

The copyright © of this thesis belongs to its rightful author and/or other copyright owner. Copies can be accessed and downloaded for non-commercial or learning purposes without any charge and permission. The thesis cannot be reproduced or quoted as a whole without the permission from its rightful owner. No alteration or changes in format is allowed without permission from its rightful owner.



**SYSTEMIC PROCESS OF “ON-TIME DELIVERY” IN
AEROSPACE COMPOSITES MANUFACTURING
COMPANY**



ROZITA LONG

UUM
Universiti Utara Malaysia

**DOCTOR OF MANAGEMENT
UNIVERSITI UTARA MALAYSIA
2018**

**SYSTEMIC PROCESS OF “ON-TIME DELIVERY” IN AEROSPACE
COMPOSITES MANUFACTURING COMPANY**



By
ROZITA LONG

UUM
Universiti Utara Malaysia

**Thesis Submitted to the
Othman Yeop Abdullah Graduate School of Business
Universiti Utara Malaysia,
in Fulfillment of the Requirement for the Doctor of Management**

CERTIFICATION OF THESIS WORK



Kolej Perniagaan
(College of Business)
Universiti Utara Malaysia

PERAKUAN KERJA TESIS / DISERTASI
(Certification of thesis / dissertation)

Kami, yang bertandatangan, memperakukan bahawa
(We, the undersigned, certify that)

ROZITA LONG

calon untuk Ijazah
(candidate for the degree of)

DOCTOR OF MANAGEMENT

telah mengemukakan tesis / disertasi yang bertajuk:
(has presented his/her thesis / dissertation of the following title):

**SYSTEMIC PROCESS OF "ON-TIME DELIVERY" IN AEROSPACE COMPOSITES
MANUFACTURING COMPANY**

seperti yang tercatat di muka surat tajuk dan kulit tesis / disertasi.
(as it appears on the title page and front cover of the thesis / dissertation).

Bahawa tesis/disertasi tersebut boleh diterima dari segi bentuk serta kandungan dan meliputi bidang ilmu dengan memuaskan, sebagaimana yang ditunjukkan oleh calon dalam ujian lisan yang diadakan pada:
3 Oktober 2017. (That the said thesis/dissertation is acceptable in form and content and displays a satisfactory knowledge of the field of study as demonstrated by the candidate through an oral examination held on: **3 October 2017**).

Pengerusi Viva
(Chairman for Viva)

Prof. Ir Dr. Che Sobry Abdullah

Tandatangan
(Signature)

Pemeriksa Luar
(External Examiner)

Prof. Dr. Megat Mohamad Hamdan Megat
Ahmad

Tandatangan
(Signature)

Pemeriksa Dalam
(Internal Examiner)

Prof. Dr. Darwina Hj. Ahmad Arshad

Tandatangan
(Signature)

Tarikh: **3 Oktober 2017**
(Date)

CERTIFICATION OF THESIS WORK

Nama Pelajar
(Name of Student)

: Rozita Long

Tajuk Tesis / Disertasi
(Title of the Thesis / Dissertation)

Systemic Process of "On-Time Delivery" In Aerospace
Composites Manufacturing Company

Program Pengajian
(Programme of Study)

: Doctor of Management

Nama Penyelia/Penyelia-penyelia
(Name of Supervisor/Supervisors)

: Prof. Dr. Shahimi Mohtar

Tandatangan

Nama Penyelia/Penyelia-penyelia
(Name of Supervisor/Supervisors)

: Dr. Fakhrorazi Ahmad

Tandatangan

PERMISSION TO USE

In presenting this research to fulfill of the requirement for a postgraduate degree from Universiti Utara Malaysia, I agree that University Library make a freely available for inspection. I further agree that permission for copying of this thesis in any manner, in whole or in part, for scholarly purpose may be granted by my supervisor or in his absence by the Dean of Othman Yeop Abdullah Graduate School of Business. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be given to me and to Universiti Utara Malaysia for any scholarly use which may be made of any material from my thesis.

Request for permission to copy or make other use of materials in this thesis, in whole or in part should be addressed to:

Dean of Othman Yeop Abdullah Graduate School of Business
Universiti Utara Malaysia
06010 Sintok
Kedah Darul Aman



ABSTRACT

There is a lack of systemic resource deployment strategy in producing the right, acceptable quality of wing panel, in the right quantity, complete and delivered on time. Thus, a study was done to examine the systemic impact of the number of labour, output, output accuracy and work-in-process on on-time delivery and net sales from a resource-based view perspective. The resource-based view theory was the underpinning theory in this study used to explain the implication of resource and capability utilization in an organization. Together with the theory of labour to explain the significance of labour as value creator, the theory of constraints explains the significance of a drum buffer rope concept to create an invisible link that tie up work- in-process at the shop floor and at the same time identify the bottleneck in the manufacturing flow to produce the right panel, in the right quantity at the right time. A multivariate statistical analysis tool was applied through a formative-causal relation type of study using a correlational approach. The study revealed that labour has the most significant impact on on-time delivery compared to output, output accuracy or work-in-process. Research contribution to the theory, organization, industry and academic is truly evident. A documented real objective research concerning aerospace industry has added another value to the corpus of knowledge in resource-based view theory, theory of labour and theory of constraint. The research findings created another optional strategy for resource and capabilities management in the aerospace manufacturing industry. The study provided a platform for the academic practitioners to test their knowledge in a real situational business case. The limitation of this study could inadvertently prove to be an opportunity for further research. Even though the study found that labour was the major contributor to on-time delivery, it did not address how to manage or how to fully utilize labour as the most important resource in the manufacturing sector. This could be another potential area for future research.

Keywords: on-time delivery, resource and capability

ABSTRAK

Terdapat kekurangan dalam strategi penggunaan sumber secara sistemik untuk menghasilkan komponen panel sayap (wing panel) kapal terbang yang betul, dapat diterima, dalam kuantiti yang betul dan tepat pada masanya di dalam industri pengeluaran aeroangkasa. Oleh itu, satu kajian telah dilakukan untuk mengkaji kesan sistemik jumlah pekerja, pengeluaran, ketepatan jenis barangan pengeluaran dan jumlah barangan separa siap untuk memenuhi penghantaran tepat pada masa dan nilai jualan bersih dari perspektif sumber dan keupayaan. Teori pandangan berasaskan sumber (RBV Theory) telah dirujuk sebagai teori asas untuk menjelaskan implikasi penggunaan sumber dan kebolehpayaan dalam organisasi pembuatan aeroangkasa. Teori buruh (Theory of labor) juga diguna untuk menjelaskan pentingnya buruh iaitu sumber manusia sebagai pencipta nilai dalam pengeluaran dan teori kekangan (TOC) yang menerangkan kepentingan konsep tali penyangga drum (drum-buffer-rope) yang menghubungkan pergerakan barangan di antara proses-proses dalam pengeluaran dan pada masa yang sama mengenal pasti kesesakan dalam proses pembuatan untuk menghasilkan panel yang betul, dalam kuantiti yang betul pada masa yang tepat. Kaedah analisis statistik multivariat diguna pakai melalui kajian formatif jenis hubungan kausal menggunakan kaedah korelasi. Kajian menunjukkan bahawa tenaga kerja mempunyai impak yang paling penting pada penghantaran tepat pada masa berbanding dengan jumlah pengeluaran, ketepatan pengeluaran dan jumlah barangan separa siap. Sumbangan penyelidikan kepada teori, organisasi, industri dan akademik dapat dilihat dengan jelas. Penyelidikan secara objektif dalam situasi sebenar yang didokumentasikan dalam industri aeroangkasa telah menambahkan nilai kepada pengetahuan dalam teori pandangan berasaskan sumber (RBV theory), teori buruh (Theory of Labor) dan teori kekangan (TOC). Hasil kajian mewujudkan strategi pilihan untuk pengurusan sumber dan kebolehpayaan dalam industri pembuatan aeroangkasa. Kajian ini menyediakan platform untuk pengamal akademik untuk menguji pengetahuan mereka dalam situasi perniagaan yang sebenar. Batasan kajian ini merupakan peluang bagi kajian akan datang. Walaupun kajian ini mendapati bahawa pekerja merupakan penyumbang utama kepada penghantaran tepat pada masanya, namun kajian ini tidak menjelaskan cara mengurus atau bagaimana menggunakan sepenuhnya tenaga kerja sebagai sumber utama dalam pembuatan. Hal ini merupakan satu lagi peluang penyelidikan yang berpotensi pada masa akan datang.

Kata kunci: penghantaran tepat pada masa, sumber bahan dan kebolehpayaan

ACKNOWLEDGEMENT

In the name of Allah, the Most Beneficent, The Most Merciful

Alhamdulillah, thanks to Allah the Almighty who gave me all that I needed for completing this thesis. PhD study has been a long and winding journey that taught me many lessons and great joy. It was a journey that was shared with many mentors and companions. Without their support, guidance and dedication, I would not see the final end of my study.

I would like to express my gratitude to those contributed and supported me in completing my study particularly, my beloved mother, Che Gayah Binti Abdullah and my late father, Long Bin Mat Isa. My gratitude goes also to my beloved husband, Zulkepli Bin Hj Bahadon, my inspirational sons and daughters, Izzat Jalil, Muhamad Izudin, NurRahah and Nur Nadirah. Not to forget my supportive siblings, especially Siti Asmahani and sister-in-law, Bashrah, for their everlasting encouragement and endless support. Their loves and awesome support have accompanied me all the way in my long struggle and has pulled me through many hurdles.

My special thanks go to my supervisor and mentor, Professor Dr. Shahimi Mohtar for his inexhaustible energy in guiding me throughout my study. Without his guidance and valuable knowledge, my effort to complete this thesis would have been a vain attempt. I am also grateful to Dr. Fakhrorazi Ahmad who has shared knowledge on research and methodology and statistical expertise throughout my journey, continuously reminding and pushing me to the limit to expand my capability in the study.

Further appreciation goes to staffs of the Othman Yeop Abdullah Graduate School of Business of UUM particularly School of Technology Management and Logistics, who have helped me along formation of this thesis. Thank you Aerospace Composites Malaysia for giving me the opportunity to participate in the MOU program with UUM. My appreciation also goes to all individuals who had tender their support and helping hands throughout my study.

Thanks a million... Alhamdulillah.

TABLE OF CONTENTS

TITLE PAGE	ii
CERTIFICATION OF THESIS WORK	iii
PERMISSION TO USE	v
ABSTRACT	vi
ABSTRAK	vii
ACKNOWLEDGEMENT	viii
TABLE OF CONTENT	ix
LIST OF OPERATIONAL DEFINITIONS	xii
LIST OF ABBREVIATIONS	xiii
LIST OF TABLES	xiv
LIST OF DIAGRAMS	xv
LISTS OF FIGURES	xvi
 CHAPTER ONE: INTRODUCTION	
1.0 Background of study	1
1.1 Problem Statement	6
1.2 Research Question	12
1.3 Research Objective	12
1.4 Scope of Study	13
1.5 Key terms – Definition	14
1.5.1 Aerospace manufacturing	14
1.5.2 Systemic	14
1.5.3 On-Time Delivery	14
1.5.4 Net Sales	15
1.5.5 Direct Labor	15
1.5.6 Work-in-Process	16
1.5.7 Output	16
1.5.8 Output Accuracy	17
1.6 Significance of the study	17
1.7 Research Contribution	20
1.7.1 Organization	20
1.7.2 Theoretical	22
1.7.3 Practical	23
1.8 Organization of the study	24
 CHAPTER TWO: LITERATURE REVIEW	
2.0 Introduction	26
2.1 Background of aerospace industry in Malaysia	26
2.2 Aerospace Composites MalaysiaSdn. Bhd.	27
2.2.1 ACM Manufacturing Process	29
2.2.2 ACM Delivery Process	40
2.3 Manufacturing System Transformation	41
2.3.1 System Theory	46
2.3.2 Systemic Concept	49
2.4 Resource Based View Theory	72
2.4.1 RBV Assumptions	74
2.4.2 RBV - Other perspective	76
2.4.3 Resource-Based View - Resource	77

2.4.4	Resource-Based View- Capabilities	80
2.4.5	Resource versus Capability	80
2.4.6	Resource Based View - Limitation	84
2.4.7	Resource Based View Theory – Application	85
2.4.8	Resource and Capabilities Deployment	90
2.4.9	Resource Based View – Literature Gap	98
2.5	ACM Organization performance key indicators	100
2.5.1	Quality (Q)	101
2.5.2	Delivery	102
2.5.3	Value (V)	104
2.5.4	Safety, Health and Environment (SH&E)	105
2.5.5	Lean (5S)	105
2.6	On-Time Delivery	106
2.6.1	Systemic view of On-Time Delivery	114
2.6.2	Labor, Output, Output Accuracy, Work-in-Process, On-Time Delivery and Net Sales	118
2.6.3	Work-in-Process, Output, Output Accuracy, On-Time Delivery and Net Sales	122
2.6.4	Output, Output Accuracy, On-Time Delivery and Net Sales	128
2.6.5	Output Accuracy, On-Time Delivery and Net Sales	130
2.6.6	On-Time Delivery and Net Sales	131
2.7	Theoretical Framework	131
2.8	On-Time Delivery as Key Performance Indicator	132
2.8.1	Critical Failure Factor to On Time Delivery	134
2.8.2	Critical Success Factors to On Time Delivery	138
2.9	Theoretical Perspective	142
2.9.1	Research Framework	143
2.9.2	Research Framework Development	145
2.10	Conclusion	151

CHAPTER THREE: METHODOLOGY

3.0	Introduction	152
3.1	Research Design	152
3.2	Research Process	153
3.3	Research Approach	155
3.4	Structural Model Specification	155
3.5	Data collection	157
3.6	Data Analysis	158
3.7	Reliability	161
3.8	Validity	162
3.9	Conclusion	162

CHAPTER FOUR: RESULT AND DISCUSSION

4.0	Introduction	163
4.1	Data Screening	163
4.1.1	Data Cleaning	164
4.1.2	Missing Value Imputation	165
4.1.3	Outliers Treatment	166
4.2	Preliminary Test	166

4.2.1	Normality Test	167
4.3	Predictive Accuracy (R^2)	168
4.4	Effect Size (f^2)	169
4.5	Predictive Relevance (Q^2)	170
4.6	Goodness of Fit (GoF)	172
4.7	Path Coefficient Algorithm Result	173
4.8	Bootstrapped Result (Total Effects)	175
4.9	Conclusion	178

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.0	Introduction	180
5.1	Overview of the study	180
5.2	Recapitulation of study findings	183
5.3	Research Findings Discussion	184
5.3.1	Relationship between number of labor and the on-time delivery	185
5.3.2	Relationship between number of labour and number of output	186
5.3.3	Relationship between number of labor and output accuracy	187
5.3.4	Relationship between number of labor and work in process	187
5.3.5	Relationship between number of labor and the net sales	188
5.3.6	Relationship between work-in-process and on-time delivery	189
5.3.7	Relationship between number of work-in-process and number of output	190
5.3.8	Relationship between number of work-in-process on output accuracy	192
5.3.9	Relationship between work-in-process and net sales	193
5.3.10	Relationship between number of output and on-time delivery	193
5.3.11	Relationship between number of output and number of output accuracy	194
5.3.12	Relationship between number of output and net sales	195
5.3.13	Relationship between the number of output accuracy and on-time delivery	195
5.3.14	Relationship between the number of output accuracy and net sales	196
5.3.15	Relationship between on-time delivery and net sales	197
5.4	Contribution	197
5.4.1	Theoretical Contribution	198
5.4.2	Organization Contribution	199
5.4.3	Practical Contribution	201
5.5	Limitation of current study	202
5.6	Recommendation for future study	203
5.7	Conclusion	205

REFERENCES	210
-------------------	-----

APPENDICES	221
-------------------	-----

LIST OF OPERATIONAL DEFINITIONS

On-Time Delivery	Delivery is on time if the product is ship on the date specified in the purchase order or demand report (ACM On-time Delivery Metric,2014).
Work-in-Process	All materials and partly finished products that are at various stages of the production process excluding inventory of raw materials at the start of the production cycle and finished products inventory at the end of the production cycle” (Investopedia).
Output Accuracy	How accurately the planned part numbers and quantity are actually produced. It is calculated as the number of actual part numbers and quantity produce compared to planned part numbers and quantity
Output	Production output is taken as the actual good quality output at the start of the process since the right on time start of the process will ensure the right, on time completion to meet the hundred percent on-time delivery
Labor	Direct labor which is the labor that is directly touching the product

LIST OF ABBREVIATIONS

ACM	Aerospace Composites Malaysia (formerly Asian Composites Manufacturing) is a composites manufacturing company where the research take place.
GDP	Gross Domestic Product
MIDA	Malaysian Investment Development Authority
SME	Small Medium Entrepreneur
MITI	Malaysian International Trade and Industry
ASEAN	Association of Southeast Asian nations
LIMA	Langkawi International Maritime and Aerospace Exhibition
BERR	Business Enterprise for Regulatory & Reform
NADCAP	National Aerospace and Defence Contractors Accreditation Program
FAA	Federal Aviation Administration, United States of America
HCDI	Human Capital Development Initiative
SABC	Society of British Aerospace Companies

LIST OF TABLES

Table 1.0	Factors influencing Malaysia as strategic aerospace investment center
Table 1.1:	On-time Delivery Percentage for year 2008 to 2011
Table 2.0	Four elements that described the structure of the system
Table 2.1	Difference between design and planning approach by Schmitt
Table 2.2	Comparison significance of on-time delivery in five companies
Table 2.3	Number of direct labour involved in production to meet on-time delivery
Table 2.4	Trend chart showing labour and on-time delivery
Table 2.5	Fishbone Analysis – Why delivery delay?
Table 2.6	Recommendation to improve delivery performance
Table 3.0	Categories of data collection
Table 4.0	Case Processing Summary Missing Data
Table 4.1	Skewness and Kurtosis
Table 4.2	Summary of hypothesis findings

LIST OF DIAGRAMS

- Diagram 1 ACM manufacturing process flow
- Diagram 2 Systemic design processes
- Diagram 3 ACM performance metrics model
- Diagram 4 Theoretical framework
- Diagram 5 The 6Ps delivery performance shortfalls by Joseph and JH Berk
- Diagram 6 Research framework development
- Diagram 7 Research process
- Diagram 8 Structural Model
- Diagram 9 Algorithm path model result
- Diagram 10 Bootstrapped path coefficient model



UUM
Universiti Utara Malaysia

LISTS OF FIGURES

Figure 1	Research framework
Figure 2	R^2 values of variables
Figure 3	Effect size (f^2) of Latent Construct
Figure 4	Predictive Relevance of Latent Construct
Figure 5	Goodness of Fit Test
Figure 6	Path Coefficient Algorithm Result
Figure 7	Summary table of bootstrapped analysis – Total Effect



UUM
Universiti Utara Malaysia

CHAPTER ONE

INTRODUCTION

1.0 Background of study

In the 1970s, manufacturing was the third highest contributor of Gross Domestic Product (GDP) by industrial origin in Malaysia, which contributed 12.8 percent compared to 42.6 percent by service sector followed 33.6 percent by agriculture sector (Malaysian Investment Development Authority, 2013). However, in a survey done in 2005 concerning the small medium entrepreneur (SME) industry players in Malaysia, especially a comparison between the agriculture and manufacturing-based industries, there was an increase in manufacturing roles in Malaysian economy. From a total of 518,996 SMEs, it was found that manufacturing composed of 7.3 percent compared to 6.2 percent of the agriculture-base industry in Malaysia. The manufacturing output contribution from 1996 to year 2005 saw an increasing trend from RM51.5 billion in 1996 to RM82 billion in 2005. The contribution by the manufacturing industry increased from 22.1 percent to 29.6 percent from 1996 to 2005. Value added by the manufacturing sector amounted to 19.5 percent in 1996 which increased to 25.9 percent in 2005. The number of employment opportunities provided by the manufacturing also increased from 329,00 in 1996 to 394,000 in 2005 (Department of Statistic Malaysia, 2011). In April 2015, total employment was 1,029,255 but decreased to 1,020,964 in April 2016 (Monthly Manufacturing Statistic Malaysia, 2016).

Progressively in 2011, the manufacturing sector had become the second highest contributor to the GDP according to industry, which was 27.5 percent compared to 58.6 percent for service and 7.3 percent for agriculture (Malaysian Investment Development Authority, 2013). As for the first quarter of 2014, the manufacturing sector played significant role by contributing to the GDP with 24.4 percent compared to the agriculture sector of 6.8 percent with a total of RM198.7 billion (MITI, 2014). The growth rate for manufacturing has increased from 4.7 percent to 4.8 percent for 2011 and 2012 respectively (Harun, 2014). It continued to increase at a rate of 4.7 percent in September 2014 over the same month for year 2013. The Star reported as of August 2014, manufacturing sector is rated the second highest contributor to the Malaysian GDP (7.3 percent) after construction (9.9 percent), agriculture (7.1 percent), private consumption (6.5 percent) and petroleum and mining (2.1 percent) (The Star, 2014).

To develop and diversify the manufacturing industry in Malaysia, the government strongly encourages Malaysian manufacturers to get involved in a higher technology, as well as knowledge intensive industries such as aerospace, manufacturing, service or sales. These industries consisted of alternative energy sources, aerospace, biotechnology, advance materials, advance electronics, optics and photonics, petrochemical, pharmaceuticals, medical devices and ICT. The aerospace manufacturing industry shows an increasing trend of involvement by industry players.

The ambition of the aerospace industry in Malaysia was transformed into reality with the creation of the Malaysian National Aerospace Blueprint in 1997. The objective of this blueprint was to make Malaysia a major aerospace player in the global scene by 2015 focusing on four major areas, namely parts and components manufacturing; maintenance, repair and overhaul; avionics and systems integration; and aerospace training; have been identified as the means that will drive the industry growth and bring social well-being to the country (Malaysian Investment Development Authority, 2013). It has been a long way since the introduction of the Malaysian National Aerospace Blueprint in 1997.

Success stories have filled up the years since then. One investment after another has been pouring into the aerospace business and evidently the approved aerospace projects in Malaysia increased from 7 projects worth of RM991.6 million in 2008 to 11 projects worth of RM2.3 billion in 2012. In 2013, another 6 projects worth of RM387.3 million were approved and was expected to generate another 552 employment opportunities in Malaysia (Malaysian Investment Development Authority, 2013). Further achievements in 2014, saw the nation's aerospace industry generating RM19 billion in revenue and RM4.2 billion in investments while successfully having created 19,500 jobs in Malaysia and it is projected that the aerospace industry will continue to contribute a total revenue of RM32.5 billion by 2030. In the forum "Charting the Future of the Malaysian Aerospace Industry" held at the Langkawi International Maritime and Aerospace Exhibition 2015 (LIMA2015), the then Minister of the International Trade and Industry, Datuk Mustapha Mohamed

said that aerospace industry players must be able to expand their capabilities and capacity to meet the objective to become the top aerospace nation in Southeast Asia and to become the integral part of the global market by 2030. Together with the right attitude and entrepreneurial instinct, the aerospace industry in 2030 is set to be a strong, dynamic and high-technology sector that supports the complete aero-system lifecycle and an important economic activity for Malaysia. A new National Aerospace Coordinating Agency has been created with a special task to implement the blueprint (Daily Express, 2015).

Located centrally in ASEAN, Malaysia was chosen as one of the best locations for an aerospace investment center due to its strategic location, political stability and conducive environment, strong aerospace supporting industry, research collaboration, human resource and industry development area to tap on the aerospace market around the region. Various factors for Malaysia to be the strategic location as an aerospace investment center is summarized in Table 1.0.

Table 1.0
Factors influencing Malaysia as strategic aerospace investment center

Factors	Justification
Regional Market	Centrally located in the ASEAN region, Malaysia is an ideal location for setting up base to tap the aerospace market around this region.
Conducive Environment	Pragmatic government policies, political and economic fundamentals, well developed infrastructural facilities as well as educated and skilled labour force have attracted large number of major international aerospace players to invest in Malaysia.
Supporting Industries	Malaysia has a strong industry base in electronics, metal, machining and fabrication as well as other supporting industries that are able to fulfill some of the requirements of aerospace activities especially in manufacturing and MRO.
Research Collaboration	Several local universities and research institutes are involved in research related to aerospace such as USM, UTM, UPM, UKM, UIAM and UNIKL. These aerospace companies can leverage on their knowledge and experience to provide solutions to company problems, such as improving process, product enhancement and so on. Investors may also strike a deal with local research institutions to establish a R&D center here in Malaysia.
Human Resource	Large skilled workforce at relatively low cost that is readily available and plan for future human resource requirement through collaboration with local training providers. More importantly, they are multicultural and well verse in English, making Malaysian workers easy to train and adaptable to new technology.
Industry Development Area	The government of Malaysia recognizes the aerospace industry as one of the future growth engines for the national economy and technology advancement. Therefore, various initiatives have been implemented including designated areas for aerospace clusters in Malaysia.

Source: MIDA, 2013

In order to provide a more structured and organized industrial facilities for the aerospace industry, the Malaysian government has created an aerospace industrial cluster area. The latest area developed for the aerospace industry is in Changlun, Bukit Kayu Hitam, Kedah, Malaysia. The reason this location was chosen is due to the existing status of the area which already houses Asian Composites Manufacturing (ACM) company that produces components for Boeing aircrafts (Star, 2012). Asian Composites Manufacturing is currently named Aerospace Composites Malaysia Sdn. Bhd. This is where this study took place.

1.1 Problem Statement

On-time delivery is ranked number three as competitive advantage priorities among manufacturing companies in US, Europe, Japan and Malaysia (Islam, Hamid, & M.A.Karim, 2007). In Aerospace Composites Malaysia, on-time delivery is also one of the most important metrics. Unfortunately, similar to many other companies, this company also suffers a bad reputation due to delivery delays. The root cause might vary from one organization to another between various manufacturing organizations but the symptoms and consequences are similar in nature. The delay in completion results in late delivery which eventually leads to losing competitive advantage to competitors. High operational costs in the aerospace manufacturing industry make it critically important to start, complete and ship on time to avoid million dollars lost in sales.

Preliminary review of the 4-year historical data from 2008 to 2011 in Table 1.1 revealed the poor on-time delivery performance in this company. The alarming delays in delivery performance resulted in the company's bad reputation has inspired the researcher to conduct a study on the on-time delivery performance in this aerospace composite manufacturing company. Based on the root cause analysis using the Ishikawa diagram, the researcher decided to examine the systemic impact of the number of labour, output, output accuracy and work-in-process towards on-time delivery and net sales from a resource-based view perspective.

Table 1.1:
On-time Delivery Percentage for year 2008 to 2011

Month/ Year	2008	2009	2010	2011
January	86.4	99.49	87.23	91.74
February	82.68	98.71	80.25	75.19
March	69.18	99.38	85.20	78.56
April	84.88	88.52	94.77	87.35
May	84.99	95.10	91.69	85.46
June	83.18	92.65	97.57	83.35
July	96.30	99.30	97.43	87.16
August	95.68	99.64	98.31	72.59
September	100.00	91.40	98.48	52.02
October	0.00	89.22	97.85	69.27
November	100.00	91.68	95.62	72.44
December	100.00	96.25	97.88	90.86
Average	81.94	95.11	93.52	78.83

Source: ACM Executive Report (Jan2016)

On-time delivery percentage trend over 4 year period between 2008 and 2011 in Table 1.1 shows inconsistencies in performance throughout the years with average of 81.94 percent in 2008, 95.11 percent in 2009, 93.52 percent in 2010 and 78.83 percent in 2011. This has directly impacted the overall organization's key performance indicator.

Delays in deliveries are highly suspected due to various internal reasons. Delay in hiring and a high turnover had attributed to a shortage of manufacturing technicians. Labour intensive type of manufacturing requires a comprehensive training before the technician can be allocated to production process. A minimum of one month of classroom training on specifications, composites knowledge, lean manufacturing and quality requirement is mandatory for all newly hired technicians followed by three months on-the-job training where the new technician is paired with a “buddy” as team mate. Coaching and training on the real production process is applied until the level of skill is at least fifty percent (certified through examination) before the new technician is qualified to perform on his own. The required period between hiring and training creates a very tight situation for the production specifically when there is gap between required and actual number of labour to meet the output and on-time delivery. A limited supply of skilled technicians in composite manufacturing in the northern region created a limited number of certified candidates for recruitment. Local culture and social economic background are some of the other area of challenges faced by the company when recruiting the right worker with the right skills, attitude and background to work in ACM.

The work-in-process is another factor to look into. Imbalance of work-in-process in the shop floor resulted in inconsistent movement and flow from one process to another. Parts that are expedited on a “hand carry” mode, often end up with last minute defect that require short lead time replacement. There are areas where work-in-process aged more than standard time of seven days,

whereas areas that just receive the parts from the previous process need to be expedited within a short time to meet completion and delivery. Shipments are made late at night and some days the shipping team need to stay until dawn to complete the packing and shipment.

The shop floor manufacturing and quality technicians are unhappy working in ACM. Too often, last minute completion and expediting require them to stay late and work after working hours. Failure to meet a hundred percent planned output accuracy results in wrong priority at the critical process causing a wrong product to be expedited. Even though the planner has made schedules according to customer's demand, production most of the time decides to produce the easy and simple part and leave the complex and difficult part at a later time. The wrong priority part produced creates last minute rushing the completion time is very close to shipping date. Even though accuracy report is published daily, the production team did not urgently correct the priority. The researcher's observation in ACM revealed that the urgency to process and complete the job was based on target quantity but not the right part required. The production team's priority of wanting to produce quantity to meet the target number based on their real-time availability of resources without considering the priority of meeting customer's demand is also a challenging issue for ACM.

Net sales figures are usually shared during monthly financial meetings among managers but never been shared as financial measurement to reflect the on-time delivery visually among team particularly at the shop floor. All the

efforts, time and penalty charges have never been calculated to reflect when shipments are delayed from month to month. Furthermore, charges on penalty, overtime and AIR shipment (normal or express) incurred additional expenses that lowered the net sales. The common understanding is even if delivery is delayed, the company still makes sales. A change in attitude is needed to eliminate waste of additional cost incurred resulted from last minute defect replacement, late completion by production and late packing by shipping team.

Overall, the literature review has shown reasons for not meeting on-time delivery is similar among industries but what makes the difference in this study was the location of the study, which was an aerospace manufacturing company in Malaysia. Workers in the Middle East, Europe and Asia are managed differently and they themselves shaped the working culture. The difference in culture, social and educational background, environment and management style shapes the way resources are managed in this company compared to other parts of the world. Thus, the existing problem cannot be resolved by just copying what others implement in the industry. The unique culture, environment and social background impacted the way labour, work-in-process, production output and output accuracy influences on-time delivery and net sales in Aerospace Composites Malaysia Sdn. Bhd., compared to other countries around the world.

