

Theoretical developments in manufacturing strategy literature

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Abstract

For investigating the extent of theory development in manufacturing strategy (MS), empirical quantitative literature in MS is categorized into reporters, testers, qualifiers, builders, and expanders following the taxonomy of Colquitt and Zapata-Phelan (2007). Trends, analyses, and future research directions are provided both in terms of theory building and theory testing.

Keywords: Theoretical development, manufacturing strategy, theory building

INTRODUCTION

The interest in developing theory in the discipline of OM grew slowly during the 1990s. Although, the concept of manufacturing strategy (MS) started to gain importance since the 1960s. The focus in the early years was primarily on understanding the concept and components of MS (da Silveira and Sousa, 2010; Schroeder et al. 2002; Skinner 1974). Subsequently, researchers focused on approaches, processes and models for developing MS (Barad and Gien, 2001; Nair and Swink, 2007; Stratman et al. 2004; Wang and Cao, 2008). In 1998, however, a special issue was published in the Journal of Operations Management in order to emphasize the need of theory development in OM discipline and to familiarize OM researchers of the ways of developing theory. Melnyk and Handfield (1998) attributed the lack of unifying theory in OM as an ultimate reason that enforced scholars to borrow theories from other disciplines such as organizational behavior, marketing, and management science. Besides, OM researchers found it imperative to refine and clarify the ambiguity in theory development process through the use of different research methodologies (Handfield and Melnyk, 1998; Wacker 1998). This was something highlighted by Swamidass (1991) as well when he emphasized the need for empirical

theory development in OM. A number of researchers focused on conducting empirical research for the purpose of indigenous theory development in the OM discipline (that includes MS).

The extent to which theoretical developments have taken place in the discipline of OM in general and MS in particular is a question that remains to be answered. Williams and Plouffe (2007) outline that the evaluation of the previous body of knowledge through literature review is “a critical step in any discipline’s growth and maturity”. Empirical research in MS evidences a growing body of literature in this discipline. Despite the vastly available literature in MS (Chatha and Butt, 2015; Dangayach and Deshmukh, 2001), there is no evidence, in the previous MS studies, of a literature review from the perspective of theoretical developments. This paper attempts to fill this gap by reviewing empirical quantitative papers in the discipline of MS. The attempts to answer to following questions: (1) what is the extent of theory development in MS literature, (2) what trends in theory development are being followed in MS literature, (3) what is the level of indigenous theories versus borrowed ones from other subdomains of management? The extent and the trends of theory development in MS literature are identified through analyzing empirical quantitative articles published in top-tier refereed international journals. Content analysis is used as a systematic method for making these analyses. At the same time, the taxonomy of Colquitt and Zapata-Phelan (2007) is used to categorize the articles. Subsequently, the publication trends are identified for each article type.

The paper is arranged in the following manner. Section 2 describes the current state of theory development in the MS literature. Section 3 describes the steps used in carrying out content analyses. Section 4 demonstrates the research findings while Section 5 provides the discussions on the findings as well as limitations of this research.

THEORY DEVELOPMENT AND MS LITERATURE

Literature reviews in MS can be conducted from three distinct perspectives. Thematic developments, that emphasize MS content (Bozarth and McDermott, 1998; Chatha and Butt, 2015b; Dangayach and Deshmukh, 2001; Miller and Roth, 1988; Minor et al. 1994; Schroeder et al. 1986; Swink and Way, 1995) and the process of devising MS (Boyer 1998; Kim and Arnold, 1996); methodological developments, comprising mainly of the identification of research methods and designs in the previous body of knowledge (Chatha et al. 2015a; Dangayach and Deshmukh, 2001; Minor et al. 1994); and theoretical developments, comprising of the use and development of theory in the MS literature (Bendoly et al. 2006; Ketokivi and Schroeder, 2004).

In the broader discipline of OM, there are several studies that have raised the need of theory development. Wacker (1998) classifies that theory building research methods in OM can be categorized into analytical and empirical. He also reviews literature between the years 1991-1995 to identify which research methods have been used the most for theory building purposes. Bendoly et al. (2006) conduct a literature review on behavioral research in OM from the year 1985 to 2005. They develop a framework of behavioral assumptions for organizing behavioral OM literature. Lewis (1998) provides a theory development process, named iterative triangulation, a structured process and explicit methodology that enables the comparison of case studies to facilitate the development of useful, innovative and clear OM theory. Handfield and Melnyk (1998), in order to clarify ambiguity in theory development, offer a theory building process drawn on the initial model of Wallace (1971). Malhotra and Grover (1998) have recommended the use of exploratory surveys to govern the relationship among variables and developing a theory. They provide a framework for building new constructs and scales in OM.

