



**IMPROVING THE RELEVANCE OF MANAGEMENT RESEARCH
BY DEVELOPING TESTED AND GROUNDED TECHNOLOGICAL RULES**

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Academic management research has a serious external relevance problem. In this article it is contended that a major cause of this problem is the very nature of common academic management research. The field could reduce its external relevance problem by complementing common description-oriented research with more prescription-oriented research. This latter type of research will typically produce so-called tested and grounded technological rules. The nature of such technological rules is discussed as well as the differences with the typical research product from description-oriented research, the causal model.

In almost all academic disciplines research is undertaken to develop valid knowledge to share with students and other interested parties. As the great majority of students of Business Schools aspire careers outside academia, the knowledge taught in such institutions should have significant external relevance, i.e. it should be relevant for the world of business and management outside academia.

This is also reflected in the statement of purpose of the Academy of Management (as can be found on its website). “The purpose of the Academy is to foster the general advancement of research, learning, teaching *and practice* in the management field and to encourage the extension and unification of management knowledge. The Academy publishes scholarly papers, conducts forums for the exchange of management knowledge and provides services that enhance the science *and practice* of management” (italics added).

Yet, Hambrick (1994) in his Presidential Address to the Academy bemoans the limited role of academic research in most major debates regarding business and management. Last year the *Academy of Management Journal* published a special issue on knowledge transfer between academics and practitioners, also because of the external relevance problem. The editors open their editorial with “There is a crisis in the field of organizational science. The principal symptom of this crisis is that as our research methods and techniques have become more sophisticated, they have also become increasingly less useful for solving the practical problems that members of organizations face” (Ryner, Bartunek & Daft, 2001:340).

- Hambrick (1994) feels that the major cause of the problem is a poor presentation of academic management research products and proposes various measures to improve this one-way communication. Ryner et al. (2001) are of the opinion that a major cause is the vast divide between the world of practitioners and the world of academics and propose to foster more interaction, more

two-way communication. The *nature* of academic management research and of the resulting research products themselves have not yet been named as a major cause of the external relevance problem. In this article I contend that that is the case. Common academic management research usually is description-oriented, i.e. it is largely aimed at describing and explaining managerial and organisational phenomena. This leads to research products like the causal model, best suited for *conceptual use* by practitioners, i.e. for general enlightenment of the issue in question. I'll argue that the external relevance problem can be reduced by complementing this type of research with more prescription-oriented research, i.e. solution-focused research aimed at developing knowledge to be used in designing solutions for classes of managerial or organisational problems. The typical research product of this type of research is – in terms of Bunge's (1967) philosophy of technology – the “tested and grounded technological rule”. This type of research product is suited for *instrumental use* by practitioners, i.e. in more specific and direct ways (see Pelz, 1978, for the distinction between conceptual and instrumental use of research results).

The discussion on external relevance and technological rules is put into historical perspective by comparing the scientization strategy of the field of Management, which transformed it from a practice-based craft into a research-driven science, with the scientization strategies of Medicine and Engineering, which I call “design sciences”. The typical product of a design science is the already mentioned tested and grounded technological rule. Subsequently the external relevance problem of academic management research is discussed, followed by an analysis of the nature of these tested and grounded technological rules in the field of Management and their differences with the typical research product of description-oriented research, the causal model.

EXPLANATORY AND DESIGN SCIENCES

One can make a distinction between “explanatory sciences”, like Physics, Biology, Economics and Sociology, and “design sciences”, like Medicine and Engineering (Van Aken, 1994, 2001a). The core mission of an explanatory science is to develop valid knowledge to understand the natural or social world, or – more specific – to describe, explain and possibly predict. The core mission of a design science is to develop knowledge which can be used to design solutions to problems in the field in question. Understanding the nature and causes of problems is a great help in designing solutions, but is not always necessary. Traditional Chinese medicine developed, for instance, powerful drugs for many diseases without knowing their causes and man was able to design and fly an aeroplane, before the laws of aerodynamics were formulated.

