Theory Building through Conceptual Methods

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Introduction

Researchers generally agree[1-4] that there is a major need for theory-building research in Operations Management (OM). For example, "[There is a] lack of high-quality *theory-building* effort in the OM area"[1, p. 796]. Moreover, "... OM research has [had] a very distinctive focus; it is the application of operations research, statistical theory, and computer-simulation experiments to operations management problems in order to derive *prescriptive solutions*". This observation is confirmed by others. "Although the proportion of empirical P/OM research is increasing, relative to P/OM modelling research, empirical P/OM research with a strong conceptual and methodological base is less common"[2, p. 251]. That is, OM researchers have been preoccupied with building quantitative models – sometimes empirical but usually deterministic or stochastic – which scholars in most fields would classify as theory-testing rather than theory-building research.

Unfortunately, there is a dearth of theories in OM, particularly theories which are specific enough to allow the formulation of hypotheses and propositions which can be tested. Instead, OM researchers have used sophisticated and powerful theory-testing methods of hypothetical constructions of operating systems which have little relation to reality and offer little or no utility to managers responsible for managing those systems in the real world. As a result: "... practitioners consider most OM research to be irrelevant"[1, p. 798].

The normal cycle[3,5] of research from description to explanation to testing with continuing iteration through this cycle is shown in Figure 1. Throughout this iterative process, descriptive models are expanded into explanatory frameworks which are tested against reality until they are eventually developed into theories as research study builds upon research study. The result is to validate and add confidence to previous findings, or else invalidate them and force researchers to develop more valid or more complete theories.

Sometimes, however, this cycle is short-circuited through the skipping of one of the stages. This can happen with any stage. If, for example, the research in a field simply iterates between testing and description, then the explanation stage is ignored and frameworks and theories are never developed; just non-explanatory models (as defined below). That is, descriptive "black boxes" are developed which simulate or replicate reality but no understanding of the phenomenon occurs. Managers are then unwilling to accept the results of the models, since they would rather live with a problem which they understand than accept a solution which they do not understand.

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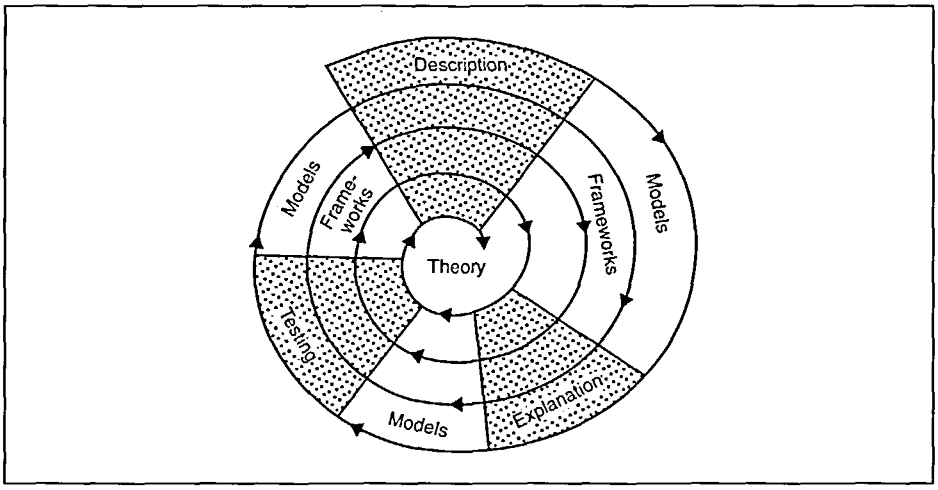

Figure 1.
The Normal Research Cycle

Similarly, if the testing stage is ignored, then the research iterates between description and explanation. There is thus no opportunity to evaluate and build on earlier models, frameworks, or theories and the field never progresses – each new explanation takes the field in a new direction. The result of this research is then a collection of what we term "war stories".