Though, these researchers developed and illustrated the use of methods and approaches for theory development in the discipline of OM, only a few studies have focused on investigating the extent of theory development in the discipline of OM in general. Moreover, none has focused on understanding the extent of theory development in the sub-domain of MS.

METHOD

Selection of Articles

The keywords of “Manufacturing Strategy” or “Manufacturing Strategies” were searched in either the *title*, *abstract* or *full-text* search fields in Business Source Premier. The research engine provided a total of 2447 articles published from 1966 to 2015. From the 2447 articles, 684 articles were shortlisted based on operations management related journal ranking schemes of Dangayach and Deshmukh (2001), Olson (2005), and Vastag and Montabon (2002), Vokurka (1996). These ranking schemes were used to shortlist articles and avoid exclusion of the important ones. The articles were further screened by two independent researchers for ensuring their relevance for the current research. This screening resulted in 574 articles for further analysis. These 574 articles were categorized into empirical and conceptual articles and then into quantitative and qualitative (Nakata and Huang, 2005). The cautious screening resulted in shortlisting of 133 empirical quantitative articles for further analysis.

Coding of Articles

Employing the framework by Colquitt and Zapata-Phelan (2007), theoretical developments in MS literature were assessed in terms of “building new theory” and “testing existing theory” (or more succinctly theory prediction). Theory building refers to the extent to which an article explains existing theory, establishes a relationship, or introduces a new construct that structures a new theory. Besides, theory testing captures the essence of prior established propositions in relation to the existing theory in empirical studies. Each dimension is ranked into five levels with “1” being the lowest rank and “5” being the highest. Therefore, an article could be categorized as one of the followings: *reporter*, *builder*, *qualifier*, *tester* or *expander*.

The shortlisted articles in MS were categorized using this method. An example is given in table 1. This article was examined keeping in view the five levels of theory building and theory testing. This article mainly examined effects that had been previously theorized, so the article was marked as “yes” in level-2 of the theory building dimension. For theory testing dimension the article predicted theory on the basis of past references i.e. level-2, conceptual arguments i.e. level-3 and existing models and frameworks i.e. level-4. All these levels were marked “yes” for theory testing dimension. The overall categorization of this article was marked as (2, 4) taking the highest levels in each dimension, which makes it a “qualifier” as per Colquitt and Zapata-Phelan.

Using google scholar, the number of citations for each article since its publication were identified to calculate citations per year for each article. Two researchers led the research work. A research associate conducted analyses of the shortlisted articles under their supervision, with daily short meetings for clarification of concepts and weekly meetings for progress review.

Table 1: Example for Theory Categorization

Paper title	Theory building					Article Categori- zation	Article Type
	1	2	3	4	5		
	Attempts to replicate previously demonstrate d effects	Examines effects that have been the subject of prior theorizing	Introducing a new moderator or mediator of an existing relationship or process	Examines a previously unexplored relationship or processes / Model	Introducing a new constructs		
Linkages between manufacturin g strategy, benchmarking , performance measurement and business process reengineering	No	Yes	No	No	No	(2,4)	Qualifier
	Theory Prediction						
	1	2	3	4	5		
	Is indicative or ground predictions with logical speculations	Ground predictions with references to past findings	Ground predictions with existing conceptual arguments	Ground predictions with existing models, diagrams, framework or figures	Ground predictions with existing theory		
	No	Yes	Yes	Yes	No		

RESULTS

Descriptive Statistics

Table 2 shows descriptive statistics and zero-order correlations for the theory building and theory testing (or prediction), together with the citations and coded years. The mean score for theory building, 3.44 (s.d.=1.190) suggests that on average the quality of theory building falls between introducing a new moderator / mediator in an existing relationship and examining a previously unexplored relationship.

Table 2 - Descriptive Statistics

	Mean	Std. Deviation	1	2	3	4
Theory_Building	3.44	1.19	1			
Theory_Testing	4.07	0.809	.165 [†]	1		
Coded_year	37.71	7.292	.197 [*]	.274 ^{**}	1	
Citations	120.81	246.164	0.128	0.132	-.282 ^{**}	1
Citations_per_yr	9.0702	13.57714	.178 [*]	.185 [*]	-0.087	.939 ^{**}

n = 133 Empirical articles.

† p< .10; *p< .05; **p< .01

The mean score for theory prediction, 4.07 (s.d.=.809), shows that on average the theory testing is as good as predicting the new theory on the basis of existing models, diagrams, or figures. There is a weak positive correlation (0.165⁺) between the two, suggesting both components of theory development are self-directed. The positive correlation between the coded year and theory building (.197⁺) and theory testing (.274^{**}) shows that more recent articles comprised of a higher level of theory prediction and lower level of theory building. The “citations per year” was found to have significant positive correlation with theory building and theory prediction.