This distinction between explanatory and design sciences is, of course, similar to the one between the so-called “basic” and “applied” sciences. However, I prefer to avoid these terms as they suggest that sciences as Medicine and Engineering just apply the results of the true “basic” sciences, thus negating the extensive and significant scientific knowledge that those sciences developed themselves. The term “design science” is chosen to underline the orientation on knowledge-for-design (of solutions for real world problems), and not on action itself and the skills necessary for adequate action, which is the domain of practitioners,

Research in the Explanatory Sciences

In the explanatory sciences academic research can be seen as a quest for truth. It is description-oriented and it aims at shared understanding. The typical research product is the causal model, with the laws of nature of Physics as the example to follow. If such laws are beyond reach, as in most issues in the social sciences, the aim is to reach at least shared understanding of causal patterns, shared between the researcher and an informed audience (Peirce, 1960). The students in these

disciplines are trained to be researchers in order to be able to contribute to the collective understanding of their field.

Research in the Design Sciences

In the design sciences academic research objectives have a more pragmatic nature. Research in these disciplines can be seen as a quest for human performance. It is prescription-oriented, using the results of description-oriented research from supporting (explanatory) disciplines as well as from own efforts, but the ultimate objective of academic research in these disciplines is to produce knowledge that can be used in designing solutions to problems. Their students are trained to be professionals, able to use the general knowledge of their discipline to design specific solutions for specific problems. The training of researchers is largely seen as a by-product and the professionals are supposed to contribute to their disciplines by reflecting on their cases and publishing their insights to be used in handling similar cases. Most academic researchers started their careers as professionals.

The typical research product in a design science is not the causal model, but the technological rule.

TESTED AND GROUNDED TECHNOLOGICAL RULES

A technological rule is a prescription to follow if one wants to achieve in a certain setting a given outcome. Such a rule follows the logic of “if you want to achieve Y in situation Z, then perform action X”. There are *algorithmic* rules which operate like a recipe and which have typically a quantitative format and whose effects can be conclusively proven on the basis of observations through deterministic or statistical generalization. But there are also rules with a more *heuristic* nature, which can be described as “if you want to achieve Y in situation Z, then perform something like action X”. A heuristic prescription has a more abstract nature and is used by the professional to design a specific variant of it for application to his or her specific case. It has typically a qualitative format.

An example of an algorithmic technological rule is: in order to cure disorder Y in adult males, you follow a treatment consisting of taking 0.3 milligramme of medicine X during 14 days. An example of a heuristic rule is: in order to cure disorder Y in adult males, you follow for some weeks a course of treatment of rest, some exercises and a low fat diet. The more indeterminate nature of the heuristic rule makes it impossible to prove its effects conclusively, but it can be tested in context which can produce sufficient supporting evidence.

Technological rules don't have to be formulated in the format given above; that format is only given to describe the *logic* of a technological rule. For instance, in mechanical engineering a set of drawings of a certain transmission system with a description of its application domain and its advantages and disadvantages can be seen as a technological rule: use this system if you want to achieve in that application those advantages. In this article the term “technological rule” is used to designate the knowledge one may use to design an intervention (or series of interventions or artefact) to produce in a given setting a certain desired outcome.

Breakthrough by Testing and Grounding

Mankind has a long tradition in developing technological rules. Early man developed rules to produce artefacts like bow and arrow, and more advanced societies developed rules for e.g building complex irrigation systems along the Euphrates and the Nile and the medical insights of e.g. Hippocrates.