And, if the description stage is ignored, the research in the field iterates between explanation and testing; hence the term "theory-testing research". The result is that the research "findings" become more and more disconnected from the real world and irrelevant to the reality of the problems facing managers. These findings we call "ivory-tower prescriptions". This is currently the situation, to a large degree, in operations management (see Figure 2).

That is, by largely excluding the messy, real world details from the research process, the research cycle in OM has short-circuited the "description" stage. The result has been continual reiteration of the "testing" and "explanation" stages without ever checking the external validity of the research conclusions. Hence OM research has become increasingly less realistic, and thus less relevant to operations managers. Lin warns against this danger with the admonition: "Plunging into functional modelling without sufficient theoretical and empirical examination usually brings confusion and frustration to the theorist"[6, p. 52]. Similarly: "Because past operations management research lacked an empirical dimension, [there is a need to increase] the pace and quality of descriptive, empirical investigations in the area"[1, p. 794].

The use of conceptual research methods based on descriptive, empirical investigation can significantly increase the external validity of OM research conclusions and thus their corresponding relevance to managers. Conceptual methods, building primarily on description and explanation, lead to a better balance between theory-building and theory-testing research. Next we clarify the terminology involved in conceptual research and discuss the publication frequency and acceptability of conceptual research methods.

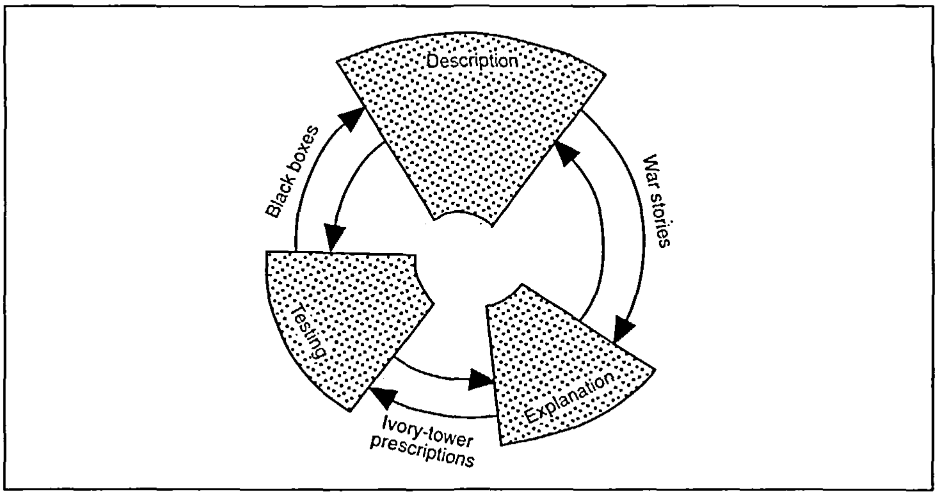

Figure 2. Dysfunctional Research Methodologies

Conceptual Modelling and Methods

A model is a "simplified representation or abstraction of reality"[7, p. 30]. It describes, reflects, or replicates a real event, object, or process but does not "explain" it[5, pp. 72, 95]. The primary difficulty in using models to analyse situations is obtaining adequate simplification, while maintaining sufficient realism. There are three major types of models, each with increasing degrees of abstraction[7]. Iconic models, the least abstract, are physical replicas of a system or situation but usually on a different scale from the original: a scale model of a bridge, a photograph, or a Tinker-toy version of a molecule.

An analogue model, the next level of abstraction, does not physically look like the original system but behaves like the relevant portion of it: an organization chart, a colour map, the blueprints of a house, an oil dip-stick, an hour-glass. Last, symbolic models are the most abstract and allow the greatest manipulation for purposes of analysis: mathematical equations, Monte Carlo stochastic simulations, Boolian logic statements.

