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The Evolution of an International Academic Manufacturing Survey

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The Global Manufacturing Research Group (GMRG) is a multi-national community of researchers dedicated to the study and improvement of manufacturing supply chains world-wide (www.gmrg.org). A major part of its effort has been the collection and analysis of empirical data gathered directly from manufacturing firms. Over the past 20+ years, new manufacturing issues have arisen, the operations management research community's understanding of questionnaire design and data collection methods have improved, and empirically based academic research has expanded. As a consequence, the GMRG questionnaire has been revised three times. In each instance an international group of researchers was involved in the effort. This article describes the evolution of the GMRG survey. Table 1 summarizes the GMRG survey periods, data collection results, and related theoretical background since 1986.

The First GMRG 1.0 (1986-1989)

With the help of the Korea Productivity Center, Clay Whybark (University of North Carolina) and Boo Ho Rho (Sogang University) developed the first GMRG survey in the mid-1980s. The primary purpose was to learn what manufacturing practices were in use in different countries. Secondary objectives included learning whether a common international survey could be developed and creating a global research community. Given the academic and industry interest in techniques like just-in-time (JIT) and material requirements planning (MRP), the questionnaire was based on the Vollmann, Berry, and Whybark (1984) manufacturing planning and control framework. Ultimately, researchers in 10 countries provided data from 600 companies.

Research based on data from the first survey was collected and published in a book edited by Whybark and Vastag (1993). The data from the first survey were freely distributed and bundled with the book in order to increase the global research community. The international academic community participation in the use of the first questionnaire data was widespread and significant. Among the contributors to the book were:

Danny Samson (University of Melbourne), **Amrik Sohal** (Monash University, Australia), **Antonio Kovacevic** (Catholic University, Chile), **Benito Flores** (Texas A&M), **Arturo Macias** (University of the Americas, Mexico), **Allan Lehtimäki** (University of Oulu, Finland), **Krisztina Demeter** (Corvinus University, Hungary), **Pavel Dimitrov** (University of National and World Economy, Bulgaria), **Alexander Ardishvili** (Academy of Sciences, Russia), **Art Hill** (University of Minnesota), **Robert Handfield** (North Carolina State University), **Scott Young** (University of Utah), **Attila Chikán** (Corvinus University, Hungary), **Curt McLaughlin** (University of North Carolina), **Karen Brown** (Thunderbird), **Gyula Vastag** (Central European University; Hungary), **Jack Wacker** (Arizona State), **Linda Sprague** (Rollins College) and **Xiao Cheng Zhong** (Shanghai Institute of Mechanical Engineering).

The first questionnaire documented manufacturing practices in the countries

surveyed and described manufacturing practices of that era.

The Revision of GMRG 1.0 to GMRG 2.0 (1991-1997)

As the research from the first survey was being published, both industrial and academic interest shifted from the difference in practices to how the practices influenced outcomes. At the same time, the manufacturing research community had learned to use more powerful analytical tools and the GMRGers had learned valuable lessons about gathering empirical data. It became clear that revisions to the questionnaire were needed to capture the new interests and to make use of the GMRG experience. The lesson learned was that for academic research, questionnaires need to be living documents.

While plans for a second survey were being formulated, several DSI members joined the GMRG meetings (among them were Lawrie Corbett, University of Wellington, New Zealand; Basheer Khumawala, University of Houston; Sang Lee, University of Nebraska; Ram Narasimhan, Michigan State University). They and others from many countries contributed to questionnaire revisions that linked practices to outcomes, incorporated some of the new manufacturing developments, and exploited the GMRG experience. Since desirable outcomes are dependent on strategy, the competitive strategy work of Hayes and Wheelwright (1984) was the organizing framework for these additions. The group engaged in multiple debates about the trade-off between changes and continuity between versions of the questionnaire. The revisions added length, but incorporated many of the new issues and retained many of the ones from GMRG 1.0.

The second survey was conducted during 1991 to 1997, with the additional questions enabling research on a broad-based spectrum of manufacturing issues. The interest generated by the first survey, the variety of issues, and the broad participation in the development of the second survey all contributed to a high level of interest in its use. As a result, the questionnaire was very successful with data from 1,222 companies being gathered from 22 countries. Unlike GMRG 1.0, this data was not made public until those that had collected the data had been able to use it and they were able to publish numerous academic articles in journals around the world based on their research using the database.

The Revision of GMRG 2.0 to GMRG 3.0 (1998-2003)

The positive experience from the second survey was greatly influenced by the broad global participation in the survey development. Of course, new developments in manufacturing, advances in analytical methods, and developments in the academic literature were taking place during this same time, motivating the development of a third survey. This again brought up the trade off between consistency for longitudinal studies and dynamism to incorporate the new issues. An important lesson learned from GMRG 2.0 was that having academics from many countries involved in the revision process greatly improved the usefulness and interest in the questionnaire.