Over the centuries Engineering and Medicine made steady and significant progress, but their real break-through came through their scientization after the Enlightenment. This transformed those fields from practice-based crafts into research-based disciplines. They used the research methods and products of the natural sciences to develop – in terms of Bunge’s (1967) philosophy of science – *tested and grounded technological rules*. Their rules were tested, using the methods of the natural sciences and grounded on the laws of nature and other insights produced by those sciences. It is, for instance, possible to design a successful aeroplane by trial and error, like the brothers Wright proved, but the design of further improvements is much more effective and faster if that can be grounded on the research results from fields like aerodynamics and material knowledge. At first the actual development of technological rules in these design sciences was done predominantly by professionals, but later on increasingly also by academic researchers (to which one may add that academic recognition for the design sciences took quite some time and struggle, see e.g. Noble (1977) for the example of Engineering in the US).

THE SCIENTIZATION STRATEGY OF THE FIELD OF MANAGEMENT.

In the old days the field of Management was, like Engineering and Medicine in *their* old days, a practice-based craft. The early Business Schools employed experienced managers to teach to their students what they had learned in their long and successful careers. The mission of Business Schools was professional training and the literature was dominated by grand old men with a strong background in business like Taylor, Fayol and Barnard. In terms of the above-given distinction between explanatory and design sciences, the field of Management might have been called a design science.

But, like early Medicine and Engineering, the field was still a craft, not yet a science, not yet research-driven (apart from early examples like the work of Taylor and his followers and the work of the Human Relations school, both firmly based on empirical observations and experimentation). The watershed came with the influential Ford and Carnegie Foundation reports (Gordon & Howell, 1959; Pierson & Others, 1959), which started a scientization process, ultimately transforming the field into a solid research-based academic discipline, both in the United States and in Europe.

This transformation process could have followed the example of Medicine and Engineering, discussed above, which used the methods and research products of the explanatory sciences, while firmly remaining design sciences. In stead, the field of Management followed largely the example of the social sciences like Sociology and Economics and became more or less an explanatory science. The mission of the field became largely the classical trinity of description, explanation and prediction (see e.g. Nagel, 1979; Emory, 1985), or tried even to follow the statement of Seth and Zinkhan (1991, p.35) “the essence of science is explanation by law” (made in a discussion of the objectives to be pursued in research in strategic management). Prescriptions became academically suspect. A late example of the shift from prescription to description is the fact that one of the leading academic journals in the field, the *Academy of Management Review*, dropped as recently as 1999 its reference to some form of prescription by changing its aim of publishing articles that “advance the science *and practice* of management” (italics added) into an aim of understanding by publishing articles “that challenge conventional wisdom concerning all aspects of organizations and their rule in society” (see its instructions to contributors).

THE EXTERNAL RELEVANCE PROBLEM OF ACADEMIC MANAGEMENT RESEARCH

Whether or not this transformation from a design-oriented practice-based craft into a research-based explanatory science caused the external relevance problem, there is a long-standing academic debate on this issue. A leading academic journal, *Administration Science Quarterly*, devoted special issues on it in 1982 and in 1983. Beyer and Trice remarked in the first one, “Recently (...) scholars have expressed concern about why organizational research is not more widely used (Beyer & Trice, 1982, p.591). Thomas and Tymon (1982) cite an impressive list of criticisms with respect to the relevance of academic organizational research, while, according to a survey at that time, academics considered only some 20% of well-established academic organizational theories as having a better than questionable usefulness (Miner, 1984). In launching their new academic journal, *Organizational Science*, Daft and Lewin also expressed concern about the relevance of received academic organizational theories (Daft & Lewin, 1990). As already mentioned, Hambrick (1994) in his Presidential Address to the Academy showed grave concern with the external relevance of the field. In 2001 the *Academy of Management Journal* published a special issue on the interaction between academics and practitioners, also prompted by the problem of external relevance, which is – as said – seen by its editors even as a crisis (Rynes et al., 2001).