A concept[5, pp. 72, 77, 91, 95; 8, p. 23] is a bundle of meanings or characteristics associated with certain events, objects, or conditions and used for representation, identification, communication, or understanding. Some examples are "table", "hot", and "conference". A construct is an abstract form of concept which cannot be observed directly or indirectly but can be inferred by observable events. Examples are "motivation", "focus", "intelligence", and "*Gestalt*". Propositions identify functional relationships between two or more concepts. Examples might be: "more A gives more B", "A moderates B's impact on C", or "familiarity breeds contempt".

A conceptual model is thus a set of concepts, with or without propositions, used to represent or describe (but not explain) an event, object, or process. Any propositions identified in a conceptual model are merely logical statements rather than epistemological relationships[6, p. 43]. Yet conceptual modelling is more an interpretative than a formally rational research method[3, p. 316]: "... a mental model of the suspected relationships is posited, which may then be evaluated by means of a framework that captures the essence of the system under investigation".

There are only a few attempts at classifying the different types of conceptual research methods. For example, using the term research "strategies", Reisman[9] has identified ripple strategies, embedding strategies, bridging strategies, technology transfer strategies, creative application strategies, structuring strategies, and empirical validation strategies. Similarly, Lin[6] identifies different "levels" of conceptual methods: classificatory, typological, contingency, associative, and functional, with each level coming closer to true theory in terms of multiple concepts and epistemic propositions.

Conceptual Research Publication History

Table I illustrates the distribution of operations management articles during a recent five-year period by type of research approach. As can be seen, and as verified by others (e.g.[1]), articles based on conceptual research methods represent a relatively small proportion (14 per cent) of the total number of articles. Furthermore, theory-testing articles (those based on quantitative modelling, simulation, and laboratory experimentation) represent 70 per cent of all the published work in the field.

Similarly, based on a survey[1] of articles published in one year, 1987, the percentage of theory-testing articles (operations research, management science, statistical theory, and simulation) was even higher, at 85 per cent, possibly indicating a trend away from theory-building research. For some of the journals, no theory-building articles were represented at all; they were all theory-testing. And in a review of pipeline research, as represented by conference proceedings[4, p. 261], conceptual research methods constituted only 9 per cent of the research methods being used.

Research approach	Journal publications[a] (%)	
Modelling	38	
Simulation	31	
Conceptual	14	
Survey	7	
Case study	5	
Field study	4	
Laboratory experimentation	1	
	100	(N = 362)

[a]1982-87 issues of: *Journal of Operations Management, Decision Sciences, Management Science, International Journal of Production Research, International Journal of Operations & Production Management, IIE Transactions, Decision Sciences Institute Proceedings, Harvard Business Review, California Management Review, Sloan Management Review, Strategic Management Journal*

Table I.
Research Publications in Operations Management

Rather than demonstrating a trend of decreasing interest in theory building, these statistics may instead indicate a lack of awareness of the importance of theory-building research methodologies on the part of both researchers and journals. Although basic to theory building, there is a surprising lack of knowledge about conceptual research methods. Thus, the remainder of this article describes the more common conceptual models and how they can be extended into frameworks and, eventually, theories. Examples of these conceptual models, frameworks, and theories are also included.

Conceptual Research Methodologies

Table II lists seven different types of conceptual research methods. The first three – conceptual description, taxonomies and typologies, and philosophical conceptualization – are basic conceptual models, as defined earlier. The second three – conceptual induction, conceptual deduction, and conceptual systems – are explanatory conceptual frameworks: a collection of two or more interrelated propositions which explain an event, provide understanding, or suggest testable hypotheses[10]. The last one, meta-frameworks, constitutes the final objective of conceptual methods – theory: a coherent group of interrelated concepts and propositions used as principles of explanation and understanding.

