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Guiding the Next Generation of Doctoral Students in Operations Management

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Abstract: This paper presents ways for senior researchers to help future doctoral students in Operations Management (OM) to overcome multiple challenges in: (a) conducting *relevant* research while demonstrating greater *rigor*, and (b) exploring *multi-disciplinary* research projects while mastering a *single research method*.

Recognizing that knowledge is generally created in four broad stages ((I) awareness, (II) framing, (III) modeling and (IV) validation), we first argue that different research approaches (analytical, behavioral, case study, or empirical) serve different roles in each of these stages: (1) case study approach for awareness, (2) empirical methods for framing, (3) analytical modeling for modeling and analysis, and (4) behavioral for validation in the real world. Then we discuss ways to enable doctoral students to overcome the aforementioned challenges.

Keywords: junior researchers; OM research; PhD students; research methods; research topics; research pipeline; rigor in research; relevance.

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1. Introduction

This article seeks to *catalyze discussion* on how to guide PhD students and other junior researchers in business schools. Our motivation is that today's operations management (OM) doctoral students face big challenges as they are required to conduct research that is more rigorous *and* relevant for publications in journals that 'matter' for academic employment and promotion in business schools. Moreover, many junior researchers in Asia and Europe are being asked to raise funds or apply for research grants through collaborative multi-disciplinary projects in areas of national importance such as environmental sustainability, healthcare management, and maritime studies, while being expected to develop mastery of a single methodological approach. We seek to provide a framework for thinking about OM research that could help to resolve these apparently conflicting demands on doctoral students and other junior researchers.

Our approach to catalyze discussion is as follows: We take the purpose of OM research to be refining knowledge in four broad stages – (I) awareness, (II) framing, (III) modeling and (IV) validation. Researchers including doctoral students, usually rely on a particular research method – *analytical, behavioral, case study* (and related), or *empirical*. However, we argue that each research method is strong in only one particular stage of research: (1) case study approach for awareness, (2) empirical methods for framing, (3) analytical modeling for modeling and analysis, and (4) behavioral for validation in the real world. Hence, when researchers focus only on a single research method, it can create two problems for the OM community: (a) 'islands of methodology' and (b) disconnect from practice. These two problems may help explaining why there is growing pressure for conducting collaborative research that is relevant to practice. Therefore, a 'solution' to problems (a) and (b) is to recognize that different research methods and research outcomes should align and feed into each other to form coherent research streams. Such braided research streams will be far more potent for refining knowledge than islands of methodology.

Implications for such a viewpoint require broadening, not contradicting, the traditional understanding of 'rigor'. Traditionally, rigor for a particular piece of

research, say a doctoral dissertation, is viewed primarily from a technical perspective that depends on the research method within a particular stage. However, we believe that the chosen research method should suit the stage at which the particular research is situated within this stream. Also, each piece of research work should build on the research stream that uses different research methods at different stages for *internal consistency*. Moreover, there should be a real world situation that motivates the research stream and a potential (or actual) application for *external consistency*.

Actionable implications of this view are that supervisors should help doctoral students:

(1) to select an appropriate research method especially when these students are learning certain research results that are based on different research methods, (2) to “triangulate” results within the same research stage by comparing results with other research that used a different research method but used the same inputs, and (3) to engage practitioners in the research process in order to motivate research at one end (e.g., Stanford Global Supply Chain Forum) and to validate research at the other end (e.g., POMS Applied Research Challenge).

The rest of the article is structured as follows: Section 2 summarizes different OM research methods. Section 3 views the use of these methods for any OM area as part of a four-stage research pipeline and sets up the ‘problem’, i.e., requiring the understanding of ‘rigor’ as research stream integrity and coupling with practice at either end. Section 4 proposes the basis for a solution before the conclusion in Section 5.

