



Behavioral Operations Management: Realm of Experimental Research Methodology

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Abstract:

Behavioral operation stems from the fact that the human are not rational as typically assumed in the traditional operations management theories. Behavioral operation management is the emerging and promising field in the domain of operations management. Being an emergent stream the researchers have experimental focus while dealing with behavioral operation management. This paper is an attempt to consolidate the published work on behavioral operation management experimental research methodologies and explain various options available for researchers. Also this paper proposes guidelines for selecting the appropriate experimental research methodology. Various experimental studies falling under the umbrella of behavioral operation management are vignettes, process simulation, laboratory simulation, natural experiments and mixed experimental studies. The problem at hand determines the type of experimental study. Though there are several pros and cons of using a particular design, the mixed experimental studies have found to be more acceptable to the researcher compared to other studies.

Keywords: Behavioral operations management, experimental research design, simulation study, literature review

JEL classification: M11, M19, M29.

1. Introduction

Behavioral operation management (BOM) is defined by Bendoly and Eckerd (2013, p.1) as “A multidisciplinary branch of operations management (OM) that explicitly considers the effects of human behavior on process and system dynamics, influenced by cognitive biases and limitations, social preferences and perceptions of cultural norms. Conversely this domain also concerns itself with the effect of process and system dynamics on human behavior, hence viewing human behavior as critical in not only its direct and moderating effects but also in its mediating role between operating policy change and connected outcomes.” BOM is relatively new discipline in the operation management area. OM as a discipline has always assumed that human are rational and always works in the self-interest (Gino and Pisano, 2008). But the reality is different. Lot of OM theories has been challenged on their false assumption ground and the applicability in the real world where human is not behaving in a rational way (Bendoly et al., 2006). In order to test and refine the traditional OM theories and practice after considering the human as irrational entity, a new stream of research has developed which is known as BOM (Bendoly et al., 2015).

As evident from the literature that any developing stream is heavily relied on the experimentation methodology. The BOM is no exception to this. There are two important aspects of the BOM, first one is the selection of the suitable research methodology and is related to the balance between the typical modelling studies vis-a-vis empirical studies (Bendoly and Eckerd, 2013). The second aspect is the multi-disciplinary nature, encircling various disciplines such as decision science, psychology, OB and management.

This paper focuses on the types of experiment studies used in BOM, in order to trace the development of the stream and envisage the future direction. In particular the paper tries to answer the following questions

1. What is BOM and how it has evolved from operations management?
2. What are the various types of experiment techniques falling under the BOM research methodology? What are the pros and cons of the above techniques?
3. How to select the appropriate experiment technique?

The rest of the paper is divided into various sections. Section 2 deals with the evolution of OM to BOM. Section 3 describes in detail the experimental techniques in BOM along with pros and cons of the each technique. Section 4 gives the guidelines on how to choose appropriate experimental techniques. And finally section 5 summarizes and gives conclusion of the study.

2. OM to BOM

As applicable to any other disciplines, the exact origin of the OM is very difficult to pinpoint. As per the argument of Chopra et al. (2004, p.8), "It is difficult to pinpoint the origins of our field." But roughly the origin can be traced back to seminal work of Adam Smith dealing with the division of work and labor written in the book titled *The Wealth of Nations* (1776). This work followed by Charles Babbage resulted into creation of sequence of general principles (Babbage, 1832; Lewis, 2003). Lot of OM dimensions for example inventory management, PPC, scheduling have deep roots in the Babbage's work. However the application of the scientific approach to the OM came only from the F.W. Taylor work generally known as "Scientific management" (Kanigel, 2005). The 20th century had witnessed the Taylor and his followers say Gantt, Gilbreth, Frank etc. giving momentum to "fostered quantification of management" (Hopp and Spearman 2008). Also the early attempts for optimization has been seen in this era only say the EOQ model by Harris (1915).