The remedies Hambrick (1994) and Rynes et al. (2001) proposed, viz. to improve the communication between academics and practitioners, certainly can reduce the external relevance problem. But that may be not enough. As yet, the nature of academic research products has not been subject of debate. The emphasis on description (plus explanation and possibly prediction) at the expense of prescription is not seen as an obstacle for greater impact on the world of management and business. This may be due to the idea

- that understanding the problem makes its solution trivial or just belonging to “the swamp of practice” (to cite Schön, 1983), or
- that conceptual use of research results, i.e. use for general enlightenment of the issue in question, is sufficient and that aiming for more instrumental use, i.e. use in more specific and direct ways, is unnecessary or the domain of practitioners, or
- that developing knowledge for designing solutions does not belong to the mission of academics (which would mean in terms of explanatory and design sciences, that all true academic disciplines ought to be explanatory sciences).

However, the thesis of this article is that, if one wants to address the external relevance problem one should aim for research products for instrumental use and complement the common description-oriented research, aiming for the classical trinity of description, explanation and prediction, with prescription-oriented research. Such research would aim for tested and grounded technological rules.

This call for more prescriptive academic management research does not mean that there is as yet no prescriptive literature. On the contrary, prescriptions abound in the so-called management literature (or “Heathrow-literature” in the terms of Burrell, 1989, or “Literature on Principles” in the terms of Whitley, 1988) and this literature is widely read by practising managers (or at least widely sold). But this type of literature usually has a generalisation problem (based only on the writers’ own experience) or a justification problem (being weak in providing evidence with respect to the effects of the proposed interventions). In this article we discuss tested and grounded technological rules, i.e. prescriptions justified by rigorous and objective testing and whose effects are understood by grounding them on an understanding of their generative mechanisms.

TESTED AND GROUNDED TECHNOLOGICAL RULES IN MANAGEMENT

Technological rules are prescriptions. Prescriptions to use a specific intervention, or series of interventions, if one wants to achieve in a given setting certain desired results. For example, to increase customer satisfaction use account management if you have a limited number of large and important customers, each with a variety of needs. Or, to decrease the throughput time of new product development, use concurrent engineering. Or, to achieve close co-operation between the partners of a strategic alliance, invest time and effort during the first phases of the alliance in building sound social relations and trust among the key players in the partner organisations.

Such rules are typically developed through multiple case-studies (see Eisenhardt, 1989 and 1991, and Parkhe, 1993, on the power of the multiple-case study). A series of cases is solved either by the researchers themselves (in the role of consultant), or by practitioners observed by researchers, and rules are developed by reflection and induction and subsequently further refined through still other cases (Van Aken, 2001b). The multiple case-study operates as a learning system: one learns how to produce certain desired outcomes.

Technological rules can also be developed on the basis of large scale quantitative studies, like the rule that one should use related, rather than unrelated diversification in designing and implementing growth strategies (Rumelt, 1972). But also in this instance it would be very interesting to do case-studies and to make cross-case analyses to get a real understanding what goes wrong and why, if one tries to set up unrelated diversification and, furthermore, to get more general understanding of the indications and contra-indications for diversification (see e.g. Bettis, 1981).

Justification through Testing

A key element of a technological rule resulting from academic research is justification. This is obtained through testing the rule in its intended context. At first during the above-described development of the rule by the researchers themselves through a series of cases and subsequently by third parties to get more objective evidence. Third party-testing counteracts the “unrecognized defenses” of the researchers (Argyris, 1996), which may blind them for flaws or limitations of their rules. This idea is borrowed from software development, where third-party testing is called beta-testing - see e.g. Dolan & Matthews (1993) - and testing by the software developers themselves alpha-testing.

Such beta-testing can be seen as a kind of replication research (see e.g. Tsang & Kwan, 1999), but its design-orientation makes that it has more in common with evaluation research of social programmes (see e.g. Guba & Lincoln, 1989, and especially Pawson & Tilley, 1997).

The alpha- and beta-testing of technological rules can give further insight in the indications and contra-indications of the rules and in the scope of their possible application, their application domain. For algorithmic rules testing can lead to conclusive *proof*. The more indeterminate nature of heuristic rules – and in Management technological rules will often be heuristic - makes conclusive proof impossible, but alpha- and beta-testing can lead to “theoretically saturated” *supporting evidence* (Eisenhardt, 1989).