2. Background: Different OM Research Methods

There are different research methods for conducting OM research (Karlsson 2009) and ‘rigor’ has different implications in different methods. Below we list four broad categories of research methods (in alphabetical order) with some references as examples:

1. Analytical modeling: This approach originated from operations research and management science whereby results are deduced from principles originated from computer science, economics, engineering, mathematics or physics. Mathematical optimization methods (e.g., Large-scale linear programming, stochastic programming,

dynamic programming) are also analytical models for solving real and complex operations problems. OM researchers also bring in concepts and theories from microeconomics to challenge traditional OM models. For example, Netessine and Tang (2009) present a compilation of recent OM research articles that do away with traditional assumptions of exogenous demand and fully observable information and actions, and instead use economic analytical models (game theory, contract theory, mechanism design, etc.) to capture endogeneity and hidden information and actions. Such research can lead to counter-intuitive results involving the interactions of multiple parties and can therefore be more impactful than traditional models (Cachon 2012). Different types of *simulation* methods, including cellular automata or multi-agent modeling, also fit here although simulation results are inferred from simulation runs rather than deduced from analytical assumptions.

2. Behavioral: By conducting experiments originated from psychology to infer actual decision-making, researchers can either validate or challenge the implications of certain analytical models. Croson and Donohue (2006), Croson et al. (2007), and Katok and Wu (2006) conduct different behavioral experiments to explore different OM issues ranging from information sharing, channel coordination, and supply contracts in the context of supply chain management. Loch and Wu (2007) present a set of methods and a structured area of study to analyze behavioral issues within the OM paradigm to guide OM researchers who wish to conduct behavioral experiments pertaining to OM issues.

3. Case study/Grounded theory/Action research: These approaches are broadly based in the social sciences where ‘results’ are generalized from detailed observations of practice. Voss et al. (2002) argue that *case study* and other field-based research are appropriate research methods for OM research because OM deals with complex management issues.¹ In the business-school setting, there are two main types of case studies: those for pedagogy to introduce students to managerial decision-making in challenging business situation and those for exploratory research to set the stage for theory building by identifying key concepts and their relationships (Eisenhardt 1989); however, the term ‘case study’ is also loosely used by practitioners and researchers as an example from an actual business setting – in this paper, we mainly refer to case studies for research. However, Barratt, Choi and Li (2011) note that the success rate

for publishing case study OM research in top-tier academic journals is relatively low partly because case-based methods are perceived as being less structured than analytical modeling or empirical research and possibly only descriptive research (i.e., not leading to theory building). Meredith (1998), Barnes (2001), Stuart et al. (2002) and Seuring (2008) discuss ways to improve ‘rigor’ in case studies. Glaser and Strauss (1967) and Strauss and Corbin (1997) explain **grounded theory** as a way to carry out, document and present qualitative research rigorously. **Action research** seeks to bring about change in organizations while simultaneously adding to scientific knowledge (cf. Shani and Pashmore 1985; Westbrook 1995; Coughlan and Coughlan 2002; Näslund et al. 2010). Finally, operations in any organization entail people. Hence, it is important to explore social conditions, attitudes, roles and interpersonal relationships using approaches developed under the umbrella of **ethnography** (Barnes 2001). **Phenomenology** is an umbrella term to describe approaches that entail observing identified variables in practice and seeking their relations without seeking causality or explanation (at least in management, but we invite readers to refer to a much larger scope in the philosophy and psychology literatures).

4. Empirical: The roots of these methods originated from social sciences. Researchers can target high-quality journals devoted to empirical OM research and some of the strategy journals. Flynn et al. (1990) provide a systematic approach for conducting empirical OM research which includes different types of statistical analysis. For instance, Hendricks and Singhal (2003) use event studies, as used in finance, to provide empirical evidence that the market responds to supply chain glitches unfavorably. Empirical research can fill gaps in our understanding from analytical models or even question their validity. For instance, DeHoratius and Raman (2008) examine the issue of inaccuracy in inventory records that is commonly observed in practice but ignored in analytical OM research.

Karlsson (2009) provides an edited collection of papers describing different methods used for OM research. Fisher (2007) classifies OM research along two dimensions: structured (less or more) and prescriptive/descriptive. Among the highly structured approaches, analytical approaches are prescriptive while empirical/behavioral approaches are descriptive, while among the less structured approaches, ‘concept formation’ is prescriptive and case study research is descriptive.

