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Empirical Research Methodology on Operation Diagnosis to Identify Operation Improvement Opportunities

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Abstract

Selection of research designs either qualitative, quantitative or mixed methods have been major discussion in the field of operation research. This paper reviews the research design and methodology in operations management to identify the common approached in research designs and strategies applied. The advantages and disadvantages of each approach are discussed in order to answer the research questions for operation diagnosis to identify operation improvement opportunities. Finally, empirical research methodology is recommended to develop, test and validate the theory.

Keywords

Operations management, Operation Improvement, Research Design, Mixed Methods, Sequential Inductive method

1. Introduction

Research method in operation management (OM) and quality management (QM) have been widely discussed in past 3 decades. In 1980 there was a call for response over reliance on quantitative method such as survey and experimental method [1]. In response to the criticism, qualitative method such case study method is proposed in late 80s [1][2][3]. Since then, qualitative method have evolved and number of literatures discussing on the detail of qualitative method increase significantly [2] [3]. Currently, qualitative method has become a favorite research method used in the field of OM and QM. According to Barrat [4], recently OM and QM field researcher discussed the research method in specific area such as sustainability, new product development, quality management, and supply chain management. However, the quantitative method is still considered valid and its methodology along the years has mature. Hence, there are numerous studies that reviewed the combination of quantitative and qualitative method. This combined method has been named as mixed method [5].

Operational diagnosis and improvement is one of the fundamental area in OM and QM. This paper discussed and presented the available research method in the area of operational diagnosis and operational improvement. Finally, the empirical research methods and steps for development of effective operation diagnosis to identify operational improvement framework is proposed.

2. Literature Review

Researcher's paradigm plays a pivotal role in the evolution and revolution of research method. Creswell [5] name the research paradigm as the "world view" and categorized the world view into four category which are: 1) Post positivism, 2) Constructivism, 3) Advocacy/ Participatory, and 4) Pragmatism. The "world view" is segmented to their favorable research design as shown in Table I.

TABLE I: RESEARCH "WORLD VIEW" ADOPTED FROM CRESWELL [5]

Postpositivism QUANTITATIVE	Constructivism QUALITATIVE
• Determination • Reductionism • Empirical observation and measurement • Theory verification	• Understanding • Multiple participant meanings • Social and historical construction • Theory generation
Advocacy/Participatory QUALITATIVE	**Pragmatism MIXED**
• Political • Empowerment Issue-oriented • Collaborative • Change-oriented	• Consequences of actions • Problem-centered • Pluralistic • Real-world practice oriented

Creswell [5] stated that Quantitative research design is either experimental or non-experimental (such as survey and correlation study). Conversely Quantitative research design is either case study, action based/ grounded theory, phenomenological research and narrative research. On the other hand, Barrat [4] discussed in detail on qualitative research design based on inductive and deductive case approaches. The inductive and deductive are related with the research aim or purpose. Majority of qualitative approaches were used for inductive case approach. The qualitative inductive approach commonly used by "Constructivism" world view in order to develop and generate theory. While, the deductive case approach was mainly use for theory testing. The theory testing may include either theory confirmation or theory falsification purpose.