In further definition of theory, and to clarify the distinction between frameworks and theories, Dubin[11] identifies five requirements for a theory:

(1) Allows prediction or increased understanding.
(2) Is interesting (i.e. non-trivial).
(3) Includes attributes or variables and their interactions.
(4) Does *not* include "composite" variables (i.e. variables which include a number of other variables, elements, or attributes which are undefined).
(5) Includes boundary criteria.

Following the example of Naumann[10], any conceptual model which includes epistemic propositions or explanatory elements, yet does not fulfil all five of the theory requirements detailed above, is classified as a framework. A framework is essentially a pre-theory and may well substitute in many ways for a theory.

Conceptual models
1. Conceptual description
2. Taxonomies and typologies
3. Philosophical conceptualization
Conceptual frameworks
4. Conceptual induction
5. Conceptual deduction
6. Conceptual systems
Theories
7. Meta-frameworks

Table II. Types of Conceptual Methods

That is, like theory it may identify relevant variables, classify them, describe their interactions, and allow a mapping of items (such as the existing literature or research studies) on to the framework.

Conceptual Models

Our discussion in this subsection concerns three types of conceptual models: conceptual description, taxonomies and typologies, and philosophical conceptualization.

Conceptual Description

This type of research is primarily descriptive in its modelling of an event or phenomenon. The conceptual model may be well-structured (e.g. a PERT diagram, a Gantt chart, or an organization chart) or ill-structured (e.g. a fish-bone diagram, a textual report). Also the description may be highly simplified or extensive. And it may represent the interest of the researcher/observer or that of the participant, depending on the purpose of the description. Again, a model does not explain *why* things happen; just that these are the relevant concepts (elements) and propositions (arcs or relations) which describe the phenomenon.

Taxonomies and Typologies

Taxonomies are listings of items along a continuous scale. The items may be classified under different headings and subheadings but they all have a relative position on the continuum which allows them to be "ranked" in order. For example, our discussion here is ranking the types of conceptual methods in order of least explanatory power (conceptual description) to most explanatory power (meta-frameworks). For ease of understanding we subdivide the methods according to categories such as "frameworks" and "models".

Typologies are two- or higher-dimensional taxonomies, where one dimension is inadequate to classify properly an item and one or more other measures are also needed. Again, the classification does not explain the relationships but simply describes the situation more accurately than other descriptions. Operations management literature is replete with such typologies, particularly the ubiquitous 2×2 matrix.

Philosophical Conceptualization

This type of theory building results from inductive philosophical reflection. It basically integrates a number of different works on the same topic, summarizes the common elements, contrasts the differences, and extends the work in some fashion. For example, it may identify an overall concept or construct (e.g. "focus" or "economies of scope") or add concepts or propositions to an existing body of knowledge (e.g. in manufacturing strategy).

At the more common, less insightful level this activity results simply in a "tutorial" on some particular topic (e.g. shift scheduling). At the more creative, theory-building level, the research has an "ah-ha" experience, as he or she suddenly sees connections and patterns in what was heretofore just a series of inexplicable events or studies (e.g. the build-to-forecast problem[12]). Clearly, the research must be thoroughly immersed in the topic under consideration in order to pull the commonalities and patterns into a unique, insightful perspective.

Conceptual Frameworks

The distinction between frameworks and the simple conceptual models described above is not the complexity of the model but rather its explanatory power. Again, there are three types of frameworks which will be described here: conceptual induction, conceptual deduction, and conceptual systems.

Conceptual Induction

In this approach, a number of occurrences of a phenomenon are analysed to infer the nature of the system or treatment which produced them. In some situations, the "system" might simply be a human interpretation or conceptualization for which explicit rules have never been explicated. An excellent example of this is Wynn and Robak's[13] analysis of the winning papers in the annual Practice of Management Science Edelman Prize contest to ascertain the underlying characteristics of what judges consider to be outstanding applications of management science.

With conceptual induction, the objective is to explain a phenomenon through the relationships observed between the system's elements. That is, the goal is not only to describe the phenomenon accurately but also to explain *how* it occurs. In fact, the accuracy of the description is usually based on the consistency between the explanation inferred and the description of the phenomenon, particularly its elements and relationships.