Van Mieghem (2013) also classifies research methods in OM as a two-by-two framework of ‘assumption-driven’ (analytical modeling) and ‘data-driven’ (empirical) versus ‘what should be’ (prescriptive) and ‘what is’ (descriptive). It is useful to compare these methods for their typical findings and the type of knowledge they create by means of contribution to literature. As shown in Table 1, ‘rigor’ has different meanings because of differences in the aims and in the nature of contribution.

Table 1. Research approaches

Research approach	Typical steps	Typical findings and contribution to literature	Rigor
Analytical	<p>Identify variables and decision-makers</p> <p>Identify starting beliefs</p> <p>Derive results via theorems from starting assumptions as axioms</p>	<p>Counter-intuitive results for some circumstances (combinations of variables)</p> <p>Identification of different policies appropriate to different circumstances</p>	<p>Choice of opening beliefs (axioms) consistent taken from literature</p> <p>No errors in derivation of results</p> <p>Technical contributions via analytical models and proofs</p>
Behavioral	<p>If available, start with analytical results (e.g., how a rational person would make a choice)</p> <p>Design experiments related to choice for decision makers</p> <p>Justification of using students instead of decision makers</p>	<p>Results markedly different from the rational decision maker assumed in analytical models</p> <p>Understand new dimensions of individual decision making</p>	<p>Show why results are not a result of the experiment itself, rather a result of behavior</p> <p>Argue why doing experiments with students can be assumed to be the same as decision makers in a work situation</p>
Case study/etc.	<p>Collect data iteratively identifying concepts that appear to be of significance and how they are related</p> <p>Identify significant concepts</p> <p>Propose a framework connecting the concepts</p>	<p>Taxonomy</p> <p>Documenting interesting phenomena</p> <p>‘Concepts’ or proposed constructs</p> <p>‘Framework’ reflecting relationships between the concepts</p>	<p>Transparency of the methods being used</p> <p>Multiple sources of data to triangulate information, not just doing interviews</p> <p>Connection with literature even though the work is exploratory</p>
Empirical	<p>Start with hypotheses from the literature</p>	<p>Constructs are validated</p>	<p>Data is representative of identified population</p>

	Design a survey or other data collection Test hypotheses and related results back to the literature	Relationships between constructs identified (theory building) or tested (theory testing)	Generalizability is demonstrated Statistical techniques are sound (and sophisticated)
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3. OM Research Streams and the ‘Problem’

Conceptually speaking, knowledge generated from OM research is created through a four-stage **research streams** going from *awareness* to *validation*. This makes sense because knowledge gathering is staged: we cannot test theory unless there is a proposed theory in place, and we cannot build theory unless there are at least some known facts to justify certain assumptions (for analytical modeling) or to justify constructs and hypotheses (for empirical research). This is not to say that any individual research article or dissertation has to follow all these stages. Rather, it should fit within a research stream and this encompassing research stream comprising many articles by different researchers should accumulate knowledge over time about a particular area within OM. The four stages are:

Stage I - Awareness: When little is known about an area in the literature, collecting facts by way of phenomenological investigation or reporting on the organizational context by way of ethnography is quite useful as a foundation. Creating taxonomies or other descriptive frameworks to organize (and filter) such knowledge is also part of this research, which aims to describe rather than to explain.

Stage II – Framing: By using taxonomies or descriptive frameworks established in Stage 1, one can develop research questions, aided by reviewing the literature for existing theories and other frameworks. The next step is to frame the problem in one of at least two fundamentally different ways: (1) qualitative research to identify constructs and hypothesize their relationships as the second part of a case study, or (2) to identify variables, assumptions (axioms) and a formal setup (e.g., a Stackelberg game) as the first part of analytical research. The latter may include setting up the experiment for behavioral research.

Stage III - Modeling: Use of empirical models builds (or adapts) ‘theory’ by validating certain constructs and testing hypotheses on how these constructs are related to each other. Alternatively, we can use analytical modeling to deduce results

via theorems to establish how different factors and actions are related to each other. Data can be gained from behavioral experiments to test against known analytical models.

Stage IV - Validation: One can conduct simulations or behavioral experiments to validate analytical results. Empirical models require replication in different contexts to improve statistical confidence in the findings – *meta-analyses* serve an important role in this regard. If empirical constructs and modeling variables can be linked (as mentioned in *Stage II*), then relationships obtained in either approach can be checked by way of simulation for validation. Validation for behavioral models may come from analytical modeling with modified assumptions and vice versa.