Grounding on generative mechanisms

In Engineering and in Medicine grounding of technological rules can be done with the laws of nature and other insights from the natural sciences. In Management grounding can be done with insights from the social sciences. Normally, these are not given in the form of laws. Here one can use the concept of *generative mechanisms*, a concept taken from Pawson & Tilley (1997). They

developed this concept in their evaluation research of social programmes, like educational programmes and rehabilitation programmes.

Pawson and Tilley use what they call the basic realist formula *mechanism + context = outcome*. Any social programme can be seen as a coherent set of interventions, applied in some context by some body of actors in order to produce certain desired outcomes. The generative mechanism is the answer on the question “why does this intervention produce (in that context) that outcome?”

Pawson and Tilley discuss the example of a programme to improve the safety of a car park. The proposed measures include the closing of the car park for non-parking public and the introduction of close-circuit TV-camera's. The generative mechanism, then, for the first measure is that it will become more difficult for potential wrongdoers to enter the car park, while for the second one the possible generative mechanisms include that it will deter potential wrongdoers because they will believe that this will increase the chance that they will be apprehended. Insight in the generative mechanisms can help to design improved interventions. In the case of the closed circuit TV-camera's it is important that the camera's are very visible and that there are conspicuous signs in the car park, drawing attention their presence. Evaluation research is subsequently used to verify the putative generative mechanisms and to supply insight on possible additional mechanisms.

The generative mechanisms can have a “structure-” or an “agency-nature”. The mechanisms produced by the controlled entrance measure given above, is an example of a “structure-mechanism”, a “structure” external to the target group constraining or directing its behaviour. The mechanisms produced by the closed-circuit TV-camera's measure is rather an “agency-mechanism”, relying on influencing certain intentional behaviour of the target group.

Likewise one can ground technological rules in Management on the generative mechanisms that will produce the desired outcomes. Again these mechanisms are the answers to the question: “Why will this intervention produce in that context that outcome?” This “why-question”, of course, strongly resembles the key-question in description-oriented research, leading to some kind of causal model. One difference is the nature of the independent variable. In description-oriented research this is often a characteristic that is already present in the organization, while in prescription-oriented research it is a carefully designed intervention, which, furthermore, may be redesigned on the basis of lessons learnt from testing and grounding (then to be tested again). In description-oriented research the dependent variable is often some operationalisation of overall organisational effectiveness (which is notoriously difficult to explain in terms of a limited number of independent variables, see e.g. Lewin & Milton, 1986 and March & Sutton, 1997). In prescription-oriented research the dependent variable is rather related to some more operational objectives, like an increase in brand recognition or a reduction of overall inventory.

As in evaluation research on social programmes, discussed above, in the field of Management the answers on the “why-question” may be given both in terms of “structure” generative mechanisms and in “agency” generative mechanisms. An example of the use of a “structure-mechanism” as generative mechanism is Goldratt's Theory-of-Constraints (Goldratt and Cox, 1986). The rule is that in managing a factory one should focus on optimising the use of the constraining capacity group. The generative mechanism is that it is this group that determines the output of the factory as a whole. An example of the use of an “agency-mechanism” can be found in Tichy's TPC-model. (Tichy, 1983). One rule is that if a given strategic change hurts the real interests of a certain subgroup, one should use political interventions rather than technical or cultural ones. The generative mechanism is that technical, i.e. content-oriented interventions will demonstrate even more clearly to that group that their interests will be hurt, which will not help to overcome their resistance to the change, that cultural interventions, i.e. inviting participation, will give them the opportunity to organise a coalition against the change, while political, i.e. power interventions can be accepted as being the duty of top management to act in the interests of the organisation as a whole.

Testing a rule can provide both driving and blocking generative mechanisms. Cases where the rule works less well can be at least as interesting as successful ones, as they give insight in those blocking mechanisms or in limitations of the application domain.

