Implementation tasks were comparatively low, reflecting the traditional MS/OR modeller/analyst role providing input for decision making, rather than active participation in implementation tasks. Yet tools are also successfully being used in this area. What makes them successful? How could we make operationalizing the strategy easier? This area provides another fruitful area for further research.

While the MS/OR practitioners were mostly using traditional quantitative MS/OR tools, a number of qualitative approaches and some non-traditional tools were also featured. The investigation of the level of familiarity with a named subset of 25 MS/OR tools highlights major gaps in knowledge of the qualitative and newer MS/OR techniques. This signals the need for more effective dissemination of basic information on the characteristic features and capabilities of tools, as well as training courses and support for new approaches. The extent to which the education curriculum effects the tool familiarity results is unknown, but investigating the gap between tool familiarity and potential usage should be a powerful influence on curriculum design.

Potential topics which follow on from this research include: industry-specific studies of tool usage practices, and qualitative research for in-depth study of the application process and effectiveness of key tools. Historical and/or longitudinal studies on the "life-cycle" of specific tools would be useful, especially to understand the critical success factors involved in their introduction and application. An exploratory study of the nature of the process by which tools are selected was included in this project and an

overview level model of this process produced; further work in this area will improve understanding and interpretation of tool usage practices and provide invaluable input for the development of professional and academic educational programmes. Theoretical work on a typology of tools is needed, as well as the development of new technological and integrative frameworks to support strategic decision making.

Tools perform an essential support role in the strategic decision making process, thereby assisting and enabling practitioners to improve the future prospects and performance of their organizations. This research is important as it signals many new pathways and opportunities for MS/OR to pursue in the future.

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Appendix. Top tools used for strategic tasks

Strategic Task	UKOR	NZOR
Phase 1: Situation Assessment		
Organisational Analysis		
Mission	Brainstorming, Spreadsheets, Porter's 5 Forces, Soft Systems	
Objectives	Brainstorming, Spreadsheets, Porter's 5 Forces	
Strategy	Simulation, Spreadsheets, LP, Heuristics, Brainstorming	
Resources:		
Financial	Spreadsheets, Lotus, Financial Models, Forecasting	Spreadsheets, iThink
Human	Spreadsheets, Simulation, Forecasting, Statistics	
Marketing/Distribution	Spreadsheets, Statistics, Forecasting, Simulation	Spreadsheets, Databases Math. Prog.
Production/Operations	Simulation, Spreadsheets, LP, Statistics, Surveys	Simulation, Math. Prog., Spreadsheets
Physical	Simulation, Spreadsheets, Statistics Forecasting, Heuristics	Forecasting
Information Systems	LP, Spreadsheets, Databases	
Research & Development	Spreadsheets, In-house Models, Statistics	Forecasting, Math. Prog., Simulation
Environmental Analysis		
Operating Environment:		
Industry	Spreadsheets, Forecasting, Regression	
Markets	Spreadsheets, Forecasting, Statistics	Forecasting, Statistics
Competitors	Spreadsheets, Forecasting, Modelling, LP	
Customers	Spreadsheets, Statistics, Forecasting, Surveys	
Suppliers	Spreadsheets, Forecasting	
Stakeholders	Soft Systems, Spreadsheets	
Remote Environment:		
Economic	Forecasting, Statistics, Spreadsheets, Lotus	Forecasting, Statistics
Political	Spreadsheets, Financial Models	Forecasting
Legal	Risk Analysis	
Social trends	Forecasting, Statistics, Spreadsheets	
Technological	Spreadsheets	
Phase 2: Strategic Analysis		
Generation of strategic alternatives	Spreadsheets, Simulation, In-house Models, LP	Delphi, Simulation
Evaluation of strategic alternatives	Spreadsheets, Simulation, Cost Benefit, LP, Statistics	Spreadsheets, Cost Benefit, NPV, Simulation, SAS
Selection of a specific strategy	Spreadsheets, Simulation, LP, Cost Benefit	Cost Benefit, Spreadsheets, SAS
Phase 3: Strategic Implementation		
Development of detailed plans	Project Management, Spreadsheets, Simulation, In-house Models	
Implementation of the plans	Project Management, Spreadsheets In-house Models, Simulation	PERT, Critical Path
Monitor/review strategic perf.	Spreadsheets, Statistics, Project Management, Simulation	Spreadsheets, SAS