This study aimed to quantitatively examine the significant impact of the labour, output, output accuracy and work-in-process on on-time delivery and net sales in the manufacturing process at Aerospace Composites Malaysia

Sdn. Bhd. for improving and sustaining the on-time delivery to a hundred percent (100%). The study was carried out within a period of four (4) years from 2012 to 2015 using an objective secondary data on the number of labour, number of output and output accuracy number and the number of work-in-process as resources or input against on-time delivery and net sales as output within the company. Further research was done to determine the significant relationship between identified variables on the on-time delivery and net sales using the Smart-PLS software and is explained using Resource-Based View (RBV) theory as the underpinning theory.

To conclude the problem statement, timeliness is a critical element that drives the resources' and capabilities operating rhythm of the aerospace manufacturing processes. Failure to meet the on-time start and complete of the processes eventually results in the failure to meet a hundred percent on-time delivery target. Major lose in sales, high unnecessary air shipment cost, bad company image and losing potential new business are among the nightmares faced by the company affected by delays in shipment. The expected outcome from the research is to identify the most strategic resource and capability combination from a resource-based view perspective to improve and sustain the company on-time delivery performance.

1.2 Research Question

In order to determine the significance level of influence between the indicators and the constructs as depicted in the research objectives, the following research questions were formulated:

- i. Does number of labour has a positive significance effect on the output, output accuracy, work-in-process, on-time delivery and net sales in ACM?
- ii. Does the number of work-in-process has a positive significant impact on the output, output accuracy, on-time delivery and net sales in ACM?
- iii. Is there a positive significant impact of the number of output on number of output accuracy, the on-time delivery and net sales in ACM?
- iv. Is output accuracy has a positive significant impact on the on-time delivery and net sales in ACM?
- v. Is there a positive significant impact between on-time delivery and net sales in ACM?

1.3 Research Objective

The research objective is to examine if there is a significant impact between identified variables, such as number of labour, output, output accuracy, work-in-process, on-time delivery and net sales, by looking at the real situation in an aerospace composite manufacturing company in Malaysia.

The research objectives can be summarized as:

- i. To examine the positive significant effect of number of labour on the work in process, output, output accuracy, on-time delivery and net sales.
- ii. To explain the positive significant impact of number of work-in-process on the output, output accuracy, on-time delivery and net sales.
- iii. To assess the positive significant effect of number of output on the output accuracy, on-time delivery and net sales.
- iv. To examine the positive significant impact of number of output accuracy on the on-time delivery and net sales.
- v. To examine the positive significant effect of on-time delivery on net sales.

1.4 Scope of Study

The research was conducted over a period of 4 years between 2012 to 2015 in Aerospace Composites Malaysia in Kedah, Malaysia. The manufacturing industry reference is generally concern within Malaysia. The main focus of the study was to examine the significant influence of the number of labour, work-in-process, output and output accuracy towards the on-time delivery and net sales performance in an aerospace manufacturing company from the perspective of Resource-Based View (RBV) theory. The terms and definition of key words were derived from the organization where the study was conducted as well as from the manufacturing industry in Malaysia.

1.5 Key terms – Definition

Operational definition of key terms was taken directly from ACM internal usage and reference.

1.5.1 Aerospace manufacturing

Aerospace manufacturing in this study referred to aerospace composites manufacturing that produces composite wing panels for a Boeing company.

1.5.2 Systemic

As defined in the Business Dictionary (2018), systemic is something that is system-wide, affecting or relating to a group or system (such as body, economy or market) as a whole, instead of its individual members or parts (Business, 2018). To have a systemic on-time delivery process is to have a system that has integrated functions to support the goal of the organization to meet the on-time delivery.

1.5.3 On-Time Delivery

The on-time delivery is a systemic performance metric as it measures the integrated performance from the supplier's end to the customer's end (Madhusudhana, Prahlada, & Muniswamy, 2011). It is the goal that cannot be realized without successful integration of supply chain functions in an organization. It is also a measure of the company's reliability to meet the shipment date. The definition used in this study refers to the ACM on-time delivery calculation methodology per ACM Monthly Executive Report. It is

calculated by taking total quantity shipped over the total quantity required per customer order within the same period, reported in percentage. Only normal, serial production is included and this is inclusive of the customer short lead time order. On-time delivery is one of the key operational performance indicators contributing 20% of the total bonus for Aerospace Composites Malaysia, (Aerospace Composites Malaysia, 2012). One of the values in ACM is customer focus, which means that customer's satisfaction is of top priority. Unfortunately, it is easier said than done at ACM.

1.5.4 Net Sales

Net sale is another indication of how well the company performs currently and its potential for further investment. Literally, net sales is the total value of a company's sales after the amount for costs such as damaged, return or missing goods and any price reduction and taxes has been subtracted (Cambridge, 2018). It is understood that, net sales as one of the criteria that investors consider when making decision for new investment.

1.5.5 Direct Labor

Labour is one of the resources involved in transformation of raw materials into complete product. In this research, "labour" is referring to "direct labour". In the Operation Management Glossary, "direct labour" is defined as a workforce that is directly assigned to manufacture a product. It also referred to the standard number of labour hours needed to produce a product (Goodson, 2002). Since most of the processes is labour intensive, number of labour at

each process has an impact on the pace and volume of work in the process movement.

1.5.6 Work-in-Process

According to Operation Management definition, work-in-process is a product that is in a semi-finished state (Goodson, 2002). In this study, the researcher refers to the work-in-process as a composite flat and contoured aero-plane wing panel between the layup process until final inspection. This composite wing panel is subject to expiry before cure, thus, it is critical for layup to start and complete on-time to avoid expiry. After the panel is cured in the autoclave oven, it is trimmed using either the 5-Axis, water-jet machine or manual trimming. Then, it will undergo inspection before it is sent to Shipping department as complete and ready to be sold.

1.5.7 Output

Output is the actual quantity produced by direct labour per planned target in a given time. In this study, the output produced is a composite wing panel for the Boeing airplane. The quantity of output produces on-time is an indication of how productive is the labour involved in producing the panels. The output rate is actually the rate at which each work center performs, which can also be explained by the formula in the Queuing theory (H.T. Papadopolous, 1996).

1.5.8 Output Accuracy

Output accuracy is the measure of the right part produced against the planned part to be produced in a given time. The accuracy of output is critical because wrong part produce will result in wrong part delivered. The challenge to meet the right output has become more critical since there are various sizes and model of composite wing panels that are being produced by the same labour within a specified time period. There is always a tendency for the production technician to purposely pick and produce the simplest and easy to complete part numbers rather than the planned part numbers. The accuracy of the part produced supported by the concept of Just-In-Time (JIT), one of the pillars in Lean manufacturing, which emphasizes on getting the right thing to the right place at the right time(V.V.S Nikhil, 2015).The ability to follow plan accurately requires highly integrated communication flow between the planning and production teams.

1.6 Significance of the study

The study intends to contribute significantly to the theoretical and managerial aspects of the aerospace composites manufacturing industry. The contribution to the corpus of knowledge is extended with the application of the theory in actual aerospace composites manufacturing business environment.

Human capitalization is an asset to the organization, which is now becoming more difficult to manage, deploy and nurture as the industry is becoming more and more complex. Significance of labour as a resource and value creator in

the manufacturing process is one of the areas that is worth looking at. Even though its operation is mainly labour intensive, ACM does not have a proper metric to measure its utilization of labor. Simplification of the process and continuous value-added activities despite advance technological development does not make labour less important but rather a more critical resource. This requires up-to-date tech-know-how and closer attention by the management, particularly in aerospace composites industry in Malaysia where processes are more labour intensive than robotic.

This research can be an eye opener to the managers, especially regarding the significance of resource and capability management. Work-in-process as one of the resources that requires close attention and timely movement to support on-time delivery. The right level of work-in-process determines the consistency of the start and complete on time process. Even though work-in-process is reported daily in ACM as part of production report, it is not consistently moved and the spread of the work-in-process is not balanced between processes. There are processes that are always short of work-in-process and some are always more than the standard level. Initiatives to expedite the work-in-process is difficult due to whatever reason provided by the production team, such as process too complex, no manpower to be assigned to the part and numerous other reasons.

Another significant area that pointed out by this study is the importance of producing the right amount of output as completed product. Output is actually the completed work-in-process manufactured by labour based on schedule

prepared by a planner. The actual quantity produced per plan determines the production reliability, which is tracked and reported as output quantity. The output significantly impacts the on-time delivery but unfortunately, has been loosely managed in the company and this result in continuous production recovery. The research significantly pointed out the importance of meeting the target quantity in order to achieve on-time delivery.

It is very important to understand the significance of output accuracy in achieving the right part produced at the right time. Accuracy of part produced is the measure of the right part produced in the right quantity at the right time. Even though the output accuracy is a very important metric, there is insufficient seriousness in obtaining hundred percent output accuracy for most of the areas in production. Apart from insufficient attention to achieve the hundred percent output accuracy, reporting rhythm is also not consistently initiated. Through this study, it is highly expected the managers will understand the critical role they play to get the right part produced as scheduled.

It is also significant to the shareholders during strategic decision-making on future investment and new product transfer as on-time delivery is a commitment to ensure delivery on-time as required by the customer and net sales as financial strength to finance a new project. Poor on-time delivery will not add value to the decision making by the shareholders and board of directors, particularly on a new product transfer.

Strategically, a successful bundling and deploying of strategic practices eventually creates a competitive advantage in terms of resource utilization and capability to succeed and sustain the achieved objective (Hitt, 2006), but the organizational practices did not reveal the strategies are imbedded in the organizational practices. The study will help the company to identify reasons for the problem and success factors contribute to best practices. The new finding will then be used to evaluate and improve the organization's operational strategies.

1.7 Research Contribution

The research contributed significantly, not only to the organization but also from a theoretical, knowledge (academic practitioners) and practical (industry particularly the aerospace industry players) perspectives.

1.7.1 Organization

This company experienced a skeptical detailed production readiness review from Boeing and Hexcel every year as a result of bad on-time delivery performance. The research findings will be an input for providing a manufacturing company with an option for operational strategies for achieving delivery objective, which is on-time delivery. This will improve shareholders confidence and evaluation when increasing investment in organization, which would increase the morale of the employees leading towards increased value of bonuses and savings on AIR shipment costs. ACM is the sole manufacturer of

several composite panels for its prime customer, Boeing, which is located in the United States. Majority of the composite parts produced in ACM are not produced elsewhere in the world. This makes the research findings critical in a sense that it will help to improve the organization's operational strategy in meeting customer's expectation (Hallgren, 2007), with regards to the on-time delivery.

Another important contribution of this study to the organization is the practicality of the research, which took place in an actual manufacturing company, thus, it will not only serve as an approach to problem solving but also improve managerial skills of the researcher and team members since the research make use of subject matter experts in the organization as participants and the researcher was part of the team. This action eventually resulted in a benchmark for current practices, increased awareness of areas of management choice and increased understanding of the dynamics of conceptually-based collaboration among researchers and managers (Coghlan, 2002).

This study is also significant as it can promote the company as a benchmark for the systemic management of resources aimed at achieving the on-time delivery components for the aerospace manufacturing industry players in Malaysia.

1.7.2 Theoretical

This study intended to point out that even though there are various documented research on on-time delivery in similar industry but this research focuses on aerospace manufacturing in Kedah, in particular and Malaysia in general. It carries with it different geographical locations, economic and social backgrounds as well as culture that shapes employees' performance and the way manufacturing issues are managed.

Theoretically, apart from being a collaborative partner in the academic community, a documented industrial research finding will add value to the current corpus of knowledge and literature in operations management, specifically in operational strategies in aerospace composite manufacturing practices. These research findings will add to numerous existing literatures on the application of the resource-based view theory in aerospace manufacturing industry in Malaysia. Furthermore, there is a lack of reference material regarding documented application of resource-based view theory in aerospace manufacturing organizations (John Mills, 2003). Critics resource-based view theory pointed out that the literature only focuses on general guidelines regarding the identification of distinctive competencies rather than the practical side of the theory particularly in the public sector. It was suggested a mechanism to put the resource-based view theory in place in the public sectors by taking a case study from the training and consultancy unit in the United Kingdom's National Health Service (John M. Bryson, 2007). There has also been a study on the resource-based view theory concerning innovation in the food industry in Italy (Carraresi Laura, 2012) and supply chain. In addition to

areas of coverage, this study had applied the resource-based view theory in a study on an aerospace composites manufacturing company in Malaysia which is another additional value to the corpus of knowledge.

1.7.3 Practical

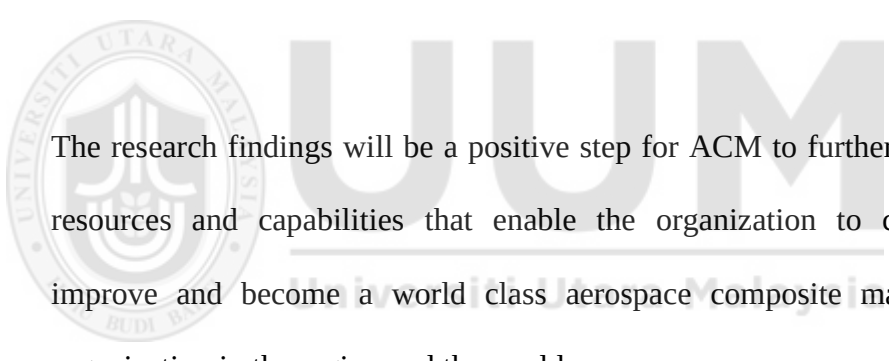
Practically, the research will contribute to the industry in Malaysia as there is a limited number of manufacturing companies specialized in aerospace composite manufacturing in Malaysia. Hence, due to its uniqueness, ACM will be a benchmark to a similar industry by providing documented standards on systemic operational strategies.

The findings will definitely be another reference for industrialist and academicians on the systemic manufacturing system approach to manage challenges faced by the aerospace manufacturing industry in order to stay competitive in the industry. This is to be in line with the Malaysian government's objective to position Malaysia as the ASEAN aerospace hub by the year 2015 and also according to the statement made by the then Kedah Chief Minister, Dato' Mukhriz Tun Mahathir that Changlun will be developed as the aerospace center by year 2015 (Star online, 2013). This will create employment opportunities for Malaysian living in the northwest region of the country. This situation received a boost of encouragement from ACM's former General Manager, Mr. Robert Moray at the MOU signing ceremony between ACM and University Malaysia Perlis (UNIMAP) as reported by Standards Malaysia (MOSTI) in January 2011:

“...it is imperative for students to be equipped with the industry related knowledge and skills. This is achievable with the assistance from industry and giving them an opportunity to get the necessary experience and information. This relationship can only be achieved by strong collaboration from both parties (industry and education institutions)”.

Source: (MOSTI, 2011).

To the academic sector, the research will be a bridge between the industry and educational institutions. This is supported by ACM which is progressively working collaboratively with the nearest universities and technical colleges for preparing future graduates with the right industrial technical know-how to provide employment sustainability when they become a part of the industrial community.



The research findings will be a positive step for ACM to further develop its resources and capabilities that enable the organization to continuously improve and become a world class aerospace composite manufacturing organization in the region and the world.

1.8 Organization of the study

Chapter One introduces the context of the study and the structure of the thesis, which briefly explains the contents of the subsequent subject. An introduction to the study consisted of the background of the study, problem statement, research objectives, research questions, scope of the study, significant of the study, research contribution and organization of the research.

Chapter Two provides an extensive review of the literature relevant to the research objective aimed at addressing the problem statement. Literature review provides an illustration of manufacturing in general and the aerospace industry in particular. The significant influence of the selected dimensions of resources and capabilities on on-time delivery and net sales is explored. The resource-based view theory, as the underpinning theory, is reviewed in terms of the origin, assumptions and its application in the study. The structural model, as well as the theoretical perspective, is explained in order to provide a view of the scope and framework of the research.

Chapter Three defines the methodology used in this study, right from the beginning to the conclusion. Chapter Four provides an analysis of the data and the subsequent findings. It also describes method of analysis used in order to facilitate data analysis in future related studies. Chapter Five provides an analysis of the research findings, recommendation and future research.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Chapter Two provides a review of the aerospace industry in Malaysia and an introduction to the research location followed with a review of the literatures relevant to on-time delivery, labor, work in process, output, output accuracy and net sales. Aside from the resource-based view theory, other relevant theories applicable to the variables number of labour, work-in-process, output and output accuracy affecting the on-time delivery and net sales are explored. Brief explanation of the organizational performance metrics is shared to point out the significance of the on-time delivery as one of the performance indicators in the organization as well as value (net sales). Finally, an explanation on the overall relationship between dependent and independent variables from the perspective of resource-based view theory and its conceptual structural model is visually explored. Theoretical perspective is explained through research framework and development.

2.1 Background of aerospace industry in Malaysia

Some documented facts on the historical aerospace industry in Malaysia are reviewed. From the agriculture, electronic, automotive and other types of industries, Malaysia has taken a very bold decision to embark itself in a high-tech aerospace industry. The history of the aerospace industry in Malaysia begin originally with the set-up of military depot in year 1970 followed by

AIROD in 1985, which is focusing on the maintenance, repair and overhaul (MRO). In year of 1995, National Aerospace Blueprint was developed to provide a framework for the development of Malaysia's aerospace industry towards achieving world class by year 2015. It is also an objective to make Malaysia as an aerospace industry hub for ASEAN region by year 2015, thus an aerospace composites manufacturing industry in Malaysia has gradually becoming an important industry on line with the Malaysian government goal (MIDA, 2013). SME was established in 1995 specializing in aerospace metal manufacturing. To embark on a different type of aerospace manufacturing activities, CTRM was set up as a composite manufacturing which involve more on research and development activities. In 1998, Asian Composites Manufacturing Sdn. Bhd. (currently known as Aerospace Composites Malaysia Sdn. Bhd.) has been established as a composite manufacturing organization supplying parts for Boeing and Hexcel as prime customer. It was officially open in year of 2000 by Tun Dr. Mahathir Mohamad and has becoming one of the major players in the aerospace industry in Malaysia focusing on composites manufacturing. ANGKASA which is the National Space Center was developed in 2002 followed by Malaysian International Aerospace Center (MIAC) in year of 2005, Spirit Aero in 2008 and Honeywell in 2009 (MIDA,2013).

2.2 Aerospace Composites Malaysia Sdn. Bhd.

In year of 1998, there was an effort initiated by Malaysian former Prime Minister Tun Dr. Mahathir Mohamad to develop northern part of Kedah, to be an inland port due to its strategic location as a transit point between Malaysia

and Thailand. With the said intention in mind, a joint venture between two US based aerospace companies - Boeing and Hexcel- and Malaysian companies namely, Naluri and Sime Darby, an aerospace composites manufacturing company was being set up namely the Asian Composites Manufacturing Sdn. Bhd. (ACM) was officiated by Tun Dr. Mahathir himself. Today Asian Composites Manufacturing Sdn. Bhd. is known as Aerospace Composites Malaysia Sdn. Bhd.

Historically, ACM started its operations in year of 2000 and proudly made the first shipment of 10 parts for Boeing747- fixed trailing edge in June 2001 (ACM Executive Report, 2001). Some years later, Naluri decided to pull out followed by Sime Darby, leaving Boeing and Hexcel as an equal shareholder holding a share of fifty percent each. As one of the manufacturing of aerospace composite companies, ACM has to meet the aerospace standard of product and system as specified by international standards and specific to Boeing as the prime customer. ACM has gone through various customer audits such as Aerospace Standard 9100 (AS9100), International Standard Operations (ISO18000), National Aerospace and Defence Contractors Accreditation Program(NADCAP), Federal Aviation Administration, United States of America (FAA); just to name a few and proven to be a qualified and respected manufacturer for such aerospace composites parts and this has put ACM at par with other international aerospace composites manufacturing companies on the globe (ACM Quality Management System).

In October 2012, the then Deputy Minister of International Trade and Industry, Dato' Mukhriz Tun Mahathir has announced that the government is looking into developing Changlun in Kedah into an aerospace center and has recognized Asian Composites Manufacturing as an established aerospace related organization in which he mentioned at the news conference in Sungai Petani, Kedah. In his speech, he commented that there was already a company producing Boeing aircraft components in the last 12 years in Changlun, Kedah, Malaysia but the opportunity has not been tapped to set up support or downstream industries in the area. The opportunity should be grabbed immediately considering the aerospace industry is growing rapidly (Star, 2012). In November 2013, the then, Chief Minister of Kedah, Dato' Mukhriz Tun Mahathir was appreciated to officially open another building expansion of the ACM, which was built next to the old building. The expansion was meant for the new business in 2014, 2015, future awarded and potential business to be gained in years to come (Hexcel, 2013).

2.2.1 ACM Manufacturing Process

Manufacturing process is where resources are deployed and utilize as value is created and added from raw material as it moves from one process to another until complete as final product. A good understanding of the process is very critical to be able to manage the process of manufacturing and delivery of the product. Process flow will help in identifying value adding and value creating process which drives to optimum utilization of resources and capabilities. Main concept as proposed in Toyota Production System (TPS) is process improvement to create a value-added process through waste elimination and

optimum utilization of resources. Process time is shortened and load is balanced between processes to create a smooth flow of process from start to end(Shingo, 1989). To have a consistent flow, it is very critical also to be able to manage the weakest linkage of the process to avoid delay and process constraint (Institute Goldratt, 2009). Value creation and addition in the resources deployment will help organization to identify weaknesses and strength in order to better manage the resources and capabilities (Gaya, Struwig, & Smith, 2013).

Production function is a network of work centers with capabilities to transforms input into output of a higher value. The expertise or capability to process input into output is a qualifier to stay in the industry together with the ability to compete the process on time and pricing in the winning factor to meet customer delivery date. Being a Repeat Business Customizers (RBC) type of industry, the order is contracted for at least a certain number of years, the orders are continuous and demand is about stable. This making it more beneficial as the production of output can be produce-to-stock manner. Queuing theory applied little law is commonly used in a service-oriented industry (Kwiecien, 2008). The theory related to the average time in the queue to the average number in the queue, the arrival which the completion and service rate. The output rate is actually the rate at which each work center can perform which can also be explained by little's formula in the Queuing theory (H.T. Papadopoulos, 1996).

Aircraft manufacturing system is a complex manufacturing system which requires a more stringent control in the process (Rouse, 2010). As mentioned in the Society of British Aerospace Companies, conceptualization of an aircraft manufacturing process is heavily dependent on the level of tier which the manufacturer is at and the kind of aircraft parts that the manufacturer produced (Wikipedia, 1998). This is supported by systems engineering approach in detailing the processes into work-based and product-based activities (Shishko, Aster, & Cassingham, 1995).

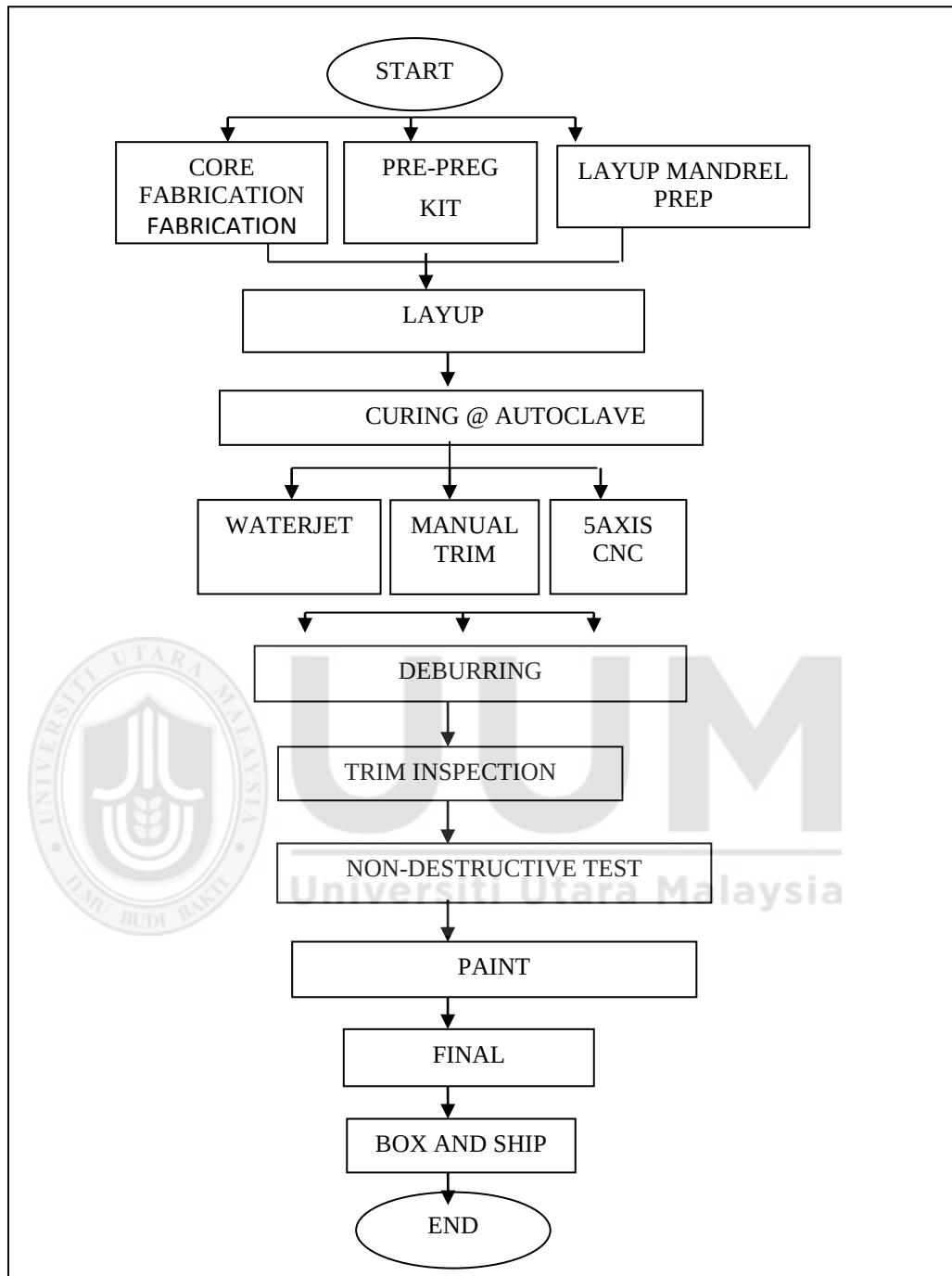
Operating as an aerospace composite manufacturing company, ACM manufacturing system is a combination of at least 3 of manufacturing type of system. There are five (5) types of manufacturing system (repetitive, discrete, job shop, process (batch) and process (continuous)) is being use single or a combination of various types depending on the nature of the process and product (Bradford, 2015). ACM manufacturing process was originally set up based on process layout where various product lines shared one common process. This created conflict in priority when urgency arise particularly in case of replacement for defect, urgent orders from customers and process / machine breakdown. It also created a complex flow of material and information resulted in long throughput time, high level inventory and work in process. Directly or indirectly it contributed to a high operational cost and reduced profit.

Its manufacturing process started from demand received from customers but value is only created and added at every stage of the process from raw material

transform into work in process and finished goods – value increase as it moves towards the end of the process. Standard operation procedure is available for all process by individual product but still every process and product are unique due to manual workmanship applied in the process. However, it is mandatory for all products to meet the specified customer standard specification. ACM manufacturing processes involves seven (7) processes which are core fabrication, kit cutting, layup, curing, trimming, deburr and painting. Layup is the process where multiple layers of cut “impregnated pre-preg” are laminated within a temperature control room and is cure in an autoclave at a very high temperature and pressure. This layup process to produce a high-quality component for aerospace industry is a labor-intensive process. This composites wing panel is subject to expiry before cure, thus, it is very critical for Layup to start and complete on time to avoid expiry. After the panel is cured in the autoclave oven, it is trimmed using either the 5-Axis CNC, water-jet machine or manual trimming. Then, it will undergo inspection and non-destructive testing before it goes to painting process. Finally, it will undergo another inspection before it can be send to Shipping department as complete and ready to be sold.

Process inspection take place at layup, trimming and non-destructive testing before part goes to paint process and final inspection. Core fabrication process is a job shop, curing is batch process, deburr and painting is a job shop. A visual step by step of ACM manufacturing process is visualized in Diagram1.

Diagram 1
ACM manufacturing process flow



Data source: ACM, 2012

Production process starts with core fabrication where honeycomb core block is cut and sliced into sheets before it is cut into core details. The next process which starts concurrently with core fabrication is the kit-cutting where the raw

material (pre-preg) is cut into sheets of pre-describe plies by kit cutting machine. These plies and honeycomb core details is then laid up on top of each other as sandwiches panel which is then cure at a high temperature using a curing machine which is the autoclave. The panel is cured at high temperature, low or high pressure, low temperature, low pressure for certain number of hours. After cured, panel is send to trimming process which is either using trimming machine which is 5 - axis or water-jet or manual trimming. Deburr process is done to touch up the excess at the edges of the panel to smooth out the edges. The panel is send to non-destructive testing which is done by scanning machine or manual scanning or backlight. Finally, panel is painted and send to final inspection prior to box where the panel is sent to shipping area for shipment or keep as finished goods.

The manufacturing process is mainly labor intensive. Production is done manually for at least seventy percent (70%) of the processes, which are five out of seven processes starting from core fabrication until end which is final inspection. Thus, labor plays major role in the company success for on-time completion and delivery. Starting with around 100 employees in year of 2000, producing hundreds of panels, ACM has grown to employ more than 1000employees including foreign labours, operating twenty-four (24) hours, seven (7) days week producing more than ten thousand panels of various shape and design for various customers around the world in a month. Its machine capacity has grown from a several major machines operating 4 days in a week, with utilization of less than fifty percent (50%), five (5) days week to more than ten (10) major machines running twenty-four (24) hours, five (5)

days week at ninety percent (90%) utilization. The management continuously look into possibilities and has added more equipment to take up additional order and new business opportunities for future years (ACM Capacity Planning, 2012). Since operation is mainly labour intensive, number of skilled direct labour to expedite the quantity of work in process within the standard lead time to meet the planned quantity and the right part are very critical. The right parts need to be produced within the right time to support the operations twenty-four hours working schedule. Any hiccup that caused operation stoppage in the process incurred high cost to operations and eventually will jeopardize on-time delivery and net sales.

ACM was set up based on a concept of Lean Manufacturing System by a group of Boeing Lean experts more than ten years ago. The system was named ACM Production System (ACMPS) which is derived from Boeing Production System (BPS). Manufacturing system is an important element that will influence the management strategic policies in managing a factory. It is synonym to the body system which operated by millions of cells directly and indirectly affected and impacted by various internal as well as external variables. To understand the system, everyone in the organization need to understand the elements that exist in the organization's system and how the elements interact and impacted each other to create the systemic interaction as a whole. Human Resource provides administration, hiring and staffing, training and development and takes care of employees' welfare under the compensation and benefit. Safety, Health and Environment takes care of the safety of employees and company properties as well as the environment.