Application of Technological Rules

An algorithmic rule can more or less be applied as a recipe. A heuristic rule is rather a *design exemplar*. It is a tested and well-described example of a course of action, a series of interventions, which the practitioner can use to design a specific variant of that design exemplar for his or her specific situation. This translation from the general to the specific necessitates a deep understanding of the rule and the mechanisms driving or blocking its effects and hence it needs thick descriptions (Geertz, 1973) and the rich evidence from testing it under various circumstances (as well as, of course, a deep understanding of the specific situation for which the specific intervention(s) have to be designed).

Description-oriented Research compared to Prescription-oriented Research

More emphasis on prescription-oriented research, as discussed above, does not mean that the results from common description-oriented research have no relevance. On the contrary, such results may be used for developing hypotheses on generative mechanisms producing desired outcomes. For instance, motivation theory can be a great help in understanding the above-discussed “agency-mechanisms”.

Furthermore, description-oriented research results can be reformulated in terms of technological rules, like

- if you want to realise a large-scale, complex strategic change, use a process of logical incrementalism (Quinn, 1980)
- if you want effective realisation of the outcomes of strategic decision-making, promote perceived procedural fairness (Korsgaard, Schweiger & Sapienza, 1995) and active participation of middle management (Woolridge & Floyd, 1990)
- if you want to manage the activities within the operational core of a professional organisation, use standardisation of skills rather than direct supervision (Mintzberg, 1979).

Compared to sound prescription-oriented research, however, a major difference is testing. In descriptive academic articles possible “rules” are often formulated as managerial implications in their last pages and these are not tested as such by the authors and even less so by third parties, the above-discussed beta-testing. Another difference is that testing and grounding can make the rules much more sophisticated. It is one thing to suggest that active participation of middle management in strategic decision-making is important, but quite another to set up effective participation and that is not just an issue of filling in some practicalities.

Still another difference is that prescription-oriented research is solution-focused, aiming at developing and testing solutions, while description-oriented research usually is rather problem-focused, aiming at understanding the problem and detecting its causes. As said, understanding can be a great help in developing solutions but full understanding is not always necessary. And – more importantly – understanding a problem is usually only halfway in solving it. Understanding the sources of resistance to certain organisational changes, still leaves undone the task of developing sound change programmes. Understanding the changes on certain markets still leaves undone the task of developing successful strategies.

Furthermore, in description-oriented research understanding may be partial. One can limit descriptive research to a specific aspect or component of a complex system. In prescription-oriented research the testing of a rule is in principle holistic: it is tested in context and both known

and unknown factors contribute to its effects. Which also means that even with solid grounding there will always be factors present which remain wholly or partially unknown. Or, in other words, even grounded technological rules usually retain to some extent a black box character.

To conclude table 1 gives an overview of the differences between description and prescription-oriented research.

<i>characteristic</i>	<i>Description-oriented research</i>	<i>Prescription-oriented research</i>
dominant paradigm	explanatory sciences	design sciences
focus	problem focused	solution focused
typical research question	explanation	alternative solutions for a class of problems
typical research product	causal model; quantitative law	tested and grounded technological rule
nature of research product	algorithm	heuristic
justification	proof	saturated evidence
testing	possibly partial	in context ; holistic

Table 1. The main differences between description-oriented and prescription-oriented research.

CONCLUSION

The development of tested and grounded technological rules by design-oriented research can reduce the external relevance problem of academic management research, because their nature makes them better suited for instrumental use by practitioners than the causal models and other research products from common description-oriented research. Description-oriented research will remain relevant to understand management problems and to provide insights for the grounding of technological rules, but it should be complemented with design-oriented research producing research products for instrumental use by practitioners.

Design-oriented research is not new, see e.g. Thoelke (1998) and Keizer, Halman & Song (2001). The point is that it tends to be frowned upon by many academics and by referees from (top-ranking) academic journals and that it is, therefore, not yet done very often. This article is written in the hope that that may change.

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