However, the scientific management has not enough thrust to take OM to the next higher level of evolution stage like causal model-based theories. As a results the field of OM was perceived to be purely descriptive and was a resembled with factory/industrial management (Buffa 1980; Hoff and Spearman, 2008; Neely 1993). The various disciplines that were part of industrial management such as finance, HRM, marketing etc., gradually started differencing and establishing themselves as a separate independent discipline. So what was remaining for OM discipline was "a nearly empty basket of techniques: time and motion study, plant layout, Gantt's production control boards, the simple EOQ model, and simplistic descriptions of how a production system worked" (Buffa 1980).

In the meantime during World War II the discipline of operations research (OR) has flourished and mesmerized everybody with its applications. OR techniques were suitable for the quantitative OM and "provided the scientific methodology that allowed us to develop something akin to the 'nature science' or physics of operating systems; the introduction of these techniques rescued the field from extinction." (Buffa 1980).

Golden age for OR and OM was 1960-1970 where influential applications in OM were developed (Meredith, 2001). Lot of progress in understanding the OM problems such as scheduling, queuing, PPC, inventory, transportation etc. has been made by various researchers. The most dominant approach to formulate the management problem as single objective function having few constraints was popularized in the same era. The high degree of dependency of OR and OM led to an "identity crisis" and the definition of the field was challenged. The pure quantitative approach to solve the problem make the practitioners difficult to interpret the results and complicating the decision making process.

After 1970s, the OM field has seen boom due to its modern production and quality philosophies say the total quality management (TQM), JIT, TPS, material requirements planning (MRP) etc. have been used in the business (Craighead and Meredith, 2008). These developments impacted the business practice in a big way, along with "suggested that the locus of creativity had shifted away from academia" (Chopra et al. 2004, p. 9).

The recent modern industry oriented advances stimulated OM to be application orientated and tried to enlighten why, how and when, diverse processes/practices are functioned. Early 1980s, OM discipline was "emerging from the OR/MS phase into a clear recognition of OM as a functional field of management. ... the field is a managerial one" (Buffa 1980). Practical and application orientation was the new research focus. OR/OM techniques became popular research tool kits. However the basic nature of addressing the tactical issues in detail became the hindrances in solving the higher level problems. So the emergence of operations strategy as a subfield of the OM came to light (Paiva, 2008; Skinner 1969), and OM established its role in creation of corporate strategy. Another development after switching the focus from tactical to higher level problems was the emergence of the 'game-theoretic models' the sub-area focusing on coordination of supply chain via contractual settings aligning incentives of various upstream and downstream players of the SCM (Chopra et al. 2004, p. 10). The emergence of these new subfields led to increasing interfacing with other areas such as Finance, R&D; sales & marketing, strategy, organizational behavior (OB) and human resource (HR) management (Loch and Wu, 2007; Gupta et al., 2006).

The interfacing with the OB/HRM, which is more of the managing people is the genesis of the BOM. The factoring in the human angle in devising the OM theories is very important (Gino, and Pisano, 2008). As stated by Hayes et al. (1988, p. 242) for factoring the people issues in traditional OM field "*it will not turn the fundamental premises of the field upside down. It is one of several interesting avenues of expansion.*"

To summarize with an analogy as quoted by Gary Becker the famous Nobel laureate about the weakness of the economics handling the people issues "Obviously, economics as a field has neglected psychology, and this needs to change. However, this does not mean throwing out of the window the premises of neoclassical economics; it provides a powerful paradigm of analysis which will be able to

incorporate the additional considerations of the psychological system and provide stronger results.” Ironically it is true in the OM field too.

3. Experiment Studies Variations in BOM

BOM has deep behavioral roots in three major streams namely sociology, cognitive psychology and social psychology (Bachrach and Bendoly 2006). So the experimentation used in BOM is rich and deep, Figure 1 depicts the variations in the experiment studies in BOM.