Quality, Technology and Engineering take care of the process, product and system quality to assure an acceptable level of quality product and process to meet customer specification. Finance department manages company's financial health to create profit and smooth cash flow for current and future business. Program Management is a bridge between customer and ACM to get the orders. Planning is to create production and resource planning and controlling the implementation of the plan to meet customer delivery date. Operation which is the shop floor is responsible to carry out the plan and meet the completion on time. Shipping, ship the completed good parts to customer on time. Purchasing procure required material on time for the operation to manufacture product. Facilities & Maintenance takes care of company's facilities including machines and equipment for operation to run smoothly. Lean Office provides support for continuous improvement in the organization.

Systemic control mechanism is very heavily dependent on the shop floor communication and monitoring technique. It plays a very crucial role in managing variables to create a systemic effect in achieving on time delivery. In today's complex manufacturing environment, one of the bottlenecks in today's shop floor manufacturing is the incapability of shop floor supervisors to move across the shop floor and see real-time information on production and make intelligent decisions at the right time. The action that should be focused on is the ability to make use of the resources and capability to overcome the bottleneck when it occurs. Having a proper tool to enable tracking of a particular part, subassembly, finished good anywhere in the shop floor by

looking at the real-time data, it would allow the person responsible for the area to remove system bottlenecks more efficiently.

Systemic communication supported the process flow as it created an integrated, open communication flows between the communication channels. The employees must be able to identify themselves by aligning the purposes, allegiance to the organizational ethos and compliance to the organizational norms. Organizational commitment driven from the systemic communities is very critical as it creates commitment in terms of compliance, identification and internalisation(Mete, Sokmen, & Biyik, 2016).Employees are committed to the goals, confident that their commitment is not being abused by others; thus, creating a sense of shared meanings and understandings, hence underpins reciprocity. They are seen as having “capacity to reason, learn, invent and produce” (Althoff & Werhane, 2011). Commitment eventually will lead employees to accept the organization’s goals and values as their own value systems. The situation in ACM has been observed comparing these characteristics and factors and the result revealed very weak and uncertain feelings and commitment among employees. A number of employees which were interviewed from various departments showed lack of interest in team involvement by avoiding additional initiatives to improve the performance due to dissatisfaction within and between departments.

The scheduling process is even more difficult since it is done manually considering thousands of panels need to be scheduled in a month. Process flow (tool, material, process) is not clearly defined or understood when production

planning is done. Manufacturing job orders specify clearly steps of process to be taken when manufactured the panel but the process of supporting the manufacturing itself has not been well defined and prepared. To prepare the details schedule for one process alone takes more than a day which is longer than the shop floor preparation pace. To be specific, for a production planner to schedule a sequencing detail of tooling to plan for layup start and completion to meet the curing schedule is very tedious and complex.

Using value stream map, the identification of value-added process can be identified which directly determine the type of resources and capabilities required to support the manufacturing of the products. It is a tool that can be employed to assess the complexity of the process and identify the bottleneck process. The map will clearly show how these factors (material, man and information) flows and interact with each other to move as an orchestra from start until end while value is added along the process. The company structure is organized in such a way that every department function according to job description. The silo effect is very strong in ACM. Information that can be pulled out from the transformation program conducted for all level of employees by a consultant in the company showed that there is a systemic concern existed among employees within and between department and also within and between hierarchy in the organization.

Aerospace industry is a high cost operation. People life is an airline business. People depend on the good quality of aeroplane when they fly travelling all over the world for business or leisure. Thus, aeroplane manufacturers depend

on a good quality parts produced by their suppliers all over the world and ACM is one of them. By transferring their manufacturing technology and tools of these aerospace composites panels to ACM; Boeing, Hexcel and few other customers such as Fischer Advanced Composite Components, Austria (FACC), Chengdu Aerospace Corporation (CCAC) and Boeing Aerospace Australia (BAA) has eventually turned ACM into their sole manufacturer and supplier of several customers in United States of America, Australia, United Kingdom and Austria which then supply to the prime customer, Boeing Company in the United States of America. The latest addition to list of ACM customer in 2015 was Boeing Tianjin China (BTC). Being the sole supplier of the specific product group of aerospace composites panels in the world, it is very critical and biggest challenge for ACM to be able to produce and deliver the right good quality part on time at a competitive price. Any delinquency in deliveries will give major impact to the customer's operation. Besides impacting the current customers, it will also impact decision for a new business ventures by the shareholders to the company. Thus, it is very important to meet the hundred percent on -time delivery to remain competitive in the international aerospace manufacturing market.

Because of the high cost and complex manufacturing process, it is highly importance for the company to possess the integrated system of resources to bind and link the processes together to get the right, good quality part produced and delivered on time to the customer. Therefore, it is very critical to have a close linkage not only between ACM, suppliers and customers but even

more critical is the internal strategies that bind and deployed the resources within the organization.

Operated as a demand driven company, ACM's main objective is to deliver the right part, good quality at a competitive price on time. Operationally, demand driven company manufactured parts based on actual customer demand received. This is more significant particularly in the aerospace manufacturing industry whereby the cost of production is very high and all the parts are subject to specification changes as and when necessary originated by the end customer, Boeing. However, with the increasing built rate from customer has put ACM on a disadvantage particularly when it carries zero finished goods inventory. Finished goods inventory plan to build up inventory for the last 3 years were not materialized due to priority and focus were given to killing high delivery delinquent which has been haunting the employees for years.

2.2.2 ACM Delivery Process

The delivery process started with the loading of demand or purchased order from customers by the Program Management team. There is also an auto-loading demand direct from customer's MRP system. From the loaded demand or purchase order, planning team will release order based on system date per customer's date. Upon releasing of orders to the shop floor, manufacturing of part started. The rate of the throughput is an indicator that determined the rate of panel completion to turn into complete panel. It was proven that work in process flow is another constraint that caused a lower inventory level in ACM. Parts do not flow smoothly due to changes in

bottleneck caused an inconsistent flow of work in process. Theory of constraint and theory of delays explained bottleneck and delays in work in process flows.

Without the accuracy of the actual against plan output, delivery will not be able to make as required by the customer. Internally, accuracy metric is done to measure the rightness of the parts produced per demand. The weekly detail plan by part numbers is developed aside from the overall monthly plan and it is being used to measure daily and weekly cumulative accuracy of order fulfilment at the front process. The metric was developed over 2 years ago and the effort to get to 100% accuracy is still a challenge. The Aberdeen Group surveyed done on hundreds organization found out that scheduling accuracy (manufacturing schedule compliance) is critical for an organization to meet on time delivery (Aberdeen, 2012). Personal observation and experience in the organization reveals the research finding is true. As a continuous improvement and readiness to take up more new businesses, an effort to transform the silo manual scheduling to an integrated scheduling and planning has been introduced starting in 2012.

2.3 Manufacturing System Transformation

This section is to explain the transformation of manufacturing system from pure machine and product to process and system in order to relate the manufacturing management system to the systemic concept where labor becoming most valuable asset in manufacturing, also to review the evolution

of the manufacturing system from systemic perspective in relation to resource-based view theory.

Various theories on manufacturing system by previous founders and researchers contributed to the understanding of manufacturing system and its development, starting with Frederick Taylor, father of scientific management, Henry Ford with the automobile industry and Taiichi Ohno, the originator of Toyota Production System, just to name a few. Each one of them has different focus in managing the manufacturing system ranging from purely machine and product to process and system. In an attempt to define manufacturing from a scientific management point of view, Frederick Taylor, father of scientific management and efficiency movement, proposed that workers are prone to being lazy and were not capable of understanding what they were doing in their job.

Even though Frederick Taylor was successful in promoting job specialization, he did not address the importance of human and system. The specialization implemented caused loss of overall overview of the manufacturing system among employees (Degan, 2011). On the contrary, Elton Mayo proposed that human element is a critical factor to consider in the production process. He has proven that human played an important role in the production processes in 1927 at the Hawthorne Works of the Western Electric company. The test was well known as the Hawthorne Effect. In his effort to find out the effect of fatigue and monotony on job productivity and how to control them through such variables as rest breaks, work hours, temperature and humidity, he

stumbled upon a principle of human motivation that would help to further re-define the theory and practice of management(Economist, 2008).

Another theory that is no less impacting manufacturing system is the concept of Theory X, Y and Z. There is no doubt these theories are more on psychological theories but it is very important for managers to understand the concept behind the theories that can help them to manage workers which is one of the critical resources in manufacturing system. These workers are the element that is going to make the system work or fail. Theory X and Y were introduced by a professor at the MIT Sloan School of Management named Douglas Mc Gregor in 1960.

Another concept that need to be understood is the “holonic” management system which was introduced by (Arthur, 1967) from the word “holos” meaning “whole” combined with suffix “on” as in “neutron” to indicate a particle or parts (Martyn, 2002). It has been claimed by Herbert Simon (1969) a complex system will evolve from simple systems much more rapidly if there are stable intermediate forms than if there are not. It reveals why every complex system’s adaptive system is hierarchic (in a loose sense) (Ricardo, George, & Batocchio, 2009). Further developed theory was introduced by Mr. William Ouchi in 1980. He took the Theory Y as a base for his further study and renamed it as Theory Z which explained that management and workers work hand in hand to carry out tasks to continuously improve quality. This is well known as Japanese “management style”. Aside from Theory Y, there was also fractal manufacturing system(Christo & Cardeira, 2006), which has been

described by an open system and self-similarity between the small components or known as fractal units. Characterized by self-organization, self-similarity and self- optimized, explained fractals as a system which act independently in accomplishing the objectives. Unfortunately, the fractal manufacturing system has no predefined organization. The point that the system is left to work on its own resulted in lack of coordination and cooperation between fractals which is required for an organization to work systemically to achieve goals.

As a comparison on the systemic organization, a bionic manufacturing system is another system that is worth looking at. It got its name from an action research originated sometime in 1940's as a result of a combination of biology and electronic. The structure and behavior of cells are compared to the enterprise. The coordinator and supervisors work to coordinate and supervise the work between the internal elements of cell or work units in the manufacturing system. The communication that exist within cells, function similarly as between work cell in manufacturing to ensure a correct exchange of information within and between cells (Christo & Cardeira, 2006).

Another theory in manufacturing which is worth look into is Lean Manufacturing. The origin of Lean manufacturing and Just-In Time (JIT) Production goes back to Eli Whitney and the concept of interchangeable parts. The theory was originated by a Japanese, named Taichi Ohno and being renamed as Lean Manufacturing by James Womack in his book "The Machine that Changed the World". Lean manufacturing focused on 7 wastes reduction strategy which resulted in a continuous improvement of process through waste

elimination. The concept of lean manufacturing focused on optimum resource utilization by elimination of non-value added and waste (Shaha & T. Ward, 2002). Process improvement is main activity under Toyota Production System (TPS) manufacturing which is looking at the whole manufacturing process improvement to eliminate waste and add value to the product through resource optimum utilization (Shigeo, 1989).

The understanding the evolution of the manufacturing system in relation to RBV is made better with the understanding of the evolution of manufacturing paradigm as being shared by (Dumitrache & Caramihai, 2010) in “The Intelligent Manufacturing Paradigm in Knowledge Society”. During the 45’s to 60’s era, the focus of manufacturing was on machines, robotic for large scale and mass production supported by automation with computer technology. During the era of 70’s, the trend moved to flexible manufacturing system, lean and just in time production supported by microprocessor technology, communications and expert system. Eventually during the 90’s and into 2000’s, the emphasize has moved to computer integrated manufacturing and virtual organization supported by artificial intelligence and nano-technology. The pressure has moved from mass production with less emphasized on quality but on low price to a customization, high quality and low cost. The latest trend to a virtual organization is a product of globalization which invited more competition without boundary. The efforts involved to expedite manufacturing objective are to be synchronized and manage systematically and systemically integrated.

2.3.1 System Theory

Resources must be deployed and bundled up within the manufacturing system. System theory is all about systemic. How does RBV relate to System Theory? Cybernetics and system theory are the two major concepts that explained the systemic approach in organization management. Cybernetics originated from a Greek word “kubernetes” which means “pilot or rudder”. Louis Couffignal (1958) defines cybernetics as the “art of assuring efficiency of action”. The word cybernetic itself carries a concept of “the art of managing and directing highly complex systems”. Comparatively, System Theory defines a system as “a set of elements in dynamic interaction, organized for a goal” and is explained as systemic concept or “vision as a whole” in Macroscopic (Rosnay, 1978) which is similar to resource and capabilities deployment under resource-based view theory. This has been further explained as an analogy of cell as a system – maintaining its structure and replicate itself, compared to the ecosystem – maintaining its equilibrium and permit the development of life. To further understand the system theory, concept of a system is explored further on the characteristics and properties that make a system.

A system which is characterized by a constant interaction, each one modifying the other and being modified in return is known as an “open system”. This is an environment where inputs (energy, information, raw material) enter the system, being process to become an output (action) that enter the ecosystem and circulate back to the open system as another input to the existing system. The process is constantly interacted, each input being modified and modifying by each other in return and should be a “closed system” where the elements

are in-active without exchanged of neither energy nor information within the environment.

It is very crucial in understanding the system in term of complexity of the system which is built upon. There are two main concepts that contributed to the understanding of the system – variety of elements and the interaction between the elements. The existence of various element characterized by unique functions are organized in its internal hierarchical levels linked with a great variety of bonds vertically and horizontally. The element, boundary of system, storage and complex system is characterized by a high concentration of interconnections and interactions between the elements resulted in a non-linear interaction. This kind of system is described as having variables multiplied or divided by co-efficient which are themselves functions of other variables. There is also an emergence of new properties which are having a great resistance to changes. To further explain the complexity of the system, an understanding of the structure and functions need to be understood. The four elements of system structures are depicted in Table 2.

Table 2.0

Four elements that described the structure of the system

Elements	Description	Functional Characteristic
Limit Element	Boundary of the system Components (people, material, process and information) that can be counted and assembled in a group, family or population.	Element flows between reservoirs to become people, material and process flow.
Reservoir	Storage of elements and energy, information and material.	
Communication or Network	Platform that allows the exchange of energy, matter, information among the elements of the system and between the reservoir.	

Source: (Rosnay, 1978)

Functional characteristics are grouped as flows of elements that circulate between the reservoirs. The element is usually expressed in quantity over certain time frame. In real situation, it is people, information and product. The flow of information will serve as a base for decision making. Valve is defined as the gate to control the volume of various flows. Each valve acts as the center for decision making which can be considered as the manager, organization or transforming agent.

Another characteristic to define the function is the delay which is a result of variation in speed of the circulation of flows, in the time of storage in the reservoir or the friction between elements of the system. This delay affected the inhibition of the behavior of complex system. Feedback / Information loop characterized by:

- a) Positive feedback is described as dynamic for change in a system and trigger growth and evolution.
- b) Negative feedback functions as a control to create stability by re-establishing the equilibrium and self-maintenance.

System and systemic description are similar to interaction of resources and capabilities under resource-based view theory.

2.3.2 Systemic Concept

How systemic thinking came about to explain this research? System thinking drives the emerging concept of systemic manufacturing system. Systemic paradigm started with the integration in manufacturing (IiM) which organized humans and machines to operate as a whole system (Morel, Panetto, Zaremba, & Mayer, 2003). Unfortunately, the interface between the enterprise corporate level and manufacturing shop floor level remain a major challenge.

Systemic concept originated from the idea of system theory. Resource based strategy was proposed by Prahalad and Hamel (Fowler, 1999) focused on resources deployment. The cornerstone of the resources-based approach took place years ago, with the basic assumptions that an organization is heterogeneous in resources and capabilities (Peteraf, 1993). Another systemic approach views the system as the System Dynamics approach. It supports the systemic manufacturing system by providing a mechanism for explaining how the system works systemically based on the concept of feedback loop, flow and reservoir originated from a concept of system theory and servomechanism

concept. It was pointed out that more than 90% of the variables considered in the model involved top management influenced structure, leadership quality, character of founders, how organizational goals are created, how past cultures and organizational tradition determine decision-making and its future. The model also considers the interaction between capacity, price, quality and delivery delay.

Communication has to be a two way – not only participative but also reflective – to create a positive constructive environment to give opportunities for the employees to grow and continuously improve. Autonomy and accountability are other factors that are practiced. Every employee has the responsibility to act as an autonomous agent, committed to the project and the practices of systemic leadership. The actions of an autonomous agent include the power of judgement as well as decision, as well as an obligation to respect, trust and understand the people in the group. Respect and accepting others as part of the team contributes to the organization's growth and each and every one is held accountable for their responsibility. The systemic culture enables the organization to value and recognize members as members of the community rather than contracted, fostering a sense of (Wenger, 1998) “a social configuration in which our enterprise is defined as worth pursuing and our participation is recognized as being competent”. Consequently, everyone “achieves consensus, assumes responsibility, works for the common good and builds a community” (Warhane & Morland, 2011). Eventually, organizational members identify themselves through engagement where they actively participate and engage with everyone else in the organization and imagine

themselves as part of the organizational drives to excellence, efficiency and effectiveness irrespective of the constantly changing environment.

The next systemic paradigm is the Intelligent Manufacturing System (IMS) aimed at organizing humans and machines into a networked system to become a unitary extended/ virtual enterprise for a world-wide manufacturing purpose (Kostal & Holubek, 2012). This concept proposed that the next generation manufacturing system must be able to distribute digital intelligence across borders to enable the flexible and autonomous operation of distributed units to transform information flows into product flow. However, the IMS was not treated neither mature information technology-oriented nor a system automation approach.

The third and most pragmatic paradigm is Systems Engineering, which is a challenge to the scientific, industrial and educational practitioners in determining the control and management of the increasing information-interaction-intelligence complexity, which should be deployed towards agile automation and new Enterprise Control and Management integration.

In summary, the shift in the manufacturing paradigm is to close the gap between the hierarchical behaviour towards a more hierarchical behaviour, which is the emerging modelling approach with the objective of creating a system that is controlled automatically based on system theory and

informational and intelligently organized according to system engineering (SE) rules.

System Engineering (SE) is a practicable management technology used to handle the increasing information-based technical and knowledge complexity in order to bring the system into operational. The system engineering concept is systemic in nature, referring back to the General System Theory strategy to explain, understand and predict the complex properties created from the interactions of numerous agents and finally modifies the agent's behaviour through the process of cooperation, competition and negotiation (Adams & Mun, 2005). However, this interaction creates new concerns that become a challenge for the top-down and bottom-up system modelling approaches to a more interdisciplinary way of thinking. Forrester (1989), mentioned that challenges of the next century faced by our society will not be technological changes but population and system in which we do our work which directly and indirectly affects the way manufacturing systems are managed (Forrester, 1989).

The "Holonc" manufacturing concept is said to be the most suitable approach in systemic manufacturing system due to the consensus that the holonic manufacturing system fit well with enterprise control integration (Farid, 2004). In other words, rather than looking at the system or subsystem as a function on its own, it should be looked at as a subsystem with its interaction with all other subsystems based on all the eleven elements of the system thinking concept.

Another view is the TQM (Total Quality Management) concept, which proposes that the integration of all functions of a business to achieve high quality product. However, it is not the manufacturing system but rather a systemic quality management system. This system was the main attraction in the 1990's. However, research has indicated a failure rate of 75% and there is a lack of theoretical exploration in reference to its implementation. The final conclusion of the research was that the systemic approach would definitely be indispensable if TQM is used in an organization (Cao, Clarke, & Lehaney, 2000).

System Dynamics (SD) is a feedback system that works based on the feedback loop, flow and reservoir concept (Forrester, 1989). It was developed from the field and applicable in complex situations involving non-linear problems. Positive feedback loop results in exponential growth and divergent behaviour creating a snowball effect, chain reaction and industrial destruction. There is no intermediate situation in positive feedback loop and if left to itself, it will lead to destruction. The negative feedback loop results in the maintenance of equilibrium and convergence. The negative feedback loop results in adaptive goal seeking behaviour, sustained at the same level and direction. The system tends to produce its own purpose and every variation towards a plus triggers a correction towards the minus and vice versa. Both positive and negative feedback loops have to complement one another.

Flow and reservoir work together based on the flow and state or level of the variable, express in terms of two instant relations to time. The flow is controlled by a valve that determines the state of the variables, which is the accumulation of a given quantity within a period of time. Thus, it results in system integration. Comparatively, the flow of water is similar to the flow of products, people and information, whereas the state of variables is equivalent to the number of products within a given time. SD used in this study because the method enables descriptive information to be organized, richness of the real processes to be retained, build on the experiential knowledge of managers and reveal the variety of dynamic behaviours that follow from different choice of policy. Comparatively, even though it has been widely accepted, case study is not a choice due to the fact that it does not reliably cope with dynamic complexity.

Hence, it is pointed out that the trend of going forward for the next twenty (20) years or so will be focus on “generic structures”. This has been experimented using bacteria in a culture and computer simulation and was concluded that “it is a world population problem”. Knowledge from one field could become applicable in another. A new trend of reversing the trends of the last century by moving away from the “Renaissance man” towards fragmented specialization is now becoming a reality. The current trend is moving towards an integrated, systemic, educational process that is more efficient, more appropriate to a world of increasing complexity and more compatible with a unity in life.

The next focus will be on the manufacturing system and concept in use to give an overview of the nature of the organization's process flow to determine the existence of systemic impact on the organization. The importance of the manufacturing industry has also brought together numerous experts and academicians to study, researched and come out with the best approach for handling manufacturing activities systematically and comprehensively as possible. By operating interactively, systematically and systemically, a manufacturing process runs efficiently to produce the required results accurately, timely and profitably.

The systemic manufacturing system has evolved into a major paradigm several years ago to create an interactive system that integrates and functions as a whole with the concept of system thinking. With an increasing challenge in the industry and companies, the systemic approach tends to manage challenges more effectively by promoting accuracy and increase the percentage of delivery dates on time schedule. (Schmitt, 2006) and (Ryan, 2011) have explored the intersection between inter disciplinary fields of complex system and design to define the relationship between complexity and military operations as basis for systemic operational systems. Both studies identified opportunities to incorporate further insights from complex systems into operational system designs to suggest an application by non-military agencies and commercial operations. Schmitt (2006), in an article entitled, "A Systemic Concept for Operational Design", used a military scenario to stress the significant impact of the systemic management concept in the operational

strategies by quoting one of many, from Marine Corps Doctrinal Publication (MCDP) 1, Warfighting (Schmitt, 2006):

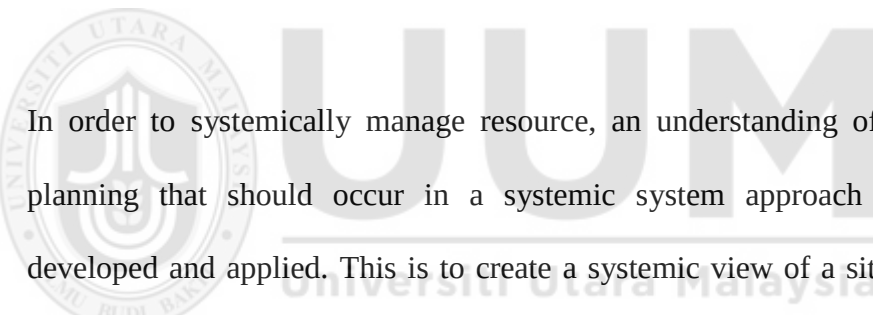
Rather than pursuing the cumulative destruction of every component in the enemy arsenal, the goal is to attack the enemy “system”—to destroy the enemy systemically. Enemy components may remain untouched but cannot function as part of a cohesive whole. ... Success depends not so much on the efficient performance of procedures and techniques, but on understanding the specific characteristics of the enemy system. ... [T]he element of ... local attrition is not merely to contribute to the overall wearing down of the entire enemy force, but to eliminate a key element which incapacitates the enemy systemically.

(Source: U.S. Marine Corps, War-fighting, Marine Corps Doctrinal Publication 1, Washington: Department of the Navy, 1997), pp. 37-38.

As pointed out by Schmitt (2006), a systemic operational design that exists in the military has several key factors considered and imbedded in the operational activities. Even though the study was done in a military context, a similar concept and importance exist in the manufacturing industry, which is characterized by a complex and dynamic situation. In general, to have a systemic operational design, several factors are required. Firstly, there needs to be a distinction between design and planning. Secondly, there should be some recognition of significance and irreducible uncertainty of the fundamental challenge of command to cope with the uncertainty, but not to eliminate it. Thirdly, the design should take an iterative inquiry approach into the nature of the situation to build and test the hypothesis. Fourthly, it has to be universally conversational because the design tends to unfold naturally as a result of interaction between stakeholders in the process compared to planning process which is most of the time unique to a particular environment and organization. The fifth characteristic is the decision-making process has to be intuitively made since the decision is made based on intuitive judgment triggered by

extensive reasoning depending on the situation in order to build the necessary level of understanding.

Aside from being intuitive in decision-making, a deep understanding of the situation and process is another critical factor to consider in the design. An understanding of the situation will help to generate the right course of action when formulating problem solving methodology rather than creating potential solutions. The last and equally important factor is the application of system thinking methodology when dealing with operational situation in response to intrinsic nature of the environment and process.



In order to systemically manage resource, an understanding of design and planning that should occur in a systemic system approach need to be developed and applied. This is to create a systemic view of a situation and a comprehensive range of capabilities in solving an existing situational problem.

Design is defined as a problem setting that involves locating, identifying and formulating the problem, underlying causes, structure and operative dynamics in order to obtain problem-solving approach. Thus, from a different perspective, Herbert Simon quoted “solving a problem simply means representing it so as to make the solution transparent”. Planning is referred to as conceptual planning, while detailed planning is called design and planning. The word ‘planning’ has been defined as problem solving that explains or defines a conceptual framework when generating a plan or series of executable actions. The focus is on a physical process, whereas design focuses on the

understanding of the nature of an unfamiliar problem, more conceptual, hypothesizing the underlying causes and dynamic in explaining the situation in the physical world. It normally acts as a guideline for planning and at the same time requires planning to translate it into an application in the real world. Schmitt's explanation of the difference between design approach and planning approach is presented in Table 2.1 (Schmitt, 2006).

Table 2.1
Difference between design and planning approach by Schmitt

Criteria	Design Approach	Planning Approach
Creativity	Allow creativity.	Follow step by step procedures.
Objectivity	Unfold conversational, subjective to individual understanding of the situation.	Breakdown the design into multiple and manageable tasks.
Application	Serve as guideline for planning to be created. Action is intuitively through learning about the situation and environment until the solution emerge. In most operational situation requires design approach due to complexity and novelty which in most cases absence.	

Source: Schmitt (2006)

The design approach tends to provide an opportunity to be creative when judging due to an implicit knowledge and understanding of the situation by those in command. It tends to create an unfolded conversation as a result of intuitive thinking and understanding, whereas the planning approach focuses on established procedures, is more staff centered, and is a step by step approach that results in an output, which would become an input for the next process or step. It breaks down the design into multiple, manageable tasks in a

formulated design context. In other words, the design actually sets a context in which planning takes place. In the design approach, action takes place as a result of intuitive learning about the situation until the solution emerges. However, in the planning approach, action takes the place of the real application of procedures and methods to generate and evaluate more than one option in the problem-solving process. Critically, in most situations that are complex, dynamic or unique, there is a necessity to act from the design approach point of view, which unfortunately, is non-existent most of the time.

Schmitt (2006) talked about the design gap that exists when there is no design process in operational activities, which provide no framework of reference for managing operations. Consequently, when an abnormal situation arises, planning activities cannot render support and work as it should be in solving the problem (Schmitt, 2006). All the references that the planners have are only the normal routine out-of-habits actions, that eventually result in the failure to solve problem. In other words, planning will address the problem using the same concept and techniques in the current, familiar boundaries of existing paradigm, whereas, design approach will address and deal with questioning those assumptions to create new alternatives and paradigms when addressing the problem on its own terms.

Schmitt (2006) also addresses the challenges and problems faced during the operational designing of a complex, dynamic and uncertain situation. To have a workable operational design, he stressed the importance of at least 3 elements as a basis for the design approach. First, a complex operational

situation is “wicked” problem. Second, a complex operational situation exists in an environment of social complexity. Third, any approach to resolve complex operational situations should be compatible with the natural human cognitive process (Schmitt, 2006).

A problem that is extremely challenging and complex, characterized by several traits is called a “wicked problem”. This type of problem cannot be defined objectively due to its level of complexity attributed by several causes. The problem can be formulated in many different ways depending on one’s understanding and interpretation of the situation. The problem must be constructed out of the situation based on the interpretation.

To understand this type of problem, a situation has to be proposed; thus, creating a requirement for information to solve the problem. It is a cognitive and intuitive process involving problem formulation that directly points to the proposed solution.

There is no “stopping rule” when it comes to ‘wicked problem’ solving considering the nature of its extreme complexity. The solution to this type of problem is always inconclusive, which means the situation changes and the solution is just “good enough” or “the best can be done under the circumstances” and it is temporary or conditional.

There is no right or wrong answer, only good, better or worst solution to a wicked problem. Since there is no objective method for solving this problem as it is subject to individual interpretation. Thus, there is no ultimate test for a solution to a wicked problem. The result of a proposed solution today might only be the best today and might be inappropriate tomorrow due to the situational changes.

Any solution to the problem is a “one shot” operation as it creates an impact to the situation leading to another problem, which in turn requires a different solution. This type of problem cannot be formulated without trying out the solutions but ironically, the solution cannot be tried out without changing the definition of the problem.

There is no fix set of potential solutions for this type of problem, which means there is no ready-made option for solving the problem. The solution is created depending on the definition of the problem. Every problem is unique and requires a tailor-made solution. The problem is actually a symptom of another problem. Thus, in defining the relationship between its cause and effect, the challenge is to decide the definition of the problem compared to the other problems because they are interconnected and interactively complex. The complexity in its interaction is defined as freedom of interaction between elements, highly sensitive to inputs, small variance will create a major impact on the situation in hand and a single effect is a result of multiple causes.

Understanding the definition of a “wicked” problem is made more meaningful when further explained in the context of its social complexity. This type of problem is socially complex where numerous stakeholders are usually involved in the situations network. Differences in background, culture, values and organizational functions create a difference in interpretation and problem-solving mechanism. There are risk involved in the diversity of the definition and problem solution formulation. On one hand, diversity is good as it provides a mixture of skills and experiences in solving the problem but on the other hand it tends to create a threat should there is no common understanding and agreement between them in solving the problem. The key to this type of problem-solving formulation is a common understanding, thus, the operational design has to provide a strategy or mechanism for creating a shared understanding and commitment for handling social complexity.

The human problem-solving process is another consideration that must be made when handling complex problem solution formulation. Decision making in complex situations involves an intuitive process triggered by the ability to create a situation and mentally project the prospective action. Problem solving formulation in a complex situation involves exploring the complementary cognitive abilities to advance the process as effectively as possible. Group problem solving is more challenging compared to the sub group due to variances that exist in the background, understanding and experience.