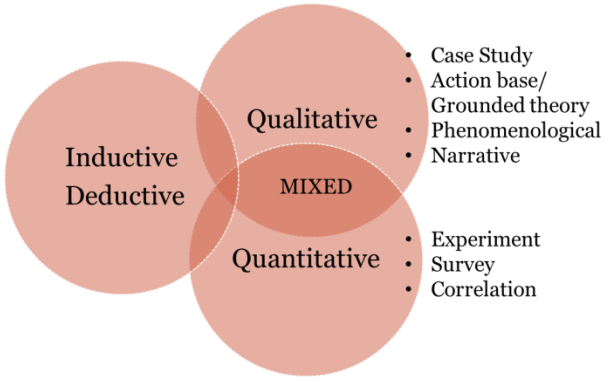

Fig. 1: Research Purpose - Research Design – Data Collection Strategy

The mixed method on the other hand employs both quantitative and qualitative design. The strategy for mixed method includes Sequential, Concurrent and Transformative. Based on different of design and strategy discussed above and as present in figure 1, several literature in the field of operational diagnosis and selection of operational improvement opportunities was examined as presented in table II. Based on table II, the research designs were dominant by Qualitative research design and utilized both of inductive and deductive case approached depending on the purpose of the research. From the summary above, there were two mixed method utilized in the research design. From the both sample above, the mixed method was used on more detail research such as research to attain degree in doctorates. Mohammad [6] quoted several thesis and research that utilized the mixed method and indicated the

strong justification of selecting mixed method in the field of selection in improvement initiatives. The justification included; increase chance to answer the research questions, provide flexibility in research, and complement the result to dominant research method. Some of the papers were focused on developing the conceptual theory through literature review and book review [7][8][9]. Creswell [5] indicated that inductive quantitative should include the additional literature review at the end of the study especially when pattern or categories have been found.

TABLE II: SUMMARY OF OPERATION DIAGNOSIS AND IMPROVEMENT RESEARCH AIM AND RESEARCH DESIGN

Author(s) and Year	Improvement Diagnosis			Purpose of Research	Research Design and Strategy
	Quality Audit/ Gap Analysis	BE Assessment	Improvement Selection		
CC Yang 2004 [10]		v	v	Integration of BE, TQM and Six Sigma	Literature Review and conceptual development. No research design presented
Thawesaengskulthai 2010 [11]	v		v	Selection of Improvement Approaches	Mixed Method - Inductive
Mohammad 2011 [12]		v	v	Selection of Improvement Initiatives	Mixed Method – Inductive/ Transformative
Yang & Hsieh 2009 [9]		v	v	Integration of National Quality Award and six sigma project selection (Taiwan).	Qualitative- Inductive/ Case Study
Karapetrovic and Willborn 2001 [7]	v	v		Develop of conceptual model to integrate quality audit and assessment	Literature and Document Review.
Simon and Taylor 2007 [13]	v		v	Integrate system and contingency approached in lean improvement selection for meat supply chain (UK).	Qualitative- Deductive/ case study
Büyüközkan and Öztürkcan 2010 [14]			v	Develop a approach to select the six sigma project (Logistic - Turkey)	Qualitative- Deductive/ case study
Hu et al 2008 [15]			v	Development of model for project portfolio selection in manufacturing company.	Qualitative – Deductive/ Case Study
Williams et al 2006.[16]		v		Critique and Perspective of BE Self-Assessment.	Literature Review and practical review.
Ritchie and Dale 2000 [17]		v		The process, practice and management of BE self-assessment.	Qualitative – Deductive/ Phenomenological
Menda 2004[18]	v			Manufacturing audit to determine operation strategic.	Qualitative – Deductive/ Action Based
Hepner et al 2004 [19]		v		Identify improvement through QMS auditing. Meat Industries, Canada	Qualitative – Deductive/ Phenomenological
Kumar et al [20]			v	Used of data envelopment analysis (DEA) to identify six sigma projects	Qualitative – Deductive/ Case Study

3. Selection of Research Design

3.1 Research Purpose

Researcher should have the research purpose before the selection of research design can be commenced. The research purpose or sometime refer to research aim is the main goal of the research. Most of the research purpose can be divided to either theory development or theory testing. If there is several purpose, the researcher should consider divide the research into several phase. For example in prior framework of Mohammad [6]:

Research Purpose: Development of a guidance model for selection of improvement initiative. The research was divided into 2 phases which are: Phase 1: Development, evaluation and refinement of a conceptual model (Inductive) and Phase 2: Development, evaluation and refinement of a guide model (Inductive and Deductive).