All four stages are equally important because they serve as links of a “knowledge chain.” For example, Mendeleev’s Periodic Table (*Stage I*) laid the basis for looking for yet unknown elements (*Stage II*). This led to finding explanations by way of a proposed atomic structure (*Stage III*) and methods to test this theory (*Stage IV*).

If we use the four-stage research stream model to see how the four broad categories of research methods span the four stages, it is clear that all research methods at least seek to span all stages. However, in reality, each method is better suited to some stages than others are (Table 2).

Table 2: Different research methods highlighting the respective stage of research for which they are best suited

Research stage	Case study, etc.	Empirical	Analytical	Behavioral
I. Awareness	Collecting facts on interesting phenomena and provide descriptive summaries	Motivation	Motivation	Motivation
II. Framing	Create taxonomies or frameworks; propose (meta) constructs;	Start from literature with proposed constructs and relationships; set up data collection	Initial assumptions; model set up	Start with what analytical models predict; set up experiment
III. Modeling	Hypothesizing relationships between proposed	Collect data to validate constructs and	Derivation from assumptions to theorems	Carry out experiments and model results

	(meta) constructs	to test hypotheses about relationships		statistically
IV. Validation	Replication	Replication, checking with results from studies, meta analysis	Similar results with different starting assumptions	Modified analytical models to cross-check behavioral results

Clearly, there are researchers who conduct research in more than one stage using different research methods with different levels of ‘rigor’. However, when each research method seeks to be self-contained without recognizing the overarching research stream across all four stages, it can create two problems: (1) ‘islands of methodology’, and (2) disconnect from practice.

3.1 Problem 1: Islands of Methodology

When conducting research that builds on literature that uses the same research method, different research methods can become *islands of methodology* that do not inform each other even if they are being used to investigate the same OM area. Some OM journals tend to favor one research method over others to bring together researchers who want their research to be understood and appreciated by other researchers following the same research method. Moreover, there may not always be appreciation of one method by the users and proponents of other methods. For instance, while *generalizability* is desirable for induction-led empirical research, *specialization* to explain a particular context is valued for deduction-led analytical research. So researchers looking for generalizability may not appreciate someone specializing broad economic principles to a specific context in a particular company.

3.2 Problem 2: Disconnect from Practice

Without viewing any piece of research in the context of an appropriate overarching research stream, the entire research streams can appear to be decoupled from practice. By asking 300+ full-time and executive MBA students to examine the topics of research articles published in *JOM* and *IJOPM* over 2001-2009, Sheikhzadeh and Heidari (2012) conclude there is a significant gap between research and practice in

OM. Slack, Lewis and Bates (2004) report a gap between practitioner needs and OM research by surveying MBA students. Pfeffer and Fong (2002) and Yip (2011) argue that there is little evidence that business school research is influential on management practice, raising the question of ‘relevance’ of such research.

3.3. Observations from Two Business Schools

To explore how these two problems can occur, we did *focus group* interviews along with a questionnaire with 35 junior researchers: 21 OM doctoral students and assistant professors from Hong Kong Polytechnic University (HKPU) and 11 from University of California Los Angeles UCLA. (Clearly, our focus group is not a representative sample of all junior OM researchers. However, we had the same observations when we conducted the focus group interviews with PhD students from Europe attending the summer research institute at the MIT-Zaragoza Logistics Centre in 2012.) This focus group also included a written questionnaire. Overall, we observe that the junior researchers’ primary destination was academia. For them, research means explaining observed facts and contributing, in decreasing priority, (1) to the literature, (2) to the practice of OM, and (3) to the classroom. They noted that they do research (a) because they wish to solve real world problems, to build/extend theories, to bridge the gap between theory and practice, and (b) because research is fun, challenging and creative (Table 3).