Today’s challenging complex situation requires a strategy that is compatible with human cognitive and communication processes to ensure the problem-

solving formulation is not against natural human behaviour. Schmitt (2006) proposed that to deal with the complex situational problem, a heuristic operational design should be adopted as a logical foundation for all planning and execution as well as continuous assessment and improvement to the design due to rapidly changing situations. Thus, due to the design and hypothesized causality that arise from the mess, chaotic situations can be the basis for planning, which might lead to the implementation of the solution. The process involves designing, planning and action as well as continuous improvement to the changing situations. Operational adaptation is a group review of a complex problem in order to mentally defined the situation as a system and to conceive a logical approach, a counter-logic to transform the system into action through the use of ‘abductive reasoning’ – the process of inferring best explanation from limited facts. The outcome of the process is a logic system that enables all operations by establishing a context for all planning and execution.

To get a deeper understanding of the process, several supporting ideas and concept need to be understood. One way to manage this complex situational problem is through a heuristic operational design. Through trial and error, the operational design should be able to provide a basis or fundamental for planning and execution and at the same time provide a guideline for continuous improvement as the situation and environment changes over time. Several concepts should be imbedded in the heuristic operational design. The process is cyclical involves several steps that are commonly used in the action research such as planning, implementation, checking and action. The process

is done repeatedly until the best, effective solution is obtained through what Schmitt (2006) called as “operational adaptation”.

“Conversational discourse” as literally as the word discourse means is defined as a structured discussion with the group which involve argumentation and interactive learning process across organization, domain and cultures. (Rittel, 1968) pointed out that the “argumentative process in the course of which an image of the problem and of the solution emerges gradually among the participants and as a product of incessant judgment, subjected to critical argument”. The conversational discourse served as a basic mechanism through which the design team works. Why we need a discourse? The process will generate key insight into a situation or resolution and focuses on rationalizing the problem rather than the course of action. The process tends to apply more of “abductive reasoning”, where the process of inferring is the best explanation from limited reference or facts. From a social aspect, managing a complex situational problem requires a common understanding about the problem and commitment. It is not necessarily agreeing on a problem but an understanding of the problem by all stakeholders that enables an intelligent exchange of knowledge and interpretations on how to resolve the problem. Discussion normally involves a classic dynamic process of thesis-antithesis-synthesis, where the ideas are open for argument and positive criticism by all stakeholders in the group, which are then reviewed and revised continuously until the best answer is agreed upon by the entire team. The focus of the argumentation process is on two logics that are complementary to each other, namely causal logic and counter logic. Causal logic is defined as the

hypothesized causality of the problem purposely to construct a logical explanation and put in an abstract model representing events in the actual world. On the contrary, counter logic is the logical guideline for the operational process that reveal the success mechanism of problem-solving process. Causal logic represents the systemic nature and dynamics of the problem, whereas the counter logic portrays the broad, comprehensive logical approach in problem-solving.

Complementing the idea forwarded by Schmitt (2006) concerning the systemic operational system, the process of four-module management proposed by Sussland (2003) is said to cultivate the systemic thinking and communication across various levels of the organization and functions. The first two modules are the strategy's fundamentals and dynamics, focusing on "doing the right thing", the third module is strategy's implementation and review on "doing the thing right". The fourth module is the strategy audit, which assesses the performance of the operations and audits the "business value" to make sure the organization is "doing the right thing right". The right deployment and bundling of resources generate capabilities to maneuver the business strategy and operationally drive the delivery performance (Sussland, 2003).

Sussland (2003), suggested that the effectiveness of the leadership network acts as the triggering hand that steers the employees to a common goals and coaches them towards sharing management practices. To measure the effectiveness of the leadership, Sussland (2003) proposed several factors. One

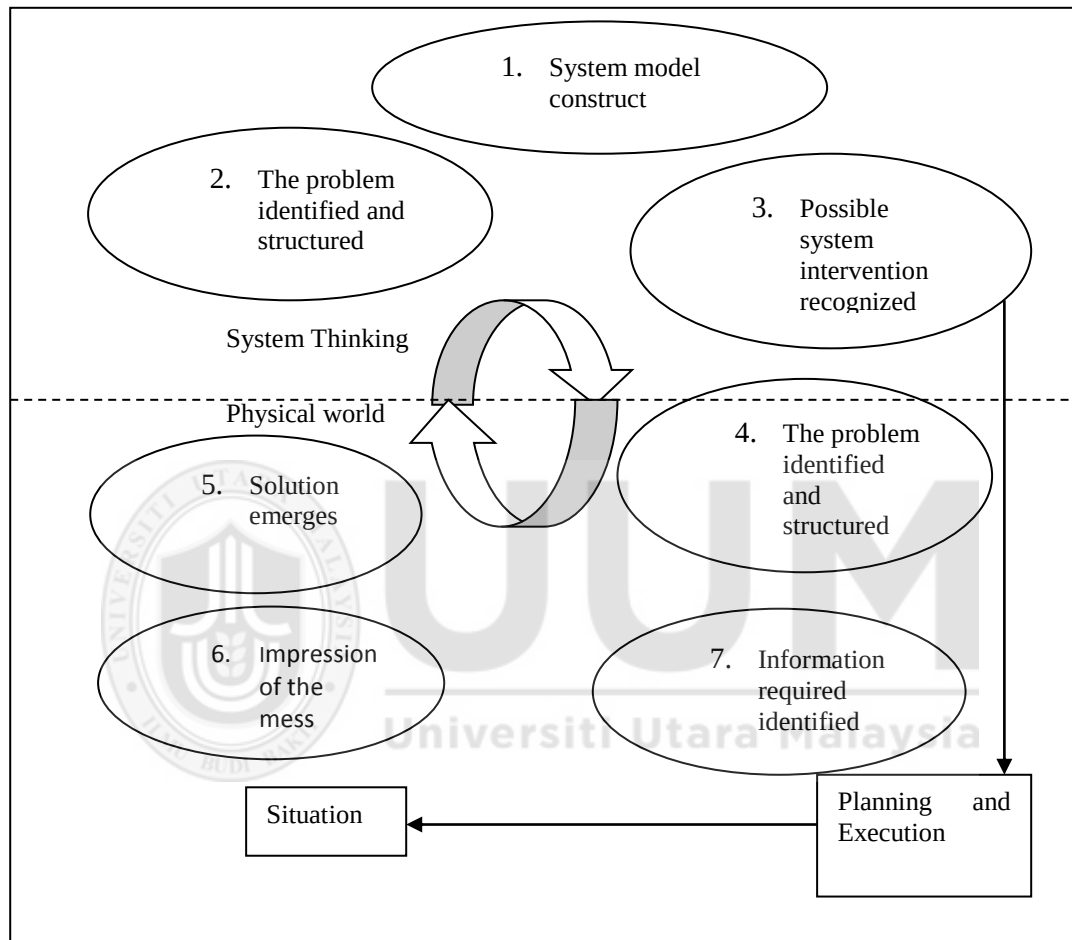
of them is the leadership's efficiency in managing synergies among the other four building blocks of the strategy. The second factor is the adaptation of the leadership style to the competitive situation of the organization. Next is the symbiosis of the leadership and the organization's internal culture, followed by the symbiosis of the leadership and the culture of the relevant departments / functions plus the symbiosis of the leadership and the relevant regional cultures and finally, the strength and cohesion of the leadership network.

The second concept that is equally important is the design process itself. The design process involves the general pattern of cognitive activities that occur during the design. Design should be iterative due to the complexity of the situational problem that normally requires a cyclical problem-solving process. This process considers comprehensive factors and relationship needed to hold the process as an integrated whole, which interacts and improves incrementally. Aside from being iterative, the design process should also be expansionist, which means the discourse and argument process should include a more comprehensive consideration of the problem. The design should cover at least two different systems, namely the object system and broader system as well as how both systems interact and impacted one another in appreciation and understanding.

The design process or process model serves as a set of general steps or flow in which designers go through when solving a problem but not necessarily following a sequence. Diagram 2 shows the key elements in the design process

which is the cyclical intellectual transition between physical and conceptual entities when dealing with abstract constructs.

Diagram 2
Systemic design process



Source: Schmitt (2006)

Apart from conversational discourse and the design process, the composition of the design team is also an important factor. The team should be small enough, consisting of those who have to live and die with the result, direct participants and have strong interest in the process. The team should also be as diversified as possible to have a good mix of experience, knowledge and exposure to enable conversational covering the widest range possible. The

composition of team members might vary from stages to stages depending on the changes in design.

The fourth concept that drives operational design is the concept applied in system thinking. System thinking is a mental process that provides an understanding and presents a subject as an interactively complex function in a broader environment. It serves as a mental discipline for a discourse mechanism. System thinking involves balancing a situation in which the system exists and distinguishes it from a wider environment.

Conceptual modeling is central to system thinking to explain the process and working of operational situations and its resolution while continuously improving and testing the model against actual scenarios. Models help to visualize the understanding of the whole system. Designing a model involves the establishing of terminology, symbiology and constructs consisting of language and grammar for planning and execution.

Intuition activated by reasoning involves two (2) types of thinking model, namely intuition and reason. Intuition is a “subconscious thought, immediate cognizance or certainty without reasoning or inferring”. It is a spontaneous, fast and does not require any effort to take place. On the other hand, reason is a rational thought where logical inference, deliberate action and conscious effort need to take place in the process of acquiring knowledge and certainty. Continuous assessment is a process through which learning and

adaptation take place and where mismatches and changes exist. The gap in mismatch and changes inevitably creates a signal for improvement.

A process of learning and adaptation is also part of system thinking found in the design process. The natural process of closing the gap that exists between design and reality requires learning and adaptation on the part of team members. Thus, only learning and adaptation can improvement take place.

The next area that should be looked into in the design process is the implication and arising issues. Schmitt (2006) mentioned several major areas that are affected in the defense industry, such as doctrine, education, training and culture. The affected procedure to carry out tasks and operations is highlighted as one of the effects on the doctrine. Design shows that current planning procedures have to be reconciled so that the systemic effect can be embedded into the practices. The flexibility of the system has to be maintained, irrespective of the formality of the design concept, which tend to promote formality. It is a challenge since operational procedures cannot be defined step by step. Other complications tend to emerge as a result of implementing this concept and those also need to be handled with care.

System theory and techniques of system thinking have to be developed and instilled in each and every team member before the successful implementation of the systemic design process. Leaders and members are currently accustomed to the culture that promotes obedience and always have a high

respect for the ranking. In the discourse of the design process to be critically argued, everyone has to accept the criticism and be open-minded in order to move and improve continuously. No doubt, the process does not require any major advance in technology but the communication and presentation of ideas and concepts need to be made known in the simplest term so it can foster understanding and imagination as the members might be located at various places which is as far as the other side of the globe.

Ryan (2011) defined an operational design as “the design of actions taken by an organization to improve a problematic situation experienced by a social group”. He said that the best natural response to complexity is to adapt to changes and multiple concurrent actions through four steps of acting, sensing, deciding and adapting. The process of reframing will increase the level of adaptation through changes in perception and action from simple individual sections to a group. The perception now is broken into at least 3 folds where an individual or section refers to the evolving operation one’s relative position to the geography or location, the evolving of the next section or sister’s unit’s operation in the relevant operational space and the evolving of the operation as a whole, the systemic implication from one’s position or functions in relation to the organization as a whole.

In military jargon, it is described as navigation (geography), orientation (relative position to a sister unit) or systemic awareness (cognitive quality implying synthesis). It is important that to prepare the navigation aid, enough investment is made in developing of common space of understanding in the

units and the setting up of operational design to enable a dynamic learning in action. There is a very interesting concept to be adopted in his infestation strategy “inverted geometry” of the urban space in order to walk through the walls:

“...this space that you look at, this room that you look at, is nothing but your interpretation of it. [...] The question is how do you interpret the alley? [...] We interpret the alley as a place forbidden to walk through and the door as a place forbidden to pass through, and the window as a place forbidden to look through, because a weapon awaits us in the alley, and a booby trap awaits us behind the doors. This is because the enemy interprets space in a traditional, classical manner, and I do not want to obey this interpretation and fall into his traps. [...] I want to surprise him! This is the essence of war. I need to win [...] This is why that we opted for the methodology of moving through the walls... like the worm that eats its way forward, emerging at points and then disappearing. [...] I said to my troops, “Friends! [...] If until now you were used to move along roads and sidewalks, forget it! From now on we all walk through the walls!” [Weizman2006b].

Another concept that is equally important as part of the systemic manufacturing system is the concept of design in virtual enterprise manufacturing as discussed by Giachetti (2005) who described the product realization design process that suits the virtual enterprise into four (4) stages (Giachetti, 2005). The first stage involves clarification of tasks where problem formulation and identification of functional requirement takes place. The second stage is the conceptual design stage involves the synthesis of an abstract structure that contributes to a solution for the design problem defined in the first stage. The third stage is the embodiment design, which focuses on the development of the abstract concept into the preliminary scale engineering drawing. The fourth stage is merely a detailed design process where the specification of the attribute values to the design parameter are defined. A standard, formal manufacturing system model generates advantages

to the organization. Being formalized as a standard guideline, it would lead to a discovery of any inconsistency, absence, unclear or uncertainty or any other act or process that is against the system. Another important benefit is the ability to generate conformance measurement as a basis for improving the measurement of speed, efficiency and systemic relationship between functions and even organizations. In an article “Feedback and feed forward as systemic frameworks for operations control”, Alan Fowler (1999) illustrated the concept of resources as material, information, customers, facilities and staff. The concept of operations transformation and control loop between resources, process and deliveries. Thus, the next topic is about resource-based view theory as the underpinning theory.

2.4 Resource Based View Theory

Traditional strategic management focused on resource positions of the firm whereas most of economic tools focused on product-market side. There was no focus on how to strategically manage an organization's resources. Fortunately, the resource-based view provides such an option. The resource-based view approach sees the organization as a set or a group of resources to address how the resources can be deployed, utilized and managed to achieve the best results. The resource-based view theory provides a strategic way of resource deployment that results in value generated capabilities leading to sustainable competitive advantage. It is also an option for management experts when explaining the difference in organizational performance and deployment of core competencies to stay competent in business (Mahoney & Pandian, 1990); (Wernerfelt, 1984).

Resource-based theory is a strategic management approach that originated in 1950's from Penrose (1959) idea of the firm as a coordinated "bundle" of resources, which is characterized as valuable, rare, inimitable and non-substitutable that are deployed as an organization capability in value creation to achieve sustainable competitive advantage for the organization. Barney's (1991) article "Firm Resources and Sustained Competitive Advantage" has been widely cited as the triggering point of the emergence of the resource-based view (Wikipedia, 2018). Richard D. Irwin (1971) pointed out that strategy development is believed to have been shaped by Kenneth R. Andrews who developed the framework in his classic book *The Concept of Corporate Strategy* (Collis & Montgomery, 2005) where he defined strategy as "the match between what a company can do (organizational strengths and weaknesses) within which the universe of what it might do (environmental opportunities and threats)". The following breakthrough in assessing strengths and weaknesses, and opportunities and threats was being developed by Michael E. Porter in his book *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. Porter proposed a structure-conduct-performance paradigm of industrial-organization economics, which focuses on the five structural forces that determine the average profitability of the industry and indirectly impact the profitability of the individual corporate strategies (Porter, 1980).

However, focuses on the external environment has put the organization into a rigid kind of strategy formulation. Since then, the trend has moved from

external to internal strategic formulation. The emergence of the Resource-Based View theory has fulfilled the proposal made by Andrews in his definition that stressed the focus on what the company can do considering outside opportunities and threats. Barney (2001) defined resources as *“all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness”*. Another definition of RBV is *“a determined collection of assets or resources that are tied “semi-permanently” to the firm*(Francisco, 2015).

2.4.1 RBV Assumptions

Despite the RBV theory being introduced by Penrose in the 1950s, the significant contribution of this theory was only recognized in the 1980s due to three main reasons. Firstly, the growth of an unstable environment requires a more secure strategy formulation. Secondly, competitive advantage is more important than the attractiveness of the industry in making profit. Thirdly, customer preferences and technology changes occur more often and are volatile(Francisco, 2015).

In early 2000's resource-based view theory emphasized on resource deployment as a strategy for running a business, contrary to the era of the 1980's, where business focused on strategy and external environment. As operations became more and more complicated, management of the internal environment became as critical as the external environment, thus, the need for

good internal strategy arose. With this awareness, this study focused on firm level dependent variables that focus on competitive advantage and resource deployment at a firm level instead of industry level (Barney, 2001).

Resource-based view theory says that resources and capabilities produce competitive advantage (Mahoney J. T., 1995); (Ismail, Rose, Uli, & Abdullah, 2012); (Robinson, 2008). This theory suggested four characteristics to describe strategic resources, which were valuable, rare, inimitable and non-substitutable. Valuable resource means that the resource contributes to the improved effectiveness and efficiency of the organization, it is rarely found in other similar industries or organizations, is very difficult to imitate and no other resource can be used as the substitute for the same resource possessed by the organization.

For example, in an aerospace manufacturing situation, the organization's expertise obtained through training and development programs results in a group of experts or subject matter experts who are very rare and difficult to imitate by other competitors. Every single employee at the shop floor and support team are unique in their own way contributing to the consistent production of quality goods and on-time completion of product even though the product is fabricated manually.

Furthermore, all the product and manufacturing processes that takes place will need an approval from the prime customer, Boeing, before it can be

considered as valid and good to proceed. This makes the process and technical know-how a very rare resource to the organization as not anyone can just learn and produce similar product without attaining approval from Boeing. Finally, there is no immediate substitute for the product produced by the organization. The brand name that it carries – Boeing – literally means that it is a Boeing product. The product produced is meant for Boeing airplane and there is no other substitute produced by other suppliers. Comparing Boeing product to other similar type of product, Boeing is well known for its excellent quality product and there is no substitute for Boeing product.

2.4.2 RBV - Other perspective

RBV from marketing, manufacturing and finance perspectives (Kamboj, Goyal, & Rahman, 2015) provides a different view about RBV. From an economist point of view, Joseph Schumpeter (1949) suggested that private organizations and industries that possesses an abundance of resources have a greater chance of surviving an environmental turbulence or what he called as “creative destruction”. Comparatively, a sociologist, Philip Selznick identified distinctive competencies as the organization’s valuable capacities and resources that are supposedly identified, invested in and protected. On the other hand, private sector-oriented theorists, Ansoff (1965) and Andrews K. (1971), both pointed out that the significance of focusing on the different resources in promoting the strength, weakness, opportunity and threat (SWOT) analysis when studying organizational capacities (Clardy, 2013). Barney (1991) described the importance of resources and competencies in impacting organizational survival, growth and effectiveness. RBV has also

been used to explain Human Capital deployment. Focusing on internal resources bundling and deployment, literature on RBV portrayed the significant role of labour or workers in organization's performance (Dunford, Snell, & Wright, 2001). Irrespective of the different points of view, resources management and exploitation of capabilities plays a crucial role in determining the success and sustainability of performance in an organization (Bryson, Ackermann, & Eden, 2007).

2.4.3 Resource-Based View - Resource

Resource is defined as “stock of available factors that are owned or controlled by the organization” whereas capabilities are defined as “a special type of resource, specifically referring to organizationally embedded non-transferable firm-specific resource with a purpose of improving the productivity of other resources possessed by the firm” (Makadok, 2001). RBV is a strategy that focuses on activities to optimize resources and capabilities as the bases for achieving sustainable competitive advantage (Francisco, 2015). Resources can be tangible or intangible. Skills, human assets, information and organizational assets as well as relational and reputational assets are among the intangible assets that the firm has. Human capital as an intangible resource (skill, experience and knowledge) is deployed to gain optimum result (David G. Sirmon, 2008). Actual practice at the research location showed that the skill set is crucial when applied in the aerospace manufacturing industry. The skill metric is defined for each manufacturing technician and a minimum of 50 percent skill is considered “acceptable” before the newly hired manufacturing technician is released to the shop floor by the Training Department (ACM

Training, 2014). Tangible assets are assets that are physically owned by the organization and create value for the whole operation. In the research location, a Non-Destructive Testing (NDT) machine is a resource for ACM which is rarely found elsewhere in Malaysia, and it is not easy to copy and no substitute for a usage of similar specification.

Resources identified as labour and work-in-process must be managed systemically to produce the right output on time. Labour is an important factor that contributes to the transformation of raw materials into products. The significant role played by labour in the production is proven to have a major impact in the value creation process from raw material to final product. A consistent supply of labour is crucial because labour creates value by transforming raw material into product as suggested under labor theory of value (Dooley, 2005). Table 2.4 showed a trend number of labour involved in the production of output from 2008 until 2011 in the organization where the research takes place.

Work-in-process (WIP) is another type of resource that can be categorized as materials required in the production. The work-in-process is meant to support the smooth flow of manufacturing process. Without sufficient WIP, the process is not smooth and will be difficult to manage as it will delay the completion time and delivery. However, to have too many WIP gives a negative impact on the organization since it become tied up capital waiting to be sold to generate revenue. The right level must be available. Labour transforms raw material into parts according to scheduled supported by the

right level of work-in-process that generates and deliver the right product on-time. An integrated resources, process and organization is critically required to achieve the on-time delivery (Madhusudhana, Rao, & Muniswamy, 2011). The study looks into the significant relationship between labour, work-in-process, output and output accuracy in achieving the on-time delivery and net sales.

The Theory of Labor explains about labour as the origin of value (Dooley, 2005) whereas, Theory of Constraint as a unifying theory that explain work-in-process and bottlenecks (Boyd, 2008) and value based chain which explained systemically, an organization should be evaluated by the economic value it generates for the shareholders (Qudrat-ullah & Lee, 1997). All these variables (labour, work-in-process, output and output accuracy) integrate systemically and can be explained by the underpinning theory of the resource-based view theory (Ford & Mahieu, 1998) to create an integrated and comprehensive processes to meet on-time delivery and generate sales for an organization (Behrens, 2010). The variables in this research are the identified resources that should be blended and integrated through a process of bundling and deployment, which defines the actions that an organization engages in to achieve an objective. The resources in the bundling and deployment strategy depend on the situational conditions in an organization. A successful bundling and deploying strategic practice eventually create competitive advantage in terms of resource utilization and capabilities to succeed and sustain the achieved objective (Sirmon, Gove, & Hitt, 2008).

2.4.4 Resource-Based View- Capabilities

Another group of intangible assets are capabilities or competence that represents what the firms does. Competence was defined by Prahalad and Hamel (1990) as “collective learning that gives firm the ability to deploy their resources productively”. Competence usually differs from one organization to another and emerge as the organization grows (Dierickx & Cool, 1989); (Teece, Pisano, & Shuen, 1997); (Wu, 2007), which would be hard to apply in a competitive context but is acquired through learning and related to previous abilities (Tanaka, 2003).

Aerospace is a very dynamic industry that requires frequent and prompt action. The dynamic capabilities concept recently evolved to add a more dynamic version of RBV to handle a rapidly evolving environment. Dynamic capability was defined as a “firm’s ability to integrate, build and reconfigure competence” (Teece, 2017), similar to Barney’s (1991) definition of resources as in the “ability to conceive and choose as well as implement strategies”. This dynamic capability possessed by the organization makes the organization operate competitively and ready to take on new challenges and business opportunities. The ability to produce products as per plan is part of company’s competency measured in output and output accuracy.

2.4.5 Resource versus Capability

The resource-based view theory depicts the relationship between internal resources and capabilities to create a competitive advantage in an

organization. Resources are categorized as human capital, machine and material. There is another resource that is equally important in the manufacturing sector but was not considered as a major problem in this study, which was money or cash flow. More opportunities are created when one party tries to exploit the other party for better value (Gaya, Struwig, & Smith, 2013). Similar practices applied in the organization where the value-added process is an integral part of the manufacturing process. Gaya, Struwig & Smith (2013) explained how the resource-based view theory combined with the transaction cost economic concept work to explain where the ownership should be on strategic capabilities in the operations and supply chain. An understanding of value creation activities at every process ensures proper identification of strength and weaknesses to gain the competitive advantage in the organization (Gaya, Struwig, & Smith, 2013). When most literatures talked about intra organization resources strategic capabilities, the internal strategy is equally important.

Every process is crucial in determining the value-added chain and need to be consistently monitored and evaluated. Machines are maintained regularly and calibrated per schedule, while skilled and unskilled labours are continuously trained and develop continuously internally and externally with up-to-date technology, skills and material availability were consistently reviewed to avoid shortages.

Human capital is considered as the number of direct labour hired to manufacture the products. Human as resource has been documented in the

earlier labour theory of value, which is also known as production theory of value. Labour is an asset to the organization and should be developed and nurtured to become a value-added resource. Productive labour will add value to the process and transform materials to become end products (Dooley, 2005).

How does the product realization process is materialized and create systemic impact in the aerospace composite manufacturing system? In the Aerospace Standard AS9101D, clause 4.1.2.1 customer focus stated that an organization will be audited and assessed to determine whether customer satisfaction is adequately evaluated and if any action need to be taken by the organization to close the gap in customer satisfaction. Among the evaluation metrics are nonconformity data, corrective action report, result of satisfaction surveys, complaint on product quality, on-time delivery, response to customers' and organizations' report or score card. These metrics are all systemic key performance indicators and the way these metrics are managed determine the capability of the process to meet the required standards set by the organization (Aerospace Standard, 2010).

Process management covers the organization's process sequence and interaction focuses on performance and effectiveness that directly impacts the customer; process-base management technique is inclusive of the way the process is being controlled, such as quality, tact time, cycle time and output efficiency; process objective and target focuses on areas that have the biggest impact on the customer and the existence of contingency plan for recovery of any gap. To ensure the process management is meeting the standards, an

evaluation is needed on the product starting from customer orders and related documents supporting the orders, through the product realization process to identify the associated processes and to verify the interface between processes as well as the links of documentation requirement, resources management and measurement as well as analysis and improvement (AS Standard AS9101D, Clause 4.1.2.4).

Product and process simplification improves process management. Fewer production processes tend to reduce physical volume and avoid work-in-progress piling up should there be any process breakdown. Furthermore, with less and simple production processes, any changes in part configuration or design would be more manageable. Unfortunately, as pointed out by William, Maull & Ellis (2002), the nature of the aerospace industry provides very little space for simplification especially when the production of parts is carried out on the other side of the globe from the prime customers.

Evaluation of the manufacturing process capability is a process carried out for a specific process in a featured product as defined in the preliminary engineering product model. The evaluation is done against the process capability, particularly the vendor's capabilities. Evaluation of specific product / process manufacturing is the last phase and it is typically done through simulation or analytical models. Product information and product/process interaction information are both critical contents to perform the detailed evaluation.

Production planning and control (PPC) is another process that is part of the product realization strategy. PPC department assumes the responsibility to plan for production requirement, operation direct head and machine capacity (resource) planning. The execution of the production plan is flows down to operation while hiring and training is related to human resources. Monitoring of the plan execution, hiring and training plus the capacity utilization is done on daily and weekly basis. However, based on the nature of aerospace composite manufacturing, various similar and different issues crop up every day demanding more attention for consistently monitoring and controlling the planning and execution. Process control to monitor and tracking work-in-process is paramount in assuring the time taken for the completion is achievable (Nickols, 2007). Thus, the whole manufacturing system must be re-evaluated frequently for a better and comprehensive transformation.

2.4.6 Resource Based View - Limitation

Numerous previous studies have pointed out two reasons that still implicate this resource-based view theory. First, it lacks a single integrating framework and the second is there is limited effort to develop the practical application of the resource-based view theory (Grant, 1991). This is supported by William, Maull & Ellis (2002), who commented that the major problem with the resource-based view theory is that its strategic formulation is a limitation on the mechanism to translate its resources and capabilities deployment concept into a practical meaningful diagnostic and prognostic managerial capabilities (Haxand Mjluf, 1996). Thus, the RBV is practically still pertinent due to some

basic grounded concepts in the practical framework. Its application has been relatively tested in key activities areas in the industry, including entrepreneurship, innovation, manufacturing competition and performance, market driven manufacturing, demand chain management and industry catch-up strategy for latecomer firms.

The application of the resource-based view theory in the firm has been made difficult by the complexity of the process. An example shared by Ford & Mahieu (1998) is about how a telecommunication network operator manages national market liberalization. An organization should develop a strategy as a guideline to move forward by manipulating the resources to gain and sustain its advantageous position (Black & Boal, 2007). To put the theory in place, first and foremost, the definition of the word “operationalization” and the reason for the “operationalization” must be clearly understood. “Operationalization” is defined as “a formalization of a theory’s ideas and concepts into applicable models which facilitate all stages of strategy formulation and decision making”.

2.4.7 Resource Based View Theory – Application

To close the gap that exists in the implementation, David N. Ford and Laurent A. Mahieu (Ford, 1998) reviewed seven models of resources-based model applied in real situations and the challenges in trying to implement the RBV. In order to implement the RBV, one has to understand the relationship between the available resources in control and company performance.

Resource-based view theory is contrary in perspective to Porter's five forces. RBV focuses on unique internal resources and capabilities in formulating its strategic decision-making to achieve performance while Porter's five forces focused on the external environment. Another model that is more widely used is the VRIO technique (Barney, 2001). The model represents the empirical indicators of usefulness of resource for generating sustained advantage. The analysis proposed by the RBV applies the Value-Rarity-Imitability-Organization (VRIO) analysis technique but the technique has its limitations. Its application focuses more on a backward looking in nurturing the existing performance but fails to explain how to sufficiently reinforce the role of management in nurturing future performance, particularly for intangible resources. It did not specify how to practically translate the theory into practice (Priem & Butler, 2001).

Paul Knott (2009) suggested instead of focusing on the VRIO only, the process should continue to include a comprehensive set of steps for analyzing a part by emphasizing the active management of conditions where firm attributes are converted to resource or competence. The first step proposed by Paul Knott is to group resources into tangible and intangible as well as competent group as in the RBV theory, followed by an evaluation of existing form of analysis available for practice. The next step is to outline the steps involve in carrying out the Value-Rarity-Imitability-Organization (VRIO) and finally determine how the VRIO analysis links to the intervention to nurture the firm's resources and competence. The concept suggested by the RBV theory is that the unique or distinctive resources possessed by a firm are a

source of sustained competitive advantage. The word “sustained” in the RBV carries an understanding about resisting attempts at duplication, which is very subjective to changes in supply and demand and the internal as well as external environmental changes. The changes in these factors directly or indirectly impact the cost involved in sustaining the resource. In other words, the value of the resource is highly impacted by the changes and might lose its competitive advantage when the cost involved is high. Furthermore, the imitable resources own by an organization emerge as time and business moves on, which requires an analysis of future competitive advantage (Barney, 2001).