3.2 Steps in selecting research design

Based on Yin [21], Creswell [5] and Barrat [4], the steps of selection of research design should have the following steps: Step 1) Derived the research purpose to research question or hypothesis; Step 2) Defined the structure of expected output i.e. unit of output; Step 3) Decide data collection method; 4) Presentation of the result.

The step 1 and 2 can be interchanged depending on which is the best approach for researcher. For example, when attempting to develop a theory, framework, or model, researcher should have a clear focus on the research output especially on the structure of research output [22]. This focus helps to define the research question, the types of data to be collected and the types of organizations to be approached [23]. The step 1 and 2 may evolved over time and constructs maybe modified [3]. At the same time the focus on structure of research output may help to maintain consistency throughout data collection and analysis[4].

The third step is to decide on data collection method. When deciding the data collection method, several consideration need to consider such as data source, sampling, unit of analysis and data analysis method [21]. Data source may include interview, observe, and check the documentation as shown in figure 2. The interviews either structured or semi structure [4]. In structure interview, the questionnaire is fixed. While semi structure interview, the questionnaire may evolved based on emerging data. The observation data source may include observation of the process, machine setting, plant tour, and attending the meeting. The check method may review the organization procedures, and production record.

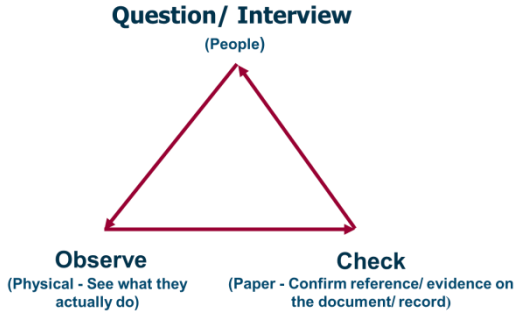

Fig. 2: Common qualitative data collection method

For quantitative research method, statistically sampling is commonly utilized. While for qualitative research utilize a theoretical or biased sampling approach where cases are chosen for theoretical reasons either to predict similar results or contrary results[24]. Eisenhart [24] recommend the use of multiple data source to provides increased reliability of data. Yin [25], recommend the use of polar extreme-types for cases that have sharply contrasting characteristics. The companies that have used the theory or the framework can be used for benchmarking and comparisons purposes ([26]. The case/ interview protocol develop may depend on the number of cases that researchers selected [3]. If the number of cases is small, the research can go into depth study. Single case studies is useful for longitudinal research [3]. However, multiple cases can augment external validity and help guard against observer bias especially for theory building purposes is likely to create more robust and testable theory than single case research is utilized. Multiple case studies should consider 4-10 case studies [4]. Typically, researchers need to continue sampling until having achieved informational redundancy or saturation -- the point at which no new information or themes are emerging from the data as shown in figure 3.

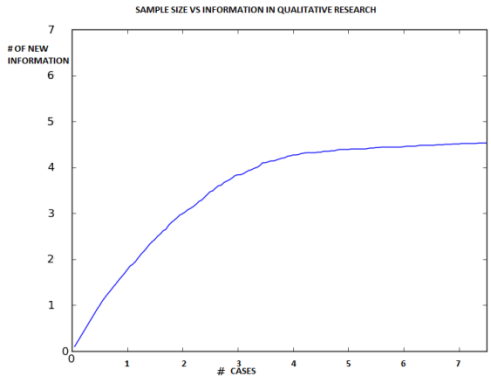

Fig. 3: Number of sample untul information saturation

Data analysis is the main element of theory building by using qualitative method to determine information saturation [2]. For structure interview the data analysis can be analyze after the data collected. While for semi structure interviews the data should be analyze concurrently during the data collection because the constructs and their relationships are adjusted when the data are collected. The adjustments come from the addition of cases to pursue a particular emerging theme, additional interview protocol and additional of data sources in existing case studies [4].