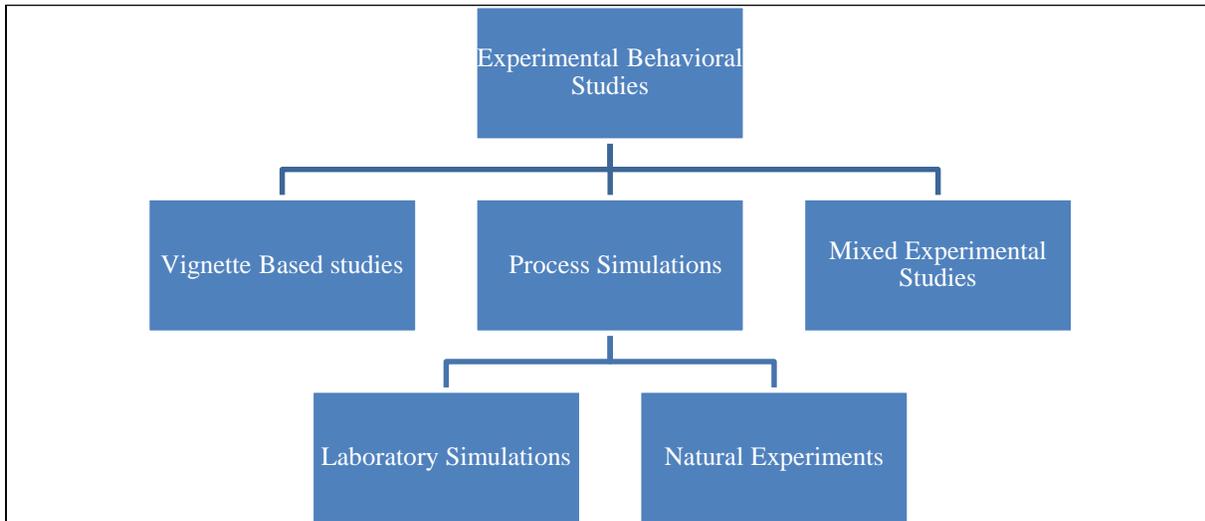


Figure 1: Variations of experiment studies in BOM

As stated by Kagel et al., (1995, p.10) in their seminal work “the design of an experiment to test a particular theory often forces the experimenter to focus on specific aspects of the theory other than those that naturally come to the fore in the theoretical literature. The insights gained from designing an experiment are often of value even apart from the actual conduct of the experiment. Thus there is interplay, on many levels, between theory and experiment.” So the various options available in the BOM domain are as below.

3.1. Vignette Based Research

Vignette based research (VBR) is one of the classical ways to understand the human behaviour (Wilks, 1994). Vignettes are valuable for accessing the anticipated reasoning, process of decision and/or understanding the intended behaviour (Stolte, 2004). Vignettes have been primarily used in context of policy making, hospitality and health care, marketing management and business ethics. Recently the VBR is strongly establishing itself in the realm of OM (Mantel et al., 2006, Rungtusanatham et al., 2011).

The VBR is termed differently in different disciplines for example conjoint-analysis, scenarios, stated choice methodology, and policy capturing (Ashill and Yavas, 2006; Caro et al. 2011). Vignette can be defined as “ Short description of person or social situation which contain precise references to what are thought to be the most important factors in the decision-making or judgment-making processes of respondents” (Alexander and Becker 1978, p. 94). As per the definition the VBR has three main components, first the decision scenario, second the manipulated critical variables of interest and the last is response items.

As with other techniques of the BO research methodologies, the VBR too has some advantages and disadvantages. The predominant benefits of VBR vis-a-vis the survey or direct question method are 1) increased the level of realism 2) enhancement of internal validity owing to use of standardize stimulus 3) high measurement reliability 4) ease to replicate 5) VBR has high construct validity owing to focus on specific features 6) Cost effective 7) Requires less time to execute 8) low on social desirability bias (Cavanagh and Fritzsche, 1985; Watson et al., 2002).