Analysis of competence – value chain (Porter, 1985) is where the value creation system is broken down into individual, linked activities. This approach provides the ability for managers to evaluate individual processes and at the same time focus on the overall, systemic qualities that appear across the organization. Resource-based view theory is also applicable in knowledge management, such as competitive advantage (Halawi, Aronson, & McCarthy, 2005). In the aerospace industry, RBV is applied to explain the demand chain management (Williams, Maull, & Ellis, 2002). The research focused on the on-time delivery as part of supply chain, thus, the RBV is applied to the research.

Unfortunately, the technique to evaluate the systemic qualities in the organization has not been widely use. The first model, which involved four (4) basic building blocks of competitive advantage (Hill et. al., 2007), is said to be

simple and closest to being proactive. A firm that achieves superior performance in one or more of the “building blocks”, such as efficiency, quality, innovation and customer responsiveness, will gain competitive advantage over the others.

In other words, the existing technique strongly handles component or system breakdown but fails in evaluating intangible on systemic resources. The limitation exposed by Hill and Barney was overcome by the RBV theory. The theory work base on the VRIO and expanded the concept to become more acceptable and manageable. The technique consisted of several steps. The first step was to select the candidate resources to be tested involving the use of value chain to identify resources to evaluate VRIO, which was not suitable for systemic qualities across the system. The dissimilarity is the distinctive characteristics that were not recognized or harnessed by the organization. (Miller & Shamsie, 2008). There are two (2) techniques available to help the process of identifying attributes. The first is to construct systematically, the individual in the process who claimed a higher degree of neutrality (Klein et. all, 1998). The second technique is to start with the distinctive and valuable qualities of a product / service that represents the attributes and interaction in the firm generating these qualities (Knott, et. all, 1996). Both techniques help to find either sources of performance, component value creating activities, synthesis of knowledge components or cause and effect dissection of outputs.

The second step involves integrating the external assessment of values. This step is very important as it ensures the attributes that represent the resources of

the firm (Bowman & Ambrosini, 2007). This is supported by Barney (1991) and Collin (1994) whereby the value of a firm's attributes depends on the context of the market and condition of the industry. Otherwise, it carries very little impact on competitive performance. The VRIO model addressed the external assessment by incorporating the criterion of whether the resources enable the firm to choose or implement a strategy to exploit an opportunity or neutralizes a threat (Barney, 2002). By addressing the question, the attributes are strongly confirmed to be advantage to the firm in a certain condition but might be a disadvantage in another condition (Leonard Borton, 1997; West and De Costa, 2001). In addition, three key attributes of value (Barney, 2002) stated that (1) the firm's resource is only valuable if it leads to superior efficiency, customer perceived values, innovation or customer responsiveness (Hill et. all, 2007). (2) The analysis must define value only when the firm captures market exchange (Bowman & Ambrosini, 2000 and 2007) and internal assessment based on assumptions about the future. The analysis must define value relative to cost of the resources employed (Barney, 2002).

The third step is integrating assessment of internal conditions to consider the attributes' impact on internal changes and on all the systemic qualities. Then, the following step (fourth step) is to analyze the competitive dynamics of the impact by the resources or competence given the firm sustains competitive advantage. Comparatively, if the firm has similar resources or competence, it will determine how strong the firm is in the industry in terms of sustaining competitive advantage. The fifth step is evaluating the interaction between the firm's attributes, which is to close the gap in the VRIO that does not compare

the individual resources as a system (Foss,1997). The sixth step is managing the conditions to nurture resources and competence by looking at the impact of internal and external condition on a firm's attributes and highlight the radical changes it causes.

2.4.8 Resource and Capabilities Deployment

Managing resources is a comprehensive process involving the structuring of a firm's resource portfolio as well as the bundling of resources to build and leverage capabilities in order to create and maintain value for customers and owners. To better manage resources, it is important to have a clear idea of which resource to focus on. Analyzing a latecomer firm's deployment of resources, it was suggested that the most desirable resources should be characterized by least rare, most transferable and most imitable as well as having a competitive advantage. However, it is not necessarily for resources to be valuable, rare, inimitable or non-substitutable but most important the organization must be able to turn the scarce resources into opportunities by working on resources leveraging (John, A.M. 2002). Another aspect of resources management is the theory of competitive heterogeneity, which is meant to have an "*enduring and systematic performance differences among relatively close rivals*" (Hoopes, D.G., Madsen, T.L and Walker, G. 2003).

Structuring the resource portfolio is a process of acquiring, accumulating and diversifying resources that the organization uses for bundling and leveraging. Acquiring involves purchasing resources from strategic factor markets

(Barney,1986), whereas accumulating refers to the internal development of resources to enhance the isolating mechanism that reduces threats of inimitability. By developing internal resources, the organization is capable of responding to sudden opportunities or significant actions. Divesting is another aspect of structuring, which refers to shedding of firm's control limited resources to ensure the resources add value to firm (Simon & Hitt, 2003; Uhlenbruck, Meyer, & Hitt, 2003). Resources that do not add value are dismissed. Unfortunately, more uncertain the situation, the more likely an error in decision-making to diversify resources. Demand chain management in an aerospace manufacturing organization is mainly controlled by the prime contractor, who is discovering new ways of managing capabilities and transaction within demand chain (Williams, T. Maull, R., Ellis, B. 2002). Due to a high variation in aircraft products and components, the aerospace industry supply chain is highly complex. The need to understand the diverse capabilities of the organizational process is paramount in determining the way resources are managed and deployed. Among the initiatives that can be applied in the demand chain process is the reduction in product complexity and simplifying processes into modular system for easy management. RBV theory has been applied to better understand capability identification in order to have a strong demand chain management. This has been defined as "the management of supply production systems designed to promote higher customer satisfaction, levels through electronic commerce (EC) that facilitates physical flow and information transfer, both forwards and backwards between suppliers, manufacturers and customers." (Williams, T. Maull, R., Ellis, B. 2002). Even though the supply chain is not a topic covered in this study, the

importance of the demand supply chain in the aerospace manufacturing industry is mentioned and noted as it impacts the resources capability management to meet the customer delivery date. This was emphasized by William, T. et al (2002) as the major focus on “capabilities” to link the internal process to external suppliers.

Bundling is defined as a process of stabilizing, enriching and pioneering to integrate resources and firm capabilities. There are various strategies that can be applied in resource bundling. Stabilizing is similar to the concept of coasting (Siggelkow, 2002) which is a process where incremental improvement in current capabilities are aimed at maintaining competitive advantage. Enriching is another approach that focuses on extending and elaborating an existing capability by adding new knowledge and skills to ensure the organization's capability is beyond the current status. Pioneering, as suggested by Ahuja and Lampert (2001), is a process of integrating new resources that were recently acquired from the strategic factor market and adding those resources to the current organization's resource group.

Leveraging is a set of processes involving mobilizing, coordinating and deploying capabilities to take advantage of opportunities in specific market, hence, creating solutions for the current and future customers (Kazanjian, Drazin, & Glynn, 2002). It starts with mobilizing the resources and capabilities. The mobilizing process aims to identify the capabilities required and design the capability configurations necessary to exploit opportunities in the market and gain competitive advantage (Hamel & Prahalad, 1994). There

are 3 leveraging strategies that can be applied. The first is the resource advantage strategy that focuses on leveraging capability configurations that produce a distinctive competence. The second strategy exploits market opportunities by focusing on identifying opportunities whereby the organization's capabilities can be reconfigured and exploited. The third strategy is to create entrepreneurial opportunities by developing capability configurations to create new goods and services that require new market.

Mobilizing capabilities require endless efforts to continuously make adjustment throughout the organization in order to purposely optimize value. The available capability must be right to enable a set of actions to create value for unique customers in a different market (Hamel & Prahalad, 1994). However, mobilizing is not enough for creating value in an organization. Resources have to be coordinated and deployed in order to create optimum value. The organization must be able to develop a management team that is capable of adopting a strategic decision, such as posing linkages of available resources to create opportunities, posing resources leverage as a means of exploiting established linkages and posing the learning capability as the result of repeated application of linkages and leveraging in the organization (John, A.M.;2002). Coordination is done through cross functional teams and developing routines for rewarding creative ideas that need team work. Deploying is a process involving the use of physical capability configuration to support the selected leveraging strategy.

The firm's perspective on value creation starts with providing value to customers. Even though the RBV theory does not show how to manage resources, (Castanias & Helfat, 2001), it is proposed that "the skills of top management combined with other firm assets and capabilities jointly have the potential to generate rent". Thus, value is created only when resources are evaluated, manipulated and deployed according to the required needs of the organization (Lippman & Rumelt, 2003). Existence of organizational learning provides the organization with a potential capability for "strategic flexibility and the degrees of freedom to adapt and evolve" (Zahra & George, 2002). In the case of a latecomer firm, a strategic decision to take advantage of the organization's advanced resources in knowledge and technologies through collaborative effort with those organizations. Apart from collaborative efforts, an organization can also be involved in licensing the most advanced technology. In other words, an organization that is able to perform the best in linking with established firms in the industry to acquire a leverage effort in resources, specifically in technology, knowledge and market access channel (Wernerfelt, 1984), will be able to overcome severe barrier to resources positioning (Willey, 2002).

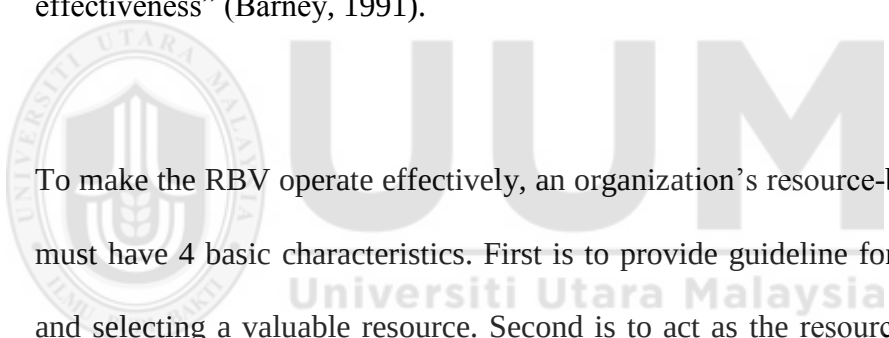
Resource management process incorporates feedback loops that allows continuous adaptation for synchronization and fit with the environment, thus, it is dynamic, with changes resulted from adapting to environmental contingencies and from exploiting opportunities created from and by those contingencies. To have a full advantage of the result, managers must be able to adapt and adopt the structuring processes in order to synchronize the resources

to create optimum value to the customers. In short, managers must have the ability to develop and diverse resources to have the optimum resources utilization, the ability to bundle resources in order to create effective capabilities and finally managers must have the skill to leverage so that the most effective co-ordination is created. Critical skill that managers must have is the ability in understanding the feedback loop and learning process to continuously upgrade the capabilities.

This research applied the resource-based view theory to examine how resources were systemically structured, bundled and deployed to create a systemic manufacturing system to support the organization's goal of meeting the requirement of customer delivery. The organization's leveraging on specific resources leveraging is an important feature that comprises the organization's competitive advantage. (Madhusudhana, Prahlada, & Muniswamy, 2011).

Resource-based theory was created to resolve the weaknesses of Industrial Organization Economics (IOE) that result from the two (2) major circumstances, such as strategically firms in the industry have similar controlled resources and pursue similar strategies as well as the fact that these resources are highly mobile within the industry and are heterogeneous, which lead to short lived sustainability (Barney, 1991).

Resource-based view theory is of no use unless it is operationalized in management strategy to create value and competitive advantage for the organization. The word “operationalization” is defined as “formalization of the theory’s ideas and concept into applicable models that facilitate all stages of strategy formulation and decision making. Black and Boal (1994) suggested that strategic analysis should clearly identify the core characteristic that put the firm in an advantageous position and provide sustainability. Resources are defined as “all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enables the firm to conceive and implement strategies that improve its efficiency and effectiveness” (Barney, 1991).



To make the RBV operate effectively, an organization’s resource-based model must have 4 basic characteristics. First is to provide guideline for identifying and selecting a valuable resource. Second is to act as the resources’ intrinsic endowment dynamics. Third is to clearly show how managerial policies affect resource management. Fourth is to possess the ability to trace consequences of potential strategies over a period of time.

There are seven RBV models proposed and evaluated by several researchers (Amit and Shoemaker (1993), Barney (1984, 1991), Grant (1991), Peteraf (1993); Black and Boel (1994), Hall (1992), Dierick and Cool (1989). The first model introduced by Barney (1986) focuses on the advantages of information when making a discovery and amassing valuable resources ahead of competitors. The second model by Grant (1991), Barney (1991), Hall

(1992) and Peteraf (1993) suggested a conceptual model to direct managers in formulating resource-based strategies through the evaluation of resources and capabilities when deciding the best strategy for manipulating and exploiting the firm's resources. The third model was explored and proposed by Black and Boal (1994) suggested the social network theory as the methodologies to apply the RBV theory by focusing on the system resource network configuration decision tree. This method makes use of six strategic questions to identify valuable resources and to understand the impact of changing one factor of one resource on other unrelated resources. However, this method is limited by lack of clearly defined picture of the resource system and the method did not provide and permit a quantification of the scale and rate of changes of resources (Dierick and Cool, 1989), (Black and Boal, 1994) both suggested a fourth model targeting the use of an intrinsic resource endowment dynamics through which an established theoretical framework aims to describe resource bundling dynamics.

Unfortunately, all these models were not commonly accepted due to weaknesses, such as not *“depict how managerial policies affect resource management or make it possible for strategists to track consequences of potential strategies over a period of time”* (David, 1998). In other words, all of these models do not have the characteristics required for an effective RBV model as proposed except providing a guideline for identifying and selecting valuable resources.

David (1998) introduced a five-step method embodying three levels of analysis as the best approach for applying the RBV. This first level involves the firm's environment where factors from outside the organization (prediction or unforeseen) that possesses the ability to affect the organization's resource-based strategy is identified and listed. The second level is the firm level where consequences of the firm's resources policies are evaluated and lastly is the firm's resource level, where resource endowment dynamics are analyzed. At every level, 5-steps methods is applied systematically, which involves listing of valuable resources, sketching resource charts, drawing key- resource maps, identifying resource strategic plans for resource and managerial policies as well as developing the system model. These five steps method to addresses specific strategy descriptions and analysis within and between the levels and interact on the specified 3 levels of analysis in order to meet the 4 required characteristics specified in the RBV model. The application of this model was conducted in one of the telecommunications network company in Norway, namely Telenor Network Operator service (TNO). The result showed that application of the model using system dynamics network theory worked well for this organization. However, the weakness was that it failed to quantify the intangible resources and need an exhaustive study and analysis for determining the factor(s) that drives decision- making on resource management.

2.4.9 Resource Based View – Literature Gap

To analyze business situations from a resource-based perspective is an advantage (Wernerfelt, 2007). The purpose of a business is to make profit. In

order to do that, sales must be made on-time according to a customer request. Optimum utilization of resource is the key to a successful operational manufacturing organization. Despite recent studies on the resource-based view adopted by organizations, there are limited empirical studies on the application of the resource-based view approach in the composite manufacturing industry in Malaysia. There is still a gap in the literatures on on-time delivery by applying the RBV perspective in a real aerospace composites manufacturing organization in Malaysia. Even though there are an abundance of literature on on-time delivery in industries, it is obvious that there are limited academic reference on the aerospace industry in Malaysia. Managing an aerospace manufacturing operation in Malaysia is definitely different than other parts of the world. These differences in culture, tech-know-how, social and academic backgrounds provide a different way to manage labour, which directly impacts the level of work-in-process, output, output accuracy, on-time delivery and net sales. The literature reviews mentioned earlier were related to the overall integrated supply chain process but this study aimed at empirically analyzing the significant impact of labour, work-in-process, output, output accuracy on on-time delivery and net sales in an aerospace manufacturing company situated in northern Malaysia. The resource-based view approach is highly relevant to the aerospace manufacturing industry as it focuses on internal resources strategy (Williams et al., 2002). As part of the supply chain, ACM is directly affected by the inter-organizational integration within and between the organizations.

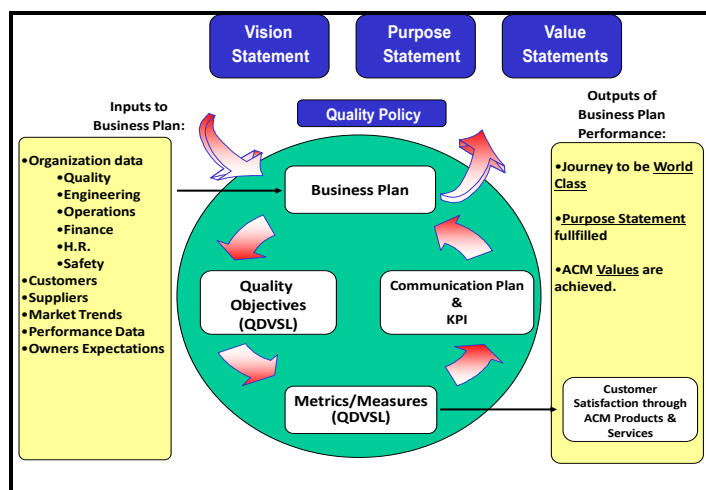
2.5 ACM Organization performance key indicators

Aside from sustainability, there must be an existence of integration between the organization level quality efforts and integration between the organization's culture and quality culture. This will eventually create a systemic quality impact on the organization (Curry & Kadasah, 2002). Organization's key performance indicators are drivers that create systemic energy amongst employees as well as amongst department. There could be one, two or three indicators depending on the department and organization's strategic policy. It can be quantitative, such as sales, attendance, accuracy of part produced or delivery; or qualitative such as customer's satisfaction.

To foster a customer's focus culture in ACM, the management team had strategically developed systemic organization's objectives, such as Quality, Delivery, Value, Safety and Lean, which are commonly termed as "QDVSL" by employees. Diagram 3 shows how QDVSL metrics are systemically integrated to each other in the process.

Diagram 3

ACM performance metrics model



Data source: ACM QMS, 2012

The model functions in such a way that the inputs to the organization's business plan (performance and organizational data from quality, engineering, operations, finance, human resource and safety together with demand from customers, material from suppliers as well as external factor, such as market demand and shareholder expectation) are being systemically deployed and managed. This function is guided by organization's vision, purpose and value statement to meet the required quality standard, customer delivery dates, targeted sales value, highest safety and 5S level through optimization of available resources and capabilities within the organization. The organization's internal communication ensures that inputs or resources are managed properly to produce the right product at the acceptable quality level, delivered on-time at a competitive price to the satisfaction of the customers. Internal communication is also important in ensuring the right indicators are visible at all time in the organization to serve as a guideline for achieving individual and company goals.

2.5.1 Quality (Q)

Literature had suggested that quality is a culture, which is defined as “all interactions that take place between people, their relationships and the feeling engendered by their behavior” (Jeffries et al., 1996). The saying “quality is everyone responsibility” was not applied in ACM but rather it was “quality is my responsibility”, which as such built a self-check quality practices among employees. Quality requirement is an area that requires close attention in aerospace manufacturing. Instead of applying quality inspection by quality inspectors, it is better to have quality assurance built into the process.

Manufacturing technicians were trained and certified through an Operator Verification Program (OV), to perform the process and quality inspection themselves. The technician is responsible for ensuring the quality of the product at each stage of the process aside from dedicated quality inspection team at every critical process. Quality product is an area recognized as a company-wide objective which must be tackled systemically. The nature of the Quality Management System (QMS) is already systemic but the implementation and responsibility by everyone is a continuous challenge for the management. From a Total Quality Management (TQM) perspective, sustainability is the utmost critical factor that ensures a continuous improvement effort is on-going throughout the years. How does quality relate to labor as resource? Labor as human capital is defined to be skill, experience and knowledge of individuals (A.Hitt, 2006). One of the initiatives practiced by ACM to develop the direct labour is through a company-wide program known as Operator Verification Program (OV). Quality is built into the process by having manufacturing technicians check and verify their own process. Multi skill technicians are trained and developed to create workforce that add value to the process and quality of work. Human resource is part of the main key resource in an organization (Hart, 1995). ACM also engaged educational institute such as technical colleges and technical universities to train and upgrade the direct labour qualification and skill.

2.5.2 Delivery

Delivery is a very important performance metrics. Literatures on delivery metric indicates that delivery is a significance indicator of an organization's

performance. On time delivery, delivery reliability, faster delivery times, delivery service, delivery frequency, delivery synchronization, delivery speed and order fulfillment lead time are all the metrics used to measure delivery performance (Rao, Rao, & Muniswamy, 2011). ACM's mission is to be a world class manufacturing center in South-East Asia and strive to meet the best-in-class in the industry in relation to on-time delivery, which is defined as the "ratio of total quantity shipment of the current month demand over the total quantity demand over the same time period". Total quantity is not only the number of panel but also the right part. As part of ACM's quality objective, "delivery" means that ACM is committed to "*On-time delivery of reliable products to meet customer expectation*" (ACM Quality Objectives). Delivery is one of the five (5) major key performance indicators in ACM. It is a systemic metric as it requires an integrated and synchronized effort as an organization's commonly shared strategy aimed at meeting committed delivery.

In 2012, ACM has decided to put in place a Key Performance Index (KPI) that was measured by individual departments instead of company as a whole. Every objective was driven by individual departments and everyone was only interested to do the job that brought benefit to their own department. By year end, results showed that only departments that achieved the target obtained full bonus. Departments that missed the target due to reasons that was not directly or indirectly affected their own department felt very frustrated. For example, the quality department was being penalized due to high rejection rate and scrap was produced by the manufacturing technician's lack of

workmanship created defects, which was a measurement for the quality department. Another example was the planning target set by planning team but production did not achieve the target. The negative results impacted the planning team but not production team. This has created tension and dissatisfaction between departments and the environment became very negative and hostile. Management reviewed its strategy and decided to go to company-wide performance metrics. Thus, creating a systemic kind of integrated strategy within the organization.

2.5.3 Value (V)

Value is measured by the number of ringgit Malaysia (RM) or US Dollar (US\$) of sales, work-in-progress, finished goods inventory and raw materials in ACM. The Ringgit Malaysia (RM) value of cost of poor quality (COPQ) and scrap cost are also among the value measured periodically. Sales value is an indicator of a systemic measurement that determines the financial health of the whole organization. Work-in-process is reported on a monthly basis as an indicator of the amount of money or cash held by process and not generating profit or sales. Bill Waddell (Lean Management Institute), suggested that the total cost is considered as one of the five (5) gold manufacturing metrics and it is a systemic metric. He suggested that manufacturing performance need to be measured as if payment was made at the time materials and services were delivered and payment was collected at the time finished goods were shipped to customer. This concept creates a system that pulled the right parts through the processes.

2.5.4 Safety, Health and Environment (SH&E)

Safety, Health and Environment (SH&E) is another company-wide effort and is systemically managed to provide a safe workplace, healthy environment where employees are guaranteed a safe work place and go home to the family in a safe condition. SH&E activities were carried out consistently over the years and the result of lost time incidents serve as an indicator of a safe and healthy company performance. Safety is one of the bottom-line measuring metrics for manufacturing as indicated by Bill Waddell in the Lean Management Institute's article. The SH&E activities in ACM were considered as one of the most critical and any safety concern will take priority over any other concern, including production because a safe workplace is the first priority in ACM.

2.5.5 Lean (5S)

5S level has been accepted to be the organization's measurement metric for Lean. In the Boeing Production System, which is the basis for ACM Production System (ACMPS), the 5S is the foundation of the manufacturing system. Without a strong 5S level and practices, the manufacturing process will have more waste than value added process. ACM has moved from level 3 for 5S to level 4 in year 2013. In the year of 2014, the target has moved to 4.2 and to 4.5 in year 2015. To further improve, target for 5S has been moved to level 5 in 2016.

2.6 On-Time Delivery

Product and service delivery systems are not a straight forward linear relationship as pointed out by Porter who suggested a flow of raw materials from suppliers to manufacturers and customers but rather a complex economic and social system involving various inter and intra organizational interactions and relationship (Rouse, 2010). To meet customer's delivery expectation is the utmost important achievement in an organization. Best-in-Class benchmark research done by the Aberdeen Group in manufacturing and non-manufacturing companies found that on-time delivery was the top two (2) key performance indicators that characterized the best-in-class performance manufacturers in the world (Aberdeen, 2002). However, to achieve and sustain on-time delivery in an organization requires an integrated company-wide effort. To operate effectively and efficiently, all factors contributing to the operations need to be comprehensively considered and strategically managed, thus, the resource-based view approach was referred to in this study as a basis for explaining the systemic perspective of processes pertaining to on-time delivery in this aerospace composite manufacturing company in Malaysia.

Delivery performance is an indicator of how well a company can satisfy its customers. It is a systemic metric that measure end-to-end supply chain performance from procuring raw materials until the end product reaches the customers. To be more specific, on-time delivery is an indicator of a perfect delivery (Gunasekaran, 2004). Even though on-time delivery is a critical measuring metric in an organization, it is yet one of the challenges that requires closer attention and improvement apart from competitiveness and

quality (Islam, Hamid, & Karim, 2007). Literature reviews on the importance of on-time delivery in Malaysia's manufacturing sector by Islam et al (2007) as well as in other countries globally by Jacob (1997), Behrens (2010), Sambasivan and Soon (2007) and Aberdeen (2000) showed that on-time delivery is a critical indicator of an organization's success but yet is a concern due to its poor performance.

Several literature reviews had dealt with the delivery performance from a supply chain perspective according to the supplier's performance rating (Gunasekaran, 2004), (Jie, 2011). However, not many studies had dealt with real situation where the real action takes place. Comparing the Malaysian manufacturing industry to the international arena, manufacturing continues to become a major industry player according to the survey done by Business Enterprise for Regulatory & Reform (BERR) under *Manufacturing New Challenges, New Opportunities in 2008*. The global transformation of British manufacturing is happening, particularly with regards to the management in increase prevalence and complexity of value chain through development of communication and information technology. This development focuses on specialization, technology exploitation to accommodate changes in technology and demand, increasing importance of intangible resource management such as branding and Research & Development (R&D), recognition of the importance of human capital and skill development and a move towards being more environmental friendly (BERR, 2008).

On-time delivery failures have caused billion dollars lost in sales to aerospace industry. Boeing had learnt a very expensive lesson with the 787 Dreamliner project (Leach, 2009). How does it relate to the RBV approach? As mentioned in literature on RBV approach, the bundling and deployment of company resource and capabilities is the most critical strategy to be employed in managing the process of creating value. Failure to address the significance of suppliers as one of their “resource and capabilities”, Boeing failed to focus on key capabilities and resources when implementing the 787 Dreamliner (Tang & Zimmerman, 2009). The Boeing Co., as an airplane manufacturer in the United States is of no exception from the challenges of late delivery. The delay that Boeing faced in its newly introduced 787 planes had triggered Boeing to realize how paramount it is to effectively manage its supply chains all over the world. Hundreds of thousands of components that make up the 787 plane is produced all over the world by subcontractors and suppliers from tier one and two has caused a major delay at the Boeing plant. This was because the delay by the subcontractors and suppliers resulted from a short of supply and difficulty in technical expertise, consequently delaying the completion and delivery to Boeing (Behrens, 2010). In the case of 787 Dreamliner project, Boeing faced a totaled of 5,014 months of delay which cost around USD2,507 million as a result of around 310 first airplanes 87 deliveries cost (Leach, 2009). Besides Boeing, Airbus also faced some bad experience as a result of delays in delivery (B. Jorg, K. Andreas, 2008).

Late delivery is not only a concern in the aerospace industry but also other industries around the globe. Similar concerns were also shared by construction

industry in Malaysia, which experienced poor resources management including the contractor's improper planning, poor site management, inadequate experience, inadequate client's finance and payment for the completed work, problem with sub-contractors, shortage of material and labour supply, equipment availability and failure, lack of communication between parties and mistakes during the construction stage (Sambasivan & Soon, 2007).

A study in a computer factory in India, which faced on-time delivery problem, revealed that reasons for late deliveries were shortage of materials, as well as production, quality and paper issues (Jacob, 1997). In a similar vein, one of the three main competencies that Malaysian manufacturers have difficulty in maintaining besides competitiveness and quality is on-time delivery to the global market. All three requirements are crucial for gaining market share and should be managed diligently (Islam et al., 2007).

Delivery is one of the five golden metrics in manufacturing besides total cost, total cycle time, quality and safety. Failure to meet the performance level usually as due to failure to identify and differentiate between a metric that measures systemic performance and those isolate points along the system or process.

A number of operations management literature mentioned about the identification of competitive priorities which organization should focus on

when improving their business performance (Leong., et al., 1990). This leads to the conclusion that cost, quality, delivery and flexibility should be consistent with operations infrastructure (Boyer and Pagell, 2000), which bring to the research focus on on-time delivery as one of the key performance indicators in an organization. BusinessDictionary.com defined Time Delivery as “a metric used to assess the ability of a business to fulfill shipping orders or other transactions within the period of time promised to a client or customer”. Time delivery is generally expressed as the percentage of transactions that are achieved within a specified time frame and is often an area of focus for process improvement initiative. It is also called “on-time delivery” which is a measure of performance service guarantee (Hart,1993; Hill,1995). There are several other performance service guarantees, namely delivery time performance guarantee, no stock-out guarantees(Hart,1993), waiting time guarantees (Friedman&Friedman,1997; Kumar, Kalwani & Dada,1997); up-time maintenance guarantees (Hill,1992) and unconditional satisfaction guarantee (Hart,1988).

To achieve and sustain the 100% on-time delivery record, several factors deserved attention. Comparatively, in a study between seven Swedish manufacturing companies, there are four major metrics to focus on in achieving on-time delivery. Gunasekaran et al. (2004) emphasized the importance of supply chain partners working together to eliminate the gap between interdepartmental and cross functional to create a smooth flow of resources in the process of attaining the on-time delivery. The study looked into customer-supplier relationship in achieving on-time delivery. The

elements in this relationship are an increase in customer service level, reduction in total supply chain cost, reduction in order cycle time and inventory cost. In this particular study, researcher strongly pointed out that the customer-supplier relationship is crucial in order to achieve on-time delivery. In a study involving seven Swedish manufacturing companies and at least five study cases, it was found that differences in handling performance metrics caused a gap in understanding the situation as well as the requirements necessary for generating on-time delivery. This gap emerged due to difference in perception and understanding of the performance metrics and its implications on the organization and individual departments. Even though the study concerned seven Swedish manufacturing companies, the same concepts are applicable to internal organization, such as between processes and departments. Thus, a smooth continuation and synchronization of resources in the organization would be eventually suffice (Hofmann, 2008).

In a case study in the battery manufacturing industry in India, on-time delivery was measured by various categories and showed the importance of on-time delivery as a measurement for success in the manufacturing sector (Rao, Rao & Muniswamy, 2011).