The final step is to determine the presentation of the results. The result presentation is the process to develop the conclusion through the case write up [24]. There is no standard format for case write up [27]. However the cases write up should have detailed, descriptive that provide the insight on emerging constructs and their relationships. Cross-case analysis is recommended to prevent making the conclusion based on limited data [24]. Cross case can be implemented by either selecting two cases or more to compare the different or select a few constructs based literature and compare with the evidences. The use of tables and visual displays is often promoted as the way to convey and summarize the rich empirical evidence within case studies [4].

4. Discussion and Proposed Research Steps

According to Creswell [5], the selection of research design is also depend on researcher personal experience and audience experience. To minimize the biasness, justification of selected research design is discussed and presented hereafter.

The main purpose of this research is to "develop the framework for operations diagnosis to identify improvement opportunities". The framework for operation improvement diagnosis provides the modalities to conduct effective operation diagnosis.

Multiphase research is proposed due to research objective is to explore the common practices in operational diagnosis. At the same time to determine the best framework for operational diagnosis. There are several prior frameworks that can be utilized and suit into operations diagnosis framework. Thus, the first part of research is to identify the relevant elements in prior framework that can be utilized to determine the main process in operations diagnosis. Since the first objective of the research is to identify the current available frameworks to select operational improvement initiatives, the research questions are derived based on deductive qualitative research strategy. Once the prior framework have been validated by using semi structured interview data collection and analysis, the next research objectives is to identify the techniques and tools to be used in operational diagnosis. The research strategy will be inductive qualitative. Hence the first phase of research utilized concurrent deductive and inductive qualitative method.

However, on the next phase, the research objectives is to refine and evaluate, the research strategy will focus on quantitative deduction in order to determine the level of agreement of the framework. Thus, the second phase of research utilized sequential mixed method. The detail summary of research objectives, research question and data collection strategy is presented in table III.

TABLE III: SUMMARY OF RESEARCH OBJECTIVES, RESEARCH QUESTIONS AND RESEARCH METHOD

Research Objective	Research Question	Research Method/ Data Collection
Phase 1 Development of Framework		
1. To identify the current available frameworks to select operational improvement initiatives	Q1.1 What are the available framework to assist in selection of operational improvement initiatives?	Literature Review
	Q1.2 What are the strength and Limitation of the existing framework?	Deductive Qualitative/ Semi Structure Interview.
2. To determine the main processes in operation improvement diagnostic;	Q2.1 What are the generic steps/ process in DT?	Deductive Qualitative/ Semi Structure Interview.
3. To identify the criteria or factors (variables) for effective operation improvement diagnostic;	Q3.1 What are the factors for each step?	Inductive Qualitative/ Semi Structure Interview.
	Q3.2 What is/ are technique(s) & tool(s) for each step?	Inductive Qualitative/ Semi Structure Interview.
Phase 2 To Refine and Improve the Framework		
4. To Refine and evaluate the framework for operation diagnosis and improvement.	Q4.1 What is the "degree of agreement" of each statement in the framework?	Quantitative/ Evaluation Survey.
	Q4.2 What are the expected improvement results from the framework?	Deductive Qualitative/ Action based Case Study.
	Q4.3 What are the suggestions for improvement of the framework to make the framework ease to use?	Deductive Qualitative/ Action based Case Study.

A swim lane diagram is recommended to visualize the multiphase research design. The swim lane process flow diagram visually distinguishes the concurrent activity to collect the data. Each of research output can be determine at each phases and presented on each lane. The swim lane diagram is presented in figure 5.