Table 3: In-case survey of 32 junior OM researchers from HKPU and UCLA, mean responses on a 7-point Likert scale (1=strongly disagree, 4 = neutral (dashed line), 7 = strongly agree)

1. As a PhD student, I really wanted (or want) a career in...	
A. <i>Academia</i>	
B. In an industry research centre/lab	
C. Consulting company	
D. Industry (regular)	
E. Government/quasi-government research centre	
F. Government administration (civil service)	
G. An international non-profit like WHO or UN	
H. A charity like the Gates Foundation	
2. To me, research means...	
A. <i>Explaining observed facts / phenomena adding to human knowledge</i>	
B. <i>Contributing to the extant research literature</i>	
C. <i>Finding solution to real-life problem</i>	
D. <i>Creating new knowledge for students</i>	
3. I do research because...	
A. <i>It is fun, challenging, and creative</i>	
B. <i>I can solve real world problems</i>	
C. <i>I can advance knowledge by building or extending theories</i>	
D. <i>I can bridge the gap between theory and the needs of practice</i>	

As regards *how* they do research, they reported that they seek feedback from senior colleagues familiar with the literature so there is significant input into their research from the research environment by way of senior researchers/visiting scholars/academic conferences, etc. (Table 4).

Table 4: In-case survey of 32 junior OM researchers from HKPU and UCLA, mean responses on a 1-7 Likert scale (1=strongly disagree, 4 = neutral (dashed line), 7 = strongly agree)

4. Typically, I find a new research topic...	
A. By reading journal articles or working papers	██████████
B. Through discussions with colleagues / advisors/ visiting researchers	██████████████████
C. Through discussions with practitioners / government	██
D. Through discussions with my students	██████████
5. For feedback on my work before submitting a paper to journal, I typically	
A. Ask fellow researchers in my area for comments	██████████
B. Ask practitioners for comments	██████████
C. Ask my students for comments	██████████
D. Ask people I know in my immediate environment, regardless of their	██████████
6. I make an effort to disseminate my research through...	
A. High-impact journals in the research literature	██████████████████
B. Small seminars for peers in my area, broadly speaking, and even those	██████████
C. Well-read industry journals and magazines to reach out to people in	██████████
D. Teaching notes and examples from industry for my students	██████████

Their responses indicate two issues: First, *their research is overly dependent on the existing literature and on senior colleagues*. These junior OM researchers find topics for research from the existing literature and seek to contribute to it, especially through journals that matter for being hired or promoted. In private conversation, some junior researchers explained that their fear of not being able to publish in certain journals drives their research topics and research methodologies.

Second, *there is little opportunity for significant input from practice to the OM research conducted by the junior researchers in our focus group*. (We recognize there are supervisors who actively engage with practitioners as regards doctoral research, but we are writing in general terms here.) In general, junior researchers especially doctoral students do not seek validation by seeking practitioners' opinions on their research nor do they seek to disseminate their work to practitioners in any way even through teaching business schools students. Although these junior researchers agree that research to them means creating new knowledge for students, they do not connect teaching business students with their own research output by way of, say, translating their research into teaching notes. A plausible explanation could be the *research-and-publication process* of academic journals: An article written by a junior researcher submitted to an academic journal is subject to a peer review process that involves senior researchers (professors) and/or other junior researchers (usually PhD students).

Although how PhD students and other junior researchers develop their research topics is sound for the purpose of rigor, it *can* create a closed system resulting in islands of methodology and disconnect from practice.

At the risk of over-generalizing from a focus group of researchers from only two very similar research-led business schools (one in Asia and one in North America), both emphasizing analytical methods, we believe their responses are typical of other research-led schools even if they encourage research approaches different from these two schools.

4. Proposing the Basis for a Solution

To overcome the problems of islands of methodology and disconnect from practice, we propose the following to create a basis for debate and discussion.

4.1 Connecting the Islands for Research Stream Integrity

Upon selecting an OM research area, a junior researcher should consider building his/her research on articles that have used different research methods in the chosen area. He/she also has to position how his/her research would be part of a *research stream* that would lead to an explanation of what was observed in a business context (descriptive research) and/or to recommendation on how the situation can be improved (prescriptive research). More than just ‘extending the literature’ (i.e., any subset thereof), it means potentially collaborating with or at least referring to the work of others who used other research methods that generate the current state of the knowledge for the chosen OM area.