The Aberdeen Group (2007) revealed that as a demand driven manufacturing company, achieving the best-in-class performance would require the demand to be synchronized with manufacturing. To achieve demand-driven manufacturing, manufacturers must focus on efforts in synchronizing demand with the execution of manufacturing. To accomplish this, two major sets of

business processes are recommended: namely defining the customer order process and the material flow process. To address the first process, manufacturers must become customer-centric by measuring against on time delivery metric. To improve these metrics, manufacturers should be integrating 'available' and 'capable' to promise calculations with real time manufacturing data. Similarly, manufacturers must focus on finished goods and work in process inventories all the way from manufacturing operations through to the customer. It is critical to focus on the right metrics and in order to improve these metrics, production schedules should be generated using real-time manufacturing data, bottleneck constraints, and actual consumption. As the study has shown, manufacturers who have successfully optimized these key business processes have achieved demand-driven manufacturing and enjoy, on average 10% more on-time deliveries, 70% lower finished goods inventories and 70% shorter lead times (Aberdeen, 2007).

On-time delivery, as a dependent variable, is a systemic metric that drives the company's performance as a whole. To successfully achieve on-time delivery, systemic effect must be present in order to achieve a synchronization between inter functional sections. The process flow shows the on-time delivery process, which starts with the receipt of on-time order and loaded into the company. The order is released to the shop floor depending on the timely customer orders processing upon the availability of resource (man, machine and material). Based on the job orders release, the right and good quality parts have to be manufactured and complete on time. Even though most of the orders were released on-time, there were numerous occasions where the order release

was not on-time and caused delay in production, which finally ended up with late deliveries. Shorter lead time also caused short cuts in operational activities that caused defects and always overlooked important aspects of the product, which is Quality.

The on-time delivery trends reveal the problems faced by the company since the start of the original product in 2001 where it has been recorded that the first customer's order received was already overdue. The problem has been haunting the management since then. Too many recovery plans were made but failed to bring down the delinquency. Research had identified several factors that contributed to the failure to meet on time delivery at this company.

The negative or positive result of this metric will impact the organization as a whole. Thomas Jacob in his article "Root Cause Analysis of Low On-Time Delivery" mentioned that the author Giorgio Merli of *Total Quality Management* described the importance of the on-time delivery as

"the ability to deliver products promptly contributes indisputably to sales increase and therefore to sales volume because firms that have that capability will be preferred over their competitors. Furthermore, when ability to serve the market is equal, the firm with lower throughput time will require less wip and less storage space. Thus, its costs will be lower and its operating margin higher" (Jacob, 1997).

Two different views of delivery performance were also discussed in this article. The first view looked at delivery in terms of promptness in measuring

the rate (how fast) a customer's order is turn into final delivery and the second view looked at delivery in terms of reliability to measure the percentage of orders delivered by the promised date. The second view was the selected definition applied by ACM to measure the delivery (Jacob, 1997). JH Berk has studied manufacturing performance improvement and identified "6P"s reasons for failure in meeting delivery which can be grouped into (1) production capacity (2) production control (3) productivity (4) procurement (5) process robustness and (6) product delivery responsibility (Berk & Associates, 1984).

Even though the literatures are dated back years ago, to date the significance of on-time delivery is still a significant indicator in an organization across the globe.

2.6.1 Systemic view of On-Time Delivery

On- time delivery is a systemic performance metric used in the supply chain. It not only measures quantity but also the right part delivered on-time to the customer. The on-time delivery is actually an end to end performance measurement in the supply chain. With the increasing awareness of systemic resource management, the study venture into examining the significant relationship between identified factors and on-time delivery performance from a resource-based view perspective as the underpinning theory. Utilization of resources in every process of transformation from raw materials to finished products require close and critical management strategies to create value at every process. An understanding of value creation activities at every process would ensure proper identification on strength and weaknesses to gain the competitive advantage in the organization (Gaya et al., 2013).

Former ACM General Manager, Mr. Robert Moray in his message to the team during an Operation Meeting dated 17th October 2012 stressed the importance of focusing on the company's performance by pulling all the resources, capabilities and efforts to improve the company's performance instead of looking at individual goals.

Delivery has been identified as one of the performance metrics in the supply chain. According to Mark S. Miller in one of the papers presented during the 83rd Annual International Conference Proceedings in 1998, several factors has been identified as important performance measurement. A survey of the significance of on- time delivery was carried out in five companies. The results shown in Table 2.2.

Table 2.2
Comparison significance of on-time delivery in five companies

Category/ Company	Walker Manufacturing	AT&T	SC Johnson	GTE	Cummins Engine
Price	20%	-	20%	10%	25%
Support	10%	-	10%	-	-
Quality / Reliability	35%	8%	30%	-	25%
Delivery	35%	25%	30%	25%	25%
Business Issues	-	15%	-	-	-
Quality Management	-	12%	-	-	-
Vendor Cooperation	-	20%	-	-	-
Product Quality	-	-	-	25%	-
Customer Service	-	-	-	25%	-
Value	-	-	-	-	-
Partnership	-	-	-	-	-
Qualification	-	10%	-	-	-
Subjective	-	-	-	-	25%

Source: M.S Miller, 1998

At Walker Manufacturing, quality and delivery weighted 35 percent each whereas price and support carried 20 percent and 10 percent respectively. On the contrary, at AT&T, quality/reliability weighted 8 percent, delivery 25 percent, business issue 15 percent, qualification 10 percent, quality management 12 percent and vendor co-operation 20 percent. SC Johnson used a similar measurement metrics as Walker Manufacturing, where quality and delivery were 30 percent respectively, price 20 percent and support 10 percent. GTE also used similar metrics with delivery weighted 25 percent, pricing 10 percent, customer service 25 percent and product quality 25 percent. Cummins Engine company had an equal weight of 25 percent for the quality, delivery, price and subjective measuring factors. Considering all the data, Case Corporation had decided to use delivery and quality at 30 percent each, value at 20 percent and partnering 20 percent. Further review of the on-time delivery metrics in Case Corporation, revealed the kind of orders measured, basis of calculation, whether it is ship date or receipt date; the time frame or period to be used and how the calculation is done (M. S. Miller, 1998).

Delivery performance has been identified as one of the key indicators, specifically in the aerospace industry, as being surveyed and concluded in a study conducted among 30 aerospace companies, including Boeing. Bill Waddell from Lean Management Institute, pointed out that delivery performance is one of the 5 golden manufacturing metrics aside from total cost, total cycle time, quality and safety. The metric is calculated as the percentage of customer orders shipped against customer's request to be shipped similar to the metric applied by ACM when measuring the on-time

delivery. On a similar perspective on the significance of delivery, Robert Handfield (1995), the author of “Re-Engineering for Time-Based Competition”, defined delivery performance from a perspective of delivery speed and delivery reliability. The speed of the delivery is being measured by the rate at which the company turn a customer order into final delivery whereas delivery reliability is measured the percentage of orders delivered by the promised date. Hence, with that definition, Handfield (1995) proposed four combination of delivery performance measurement such as poor-speed poor-reliability; poor-speed high-reliability; high-speed poor-reliability and high-speed high-reliability.

The quantity demand shipped over total demand for the same period was calculated as a metric to measure On-Time Delivery (OTD) in ACM. This was the metric that ACM has been struggling to achieve and maintain consistently over the years. To achieve 100% OTD for one product line does not help to push the company's goal to achieve 100% OTD. Irrespective of plans and actions put in place, the OTD is still a major challenge faced by everyone daily. Thus, the study focused on finding a systemic strategy to resolve the failure to meet the 100% on-time delivery (ACM Bonus Metric, Dec2012).

Efforts to improve the products on-time delivery is not really a one-man show. The study done by Thomas Jacob in a computer manufacturing company, found that efforts taken to improve on-time delivery in the company was fruitless due to the fact that there was a lack of understanding on the whole system's impact on delivery performance. Too many changes at the same

time, lack of facts and data to support changes and impact on delivery performance, no clear identification of problems affecting delivery performance and focus only on specific problems resulted in vague systemic impact on the whole delivery system had caused failure in improving delivery performance (Jacob, 1997).

2.6.2 Labor, Output, Output Accuracy, Work-in-Process, On-Time Delivery and Net Sales

The importance of labour went back to years ago from Marx's era. Labour theory of value explained the significance of labor in the resource deployment (Dooley, 2005). Labour is an important resource and it can be tangible and intangible resource in manufacturing. Number of labour (people) is tangible whereas human skill is intangible. Labour contribution to the production performance is measured by number of product produced (output) in the organization. Labour performance (number of people and level of skill) will impact production output as the bad labour performance will impact quality and quantity of output. Production line performance depends on both machine and labour efficiency. To better manage labour in production, labour was divided into support and direct labour (Subramaniam, Husin, & Yusop, 2009). In this study, the researcher is looking into the number of direct labour, which is the labour that is directly touching the product and is called direct labour. Lower number of labour does not necessarily resulted in lower number of output. Labour is an important resource in an organization and should be treated as a valuable asset. In one of the literatures, labour in automotive factories in China expressed openly their dissatisfaction on the scheduled

work, which has not been planned and communicated in advance in case of extra working hours required (Zhang, 2008). This showed that labour is an important asset that cannot be taken for granted. Similarly, in ACM, labour (human capital) is treated as an asset to the organization. “People” is an important element in ACM Quality policy. The aim is to train and develop all employees to be the best aerospace employees in the world that drive quality performance through proactive action to improve process, reduce defects and improve customers’ satisfaction by delivering the right product right on time at a competitive price. In an effort to make the company a place to develop people and capabilities, ACM has continuously working with technical colleges and universities to take in trainees to work during their practicum and upon evaluation will permanently absorb as employees. Further development of human capital is a continuous effort that ACM has engaged on in order to materialize the vision to promote people working together as a premier composites manufacturing provider for aerospace industry in the world. Monthly skill evaluation is being done to assure skills and capability of shop floor employees is on the right direction and more efficient. On a higher level, Boeing company, in one of its news released has agreed to work with Malaysian to develop and train potential employees in aerospace workmanship and capabilities through its Human Capital Development Initiative (HCIDI). The objective is to create programs which will prepare Malaysian for careers in aerospace to complement country’s aerospace development programs (Grumman, 2013). In a study done and published in Australia, with global supply chain it was found that many manufacturing companies has shifted to Asian countries for a lower labour cost. Many labour intensive job has been

automated so that labour need to be developed for skill and tech-know-how to operate the machine (*Manufacturing workforce issues paper October 2013*, 2013). Resource-based view theory assumed labour or human capital as resource that need to be deployed for optimum utilization.

Labour theory of value explained labour contribution to the manufacturing process to on-time delivery in manufacturing. Labour as value creator affected the fit, form and function of the raw material transformation into final product, which is paid for by the customer. The required number of labour is a direct calculation from total quantity of parts converted into labour hours by multiplying total quantity by standard cycle time per part divided by standard hours per head (ACM Work Center Capacity Analysis Procedure, 2015). Table 2.3 and 2.4 showed labour trend from 2008 to 2011. Labour as value creator (Dooley, 2015) must produce the right product at the right time in the amount required as described in Just-In Time concept of Lean Manufacturing. Boeing started using the lean approach by establishing a moving line for 737 product line and managed to improve the production process time from 24 days to 18 days and at the same time reduced cost (Hsien-Ming Chang, 2013). Labour that is managed efficiently only will produce the right output at right time, in the right quantity moving smoothly as work-in-process. which will complete right on time to meet on-time delivery and generate sales for the company.

Table 2.3

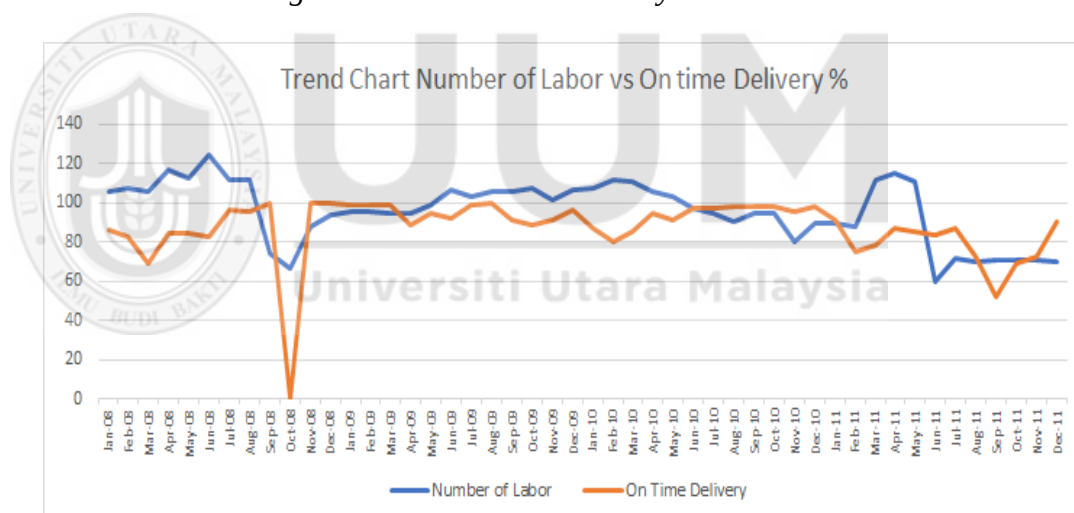
Number of direct labour involved in production to meet on time delivery

Month / Year	2008	2009	2010	2011
January	106	96	108	90
February	108	96	112	88
March	106	95	111	112
April	117	95	106	115
May	113	99	103	111
June	125	107	97	60
July	112	103	95	72
August	112	106	91	70
September	74	106	95	71
October	67	108	95	71
November	88	102	80	71
December	94	107	90	70
Average	102	111	99	83

Source:ACM Direct Head Report (Jan2016)

Table 2.4

Trend chart showing labour and on-time delivery



Source: ACM Direct Head Report, 2016

An average of 102 heads in year 2008 dropped in 2009 to 101heads. From year of 2010 average of 99 heads dropped to 83 heads in 2011 indicated a reduction in available head to produce the output which suspected to be the reason on time delivery is consistently not meeting the on-time delivery. Trend chart gives better visibility on the impact between labour and on time delivery.

Labour as value creator (Dooley, 2015) that produce the right output, at the right time in the right quantity from raw material into work-in-process and final product is an important resource that requires the best strategic way to be managed. Financially labour is variable cost, which is cannot be ignored since it is required in the labour-intensive manufacturing process. With direct labour taking up 40% of the product cost, it is highly important to examine the significance impact of labour on net sales aside from on-time delivery. One of the main reasons that cause the aerospace investors came to Malaysia for investment is the availability of skilled and productive workforce at a relatively lower cost (MIDA,2013). Lower labour cost will help to lower the variable cost but not to jeopardize the quality and skilled or workmanship.

Therefore, the following hypotheses are proposed:

H1: Labour has a positive significant effect on on-time delivery.

H2: Labour has a positive significant effect on output.

H3: Labour has a positive significant effect on output accuracy.

H4: Labour has a positive significant effect on work- in- process.

H5: Labour has a positive significant effect on net sales.

2.6.3 Work-in-Process, Output, Output Accuracy, On-Time Delivery and Net Sales

Work-in-process (WIP) is use interchangeable with work-in-progress in this study is referring to “all materials and partly finished products that are at various stages of the production process excluding inventory of raw materials at the start of the production cycle and finished products inventory at the end of the production cycle” as stated in Investopedia. WIP tracking is critical for manufacturing which handle large volumes that require days to complete the

process (NetSuite, 2013). The way WIP is managed as a process is one of the capabilities that can be explained under resource-based view theory. Furthermore, the importance of work-in-process as manufacturing resource should not be taken for granted (Wernerfelt, 1984). WIP is the element that smoothen the process flow that can be explained by the Theory Of Constraints (TOC) drum buffer rope concept introduced by Mr. Eliyahu M. Goldratt's in the early 1980's. TOC is a system management philosophy that aims to optimize total system resources, operated based on the underlying principles, where the organization makes up of processes that are operated and chain-linked where the sum of the individual process is not similar to the overall system because of the variation and balancing along the flow. The weakest link or process is said to be constraints that impeded the performance of the organization, thus, the weakest process and link need to be managed diligently to avoid loss of time, which eventually results in late completion to meet on-time delivery. The existence of cause and effect relationship in the system results in a complex system and the impact should be identified to optimize performance. The complexity of the system is also being explained in system theory as a "a set of elements in a dynamic interaction, organized for a goal" (Rosnay, 1978).

The bottleneck concept is applied in the Drum-Buffer-Rope - Theory of Constraint (TOC) –which creates a systemic and synchronous manufacturing flow at the shop floor to provide a smooth process from start to end to support on-time completion and delivery. TOC proposes that constraint sets the limit for system performance. In this case, a high level of work-in-process can be

considered as a constraint to the process and need to be managed diligently. Briefly, the Drum Buffer Rope theory explains how work-in-process is handled in the manufacturing shop floor. The drum-buffer-rope concept is part of theory of constraint, which is the basis of production flow that literally means the flow of processes is linked by a “rope” where the inventory between each process is well balanced and the next process will pull the previous process inventory. The “bottleneck” becomes the ‘drum beat’ for more orders. The ‘time-buffer’ translates due-dates into release-dates, and the action of choking (or restraining) the release becomes the ‘rope’ that ties the order to the release of work. In fact, this is how the time-based application of the Theory of Constraints became known as the drum-buffer-rope system (Institute of Management Accountant, 1999).

The lower number of WIP is said to result in shorter processing time, which eventually ends up with an earlier completion time (Whybark, 1993). WIP level within and between process is per standard formula in the operation book. The level of work-in-process is impacted not only by the cycle time of each process but also the balancing of work load between processes. The work load balancing is a very dynamic process, particularly in an organization such as ACM where there exists a situation where one machine is one-point failure, meaning that there is only one machine or equipment available, where service and maintenance is subjected to the sole supplier in the world. The Theory Of Constraint (TOC), as a broad-based theory, is equivalent to Total Quality Management (TQM), Just in Time (JIT), Lean Manufacturing (LM), Six Sigma (SS) and Supply Chain Management (SCM). Implementation of all

these philosophies requires systemic thinking mindset that emphasizes cross functional integration and decision-making.

In other words, the cross functional and interdependent organizational processes view the organization as a chain of interdependent processes and functions, departments or resources where various inputs are transformed into various outputs that are sold as throughput. How is this applied to the Resource-Based theory? It is said that the system's rate of output is the rate at which an organization accomplished its goal. From a functional perspective, the weakest chain that exist in the whole processes might be an indicator of limited resources that are not fully utilize, insufficient or lacking; thus, it requires further management attention and action to improve the interdependent resources and its utilization. From an operational strategy perspective, it is crucial that each and every functional unit is consistent in achieving its goal in order to achieve company's overall goals. It is also paramount to focus on the weakest link in the process so as to rightfully manage the resources to meet the minimum threshold at the weakest process. Another mindset that this theory focuses on is the throughput-world thinking, where all the resources are geared towards achieving the most through-put in the overall process. Finally, TOC suggests that the location of the weakest linkage or resources must be identified as it is the key area that the operational strategy need to be defined (Gupta & Boyd, 2008). The rate determines how fast the work-in-process moves in the process which also impacts the number of output and completion of the right output on- time. Work-in-process becomes the output that is produced in the right quantity, at

the right time and right part number that would be sold on-time to capture net sales. The rate at which the work-in-process moves between processes determines the rate at which the output is made. This is called throughput. Transforming work-in-process into the right output delivered on-time requires an efficient way of managing resources and capabilities. Few methods have been suggested, among others is forecasting and WIP level, sharing capacity, adding machine or improving the workforce, just-in-time, time saving and allocating the right operator (Breyfogle, 2014).

In other words, these methods focus on resources and capabilities deployment. Time-based manufacturing is a strategy applied to reduce throughput time. Throughput is a metric used to measure process flow, whereas throughput time is a metric used to measure the efficiency of the process. The lower the throughput time the better is the process flow. Throughput time is measured by aggregating the number of days of raw material inventory, value-added process time, days of work in work-in-process inventory and days in finished goods inventory.

Danny (2003) defined manufacturing throughput time as the “length of time between the release of an order to the factory floor and its receipt as finished goods inventory or its shipment to the customer”. Among advantages of reduction of throughput time are lower work-in-process and finished goods inventory, improved quality, lower cost and less forecasting errors due to a shorter time horizon. Throughput comes from the idea of Little’s Law that explained the relationship between the number of items in the system and

arrival rate as well as length of time in the system, assuming the system is in a steady state. It also defines system's capacity as the maximum rate of output that can be sustained over a period of time and a bottleneck is a resource that renders the most constraints in the system (Johnson, 2003).

Time-based manufacturing is said to be the best practices to improve throughput time since it works based on reducing response time for every value-added process in the value-delivery system (Abegglen and Stalk, 1995). Based on the study of 244 discrete manufacturing firms, including firms involved in fabricated metal products, industrial and commercial machinery as well as electrical equipment and transportation equipment, it was concluded that quality improvement and pull production are critical elements in time-based manufacturing practices that could reduce throughput time. Reduced throughput time will speed up completion to meet delivery date.

Pull production occurs with re-engineering setup, cellular manufacturing and preventive maintenance. Quality improvement on the other hand requires full employee participation, specifically at the shop floor to create a systemic environment where communication occurs freely and information flows undeterred, except for few confidential proprietaries belonging to the organization (Fairtlough, 1999) to continuously improve the process.

Increased throughput would eventually speed up the completion time for the parts produced. The increase in throughput has to be achieved through an

increase in productivity by increasing the throughput at a constant operating expense. The study on various literature had proposed the same measuring metrics for evaluating process flow. This research also revealed the same metrics using throughput and its relationship with work-in-process and cycle time based on Little's Law view. Apart from the process itself, the capacity point of view is also an indicator for evaluation of process flow.

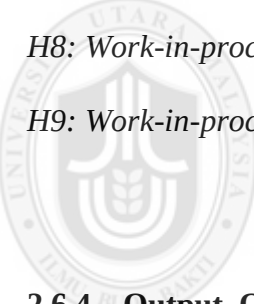
The following hypotheses were suggested:

H6: Work-in-process has a positive significant effect on on-time delivery.

H7: Work-in-process has a positive significant effect on output.

H8: Work-in-process has a positive significant effect on output accuracy.

H9: Work-in-process has a positive significant effect on net sales.



2.6.4 Output, Output Accuracy, On-Time Delivery and Net Sales

Production output is a result of resources (labour, material and land) deployment. Optimum utilization of resources will result in good quality output and right number produced on time. Production theories from various background, such as economics and finance, focus on the same idea, which is to produce output using optimum resource at the lowest cost and cycle time. Production output is the actual good quality output at the start of the process since the right on-time start of the process will ensure the right on-time completion to meet the hundred percent on-time delivery. The production target is to produce the demanded parts using available resources and capabilities(Kingsman, 2000). The Theory of Constraint suggests that the

output of a system is determined by the capability of the weakest link in the system. How to manage the weakest link is a challenge that leaders and managers need to be good at.

Production is a combination of processes that transform materials into semi-final or final products. In Toyota Production System, production is considered as a functional network of processes and operations. The operation is where the product is transformed from raw material into semi-final or final product through processes carried out by machines and labours (Shigeo, 1989). How does the resource-based view approach impact the way key resources are managed to influence on-time delivery in this research location? Strategically, resources such as number of labour, output, output accuracy and work-in-process are managed as a whole to generate right part in the right number of output and a smooth flow of manufacturing process.

The production system is operated by a group of productive labour in the shortest lead time to produce the right quality and quantity required to meet on-time delivery to customers. Output must be the right output before it can be sold to generate sales. There were cases where wrong part was sent to customers ending up in penalty and additional cost for the labour used to re-produce or re-pack plus air shipment to ship the right part as replacement. Among the top ten reasons for sending back the product to suppliers is due to initial ship of wrong product (Matthews, 2015). Thus, this resulted in additional charges for replacement and unnecessary air shipment cost. The

right quantity and right part produced on-time assure the delivery is made on-time to meet the target sales.

Therefore, these hypotheses were proposed:

H10: Number of output has a positive significant effect on on-time delivery.

H11: Number of output has a positive significant effect on output accuracy.

H12: Number of output has a positive significant effect on net sales.

2.6.5 Output Accuracy, On-Time Delivery and Net Sales

The right part must be produced at the right time in the quantity required. One of the Lean manufacturing pillars is the Just-In-Time, which literally means to produce what is needed, in the quantity needed, when it is needed (V.V.S Nikhil, 2015). This lean concept best describes what output accuracy metric is intended for. Output accuracy measures how accurately the planned part numbers and quantity are actually produced. It is one of capability performance metric in the organization. It is calculated as the number of actual part numbers and quantity produced compared to planned part numbers and quantity. It is being measured daily, weekly and monthly. It is diligently monitored and reported as a measure of output accuracy, which determines the number of right parts produced to support on-time delivery, which then generate as sales.

Thus, the following hypotheses were proposed:

H13: Output accuracy has a positive significant effect on on-time delivery.

H14: Output accuracy has a positive significant effect on net sales.

2.6.6 On-Time Delivery and Net Sales

On-time delivery must be measured as a financial metric to indicate its significant impact on net sales. Empirically, it has been suggested that a financial measurement metric is the most significant impact that all business players are interested in at the end of the day. Failure to acknowledge timely delivery in relation to financial aspect is a barrier for the company when identifying the right action to engage in its continuous improvement within its business strategy. Late or early delivery renders a different financial impact. Late delivery ends up in penalty charges, but early delivery creates excess holding cost at the customer side. Thus, it is critical for a company to balance between meeting the delivery and net sales (Alfred L. Guiffrida, 2007).

The following hypothesis proposed:

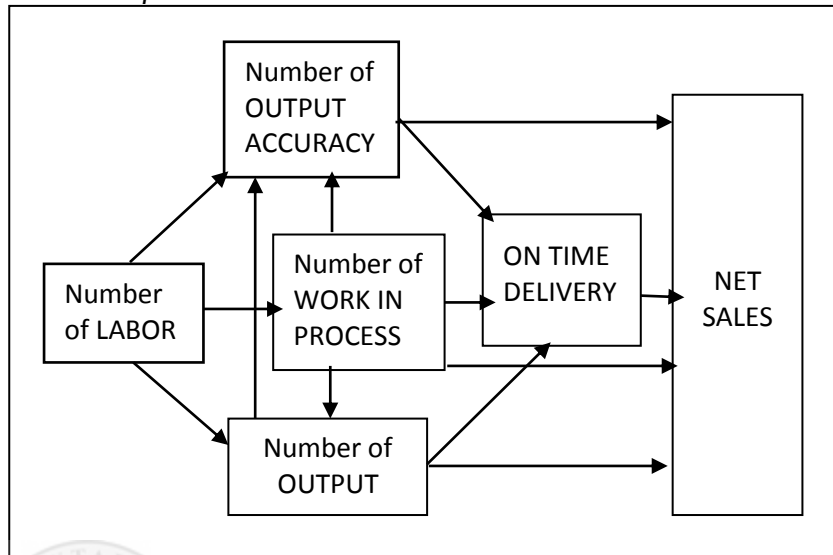
H15: On-time delivery has a positive significant effect on net sales.

2.7 Theoretical Framework

The theoretical framework conceptually links the number of labour, work-in-process, output and output accuracy to the on-time delivery and net sales from a resource-based view perspective. Diagram 4 shows the relationship displayed in the theoretical framework portraying five (5) research questions and objectives. The framework provides a guideline for the researcher so as to stay within the scope and target of examining whether the significant influence exists between number of labour, work-in-process, output and output accuracy

and on-time delivery and net sales. The framework reflects the real situation in a composites manufacturing company in Malaysia.

Diagram 4:
Theoretical framework



Labour and work-in-process are resources to ACM, whereas the output and output accuracy are results of the capability of the workforce to materialize the plan, meet completion and achieve on-time delivery to generate net sales. These variables are linked to each other starting with labour as value creator to begin the transformation of raw materials into work-in-process and the final product (output) in the right quantity as well as right part number at the right time to be shipped on-time to generate sales (net sales).

2.8 On-Time Delivery as Key Performance Indicator

On-time delivery is a metric used to measure supply chain performance. There are various definitions or methods for measuring the delivery in the industry inclusive of on-time delivery, delivery reliability, faster delivery time, delivery service, delivery frequencies, delivery synchronization, delivery speed, order

fulfillment lead time and supplier's delivery performance. In this study, the researcher used on-time delivery (Rao et al., 2011).

In this study, the on-time delivery was defined as the total quantity (per customer requirement) shipped over total customer's required quantity within the same period (ACM Monthly Executive Report, 2012). The shipping date refers to the customer's purchase order (PO) date or as specified in the demand report. Originally, the demand or customer PO referred to normal demand excluding the short notice request, Part on Assembly (POA), Aircraft on Ground (AOG), spare and a short lead time order. The target of achieving a hundred percent (100%) on-time delivery is not only the number of parts but also the right part shipped on-time (ACM On-Time Delivery Metric, 2012). However, in 2014, it was decided that the definition of on-time delivery to include not only normal PO but also part on assembly, aircraft on ground, spare and short lead time order. Delivery is considered on-time if the product is ship on the date specified in the purchase order or demand report (ACM On-time Delivery Metric, 2014). Similar concerns have been observed in an aerospace composite manufacturing company in one of aerospace manufacturing company at the northern part of Malaysia. Record showed forty-five (45) out of forty-eight (48) months from January 2008 to December 2011, the on-time delivery is below than 100% which resulted in high air shipment cost paid by the company and below expectation rating for bonus payment.

2.8.1 Critical Failure Factor to On Time Delivery

To identify the success factors, it is important to note the causes of the delays in delivery at ACM. A Fishbone analysis was carried out to identify why delivery failed. Possible reasons are listed in Table 2.5.

Table 2.5
Fishbone Analysis – Why delivery delay?

FACTORS	ISSUE CONCERN
MATERIAL	1.Shortage of material 2.Material available but defect 3. No finished goods buffer
MAN	1.Low or absence of skilled laminators due to lack of technical skill. New operators perform job without completing the training period due to urgency. 2.Repeated defect due to lack of awareness of defect prevention skill and technique and operator nonconformance. 3. Lack of operator's due to sudden resignation and absconded.
MACHINE	1.Frequent machine breakdown. 2.No immediate identification of root cause of machine breakdown. 3. TPM to maintain the machine is not consistent. 4. Machine downtime takes long time to resume. 5.Plan shutdown to support machine upgrading and maintenance is too risky due to lack of finished goods buffer to support delivery during the machine shutdown.
PROCESS	1.Unstable process due to inconsistency in quality when the panel is produced by different laminators. 2.Complex scheduling process – high mix high volume – shared production line. Changes in scheduling are done manually and take a longer time to reschedule and too many factors caused schedule fluctuation. 3.Lack of synchronization of required material, tools and machine to support start of panel. 4.Work in Progress flow is not smooth and inconsistent between all processes in the shop floor. 5.Panel and document is missing end up in panel scrap due to loss of traceability.
QUALITY	1.Repeated defect without improvement action. 2.Replacement is done but same mistake repeated.