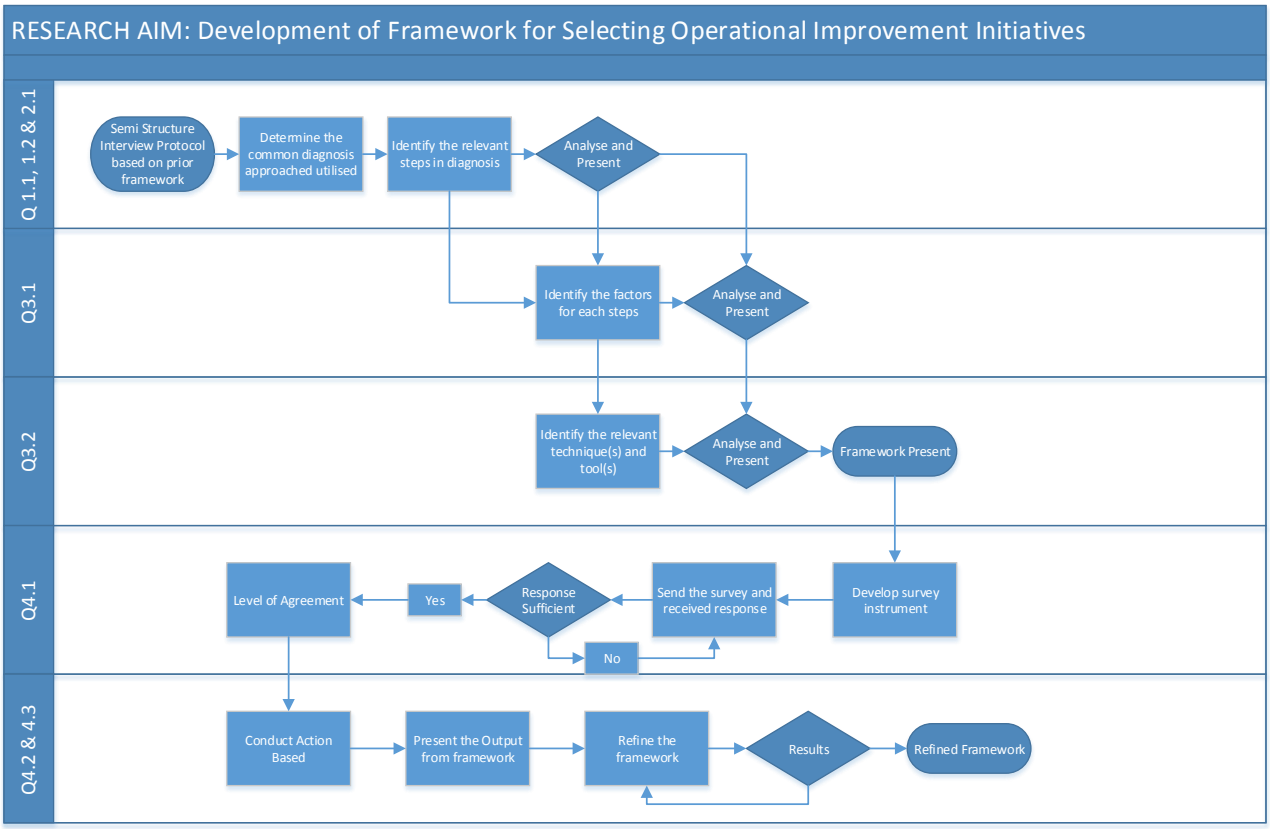

Fig 5: Proposed Research Multiphase Research Process Flow

5. Conclusions

Although there are numerous researches design discussed in the area of OM and QM, the recommended research method for operation diagnosis to identify operation improvement opportunities is to utilize multiphase mixed method with qualitative dominant. This study has provided some rational for considering the above method and provide recommendation of research process flow. However the consideration has to be made before applying the above method. First, the data collection can be time consuming. Secondly it may require researcher well versed in interview skill and has background experience in the field of auditing and assessing the operational excellence. Finally selection of organization and interviewee is crucial in order to get the reliable research answer.

In other words, the research method proposed above may not altogether be the most efficient way to achieve the research aims in developing the framework for operation diagnosis. However, multiphase design may answers research questions that are useful and applicable to the industries. This is such that the method considers common issues, relevant tools, techniques, and effective investigation methods.

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