SCHEDULE INSTABILITY AND COLLECTIVE EFFICACY:
A WORKING PAPER IN THE PEARL RIVER DELTA

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ABSTRACT
Hong Kong’s manufacturing and trading sector is the biggest pillar among all business sectors, which accounts for 25% of GDP in 2004¹. While the industrial sector of Hong Kong was enlarged with the expansion of offshore production, many local companies are the integral part of global supply chain, and have a wide scope of responsibility among the suppliers, customers and themselves. However, schedule instabilities are frequently noticed.

The aim of the research was to obtain insights from practitioners on how they view schedule instability and to identify factors that affect the degree of instability experienced by manufacturing companies in Hong Kong. In addition to schedule nervousness, collective efficacy on the performance is measured. A research framework developed hypothesising the effect of three factors on schedule instability is further testified for its impact on the collective efficacy on performance. This paper presents how the research framework and survey are developed for the study in Hong Kong and the Delta. The results would be further analysed and extended to other countries in the region. Literatures of schedule instability and collective efficacy, and current situation of Hong Kong manufacturing companies are reviewed. The research paves the way for comparative studies in different parts of the world and in different sectors.

KEYWORDS
Schedule Nervousness, Supply Chain, Manufacturing Logistics

1. Introduction

Supply chain refers to the series of manufacturing plants that perform the production tasks. Manufacturing logistics refers to the operations and service functions that are required to carry out manufacturing activities [1, 21]. For a manufacturer to optimize its production operations, there always exists such a need to optimize the performance of the supply chain connecting raw material to finished product by controlling the transmission of schedule instability [2]. Researches have been carried to find the best way to optimize the supply chain performance [14, 19, and 23]. Schedule instability is associated with frequent changes to production schedule due to various reasons such as changes in customer orders, delay in delivery of materials, internal breakdown such as employee strikes, sudden machine breakdown, or material shortages due to inaccurate inventory records. Frequent changes or instabilities in schedules are also referred to as nervousness [10, 17]. Schedule instability and schedule nervousness are thus often used interchangeably. While on one side such changes are reflecting ability to react to environmental dynamics, too many changes could be very disruptive to the effective operations of a manufacturing system. In a case study conducted in a labour-intensive manufacturing company in Indonesia, Pujawan [16] suggested that frequent schedule changes results in significant reduction in the shop floor productivity. The author mentioned that whenever a changeover is introduced to the shop floor, as much as 20% reduction in system productivity was observed due to the learning process of the workers.

In today’s turbulent manufacturing environment, where markets are becoming more and more dynamic, many parts of the value added activities are outsourced, and the procurements are often from global suppliers with uncertain lead times, changes to production schedules have been a major concern in most manufacturing companies. The tremendous competition, rising consumer expectations and demands on product variety and relationship with suppliers, is forcing the manufacturers to optimize their operations. Revisions to production schedules or production plans are a common complaint in most manufacturing companies.

¹ Hong Kong Trade Development Council, 2006
Furthermore, as most changes in the production schedule also result in changes in the material requirements, not only internal manufacturing system that is affected, but also those of suppliers and third party logistics.

There have been records of published works that address schedule instability in manufacturing systems. However, most of the works have been theoretical in nature and little attempt has been made to learn this issue from practitioners. Study done by Pujawan & Smart [15] showed that the three factors: relationships with suppliers, relationships with buyers, and internal operations, affect schedule instability significantly in the manufacturing companies.

Based on this theoretical background, we are also hypothesizing that the schedule instability will affect the collective efficacies of staff working within these companies, and thus affect the performance outcome.

2. Efficacy and Performance

During the 1990s, researches focused on several important issues related to the theory of goal setting were carried out. These include the study of goal difficulty-performance relationship, goal commitment in goal setting [20], personal goals and efficacy as well as effectiveness of goal setting. Wofford’s study examined the role of self-efficacy in goal setting. Self-efficacy generally refers to what a person believes he or she can do in a particular task. It has been associated with the intrinsic motivation and goal commitment [20]. People with high self-efficacy are likely to set high goals and to perform well [13]. Self-set goals are often more desirable than assigned goals because they automatically engender high commitment [8]. Thus, self-efficacy and personal goals are likely to play important roles in determining performance in the presence of assigned goals.

Based on the theoretical assumption that efficacy level is associated with performance outcome, this study is to investigate if working in such environment at high level of scheduling instability correlates to the efficacy beliefs and thus the performance. We are interested to extend such a study to industries in Hong Kong and Delta Region in order to obtain better and wider understanding on whether such conclusion also hold true for industries in other part of the world.