Trends in Theory Building and Theory Testing from 1966 to 2015

Figure 1 provides trends in theory building and theory testing. The mean score of theory testing has been hovering around 3.8 (or so) since 1990, however, for the last one decade this trend is on the rise. This upward trend can be attributed to MS researchers’ awareness of the need of explaining MS phenomena on the basis of sound theoretical frameworks, models, and / or existing theories (indigenous or borrowed from other sub-domains of management). Theory building, on the contrary, shows variation since 1990 owing to the researchers’ apprehension that lower contribution in theory development might not be admired by the top journals. This apprehension disappeared by recognizing the need for establishing indigenous theories in OM to facilitate researchers (Meredith 1993), confirming or refuting previously established results (Handfield and Melnyk, 1998; McCutcheon and Meredith, 1993) and to provide new insights in the field of POM (Malhotra and Grover, 1998).

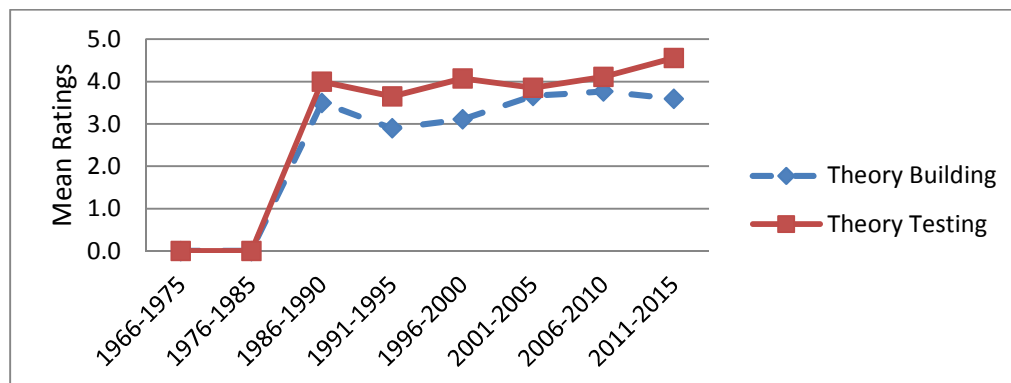


Figure 1 - Trends in Theory Building and Testing from 1966 to 2015

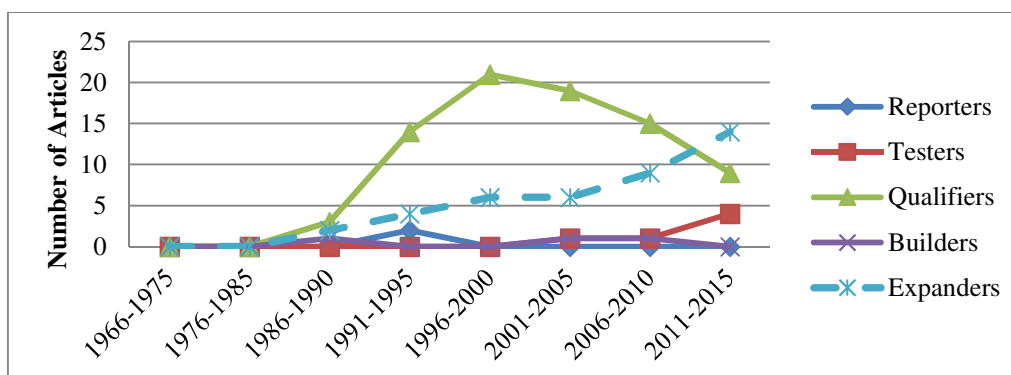


Figure 2 - Trends in Article Type from 1966-2015

Figure 2 provides publication trends for each article type i.e. reporter, tester, qualifier, builder, and expander. During the years 1991-1995, ten percent of the articles were *reporters* which dropped down to zero in the later years. *Testers* lingered around 3.7% during 2001 to 2010 which subsequently grew to 14.8%. *Qualifiers*, amassing around 80% of the articles, represent the highest peak during 1996-2000. *Builders* hovered around 4% of the total studies without any visible trend over the years. *Expanders*, which once constituted the slightest portion, have taken up the largest fraction at present among all article types.

Theory Building, Theory Testing, and Article Impact

Table 3 provides the results of regression analysis to show relationships among the coded years, theory building, and theory prediction. The regression model represents that 16 percent of the variance in citation per year is explained by the model. The expanders are taken as referent, where four dummy variables are representing remaining categories of articles. The results show that expanders are cited higher than all other four article types. Reporters and qualifiers receive about 16.8 and 9.6 lesser citations respectively on average than expanders and the results are significant. Builders and testers, on the other hand, showed insignificant results. This is perhaps for the reason that testers and builders are the least researched article types in the MS literature.