Learning from and collaborating with researchers using other methods can be fruitful. For example, through collaboration with the end user/practitioner (Mr. Obermeyer of Sport Obermeyer) and with OM case study researcher (Jan Hammond of Harvard Business School), Fisher et al. (1994) developed an insightful case study about “accurate response” to help Sport Obermeyer to make supply meet demand. This case study in turn motivated Fisher and Raman (1996) to develop an analytical model to quantify the benefits of accurate response. Likewise, consider the bullwhip effect: Hammond (1994) developed a well-known pedagogic case study while Lee et

al. (1997) showed analytically that the bullwhip effect would occur even when each supply chain partner acts rationally, and motivated empirical research (cf. Cachon et al. 2007) and behavioral research (cf. Croson and Donohue 2006). These are examples of well-developed research streams with articles using different research methods to create knowledge through all four research stages.

Academic OM journals are beginning to embrace different research methods,² which will facilitate interaction between or at least create awareness of researchers who conduct different types of OM research. It also enables researchers to “triangulate” different research findings based on different research methodologies to gain deeper understanding of complex OM issues (Singhal and Singhal, 2012a and 2012b). To this extent, the call for papers following mixed methodologies is a healthy development (cf. Cheng, Choi and Zhao, 2012).

We note that linking constructs on the empirical side with variables and assumptions on the analytical modeling side is not an easy task. However, it is certainly worth doing for triangulation or for applying the results of empirical research to analytical modeling.

4.2. Coupling Research Streams with Practice

Many senior OM researchers have long urged their colleagues to conduct research on topics motivated directly by practice to ensure that the assumptions or data are taken from a real context. The research would then have results that could be validated and implemented in practice. In the first article published in *Journal of Operations Management* in 1980, Elwood Buffa of UCLA suggested that: (1) we should venture into “issue oriented” topics not limited to ‘traditional subject areas’ in OM (i.e., inventory control, production planning, scheduling, capacity planning, facility location, process design, and quality control); and (2) we should look for topics from practice that deal with broader problem definitions and performance criteria in order to narrow the gap between theory and practice. Indeed, many practitioners associated with INFORMS and POMS have expressed their desire in forums (INFORMS Roundtable and POMS Practitioner Forum) to see more articles with practical value.³

Doing so is justifiable also on grounds of rigor. Any OM research stream needs to be coupled with practice at both ends: motivation and validation to ensure rigor by way of external consistency. If the starting points of the research pipeline are not motivated by actual practice, then the end result may not be meaningful for practice. Again, this does not mean each individual article or dissertation needs to be coupled with practice; instead, it must situate itself in a research stream that is coupled with practice.

Senior researchers and supervisors can help engaging practitioners in improving the coupling of the OM research streams with practice:

1. ***Engaging practitioners for generating new research idea:*** Senior researchers could encourage junior OM researchers to attend some professional conferences (e.g., conferences organized by the Council of Supply Chain Management (cscmp.org)) as well as forums for interaction between OM researchers with practitioners.⁴ In addition, journal editors could invite practice leaders to submit their ideas as “forum” articles to communicate OM research priorities from the practitioners’ perspectives. This way, junior researchers will have better access to research topics with practical significance, while noting that these topics have been validated by their senior colleagues and by journal editors.
2. ***Engaging practitioners for embracing new research ideas.*** To encourage more submitted articles with academic rigor and practical relevance, OM academic journals should “supplement” academic reviewers for methodological rigor and with practitioner reviews for business context. Specifically, where applicable, practitioners should be invited to judge the relevance of submitted articles (or a set of articles) and comment on whether the presented ideas are: (a) applicable or implementable; (b) insightful for understanding certain issues; or (c) helpful for identify problems and/or solutions (de-Margerie and Jiang 2009). This activity can create dialogues between researchers and practitioners to facilitate mutual learning. Currently, it is rare for practitioners to participate in the review process or to serve on editorial boards of major OM journals (Sodhi and Tang 2008). However, by having practitioners to serve as supplementary reviewers, especially for special issues focusing on broad business problems, our OM journals can ensure practical relevance without losing academic rigor. As practitioners

examine the relevance of the OM research articles, the insights provided in some of the articles may help them think about new issues. In this vein, *Interfaces*, the OR Practice department of *Operations Research*, and *Supply Chain Forum: an International Journal* publishes research articles along with practitioner's reviews and comments.