3. Hong Kong Manufacturing Industry

The industrialization of Hong Kong from 50s to 70s coincided with the supporting environment made Hong Kong be able to establish itself as a major manufacturing base for US and European markets. Hong Kong’s manufacturing and trading sector is the biggest pillar among all business sectors, which accounts for 25% of GDP in 2004. While the industrial sector of Hong Kong was enlarged with the expansion of offshore production, many local companies are operated as trading companies in Hong Kong for their offshore production activities. These companies perform non-manufacturing activities in Hong Kong, providing support services such as marketing, orders processing, materials sourcing, product design and development, quality control, and logistics support to their affiliated factories offshore, particularly in the Chinese mainland. They become the integral part of global supply chain, and have a wide scope of responsibility among the suppliers, customers and themselves. However, the widening of the scope of responsibility does make the operation more complicated, and schedule instabilities are frequently noticed.

It has been reported by the Surface Mount Technology Magazine that the manufacturing in China has experienced a steady increase since 2003. Manufacturers are being faced with challenges of keeping up with competitors and lowering costs. It is also forecasted that the market for electronics manufactured in China may reach a compound annual growth rate of 15.4% from 2003 to 2008. Hong Kong and Delta manufacturing companies are too facing tremendous competition. In the recent decades, logistics and supply chain have been playing a very important role in the economical development of the region, while PRD has been the major logistics centre.

4. The Research

The objective of the research is to conduct a comparative survey study on schedule instability in Hong Kong and Pearl River Delta region. In this section we will explain the framework to be used in the study, hypotheses development, and research methodology.

2 Hong Kong Trade Development Council, 2006
3 M. M. Boisvert, 2005, China’s Manufacturing Growth Catches Government’s Eye, SMT Magazine, Jan, 2005
4.1. The Framework

Evolved from Pujawan & Smart’s [15] previous works on the schedule nervousness, this study suggests the possible impacts on the schedule nervousness of a manufacturing company from the supplier side, customer side and internal operations. A framework has been developed to relate supplier relationship, customer relationship, internal operations and schedule nervousness. In this study, it is also proposed the possibility of correlation between schedule nervousness and collective efficacy of practising staff. Collective efficacy here refers to the confidence of the team in performing scheduling related tasks. These include the collective efficacies in having efficient scheduling, achieving goals, maintaining good relationships with both suppliers and customers and as well maintaining high level of excellence.

Figure 1 shows the schematic representation of the framework. The conceptual framework postulates that supplier relationship, customer relationship and internal operation affect the schedule nervousness, and moreover, the linkage between collective efficacy and schedule nervousness.

4.2. Hypotheses development

**Hypothesis 1: Schedule Nervousness and Customer Relationships.**

Many Hong Kong or Delta based manufacturing companies generally develop good partnering relationships with their buyers/customers. Information sharing between these companies and their customers is highly valued, while literature on supply chain management has been advocating the importance of frictionless information sharing with customers. Dealing with the increasingly stringent product life cycles, manufacturers require accurate and timely information to enable their planning of production and deliveries, while reduction of inventories is also an objective. Furthermore, better relationships with customers could affect the demand forecast accuracy and thus schedule nervousness [3, 4 and 5]. It has been well accepted by Hong Kong and Delta managers that they have to maintain good relationships with customers, in order to maintain low level of schedule nervousness. Thus, our research framework takes external factors, the customer relationship, into account. The first hypothesis in this study is evolved from Pujawan’s previous work:

\[ H1: \text{Better relationships with buyers lead to lower schedule nervousness in Hong Kong and Delta Manufacturing companies.} \]

**Hypothesis 2: Schedule Nervousness and Supplier Relationships**

Partnerships between both the buyer and supplier could improve the performance of manufacturing logistics [6, 7 and 12]. In addition to customer relationship, many logistics managers of Hong Kong and Delta manufacturing companies perceive that relationships with suppliers also affect greatly the strategic and operational performance. We suspect that the ability of a company to manage their direct suppliers is also a potential determinant of schedule instability. In the highly competitive market in Hong Kong and Pearl River Delta (PRD), it is common that the manufacturing companies have multiple suppliers for better quality and price of materials, schedule nervousness may be thus reduced if the company has better relationships with their suppliers.

\[ H2: \text{Better supplier relationships lead to reduced schedule nervousness in Hong Kong and Delta Manufacturing Companies} \]