Table 3 - Article Types and Article Impact

Model	Citation_per_yr		Unstandardized Coefficients	t	F Statistics
	R ^R	Adjusted R ^R	Beta		
Coded_year	0.16	0.08	-0.29	-1.75 [†]	3.38***
Reporter			-16.8	-1.75 [†]	
Testers			-8.51	-1.48	
Qualifiers			-9.6	-3.77***	
Builders			-2.87	-0.37	

a. Dependent Variable: Citation_per_yr

[†] p<.10; *p<0.05; ***p<0.001

DISCUSSIONS

Recognizing the need and the importance of theory development in OM, growingly more research is focusing on both theory building and theory testing. MS literature shows a higher level of development in theory testing (or prediction) than in theory building. Low level of development in theory building can be attributed to obstacles such as the availability of extensive and mass research previously available in other subdomains of management that inhibited the need of indigenous theory development in MS / OM, the need for extensive research and data gathering for theory development purposes, intricacy in the multilevel theory development owing to the differences in interests, principles and heuristics of researchers (Klein et al. 1999), the factors considered generally true for other subdomains of management as well. The following provides some insights into the various type of articles being produced in MS literature.

Expanders

Expanders contain highest levels of both theory building and theory testing and are found to be more impactful. These articles provide new insights and add to theory development through introducing new constructs or taxonomies in order to better capture the phenomena (Schmenner and Swink, 1998). Wacker (1998) stresses the importance of uniqueness and generalizability in new constructs. Lewis (1998) attributes a theory's quality to the extent to which it is scientific, innovative and useful, in addition to, operationalizability of constructs (McCutcheon and Meredith, 1993). Expander articles touch upon these dimensions and bring about new constructs and taxonomies in the MS literature by making narrating the novel ideas presented in each expander through making reference to the existing theories. These articles excite researchers to conduct more innovative work and are resulting into more expander articles in MS.

Builders

Builders assume a second place among most impactful articles (shown in table 3). Builders serve indigenous theory building by establishing novel ideas through the development of constructs, taxonomies or re-definition of the previously established constructs. Melnyk and Handfield (1998) specify that MS should incorporate their own theories to lessen the need of borrowing theories from other disciplines. In this regard, Hempel's (1966:15) recommends that rather than assuming the previously established ideas and theories universally, creative and productive imagination should be considered as a key to building theory. Builders present new constructs by carefully analyzing existing conceptual arguments as well as making references to the empirical evidence e.g. enterprise resource planning (Stratman and Roth, 2002), or re-define existing concepts e.g. agility as manufacturing strategy (Zhang and Sharifi, 2007). We identify a total of 10 new constructs and 3 taxonomies that have been introduced in the empirical quantitative MS literature.

Qualifiers

Qualifiers contain "moderate levels of both theory testing and theory building" (Colquitt and Zapata-Phelan, 2007: 1286). In the MS literature, qualifiers mark significant presence among the other article types both in terms of "number of articles" as well as the "number of citations per year" (table 3). Malhotra et al. (2014) have also evidenced the advancement of 'multi-mediator' models in the field of OM. Qualifier articles predict theory building on the basis of existing conceptual frameworks and models of MS. Discrete event simulation models (Stratman et al. 2004), manufacturing strategy and performance matrix (Sweeney and Szwejczewski, 1996), framework for SME resilience and competitiveness (Gunasekaran et al. 2011) are few of the examples of frameworks / models / processes utilized by qualifiers articles.

Reporters

Reporter articles replicate previous research in new settings and hence receive least citations than other article types. This is because these articles are not targeted to further develop or broaden the scope of existing theories. Madden et al. (1995) proposed replications as an essential

part of research. JOM in 2003 raised the need of replication studies in OM as these studies were considered to have the potential of reaffirming (or refuting) the effects of previous studies.

Testers

Tester articles evaluate and build on earlier models, frameworks, or theories to advance a field in novel directions (Meredith 1993: 4) or test the generalizability of proposed theory for deeper understanding (Schmenner and Swink, 1998). Testers mark theoretical contributions and have started to restore place in theory development after 2010 (thus have not received significant citations per year to date). Reporters have the potential to be converted into testers by invoking existing micro and macro level theories [Macro-level theories are properties of large-scale collectives i.e. organizations, populations, societies; while micro-level theories are properties of individuals and small groups (Markus et al. 1988)] for explaining a phenomenon under study. Among frequently used macro-level theories are resource based view (Barney 1991), contingency theory (Lawrence and Lorsch, 1967), and knowledge-based view suggesting a high frequency of these theories over micro-level theories.

Research Gaps and Future Research Directions

The mounting interest of researchers and demand for building new theories and the need for testing the existing ones mark opportunities for conducting more research on these grounds. Secondly, there is a considerable need to introduce more builder articles to advance indigenous theory development as well as more tester articles to improve generalizability of existing theories in MS discipline. Further analyses focusing on topical coverage in theory development and the extent of the use of statistical techniques in testing theories can also help unearth important trends in theory development within the MS discipline.

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