A very important pitfall of the VBR is unlike the empirical studies this methodology focuses on “facsimiles of real situations and the subjects’ responses to the scenario demonstrates intended reasoning, decisions or behavior” (Finch, 1987; Weber, 1992). Unlike the pilot survey in empirical studies vignettes should be pretested for the representativeness. Plus there has to be post testing for assuring the respondents’ understandings of the vignettes (Rungtusanatham, 2011; Weber, 1992).

3.2. Process Simulation

Process simulation (PS) is an alternative to classical VBR studies. PS may involve computerized or manual task, or it may be executed either as facsimiles of reality or it may be the real life natural experiment (Tumay, 1995). The main difference between the VBR and PS is the ability of PS to test the multiple occurrences of stimulus and responses over a period of time (Kellner et al., 1999; Mujber, et al., 2004). So in PS there are more than one objective to be achieved using the variations involved in PS say change of tasks, time taken to complete the tasks, number of errors made (Jahangirian, 2010; Schultz et al. 1998). In recent times attempts have been made

by various researchers to capture the biometric details using PS (Bendoly 2011, seawright and Sampson 2007). Laboratory simulation (LS) and natural experiments (NE) are the two variations under the PS.

3.2.1. Laboratory Simulation

'Beer Game' is one of the most popular examples of the laboratory simulation (LS). The natural experiments bring the elements of uncontrolled nature with them, so to avoid it LS are widely used in the BOM (Meredith, 1998; Yang et al., 2000). LS are particularly helpful for various purposes of research including theory testing, examining anomalies and evaluation of new policies or processes (Croson and Donohue, 2006; Roth, 1988). Each of these purposes needs a different kind of treatment when conducting the LS.

Despite the differences in the treatment, LS follows certain steps (Croson, 2002). These steps are as below

- 1) The experimental design
- 2) Subject pool selection
- 3) Implementation
- 4) Compensation

3.2.2. Natural Experiments

According to Bendoly et al. (2006), Natural experiments are those in which real workers are observed doing real job at their respective location in real time. While the LS try its best to increase the internal validity the natural experiments (NE) tries for achieving high external validity (McCutcheon, and Meredith, 1993). The general motive of opting for NE is to test for new policies and processes in real time. So the NE is superior from LS and VBR in terms of achieving high realism and multi period observations respectively. Another benefit of NE is that many times the subjects of the study are unaware of the fact that they are being observed or studies so they act in their natural way, so it reduces the sampling bias (Greenberg and Tomlinson 2004).

Taking an experiment to the NE is not an easy task. Striking the correct balance between the control and naturalism is very critical. The time experiment is moved out of the laboratory the researchers control over the experiment is challenged (Greenberg and Tomlinson 2004). Other than the loss of control, hindering the individual relationships, drop in quality of variable of interest are some of the drawbacks of the NE. The drawbacks can be overcome through thoughtful experimental design and rigorous adherence to procedure. The insight gained from the natural experiments justifies the pain of conducting the experiments. In a nutshell, the mixed experimental studies, the combination of LS and NE will be the right way to achieve the right balance (Bendoly et al., 2006; Fisher, 2007; Gupta et al., 2009).

3.3. Mixed Experimental Studies (MES)

Having outlined the common approaches used in the BOM, it is worth noting that there are opportunities in the joint use of more than one approach. For example vignettes have used in various studies as stand-alone methods; they have been used in mixed studies as backdrop to process simulation. In such applications, vignettes can serve to prime individuals for more ideal experimental responses; hence, permitting greater clarity in the analysis of research questions. The mixed experimental studies can provide deep insights into the higher level operations management, project management, Board discussions etc.

4. Selection of the Experiment Technique

The selection of the experiment technique is a critical decision. All the technique describe above have their own merit and demerits. The selection of the experiment technique solely depends upon the nature and the complexity of the problem. It is the duty of the researcher to select the best experiment technique to give justice to the research problem. The table 4.1 gives the checklist for the selection of the appropriate experiment technique.