Conceptual Deduction

With conceptual deduction, a framework is postulated and its ramifications (or predictions) are detailed for comparison with reality, as well as to provide guidelines for managers. The product-process matrix of Hayes and Wheelwright[14] is such an example, because it "explains" the relationship between the production process and the product's life-cycle volumes. It also guides managers as to the best production process for specific volumes and the difficulties likely to arise from "off-diagonal" positions. Thus the product-process framework helps to explain to managers and researchers what is happening.

The question frequently arises as to the basis for the formation of the original conceptual framework – is that process not induction? Indeed, the researcher may well be integrating a number of instances in the process of forming the conceptual framework in the first place, which would be conceptual induction. However, induction stops with the conceptual framework and deduction begins with the ramifications and predictions of the framework, regardless of whence it came or how it was formulated.

It should also be noted that deduction is not necessarily from the singular to the many, as Sherlock Holmes was famous for his ability to make a single deduction from many fragments of evidence. The critical difference is that deduction leads to inescapable conclusions, whether one or many, based on either one or many elements. Induction is a process of inference, which may well be incorrect. Of course, deduction may be incorrect also, but then the framework was invalid in the first place.

Conceptual Systems

This type of framework is characterized by the many interactions occurring among the elements of the conceptual framework. That is the conceptual system consists of multiple concepts with many interrelated propositions. The system is typically as complex as a theory but fails to satisfy at least one of Dubin's five requirements for a theory.

Some examples of conceptual system frameworks include Saladin's[15] conceptual framework of the field of operations management, Schonberger's[16] framework of the effects of Just-in-Time (JIT) on production management, and Skeddle's[17] framework of the capital investment decision process for the float-glass innovation. All three of these examples satisfy the first three of Dubin's five requirements but are incomplete on one or the other, or both, of the last two.

Theories

A theory may be as simple as a straightforward framework, yet satisfy Dubin's five requirements. Some well-known examples from management are Weber's theory of bureaucracy, Herzberg's two-factor theory of motivation, and Maslow's theory of human needs. In the field of OM we have fewer well-recognized theories based on empirical work; almost all our "theories" are postulated quantitative models, such as inventory theory or queueing theory.

Meta-frameworks

One way of forming theories is the compilation and integration of previous frameworks (thus a "meta-framework"), while avoiding composite variables and clearly defining the boundaries of the theory. An example of this approach is Gerwin's[18] theory of technology adoption and implementation. Here he integrated three frameworks concerned with adoption, preparation, and implementation by identifying their interactions, eliminating all composite variables, and delimiting the boundary of theoretical applicability.

Conclusions

The descriptions of conceptual methods above have not included much discussion of their validity. In many research situations, the credibility of the model, framework, or theory is gained through its simple face validity (the intuitive recognition of its correctness). This can be both advantageous and disadvantageous. It provides for more immediate acceptance, particularly in the managerial community but, if wrong, it reinforces incorrect assumptions or beliefs and may lead to highly erroneous managerial decisions. You will recall from Figure 1 that building *valid* theories requires empirical testing and, usually, reiteration of the research cycle. That is, theory building and testing go hand in hand to establish valid theories which will be useful to managers as well as researchers.

However, in order to achieve this objective it is critical to start building useful, empirically-derived theories in the first place. To continue the dysfunctional theory-testing mode of constant iteration between explanation and testing without ever checking back to the empirical description stage will continue to take us further afield from our true responsibility to operations managers: building valid operations management theories.

The use of conceptual research methods offers a significant improvement in our ability to build valid theories in operations management. They lead naturally to synthesizing previous research, thus building on earlier studies, and depend heavily on real-world description, thereby serving as a check on the external validity of our research findings. As a research methodology, conceptual methods should have a bright future in operations management.

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