**Hypothesis 3: Schedule Nervousness and Internal Operations**

In addition to supplier relationship and customer relationship, the quality and reliability of internal operations in manufacturing companies also affect the level of schedule nervousness they experience. A number of sub-factors are considered, namely, the reliability of the production system, component commonality, skills of the corresponding staff in managing planning and scheduling activities, the existence of an effective time fencing system, and the flexibility of the scheduling system [9, 10, 15 and 23]. Internal operation may include the various factors within a company, such as production system, planning strategy, products, human factors, and the schedule system. System related parameters affect the planning system performance in terms of stability, cost and service level. Thus, we hypothesized that better internal operation leads to reduced schedule nervousness in the Hong Kong and Delta manufacturing companies.

\[ H3: \text{Better management of internal operations leads to reduced schedule nervousness} \]
Hypothesis 4: Schedule Nervousness and Collective Efficacy in Logistics Performance

Self-efficacy generally refers to what a person believes he or she can do in a particular task. It has been associated with the intrinsic motivation and goal commitment [20]. People with high self-efficacy are likely to set high goals and to perform well [13]. Self-set goals are often more desirable than assigned goals because they automatically engender high commitment [8]. Thus, self-efficacy and personal goals are likely to play important roles in determining performance either in the presence of assigned goals.

While good designed logistics systems are put in use, individuals working within them also account for the effective logistics operation management. Human factors do play an important role in the logistics operation. It is hypothesized that, if schedule nervousness is at a lower level, individuals working for the internal operations are at a higher level of collective efficacy. That is, they are with higher level of confidence that they can perform well, and vice versa. This leads to the following hypothesis.

H4: Higher level of schedule nervousness lower collective efficacy
5. Research Methodology

Quantitative method is adopted in this study. The quantitative data is collected based on a survey methodology. The survey study is divided into two stages:

1. Design of questionnaire and pilot study - Practising managers are invited to participate in the pilot study which serves as the pre-test of the survey.
2. Data collection - A questionnaire survey is in late 2006, after the pilot study and corresponding modifications.

5.1. Questionnaire

The questionnaire consists of two parts. The first part is about the particulars of the company and the respondent. The second part is about the participant’s perceptions on supplier relationships, buyer relationships, internal operations and the schedule nervousness as well the perceived efficacy in logistics performance. The respondents are asked to rate each statement by using a 5-point Likert scale where 1 represents ‘strongly disagree’ and 5 represents ‘strongly agree’. The questionnaire is written in English and Chinese. A brief explanation on the terms, such as schedule instability, component commonality and time fencing systems are provided.

5.2. Pilot Study and the finalized questionnaire

Pilot study was carried out in July 2006, to serve as a pre-test of the survey and to justify the appropriateness of the questionnaire design. Practitioners in manufacturing companies were invited to participate in the pilot study. Most of them are the direct administrators of manufacturing logistics. The study was performed by direct interviewing. Five practitioners were invited. Participants were briefed before they did the questionnaire, to ensure there is no misunderstanding of the terminologies being used. Participants were asked to give comments on the questionnaire design. Most of the questions in the questionnaire were well understood by the respondents in the pilot study. Comments were generally given on the wordings and the description of details. Some ambiguous words were suggested to be crossed out and statements were simplified for the ease of better understanding. This is to avoid any misinterpretations and misconceptions. The modified questionnaire is as follow:

Table 1: Sample Statements of The Survey

<table>
<thead>
<tr>
<th>Relationship with suppliers</th>
<th></th>
<th>Relationship with customers</th>
<th></th>
<th>Internal Operations</th>
<th></th>
<th>Schedule Nervousness</th>
<th></th>
<th>Efficacy Beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Suppliers are generally flexible in delivery, i.e. locations, time and means.</td>
<td>C1</td>
<td>Customers provide information on order quantities and associated due dates well in advance</td>
<td>I1</td>
<td>We have a reliable production system;</td>
<td>G1</td>
<td>Schedule nervousness is always observed and much affects our business performance</td>
<td>E1</td>
</tr>
<tr>
<td>S2</td>
<td>Suppliers are generally reliable in providing on-time delivery</td>
<td>C2</td>
<td>Customers rarely change the agreed order quantities, specifications, and delivery times</td>
<td>I2</td>
<td>Our product designs have many materials/components in common, which are interchangeable.</td>
<td>G2</td>
<td>Significant costs are incurred due to schedule instability</td>
<td>E2</td>
</tr>
<tr>
<td>S3</td>
<td>Suppliers are willing to share information on their inventory levels, production capacity and delivery schedule</td>
<td>C3</td>
<td>Customers are willing to provide information for better cooperation.</td>
<td>I3</td>
<td>We have a flexible planning system</td>
<td>G3</td>
<td>Schedule instability in our company affects our inventory handling management.</td>
<td>E3</td>
</tr>
<tr>
<td>S4</td>
<td>Most of our suppliers have effective information and communication infrastructures</td>
<td>C4</td>
<td>Our major customers have effective information and communication infrastructures</td>
<td>I4</td>
<td>Our planning staff are skilful and well able to handle the planning, scheduling and rescheduling activities</td>
<td>G4</td>
<td>Continual rescheduling significantly undermines management’s confidence in our company’s scheduling system</td>
<td>E4</td>
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<td></td>
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<td></td>
<td>I5</td>
<td>We have good operations management that the planning system allows sufficient tolerance for making rescheduling decisions</td>
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</table>
5.2. Translation of Questionnaire