Another important thing while selecting the appropriate experiment technique is the validity of the measurement. According to the Giannoccaro (2013, p. 13), "The validity of a measurement is one indication that the linkage between the (empirically) observable and the (theoretical) unobservable that has been proposed is a strong, high quality linkage from which useful inferences can be drawn." There are various ways to test the validity such as face validity, content validity, predictive validity, concurrent validity, convergent validity, and discriminant validity (Donnelly and Trochim, 2007).

Other than the validity and the nature of the problem few more dimensions that are critical to the selection of the experimental research methodology are 1) Number of decision variables 2) Physical presence of respondents 3) Technological support 4) Sample space 5) Financial support requirements.

Generally there will be least one decision variable, but the exact quantity of the decision variables is not standardized. In doing the experiments it is generally a [2*2] or a [2*2*2] decision matrix. The physical proximity of the respondents is needed for some experimental designs while few experiments can be conducted remotely. For capturing the physical changes say eye movements, retina analysis, heart beat measurement, sweat etc. the physical presence of the respondents is must. Some kind of experiments are better conducted using various technological. These tools will help to monitor and moderate the experiments in real time boosting the validity of the overall experiment. For some kind of experiments one sample point will be sufficient and for few experiments sample size will be greater than one. So the number of data points needed to discover the underlying pattern is a critical dimensions while selecting the experimental research methodology. Last and very important parameter is the financial requirements. The researcher has to strike balance between the available resources and the study requirements. While doing the justice to the research problem the researcher must allocate all the possible resources available at hand.

So based on the above arguments and the literature review, the following guidelines have been created to help the researchers in selecting the appropriate experimental research methodology (Refer table 1)

Sr. No	Dimensions	VBR	PS	LS	NE	MES
1	Problem complexity	Low to medium	Medium to high	Low to high	Low to high	Low to high
2	No of decision variables	1 – 2	>2	>2	>2	>2
3	Physical presence of respondents	Optional	Not needed	Needed	Needed	Optional
4	Technological support	Low	Medium	High	Low to Medium	Low to high
5	Sample space	Medium to large	Low to high	Low to high	Low to high	Low to high
6	Validity checks	Easy	Easy	Easy	Difficult	Difficult
7	Financial support requirements	Low	Low to medium	Low to medium	Low to high	Low to high

Table 1: Checklist for selection of experiment technique

Source: Created by authors

5. Conclusion

BOM has been acknowledged as one of the most fertile and emerging fields in OM. BOM works as a twofold strategy, one it studies how the human behavior affects the performance of operating systems, and second BOM gives ways to improve the performance. Being a developing stream in the domain of operations management BOM is heavily relied on the experimental studies. This paper has attempted to consolidate the work related to experiment techniques used in BOM and proposed guidelines to select the appropriate technique.

Various types of experimental studies used in the BOM such as vignettes, process simulation, laboratory simulation, natural experiments and mixed experimental studies. The nature of the problems determines the study to be opted. There are various pros and cons of using these studies and not all studies are applicable in all the situations. But in all the mixed experimental studies is found to be more acceptable to the researchers compared to others. However the selection of the appropriate experiment technique is also affected by Problem complexity, number of decision variables, physical presence of respondents, technological support, sample space, validity checks. The design of the experiment is very crucial step in order to capture the true insights of the behavioral aspects underlying the operation management.

The BOM is very fertile and lucrative area of research. Lot of academicians and the practitioners are getting involved into the realm of the BOM. The discovery of the hidden and important intangible human behaviour that is always neglected by the OM literature brings deep insights both into the academia as well as in the industry. In particular the BOM will help refine the theories of OM and help develop the field. And for industry or practitioners BOM will help them to make better decision making, devising new strategies, better allocation of the resources, policy making and human resource management in an efficient and effective way.

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