However, having a large number of international researchers involved caused the revision to include many diverse issues of individual interest. Manufacturers were concerned about environmental sustainability, ISO certification, supply chain partner relationships, lean manufacturing, and additional issues. At the same time, there was evidence that survey burnout was beginning to occur among manufacturing executives. On the academic side, journal editors and article reviewers were shifting toward more theory testing than theory development. This also necessitated revisions in the questions.

In the attempt to incorporate current issues, editors' preferences and trends in the literature, GMRG 3.0 grew to be quite lengthy. In light of the companies' survey burnout this substantially increased the effort required to gather data. Despite these impediments, data from some 500 companies were gathered from five countries. The data have not been made public and the publication of research results still continues.

The Revision of GMRG 3.0 to GMRG 4.0 (2007-present)

The experience with the third survey made clear that substantial changes would be needed to continue to perform successful empirical research in the new environment. The combination of survey burnout, researcher issues expansion, and the theory-testing interest of journal

	GMRG 1.0 (1986-1989)	GMRG 2.0 (1991-1997)	GMRG 3.0 (1998-2003)	GMRG 4.0 (2007-present)
Number of Samples (Countries)	600 samples (10 countries)	1,222 samples (22 countries)	500 samples (5 countries)	1,310 samples (22 countries)
Theoretical Framework & Issues	Manufacturing planning & Control (Vollmann, Berry and Whybark, 1984)	Survey #1 plus Strategy (Hayes and Wheelwright, 1984)	Survey #2 plus contemporary issues (e.g., ISO, sustainability, lean)	Academic literature Module-based (e.g., Outsourcing, Info systems, Purchasing, Forecasting)

Table 1: GMRG survey evolutions (1986 – present).

editors dictated the needs. These were, simply, to shorten the length, focus the issues, and provide a theoretical reference for each issue. The general lesson learned from GMRG 3.0 was that only a short questionnaire would generate enough responses (at least currently) to enable acceptable research results.

A committee of four agreed to oversee the revisions: Karen Brown (Thunderbird), Rob Klassen (University of Western Ontario), Danny Samson (University of Melbourne), and Chwen Sheu (Kansas State University). The result of debates by the GMRG as to how to accommodate new needs but still maintain consistency between revisions was to have two parts to the survey. The first part is a section on company demographics, manufacturing practices (to provide the consistent link between questionnaires), competitive goals, and internal performance. This section is common to all companies surveyed. The second part contains optional modules addressing specific management issues. Each module is based on a conceptual model supported by the academic literature.

There are currently four modules. They and their developers are: **Manufacturing Information Systems** (Patrik Jonsson, Chalmers University, Sweden; and Clay Whybark, University of North Carolina); **Outsourcing** (Luis Mesquita, Arizona State University); **Forecasting** (Benito Flores, Texas A&M; Matteo Kalchschmidt, Bergamo University, Italy; and Arturo Macias, University of the Americas, Mexico); and **Purchasing** (Phil Carter, Tom Hendricks, and Jack Wacker, Arizona State University). Most questions used in these modules were extracted from the extant academic literature. In addition to the developers, the questionnaire committee reviewed all modules.

GMRG 4.0 has generated considerable interest from researchers around the world. As of May 2009, the core data has 1,310 manufacturing plants from 22 countries. The optional modules have approximately the following sample sizes: Manufacturing Information Systems (900+), Outsourcing (1000+), Forecasting (600+), and Purchasing (700+). The questionnaire is theory based to empirically analyze literature-based manufacturing issues.

Conclusion

The evolution of the GMRG survey over the last 20+ years indicates that longitudinal survey instruments are evolving, living documents. They need to respond to changing realities in the population of study, newly emerging academic issues, and developments in analytical techniques. This dynamism presents a challenge to those who are interested in temporal research. For the GMRG questionnaires, the purposes have evolved from documenting manufacturing planning and control practices to testing specific theory on outsourcing, purchasing, forecasting, and manufacturing information systems. In the process of this evolution about one quarter of the questions have remained the same for the four rounds of survey.

The GMRG has always been an inclusive organization embracing researchers from countries around the world. It is not externally funded and there is no longer free access to the database. However, researchers who gather a complete representative sample of data do get access to the data for all modules for which they collect data. Come join with the group and participate in the enterprise. For more information contact Lawrie Corbett (President-elect, Lawrie.Corbett@vuw.ac.nz) or Matteo Kalchschmidt (President, Matteo.Kalchschmidt@unibg.it).

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