The original questionnaire was designed in English. For the study to be carried out in the region, it is required to translate the questionnaire into the appropriate language. Chinese is the most commonly used language in Mainland and Hong Kong. Therefore, it is most appropriate to translate the questionnaire to a Chinese version.

For the translation of questionnaire, backward translation was adopted. We firstly got a professional translator to translate the original English version into a preliminary Chinese version. Then we got another professional translator to translate the Chinese version back to English. Comparison between the two English versions was conducted to identify if there was any discrepancy. Modifications were made to the questionnaire and it was then translated to the second Chinese version by a professional translator. Table 2 presents the finalized Chinese version of questionnaire.

5.3. Data Collection and Analysis

The pilot study was intended to provide us feedbacks of the questionnaire design, from the production planning practitioners. The participants in the pilot run were experienced practitioners in the field, the comments they provided were thus valuable for the questionnaire modification. From the pilot run, the questionnaire design was proven valid to be a data collection tool for the prescribed study, while there were some minor modifications.

With the questionnaire developed, data collection is scheduled during the late 2006 to early 2007. Samples are selected from the list of manufacturing companies in the region (Hong Kong and Pearl River Delta, China). We tried to start our study in the main stream of industry here in Hong Kong. We have identified more than 100 companies in the field of electronic manufacturing. To date, we have got responses from about thirty (30) companies while it is equivalent to about 30% of the population. Respondents are the practitioners of the planning system.

The accuracy of the survey study will be further verified by validity and reliability. To warrant the reliability of a particular measure (scale), the set of items measuring the construct should be highly correlated. The reliabilities of the survey questions will be tested by the SPSS-Reliability Analysis technique. The validity of the constructs of the questionnaire will then be verified through the principal component analysis of factor analysis, by SPSS.

Table 2: Chinese Version of Questionnaire Statements

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<tr>
<td>C1</td>
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<td>C3</td>
<td>C4</td>
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<td></td>
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<tr>
<td>I1</td>
<td>I2</td>
<td>I3</td>
<td>I4</td>
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<td>I5</td>
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<td>G1</td>
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<td>E5</td>
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</table>
5.4. Qualitative Interview

To justify and to verify the data obtained, a qualitative study will be carried out after the data analysis of the survey data. Semi-structured interviews are proposed. The interview aims at getting a general idea of how the practitioners in the supply chain are feeling about the three schedule nervousness factors, their efficacies and thus the performance. Discussions will be held in casual manner for the participants to share their true feelings towards the issues being interviewed, as this would yield a richer data to describe the actual situation and to verify the results obtained in the preceding survey study.

6. Concluding Remarks

This paper presents the research framework of a study on schedule nervousness of manufacturing companies in Hong Kong and Pearl River Delta.

The study also attempts to establish and evaluate the impact of various factors on schedule nervousness, and hence on the collective efficacy. Three main factors were considered in this study: relationship with buyers, relationships with suppliers, and internal operations. We hypothesized that schedule nervousness can be reduced by stronger relationships with buyers and with suppliers, and by better internal operations. Higher level of collective efficacy will thus be resulted. This study has extended the current context of buyer-supplier relationships in supply chain, by bringing in the internal operations and collective efficacy.

Based on the theoretical assumption that efficacy level is associated with performance outcome, this study is to investigate if working in such environment at high level of scheduling instability correlates to the efficacy beliefs and thus the performance. We are interested to extend such a study to industries in Hong Kong and Delta [1]. Region in order to obtain better and wider understanding on whether such conclusion also hold true for industries in other part of the world.

In this paper, the authors discuss the methodological issues of a study, in which survey study is adopted. We have described many steps involved from the very beginning of the survey design and hypotheses to the pilot study prior to the data collection. The large-scale survey study is being carried out as at early 2007. We are looking forward to the results and expecting that the results can bring forth inspiring ideas to the field.

References