CUSTOMER ORDER	1.Short lead time order without upfront notification from customers but due date needed to meet the delivery. 2. High number of delinquent continuously.
----------------	---

Data source: Own compilation, 2013

Table 2.5 showed a comparison, several other researcher's point of views and findings on the failure to meet on-time delivery and how the analysis was done.

There are five reasons why production was delayed leading to late completion as similarly shared in the article "5 reasons that fail production plan and cause shipment delay", which described the behavior of an Indian garment export house. First is product development. This became one of the reasons for delayed shipment because the company failed to plan the pre-production process in an absence of control in the pre-production process. ACM's product development also faced similar concerns. Readiness and flexibility of the group in managing product transfer and implementation need closer attention by the management.

The second reason was the delay in sourcing of raw materials. The supplier's commitment and delay in supply of materials had directly impacted the start of production in a factory. There were cases experienced by the garment factory where fabrics were piling up together with partly stitched garment waiting for care labels, laces or main label, which was delayed by the supplier. In ACM, it is the fact that dealing with a sole supplier appointed by the premier customer,

Boeing had caused a major concern when it came to a shortage of supply due to economic reasons or the supplier's internal issues.

The third factor was the inferior quality of source goods. Unorganized factory contributed to a low-quality product from one process to another causing rework and repairs, which caused delay in production and shipment. Lack of synchronization between process and departments was clearly one of the failures to meet the completion date, which resulted in failure to meet delivery date. When there is failure in quality at one process, the other processes or related departments were not aware and there was a lack or failure of follow up action to get the process back on track immediately.

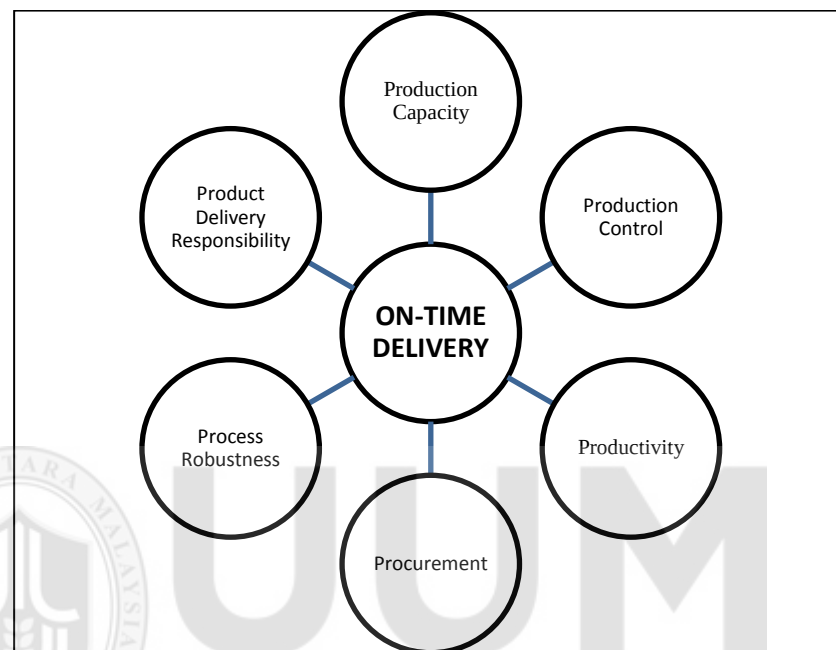
The fourth reason was the urgent production. Starting late and facing a shortage of materials that were of inferior quality created an urgency for the production to push for completion to meet delivery date. This urgency caused numerous production managers to push for quantity rather than quality, which normally will end up further rework and repair and consequently increase production time.

The last but similar impact was the delay from sub-contracting job. For special design and other value-added process orders, the factory would normally send sub-contractors for the special job. Thus, due to lack or insufficient planning at the sub-contractor's factory, it adds more days to the main factory, resulted in further delay in shipment.

Joseph and associates from Upland California proposed a theory stating that delivery performance shortfalls were driven mainly by six (6) and the points can be illustrated in Diagram 5.

Diagram 5

The 6Ps delivery performance shortfalls by Joseph and JH Berk



Source: Joseph and JH Berk (1997)

Joseph and J.H Berk (1997), pointed out that companies that are organized as process oriented tend to fail in their deliveries due to the complexity of the situation when same priorities arise for more than one product group using shared resources at the same time. The best methodology to find the root cause of the delivery problem as proposed by Joseph and J.H. Berk is by using the Failure Mode Analysis (FMEA) approach.

In an MRP-based manufacturing organization, delivery delinquencies are systemically driven by failure to understand and abide by lead times, failures

to address capacity constraints, ignoring manufacturing productivity, diffused organizational responsibilities for on-time delivery performance, internal procurement failures, and non-robust processes. To test the practicality of the theory, the success factors are tested in the system that ACM has in place.

2.8.2 Critical Success Factors to On-Time Delivery

The first success factor was the understanding and observing of the completion based on lead time. In ACM, the application was directly used in the direct headcount and machine capacity calculation but not widely use in the scheduling of parts at the shop floor. The plan and scheduling were done manually based on estimates of the overall process cycle time as a whole but not on each individual process.

The second factor was the ability to address the constraint in capacity within and between processes. The layout of the shop floor according to product and process indicated a lack of fully understanding the capacity constraint for each process from start to end. Knowledge of capacity constraint should be made available at the operating level to initiate a systemic interactive effort by the operating team.

The third factor was the manufacturing productivity. The measurement of labour productivity and machine efficiency was monitored and reported but several years back it stopped due to unclear reason by management.

The fourth factor was the organizational responsibility for on-time delivery performance. The awareness was apparent at the middle level but lacking at the operating level. The mechanism to drive parts out from each process is aging parts measurement, which is sometimes misleading. The next factor is the understanding of the internal procurement process by employees across the board.

A robust manufacturing and support process were another critical success factor that still requires improvement in ACM. The question is how does an organization avoid the six problematic shortfalls? Recommendations were proposed by Joseph and J.H. Berk (1997) and the evaluation of ACM based on these factors as summarized in Table 2.6.

Table 2.6
Recommendation to improve delivery performance

-
1. Factory is structured and operated along product (rather than process) lines to the maximum extent possible
 2. Work centers are unique to specific product lines report to individual operations managers responsible for the product lines.
 3. Supporting departments that provide generalized support (such as a machine shop, process lines, stock rooms, and other generalized functions) report to a single factory manager
 4. Have the product-unique functions for each product area (e.g., manufacturing engineering, scheduling, final assembly, and any other product-unique manufacturing areas) report to the product-line-specific operations managers
-

Data source: Joseph and J.H. Berk (1997)

In order to improve the delivery performance, the following improvement factors were highly recommended. First, employees and the management team must understand the nature of capacity, load and lead time relationship. In other words, the process flow must be visible and clearly grasped in order to operate smoothly.

The next step is the development of a meaningful lead time and all scheduling and operations must be diligently made with supporting rescheduling plans. Product-based layout and management was recommended to create a focused management. Manufacturers should practice the optimization of a robust process using system failure analysis tool such as the FMEA process, to focus on immediate cause identification and implementation of corrective action.

Besides employee's roles, the management must understand their productivity and develop action plans for areas that do not meeting the standards so that productivity is addressed as a systemic factor that drives the organization. Manufacturers on the other hand, must be able to understand the procurement process and its related internal lead time and monitor the procurement organization's performance to ensure the supplier's commitment and deliveries to support delivery dates. Manufacturers should operate on product-base lines rather than process-base lines to ensure appropriate focus on delivery performance.

Comparatively, application of Lean approach in the manufacturing process results in the opposite result. Using a "pull"-based or demand-driven methodology, the approach is predicated to produce products directly only as the result of a customer order. In other words, without a customer's order no production is plan or created. Cost management on the other hand is done based on a concept of throughput accounting, which looks at the overall cost reduction. Throughput accounting focuses only on variable costs, such as materials and outside services. Instead of focusing on make to order, the focus becomes one of selling more products and manufacturing only to customer-specific orders. Consequently, the Lean approach can help the organization free up additional capacity to work on customer-driven orders once they are no longer simply building to forecasted demand. In other words, the Lean approach eventually creates a systemic impact as it focuses on the overall process and system in achieving the company's overall objectives.

The observation made on ACM's application of both the MRP/ERP and Lean in the manufacturing process showed that MRP/ERP was being currently use for order processing, order release as well as receiving and issuing material only. In addition, Lean has been in place for some time at the shop floor.

Critically, one of the studies discovered the concerns on manufacturing competitiveness in recent years, which has been pointed out at a meeting of the System Dynamics Society in 1989 in Germany by Jay W. Forrester. He pointed out that over 90% of the variables in the manufacturing lay in the top-management's influence on structure, leadership qualities, character of the founders, the way goals of the organization are created and how the previous traditions of an organization determine its decision making and its future. The model simulated during the study also involved interactions between capacity, price, quality, and delivery delay(Forrester, 1989).

Having said this, it has been very challenging for ACM to experience delays in the manufacturing process and consequently delay the completion and delivery to customers.

2.9 Theoretical Perspective

Theoretical perspective provides a detailed layout of the research framework and development in which the research is to be conducted. The research is underpinned by the Resource Based View (RBV) theory, which focuses on the idea of an organization's capability in resource deployment to generate value

and achieve sustainable competitive advantage (Barney,1991). The focus on value creation is the main objective in the process of transforming raw materials into finished products(Lee, 1997). A similar perspective is shared by System Theory and System Dynamics (SD) concept, which was introduced by Jay W. Forrester in 1956. As mentioned by Wolstenholme, “the theory is used to structure and analyze ill-defined situations that can be considered as a *“free standing methodology”*, having much in common with the soft system problem-solving methodologies recently developed as an alternative to science-based approaches” Ackoff, (1978), Bryant (1989), Checkland, (1983,1987), Eden et al, (1979), Keys (1988), Rosenhead (1989)). Meanwhile, the numbers of output, output accuracy and the work-in-process were being explained from the Theory of Constraints (TOC) perspective and labour from the Labour Theory of Value perspective.

2.9.1 Research Framework

Research framework aims to explain or help understand the influence of the outcome of the implementation (Nilsen, 2015). The research framework was derived from the actual gap that existed at the research location based on real situational issues. Based on the awareness of the significant impact of the delivery performance on business decision-making, the research aimed to strategically identify the most significant resources and capabilities to be deployed in order to improve and sustain the performance of on-time delivery.

Figure 1
Research framework

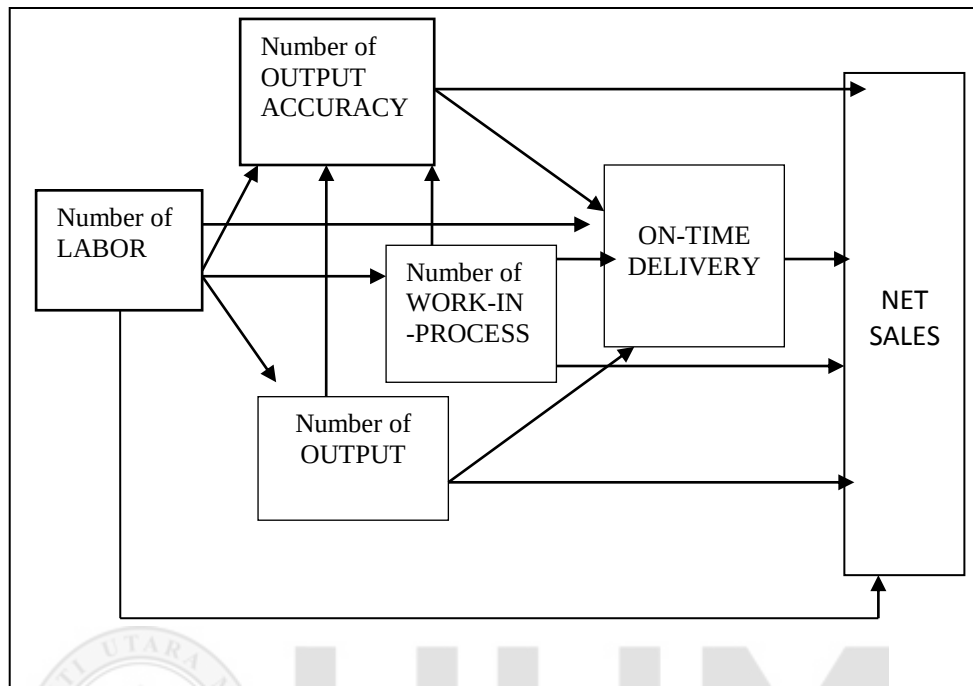


Figure 1.0 shows the research framework for potential variables that impact on-time delivery and net sales from a resource-based view perspective. The researcher also understood that the research framework serves as a guideline in which the research is implemented to achieve the research objective (RO). This step was intended to examine the significant influence of number of labour, number of work-in-process, number of output and number of output accuracy on the number of on-time delivery and net sales. Each of 15 paths in the research framework defines the relationship that was tested. It is also no doubt that the manufacturing process refers to materials that are transformed into a product compared to operational, which refers to the flow of materials in space and time (Shingo, 1989). Besides the comprehensiveness of the resources, the research also considered the complexity of the manufacturing process in which the research took place since the aerospace manufacturing is

a complex system (Rouse, 2010) and requires a deep understanding of the detailed processes involved. Finally, to gain better benefits of more reliable data, firmer basis for exploitation and better efforts to identify capabilities that is unclear, the research used the bottom up approach (Mills, Platts, & Bourne, 2003). This means that at the business unit level, internal resources and capabilities of the organization would be examined and deployed (Mills et al., 2003) together with the individual and group competencies to support on-time delivery.

2.9.2 Research Framework Development

Research framework was developed in order to define the scope and limitations as well as serve as a guideline for the researcher to carry on with the research within the scope and limitations or assumptions. Development of the research framework is shown in Diagram 6. The research started with an overview of manufacturing theories in general and move to a more specific systemic manufacturing system theory. Problem identification was the first process and it is critical. What is a problem to one person might not be a problem to another. A Fishbone diagram was used as a tool to identify the problems. Dependent variables, which were the cause of the problem were reviewed and discussed between team members. The dependent variable was identified as systemic parameters and examined to verify the systemic impact on the independent variable, that is on-time delivery, using the resource-based view theory (RBV). The proposed theoretical construct was the base for the explanation and served as a guideline for the desired findings to measure and decide on the relationship that this study is intended to establish.

The focus was to define a systemic parameter(s) and concept in term of resources and capabilities as well as its function as illustrated by the literature. The parameters, which were categorized into resource and capabilities, were being proposed to have a systemic interactive relationship with on-time delivery and net sales. The literature on the criteria for on-time delivery was examined to provide a reference for industry standards, which is a standard measurement for the organization under study. Observations were carried out on the organization under study to examine the current manufacturing process flow to determine the level of complexity of the process. It was observed that various product mix going through a variety of processes (labour intensive and machine operated) and requirements to meet various international aerospace standards has put the organization's manufacturing process into a type of manufacturing situation that can be categorized as complex, high-mix and high volume. A small change in the prime company, which is Boeing Inc. USA, had caused big changes in the upstream and downstream processes in the organization. Thus, it was very important to have a system that would automatically trigger a systemic interactive impact on the organization's whole manufacturing system. Personal observation and working experience in the organization for the last fifteen years in various departments showed there were a lack of interactive functions and coordination in the organization that caused mis-communication and conflicting priorities that finally resulted in a delay in part completion to meet on-time delivery.

Understanding organizational process is critically important to enable a comprehensive analysis of the organizational situation in order to determine

the problem faced by the organization. The impact of each and individual department's resources and capabilities need to be functionally examined and analysedcomprehensively so that the ineffective area can be identified for further analysis.

Problem identification is a result of in depth understanding and analysis of the gap that exists between the organizational objective and the actual performance over a certain period of time. In this study, the secondary objective historical data on delivery performance of the organization under study was reviewed to identify the trend of the mentioned problem. By observing and evaluating the manufacturing process from a resource-based view perspective, the parameters that affect the organization's delivery performance was defined. A proposal on the recommended solution based on the situational analysis according to a resource-based view theory perspective suggested that an organization's capability toeffectively manage and deploy its valuable resources (tangible and intangible), which is characterized as valuable, rare, in-imitable and non-substitutable, will result in value creation to achieve a sustainable competitive advantage for the organization (Barney,1991).

The research findings were tested and explained using the statistical tool called Smart-PLS as it is an actual eventoccurring at the work place where the data is valid and highly reliable as it was taken from actual environment. It is a proven measurement method and metrics used by the organization for business operations and decision- making. The final objective of the study was to

achieve 100% on-time delivery by implementing a manufacturing process that instilled with systemic key drivers as it creates an orchestra that pulls and pushes the organization's resources to function appropriately at the right time to generate actions that systemically interactive from the start to the end of the manufacturing process. The systemic impact, which is the base that supports the resource-based view theory, provides an integrated effort for an organization by proposing an analysis of internal situational environment and the impact on resources and capabilities (Mills et al., 2003).

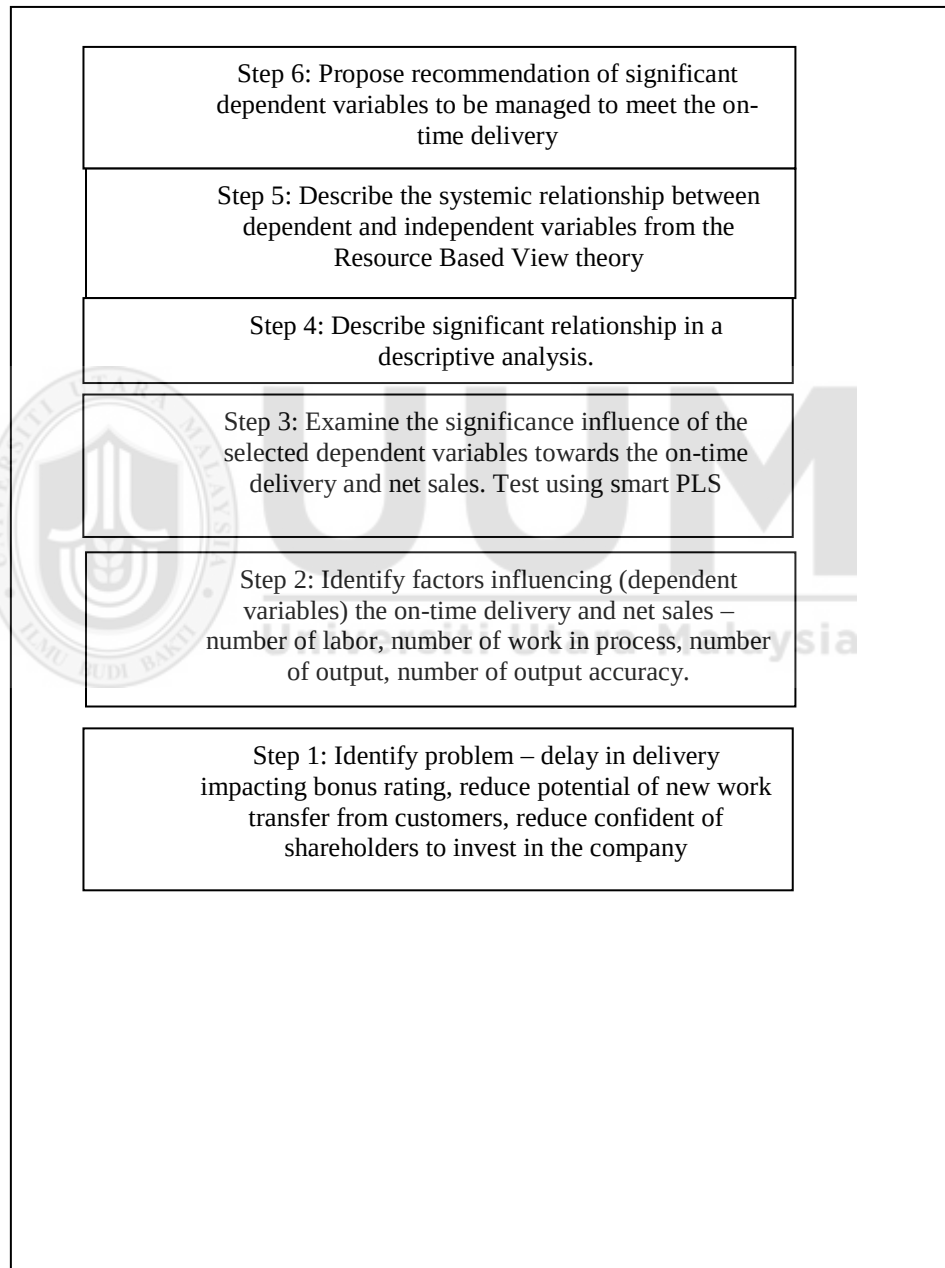
Resource-based view theory was the underpinning theory chosen as a basis for analysis of the systemic relationship between dependent and independent variables due to the advantages of the resource analysis compared to models and simulations. Resource-based view theory focuses on internal situational environments rather than on external circumstances, such as looking at internal organizational resources and capabilities. The researcher was also interested in exploring the long-term, internal strategy to improve and sustain improved performance (Bridoux, 2003). The research looked at the impact caused by the number of labour, work in process, output and output accuracy on on-time delivery and net sales in an organization manufacturing composite parts.

A brainstorm session involving a group of key employees from key areas involving the entire range of processes (from start to finish) was done to identify the potential reasons for the delay in on-time delivery. From the identified reason(s), the researcher examined the significant relationship between the independent and dependent variables. The study tested the

relationship between dependent and independent variables using Smart-PLS software in order to describe the systemic relationship from the Resource-based view theory, the significant relationship in a descriptive analysis and propose recommendations.

Diagram 6

Research framework development



The first step in the process is problem identification. The problem selected for the research concerns the dissatisfaction over poor on-time delivery faced

by the organization for years. On-time delivery composed 20 percent of the organization's total bonus metrics but due to its poor performance, employees were never been paid in full for the on-time delivery category. Every day was like “fire-fighting”, particularly on shipment day. Committed completion date and time was not met as agreed, caused more and more quantity of parts shipped by air instead of sea. Thus, resulted in higher shipment cost and lower the profits.

The next process after problem identification was the identification of variables impacting on-time delivery performance. The identified variables were selected based on actual monitoring which is the topic of the study. Number of labour, work-in-process, output and output accuracy were the variables that were monitored and reported daily. Data were collected based on actual reports from the organization and plotted into the SMART PLS, which was the selected tool used to test the significant influence of these variables on the on-time delivery.

The fourth was describing the significant influence of the level of each variable on the on-time delivery based on the SMART PLS test results in a descriptive analysis. The significance test result showed that the variable was the right variable to achieve the target level of on-time delivery.

The fifth step was to describe the systemic relationship between variables, such as number of labour, work-in-process, output, output accuracy and net sales on the on-time delivery using the Resource Based View approach. The

systemic relationship between variables and on-time delivery is very important because no one variable works alone to give the best performance result. “It takes two to tango” is the right term to use in this relationship. The right explanation to describe this relationship is to use the Resource-Based View theory.

2.10 Conclusion

Chapter two provides a comprehensive background of the aerospace industry, explaining the relationship between on-time delivery and nets sales, labour, output, output accuracy and work-in-process. A conceptual framework for the research is described and resource-based view theory as the underpinning theory is explored according to its origins, assumptions, application and limitation. Company performance metrics are revealed and manufacturing system transformation explored to explain the existence of systemic effect in the manufacturing process.

Chapter three provides details on research design, process, approach, structural model specification, data collection and analysis methodology.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter describes the methodology or actions to be taken to investigate a research problem and the rationale for the application of specific procedures or techniques used to identify, select, process and analyze the information applied to understanding the problem to enable the reader to critically evaluate the study's overall reliability and validity. The methodology provides answers to two main questions, namely how data were collected and generated and how they were analyzed (Kallet, 2004). A quantitative method emphasizes on objective measurements and statistics, mathematical and numerical analysis of data collected through polls, questionnaires and surveys, or by manipulating pre-existing statistical data using computational techniques. It focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon (Babbie, 2010). This study uses a quantitative method as it emphasized on a secondary objective data and numerical analysis.

3.1 Research Design

Research design is refers to the overall strategy that the researcher chooses to integrate the different components of the study in a coherent and logical way, thereby, ensuring the researcher effectively addresses the research problem. It makes up the blueprint for the collection, measurement and analysis of data.

The research design is determined by the research problem (De Vaus, 2001),(Trochim, 2006). This research is a formative causal relation type of study using a correlational approach. The formative measurement includes the co-linearity among the indicators using the smart-PLS software as a statistical tool for analysing multivariate data analysis.

3.2 Research Process

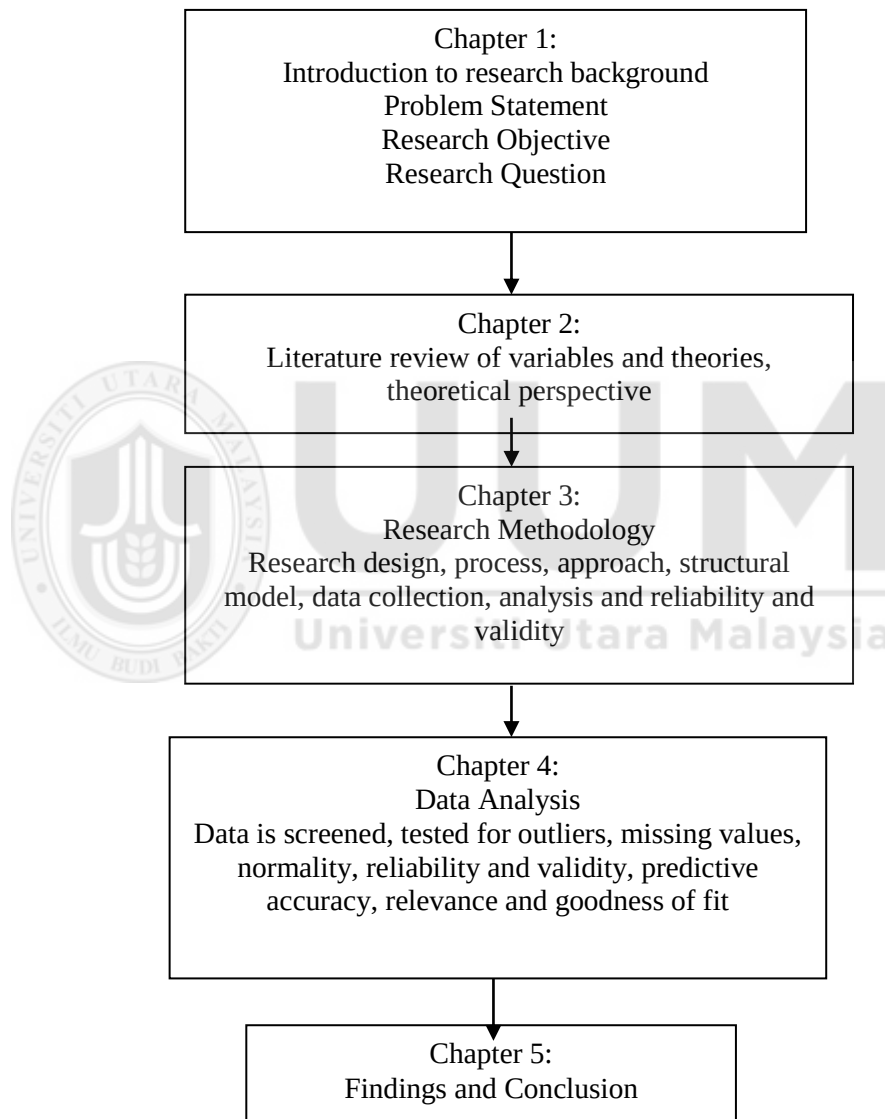
There are seven (7) steps in the research process that starts with identifying research topic, followed by identifying the research problem. The third step is to set research questions and then decides how to conduct the research. The next step is data collection followed by data analysis and interpretation. The last step is to write the report on the research (Library Olin Uris, 2012).

The process started with the identification of the on-time delivery performance pertaining to the research topic of interest. Five (5) research objectives were identified and five (5) research questions are developed. The methodology was defined to decide how the research would be conducted. Analysis was done to examine and report on the significant impact of the indicators on the construct through statistical test tools using the SPSS and Smart-PLS multivariate statistical tool.

The structural model of indicators and constructs were developed to conceptually visualize the relationship between the four indicators or variables that were formed into fifteen (15) different paths. In this formative correlational model, the indicators (the number of labour, number of output,

number of output accuracy and number of work-in-process) on the left are predicted to have a significance impact on the construct on the right (on-time delivery and net sales). This research process is depicted visually in Diagram 7.

Diagram7
Research process



3.3 Research Approach

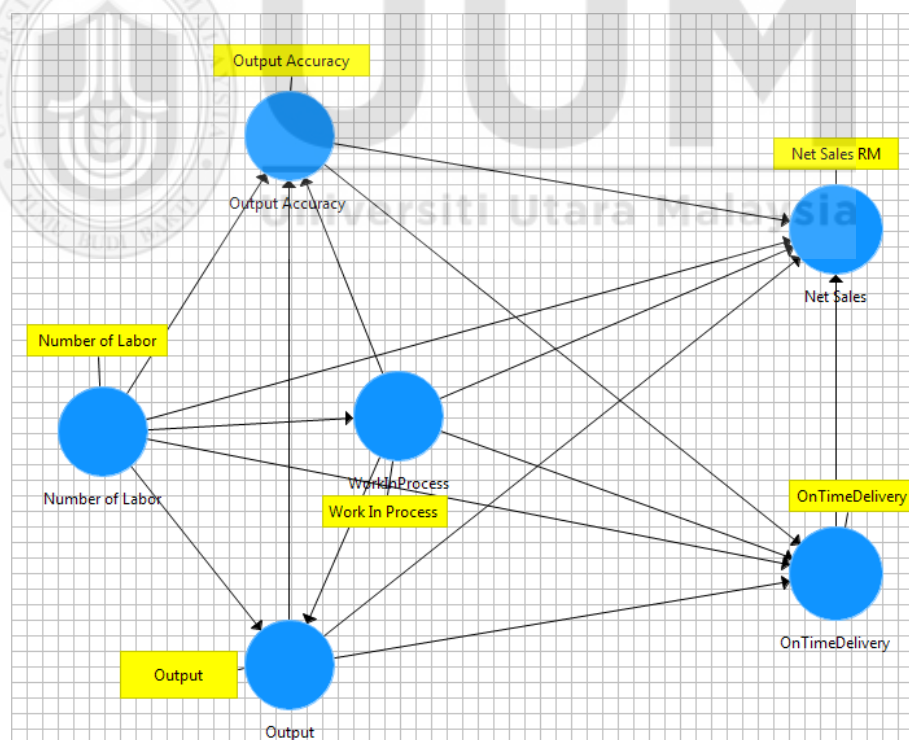
This study has employed a quantitative approach. A formative objective measurement model using the Resource -Based View approach (RBV theory) which focuses on deployment of resources and capabilities was the basis of this study. As mentioned in the earlier chapter, resource-based view theory suggests four types of characteristic to describe a strategic resource, which are value, rarity, inimitable and non-substitutable. Valuable resource means the resource contributes to the improved effectiveness and efficiency of the organization, it is rarely found in other similar industries or organizations, is very difficult to imitate and no other resource can be used as a substitute for the same resource that the organization possesses. Related theories in operation management, supply chain such as labour theory of value and theory of constraint (TOC) were used together with the RBV theory to explain the research approach. Using a quantitative approach, data were tested using the multivariate statistical analysis tool, which is the SmartPLS3 software.