3. ***Engaging practitioners for developing joint research projects:*** Senior OM researchers should establish practice-driven research (and education) activities. For instance, the Stanford Global Supply Chain Forum provides an environment for researchers and educators to work closely with managers from member companies to conduct multidisciplinary supply-chain-related research projects and write teaching cases (Lee 2006). The MIT-Zaragoza Logistics Center is another research center that works closely with practitioners and end-users in the logistics industry. With their senior colleagues involving practitioners to engage in joint research projects, junior OM researchers will have more opportunities to work on research topics of relevance to managers. Internships for PhD students in companies can also be a way to engage practitioners – see Van Mieghem (2013) and recall the *action research* method from Section 2. Such practical experience can help PhD students to get university jobs as they will be perceived as better equipped to teach business students..

However, just because academic researchers want to work with practitioners, it does not necessarily mean that practitioners will want to work with researchers. For instance, in the UK, despite government funding for joint work between companies and universities, it is sometimes difficult to get industry people interested in collaboration because they still have to invest their time while the business school academics also cannot invest much time because such efforts do not help much to publish in the journals that matter for research assessment, promotion or salary. As such, it is important for senior researchers to build relationships with practitioners and then create umbrella efforts such as the Stanford's Global Supply Chain Forum under which junior researchers can work with practitioners and under which practitioners can engage with the research-and-publication process.

Perhaps a shortcut to understanding practitioner's concerns is to look at CEOs' and senior managers' concerns as seen from annual surveys conducted by consulting companies. Researchers can compile and cross-reference such lists to the OM research literature to infer operational issues being discussed among the C-level

executives of companies. This would provide motivation and a basis for discussions with managers (and with business students). Although such lists can appear quite general,⁵ they can be helpful in motivating junior researchers to think about the broad context of a research topic. This way, researchers can broaden their gene pool of research topics by taking CEO and senior management concerns onboard while relating these to the literature -- see Table 5 as an example.

As regards to *validation* of the results of research through practice, engaging practitioners appropriately to supplement the process could be useful. Depending on the ‘stage’ of the research being reported in an article, OM academic journals could supplement academic reviewers with practitioner reviews and invite practitioners to judge the ‘managerial insights’ claimed by submitted articles. Specifically, practitioners could comment on whether the presented ideas are: (a) applicable or implementable; (b) insightful for understanding certain issues; or (c) helpful for identifying problems and/or solutions (de-Margerie and Jiang 2009).

Table 5: Top concerns of CEOs and of supply chain executives with a sample of related OM articles

	PwC Global CEO Survey 2012*	McKinsey Supply Chain Challenges**	Sample of related OM articles
Supply	Energy costs	Increasing cost pressure in logistics/transportation; Increasing complexity in supplier landscape; Increasing volatility of commodity prices	Anderson, Fine and Parker (2000); Bidarkota and Crucini (2000); Zeng and Rossetti (2003); Garavelli, A. (2003)
Processing	Availability of key skills	Increasingly global markets for labour and talent, including rising wage rates ;	Blanpain (2001); Chopra (2003); Lima et al (2004); Levy (2005); Peck and Ward (2005); Bhalla, Sodhi and Son (2008); Fung (2008)
Demand	Shift in consumers	Increasing volatility of customer demand; Increasing consumer expectations about customer service/product quality; Increasingly complex patterns of customer demand;	Yusuf, Gunasekaran, Adeleye, and Sivayoganathan (2004); Sodhi (2005); Matsui (2010); Han, Dong and Dresner (2013)

Context	Uncertain or volatile Growth; Public deficits; Over-regulation; Unstable capital markets; Increasing tax burden; Exchange rate volatility; Protectionism; New market entrants; Inability to finance Growth; Inflation; Bribery and corruption; Inadequacy of basic Infrastructure	Increasing pressure from global competition; Increasing financial volatility (e.g., currency fluctuations, higher inflation); Growing exposure to differing regulatory requirements in the areas where we operate; Increasing environmental concerns; Geopolitical instability	Cohen and Mallik (1997); Christopher, Peck and Towill (2006); Tang (2006); Manuj and Mentzer (2008); Wang, Gilland and Tomlin (2011); Sodhi, Son and Tang (2012)
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Source: *PwC Global CEO Survey, 2012 at pwc.com and **McKinsey Global Survey Results, November 2010 at mckinseyquarterly.com

OM journals are helping to remove the ‘fear factor’ for junior researchers as regards new research topics that are pertinent for practice through special issues. For instance, *M&SOM* has announced a practice-based theme (Gallien and Scheller-Wolf, 2013) and *POM* has announced a *socially responsible operations* theme (Sodhi and Tang, 2012). Thus, Editors-in-Chief are using special issues with regard to topics that could be considered relevant by managers and society.

In addition to the INFORMS Franz Edelman Award that recognizes contributions of operations research and analytics in both the profit and non-profit sectors, OM Societies are also doing their part to enable junior researchers to engage with practitioners. In 2013, POMS started the annual POMS Applied Research Challenge to encourage OM research on practice-relevant topics. Submissions are sought on any OM topic using any research methodology. There are two review cycles, the first by an academic panel with academics from different methodological backgrounds to ensure rigor and the second by a distinguished Practitioner Judge Panel with all panel members being former POMS Martin K. Starr Excellence in POM Practice Award Winners.⁶ Moreover, as a way to engage practitioners for generating relevant research ideas, POMS has launched a new POMS Practice Leaders Forum (a full day event to be held during each annual conference) so that OM researchers can have an open dialogue with senior OM practitioners about emerging practical OM issues arising from actual business.⁷

5. Conclusion

We must encourage doctoral students to position their topics in research streams that braid different research methods as appropriate at different stages of research. Besides rigor for the individual dissertation or article, we must also require rigor for the research stream in which their work will be situated. This requires the research stream to be internally consistent to ensure the continual refinement of knowledge using stage-appropriate research methods and to be externally consistent via motivation and validation with practice. Adopting this view would not only ensure greater rigor as demanded by OM journals but also provide ‘relevance’.

As we said at the outset, our aim is to catalyze discussion on how to train the next generation of OM researchers. On our side, we have started implementing some of the suggestions, but the real value of this article would be to engender debate leading to concerted action by senior academics including supervisors and journal editors to benefit the OM community.

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Notes

¹ In the same vein, Yip (2011) argues that practitioners "prefer to read articles in management journals that are based on in-depth case studies where there are more variables than observations, rather than large sample statistical studies with many more observations than variables."

² Both *JOM* and *POM* have expanded their scope. *JOM* (focusing on empirical OM papers) has expanded its scope to include: (1) studies that use a broader set of methodologies: case studies, sample surveys, laboratory experiments, econometric analysis, and ethnographic studies; and (2) Empirically-grounded analytical modeling studies. The previously modeling-oriented *POM* has expanded its departments to include behavioral operations as well as empirical research. *Operations Research* has also published a few case study papers in the "OR Practice" section the past 10 years, averaging 3.5 papers per year (c.f., Fricker 2011).

³Institute of Operations Research and Management Science (INFORMS) and Production and Operations Management Society (POMS)

⁴The INFORMS annual practice conference is a useful initiative, but it would be even more useful if more OM researchers would attend this practice conference. To enable more academics to interact with practitioners, POMS established the POMS Practice Leaders Forum (http://www.poms.org/pom_practice/poms_practice_leaders/) in 2013 that takes place during the academic conference.

⁵For instance, the ‘top 5 CEO concerns’ list by the CEO Institute in Australia lists: (1) Sourcing and retaining (millennial generation) talent, (2) achieving top-line growth, (3) reducing costs, (4) improving operational efficiency, and (5) managing increased competition. A much more detailed PwC Survey of Global CEOs -- 1,258 interviews of CEOs in 60 countries including 161 headquartered in the US -- in 2012 lists similar items as regards emphasis but also lists heightened fears of disruptions and increased shareholder expectations relative to the same survey in 2011. The survey also lists growing US CEO attention on Africa and Latin America.

⁶See details on http://www.poms.org/pom_practice/poms_applied_research_challeng/

⁷ See details on http://www.poms.org/pom_practice