3.4 Structural Model Specification

Structural model relates latent variables to one another (Livote, 2009). A combination of labour, output, output accuracy and work in process working together in a system to produce a 100% on-time delivery and net sales in a composite manufacturing company in Malaysia. The model is showing in Diagram 8. The first order level structural model (inner model) was developed to show relationship between indicators and its impact on one another in relation to producing the targeted objective.

This is a formative measurement model using objective data. The model looks at a relationship between a group of latent variables (labour, output, output accuracy, work-in-process) as indicators with the on-time delivery and net sales from a resource- based view perspective. The delivery system model was created to reflect the required systemic and integrated process based on the resource-based view perspective. Research questions to test the significant effect and existence of the relationship between variables was visually mapped and conceptually defined in a path diagram using the SEM Smart-PLS software.

Diagram 8
Structural Model



Source: SmartPLS3

All the fifteen paths were created to show the relationship between labour and other indicators (the number of output accuracy, number of output, number of

work-in-process) towards on-time delivery and net sales. The analysis intended to examine the significant relationship between the indicators, identify low impact indicators and paths with low significance and at the same time maintain path with highest significance as the main path model in the study. Hence, this would help the organization to focus on the right indicators to manage on-time delivery. The process started with labour, as the value creator that contributes to the work-in-process, output and output accuracy, which finally achieves ship on-time and become the company's net sales. The right number of labour and utilization is crucial because labour creates value in the manufacturing process (Dooley, 2005).

3.5 Data collection

The study took place in an actual manufacturing environment where the scenario was real. The objective secondary data was extracted from the organization's (an aerospace composite manufacturing company in Kedah) periodic reports specific on production output, production output accuracy, number of labour, work-in-process, on- time delivery and net sales from 2012 to 2015 revealed that there were inconsistencies in the on-time delivery at the location of the study. Data collected was objective secondary data, inclusive but not limited to operational performance records, processes and product information and issues, operational system issues and concerns arising from the impact on on-time delivery in the organization through shop floor observation and expediting activities in the organization. Secondary data (number of labour, work-in-process, output, output accuracy, on-time delivery

and net sales) were extracted from real situations in the organization where the study took place.

3.6 Data Analysis

Knowing what kind of data and how much data to collect is a critical choice that the researcher has to take. Then, the analysis process would need to be right and timely to provide a result that indicates a significant relationship with the elements tested. The relationship between the elements and the on-time delivery was analyzed using the SMART-PLS because this software is a multivariate data analysis software that enable analysis of multiple relationship between more than one variables is done. This tool not only help to identify significant path coefficients but also the significant and relevant effects between all the latent variables and indicators (Hair, Hult, Ringle, & Sarstedt, 2014). It is a good tool for predictive purpose. The relationship between these elements was described using resource-based view theory to explain the significant influence of the internal resources and capabilities on the on-time delivery.

Quantitative data are measurements where numbers are used to directly represent the properties of some phenomena, which is the most suitable for this study, involving a collection of objective secondary data from actual documented reports. They are number of labour, production output, work-in-process, output accuracy, on-time delivery and net sales reports in the organization from 2012 to 2015. Data collected is then organized and reduced through selecting, simplifying and transforming to make it more manageable

and understandable (Hair, et al. pp 292-293). Data was strategically analyzed using the smart-PLS software to create an equation model to confirm the significant relationship between identified independent variables(IV), which are the indicators (number of labour, work-in-process, output, output accuracy and net sales) impacting the dependent variable(DV), which is the construct (number of parts delivered on-time).

Historical data on delivery related performance for 4 years, (2012 to 2015), series of personal notes from daily, weekly and monthly meetings and reviews about the company was used as a feedback on the effectiveness of the practices. Data was collected on daily, weekly and monthly basis for planned and actual output, accuracy of actual part produced, work-in-process, on-time delivery and net sales. Data collected for operational performance was summarised in a report format and shared with key area managers in the company on a daily, weekly and monthly basis (depending on the type of metrics) between senior and middle level managers and executives. Data reviewed were inclusive of the organization's monthly on time delivery performance, daily production output, number of output accuracy, number of work-in-progress daily reports and other performance related reports in ACM from year 2012 until 2015. The researcher did not focus on any specific time frame for the performance trend over the 4 years but instead looking at the overall performance to investigate the impact of the variables on the on-time delivery and net sales.

Unit of data or data population refers to a group of resources identified as having a significant relationship with on-time delivery. How the resources are deployed and managed eventually determined the capability of an organization to achieve and sustaining its competitive advantage (Bridoux, 2003). The capability resource in this study is referred to the group of variables which are the number of labour involved in manufacture the output quantity, number of work in process, number of output accurately produced, number of quantity delivered on-time and net sales value.

Aside from the performance and production reports, issues found in daily production and quality meetings were also major contributors to the information. A group meeting between related departments involved in the planning and implementation of the plan to meet the 100% on-time delivery has discussed on issues and improvement activity was done repetitively to generate ideas and proposals to solve emerging issues. The meetings and discussions involved employees at the shop floor level inclusive of direct, supervisory and managerial levels from operations and operation support to ensure the comprehensive coverage of the issues discussed. Personal involvement and observations made during the operational meetings attended daily, weekly and monthly is a source of hands on information and experience that are part of the data source in this study. Normality was tested using Skewness and Kurtosis test to measure the size of the gap which data deviate from the normality (Hair, et al., 2000). Homoscedasticity test was carried out to verify if the variance around the regression line was the same for all.

Table 3.0
Categories of data collection

Items	Description	Unit of Measurement	Time Period
Number of labour	Number of labour involved in the manufacturing output	People	2012~2015
Number of On-Time Delivery	Number of parts delivered on time per company delivery date	Piece	2012~2015
Number of output	Number of output produced based on plan	Piece	2012~2015
Number of Output Accuracy	Number of output produced that is right per the plan	Piece	2012~2015
Work-In-Process (WIP)	Number of work-in -process for the total from start to end manufacturing process	Piece	2012~2015

3.7 Reliability

Data on number of labour, work-in-process, output, output accuracy, on-time delivery and net sales were obtained from the Finance and Operations and were endorsed in the meeting as key performance metrics. This report was reviewed daily, weekly and monthly by area Managers and Directors. Business decisions were derived based on these metrics for determining future business directions and investment. Thus, it was reliable.

3.8 Validity

Data used in the study was valid as they were real, objective data reported to measure the company's performance metric and being validated by the company's finance department as well as audited by an independent body from the industry, namely from Hexcel and Boeing (ACM Quality Management System, 2014). The actual data used at the operational level to achieve operational targets. These reports (monthly work-in-process report, output report, on-time delivery report and accuracy report) are a basis for monthly operation performance, which are shared with the organization's board of directors and shareholders for making decision pertaining to future business investment and potential business opportunity.

3.9 Conclusion

To recap, chapter three actually defines how research was conducted. The study was a formative objective measurement model, using a quantitative approach. Data was collected from historical records and analyzed using the multivariate analysis method via the Smart-PLS software. All the variables are explained from a resource-based perspective as resource and capabilities.

CHAPTER FOUR

RESULT AND DISCUSSION

4.0 Introduction

Chapter four elaborates on the findings on data screening, cleaning, missing value, treatment of outliers, preliminary test inclusive of normality test. Predictive accuracy, effect size, predictive relevance and the goodness of fit test were carried out and explained in this chapter. An algorithm path coefficient was run to test the significance of the indicators and a structural model specification was created. The analysis was done using the statistical tool International Business Management (IBM) Statistical Package for Social Sciences (SPSS) version 21, while the multivariate data analysis used the Smart-PLS 3.0 software.

4.1 Data Screening

Data does not provide any value unless it is processed, analyzed and transformed into meaningful information to add value to the resources, process, product or the organization's operational system. Thus, data need to be screened through a process of inspecting those data for errors and correcting them prior to the analysis. The screening might involve checking raw data, identifying outliers and dealing with missing data (Business, 2018). Data used in this study was collected from documented historical reports in an aerospace composite manufacturing company situated in the northern part of Malaysia from 2008 to 2015. Data from 2008 to 2011 were collected to show the trend of inconsistency of on time delivery. Six (6) types of data (number of

labour, output, output accuracy, work-in-process, on-time delivery and net sales) were collected within period of four years from 2012 to 2015 consisting of 288 data. All the data were incorporated into the SPSS and tested for normality, predictive accuracy, predictive relevance and goodness-of-fit model. Data were also loaded into the Smart-PLS software to create a path diagram in order to identify the significant path coefficient. The significant and relevant effects were run using algorithms as well as the bootstrap method to reconfirm the significant influence between the latent variables and the indicators.

The on-time delivery indicators were the numbers of labour, number of output, number of output accuracy and number of work-in-process. The on-time delivery was measured based on the number of parts shipped on time per customer agreed to a shipment date. According to the reference data from 2008 to 2011 (Table 1.1), the on-time delivery trend reviewed showed the average on yearly basis was reported at 81% in 2008, moved up to 95% in 2009, dropped to an average of 93% in 2010 and plunged to 78% in 2011. The trend analysis was not reviewed as a specific time frame trend but rather as an overall cumulative trend for the whole four years performance period. Data from year 2012 to 2015 were grouped and presented in Appendix 2 and used for research analysis.

4.1.1 Data Cleaning

Data is cleaned to remove outliers, which are abnormal data from the data pool. Data is considered abnormal when it is different from the average or

mean as explained in the section on outliers' treatment. This study was based on actual data taken from historical documented report that were justified and correct.

4.1.2 Missing Value Imputation

Data was checked for missing values and there was no missing value found for all the variables such as labour, output, output accuracy, work-in-process, on-time delivery and net sales. A comprehensive review was done and it was assured no missing data in this study. A summary of the missing data processing results is tabulated in Table 4.0.

Table 4.0
Case Processing Summary Missing Data

	Valid Number	Percent	Percent
On-Time Delivery	48	100	0
Labor	48	100	0
Output	48	100	0
Output Accuracy	48	100	0
Work in Process	48	100	0
Net Sales	48	100	0

Source: SPSS

Analysis using the SPSS statistical tool indicated that all 48 data for each variable was valid and none was missing.

4.1.3 Outliers Treatment

SPSS statistical analysis aimed to determine the z-value or outliers from these data pool of labour, output, output accuracy, work-in-process, on-time delivery and net sales.

The outliers analysis showed that the z-value for on-time delivery was 2.33 standard deviation from the mean on-time delivery. The z-value for output was 2.25 standard deviation while output accuracy was -3.29 standard deviation from the mean. The z-value for work-in-process was -2.09 standard deviation from the mean. The z-value for labor was -1.54 standard deviation from the mean. The z-value for net sales was -2.009 standard deviation from the mean. All these z-values did not fall within the ± 3 or ± 4 except for output accuracy which was -3.29.

Only one outlier was found, which was z-value for output accuracy (-3.29952) and it was treated by replacing it with an output accuracy value of 1313 with the mean of the output accuracy value. From the outlier's analysis, it could be concluded that these data were good and could be used.

4.2 Preliminary Test

The test was conducted to determine the correlational relationship between these indicators towards on time delivery. From the test results, it is expected to show if the indicators have a significance impact on the on-time delivery. Beginning with an end in mind, a preliminary test was done to determine data

characteristics, distribution and trend which will determine the analysis tool and approach.

4.2.1 Normality Test

Testing for normality is a prerequisite for all data before it can be used under any statistical test because it is part of the assumptions in the test data. The Skewness is a measure of symmetrical distribution of data whereas the Kurtosis is a measure of the size of the gap which data deviate from the normality (Hair, et al., 2000). On-time delivery distribution had a skewness of -0.160, indicating a distribution skewed to the left direction. Kurtosis value of -0.626 indicated a light-tailed for on-time delivery. Skewness was -0.405 with Kurtosis of 0.423 for the number of output, meaning data were skewed to the left with heavy-tailed distribution. Skewness for output accuracy was -0.774, indicating data were skewed to the left and Kurtosis of 1.921 meaning heavy-tailed. For distribution of work-in-process, the Skewness was -.155 with Kurtosis of 0.982. The number of labor Skewness is 0.035 indicated data skewed to the right distribution and Kurtosis of -1.591 indicated a light-tailed distribution. Labor distribution is on the right direction based on its Skewness of 0.035 and Kurtosis of -1.591, indicating a light-tailed distribution. Net sales Skewness of -1.018 indicated the distribution was to the left direction and Kurtosis of -0.650, indicated a light-tailed distribution. Table 4.1 summarized the skewness and kurtosis of each the variables.

Table 4.1
Skewness and Kurtosis

	Skewness	Kurtosis
On Time Delivery	-0.160	-0.626
Output	-0.405	0.423
Output Accuracy	-0.774	1.921
Work in Process	-0.155	0.982
Labor	0.035	-1.591
Net Sales	-1.018	-0.650

*Skewness and Kurtosis value close to 0 indicates normal distribution

*Negative (-ve) value indicate left skewed. Positive (+ve) value indicate right skewed.

Negative Skewness values indicate that data are skewed to the left and a kurtosis value of higher than 0 indicates an abnormal distribution.

4.3 Predictive Accuracy (R^2)

The R^2 , or the predictive accuracy value, ranges from 0 to 1 with a higher level indicating higher levels of predictive accuracy.

Figure 2

R^2 value of variables		
Variables	R^2	Significant Level
On Time Delivery	0.399	***
Net Sales	0.551	***
Output	0.456	***
Output Accuracy	0.849	***
Work in Process	0.122	*

Source: A Premier on Partial Least Squares Structural Equation Modeling (PLS-SEM)

Significant level R^2 (Cohen, 1988): >0.32 (Substantial)***, >0.15 (moderate)** , >0.02 (weak)*

Figure 4.0 shows a substantial significant level of the on-time delivery, output, output accuracy and net sales, indicating a high level of predictive accuracy if

used in forecasting the future trends. A low work-in-process predictive value indicates low predictive accuracy when used in future forecasting trends.

4.4 Effect Size (f^2)

Cohen's f^2 , is the effect size for multiple regression that measures the level of exogenous construct impact on the endogenous construct in a relationship.

Figure 3
Effect size (f^2) of Latent Construct

Effect Size of Latent Construct	R ² Individual Model	Include d Value	Excluded Value	f^2	Sign
		R ² Full model	R ² Excluded		
f^2 Labor $\square$ Output	0.126	0.456	0.438	0.032	*
f^2 Labor $\rightarrow$ Output Accuracy	0.028	0.849	0.821	0.190	**
f^2 Labor $\square$ Work in Process	0.122	0.122	0.000	0.139	*
f^2 Labor $\rightarrow$ Net Sales	0.403	0.551	0.355	0.438	***
f^2 Labor $\square$ On Time Delivery	0.368	0.399	0.201	0.331	**
f^2 Output $\rightarrow$ Output Accuracy	0.821	0.849	0.373	3.161	***
f^2 Output $\rightarrow$ Net Sales	0.024	0.551	0.484	0.150	*
f^2 Output $\rightarrow$ On Time Delivery	0.105	0.399	0.399	0.001	*
f^2 Work-in-Process $\rightarrow$ Output Accuracy	0.371	0.849	0.848	0.011	*
	0.438	0.456	0.126	0.606	***
f^2 Work in Process $\rightarrow$ Output	0.045	0.551	0.540	0.024	*
f^2 Work in Process $\rightarrow$ Net Sales	0.142	0.399	0.381	0.030	*
f^2 Work-in-Process $\rightarrow$ On-Time Delivery	0.008	0.551	0.433	0.263	**
f^2 Output Accuracy $\rightarrow$ Net Sales	0.041	0.399	0.399	0.001	*
f^2 Output Accuracy $\rightarrow$ On Time Delivery	0.070	0.551	0.525	0.058	*
f^2 On Time Delivery $\rightarrow$ Net Sales					

Note: According to Cohen (1988), f^2 is assessed as: >0.35 (Large)***, >0.15 (medium)** , >0.02 (small)*, <0.01 (no effect)#. Significant level R^2 (Cohen, 1988): >0.32 (Substantial)***, >0.15 (moderate)** , >0.02 (weak)*.

Figure 4.1 portrays the effect size of each construct. Of all the variables, labour had the strongest effect on on-time delivery (36.8 percent) followed by

work-in-process (14.2 percent) and output (10.5 percent). Output accuracy (4.10 percent) had the least impact on on-time delivery.

4.5 Predictive Relevance (Q^2)

Predictive relevance was calculated using the Smart-PLS software and confirmed that data in this study had a good predictive relevance (Fischer, 2012). Figure 4.2 showed predictive relevance for all constructs in the model. Among all the constructs, it was found that labour had a strong predictive relevance on net sales, while output had a strong predictive relevance on output accuracy, with work-in-process having a strong predictive relevance on output. A comparison between data on labour, work-in-process, output, output accuracy, revealed that labor had the strongest impact on on-time delivery.

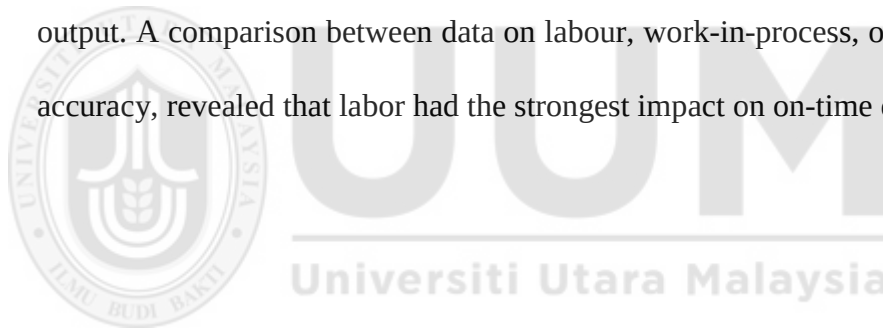


Figure 4
Predictive Relevance of Latent Construct

Effect Size of Predictive Relevance	Q ² in Individual Model	Q ² in Full Model		q ²	Sign
	Included Value	Included Value	Excluded Value		
q ² Labor → Output	0.085	0.348	0.384	0.055	*
q ² Labor → Output Accuracy	-0.041	0.755	0.773	0.073	*
q ² Labor → Work in Process	0.091	0.091	0.000	0.100	*
q ² Labor → Net Sales	0.395	0.397	0.180	0.360	***
q ² Labor → On-Time Delivery	0.354	0.275	0.084	0.263	**
q ² Output → Output Accuracy	0.800	0.755	0.193	2.294	***
q ² Output → Net Sales	-0.004	0.397	0.394	0.005	*
q ² Output → On-Time Delivery	0.085	0.275	0.331	0.077	*
q ² Work in Process → Output Accuracy	0.286	0.755	0.787	0.131	*
q ² Work in Process → Output	0.384	0.348	0.085	0.403	***
q ² Work in Process → Net Sales	0.009	0.397	0.432	0.058	*
q ² Work in Process → On-Time Delivery	0.126	0.275	0.281	0.008	*
q ² Output Accuracy → Net Sales	-0.045	0.397	0.338	0.098	*
q ² Output Accuracy → On-Time Delivery	-0.018	0.275	0.348	0.101	*
q ² On-Time Delivery → Net Sales	0.046	0.397	0.417	0.033	*

Note: According to Cohen (1988), q² is assessed as: >0.35 (Large)***, >0.15 (medium)**, >0.02 (small)*, <0.01(no effect) #. Significant level R² (Cohen, 1988): >0.32 (Substantial)***, >0.15 (moderate)**, >0.02 (weak)*.

The latent constructs tabulated in Figure 4.3 confirmed the existence of predictive relevance for each variable.

Figure 4.3
Q-square Statistics Results for all Latent Constructs

Construct	R ² Value	Q ² Value	Acceptability of Predictive Relevance
Net Sales	0.551	0.397	<u>Yes</u> /No
On-Time Delivery	0.399	0.275	<u>Yes</u> /No
Output	0.456	0.348	<u>Yes</u> /No
Output Accuracy	0.849	0.755	<u>Yes</u> /No
Work in Process	0.122	0.091	<u>Yes</u> /No

4.6 Goodness of Fit (GoF)

Fit of the model is an assessment of how well the model matches the original matrix of the data or in other words, goodness of fit (GOF). R square (R^2) is a statistical measure of how close the data is to the fitted regression line. It is also known as the coefficient of determination or the coefficient of multiple determinations of multiple regressions. The R square adjusted, on the other hand, is an indicator of the fit quality when comparing two different models that are nested. The value of R^2 and R^2 Adjusted indicates better fit if it is less than or equal to 1. The value for these indicators in this study shows that the equation is best fitted to be used. The result is shown in Figure 5.

Figure 5
Goodness of Fit Test

Goodness of Fit			
	R Square	Communality	Redundancy
Net Sales	0.551	1.000	0.397
On Time Delivery	0.399	1.000	0.275
Labor	0.000	1.000	0.000
Output	0.456	1.000	0.348
Output Accuracy	0.849	1.000	0.755
Work in Process	0.122	1.000	0.091
$\sum x/n$	0.396	1.000	0.311
$(\sum xR^2)/n$ x $(\sum xComm)/n$		0.396	
Goodness of Fit (GoF)		0.604**	

Goodness of Fit of the model was 60%, which is good to be used for prediction.

4.7 Path Coefficient Algorithm Result

The PLS algorithm results showed the level of significance between indicators that contributed to the on-time delivery.

Figure 6
Path Coefficient Algorithm Result

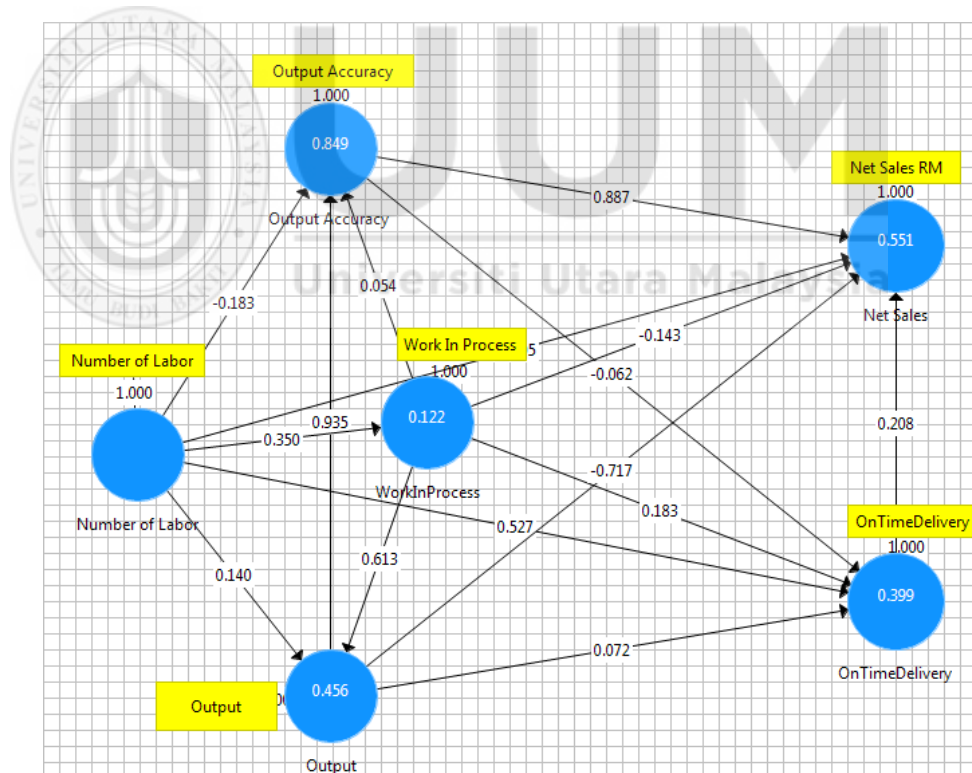
Variables	R ²	Significant Level
Labor	0.527	***
Net Sales	0.399	***
Output	0.072	***
Output Accuracy	-0.062	***
Work in Process	0.183	***

Source: Smart PLS

Note: Good path coefficient < 1 or > -1

PLS Algorithm was run to find the path coefficient value as the indicator of the relationship between the latent variables. The path coefficient as shown in Figure 4.5, between the number of labour and on-time delivery was 0.527 whereas work-in-process and on-time delivery was 0.183; output and on-time delivery was 0.072; output accuracy and on-time delivery was -0.062. The R-square for on-time delivery was 0.399. Thus, the statistical data showed that all these variables were significant indicators of on-time delivery. The blindfolding process was implemented to obtain a predictive relevance indicator for each latent construct. A details diagram is shown in Diagram 9.

Diagram 9
Algorithm path model result



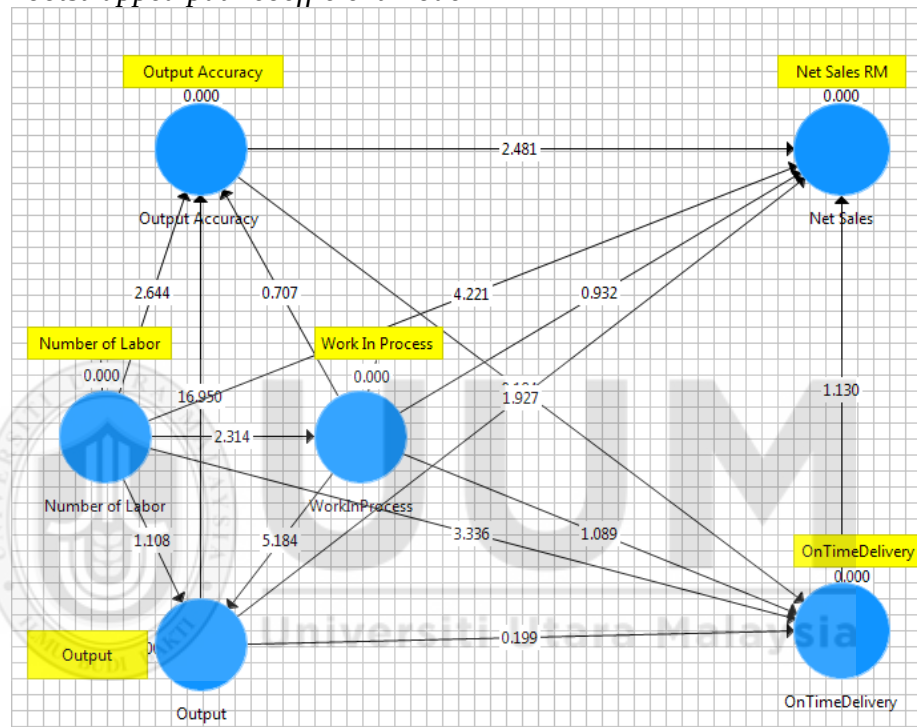
Source: Smart PLS

Note: Good path coefficient < 1 or > -1

4.8 Bootstrapped Result (Total Effects)

Bootstrapped analysis was run to reconfirm the existence of the significant relationship between variables and construct. Results of the bootstrapped analysis are shown in the algorithm results in Diagram 10.

Diagram 10:
Bootstrapped path coefficient model



Source: SmartPLS

The summary of the total effects analysis are summarized in Figure 7.

Figure 7
Summary table of bootstrapped analysis – Total Effect

	Original Sample Mean (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistic (O/STDEV)	P Value
Labor → Output	0.355	0.347	0.139	2.550	0.011
Labor → Output Accuracy	0.167	0.173	0.167	1.004	0.316
Labor → Work in Process	0.350	0.356	0.151	2.314	0.021
Labor → Net Sales	-0.635	-0.630	0.086	7.342	0.010
Labor → On Time Delivery	0.606	0.600	0.125	4.855	0.000
Output → Output Accuracy	0.935	0.934	0.055	16.950	0.000
Output → Net Sales	0.115	0.090	0.158	0.730	0.466
Output → On Time Delivery	0.014	0.008	0.171	0.084	0.933
Work in Process → Output	0.613	0.614	0.118	5.184	0.000
Work in Process → Output Accuracy	0.627	0.614	0.128	4.898	0.000
Work in Process → Net Sales	0.012	0.010	0.131	0.094	0.925
Work in Process → On Time Delivery	0.188	0.184	0.125	1.502	0.134
Output Accuracy → Net Sales	0.874	0.897	0.316	2.767	0.006
Output Accuracy → On Time Delivery	-0.062	-0.040	0.335	0.184	0.854
On Time Delivery → Net Sales	0.208	0.192	0.184	1.130	0.259

Source: Smart-PLS

Notes: P-Values: $p \leq 0.05$ significant; T-Statistic: $t \geq 3$ significant

The bootstrapped analysis ($p \leq 0.05$; $t > 3.00$) confirmed the significant impact of the variables number of labour, work-in-process, output and output accuracy on on-time delivery and net sales; and also, the impact of on-time delivery on net sales.

The significant effect of the number of labour on on-time delivery, net sales, output, output accuracy and work-in-process were ($p = 0.000$; $t = 4.855$); ($p = 0.010$; $t = 7.342$); ($p = 0.011$; $t = 2.550$); ($p = 0.316$; $t = 1.004$) and ($p = 0.021$; $t = 2.314$). The analysis shows that:

H1- H5: Number of labour has a positive significant effect on net sales and on-time delivery, but not on output, output accuracy and work in process.

The significant effect of the number of work-in-process on on-time delivery, net sales, output and output accuracy were ($p = 0.134$; $t = 1.502$); ($p = 0.925$; $t = 0.094$); ($p = 0.000$; $t = 5.184$) and ($p = 0.000$; $t = 4.898$). The analysis shows that:

H6 - H9: Work-in-process has a positive significant effect on the number of output and output accuracy but not on on-time delivery and net sales.

The significant effect of the number of output on on-time delivery, net sales and output accuracy were ($p = 0.933$; $t = 0.084$); ($p = 0.466$; $t = 0.730$); and ($p = 0.000$; $t = 16.950$). The analysis shows that:

H10 - H12: Output has a positive significant effect on output accuracy but not on net sales and on-time delivery.

The significant effect of the output accuracy on the on-time delivery and net sales were ($p = 0.854$; $t = 0.184$) and ($p = 0.006$; $t = 2.767$), respectively. The analysis shows that:

H13 - H14: There is positive significant effect between output accuracy and net sales but not on on-time delivery.

The significant effect of on-time delivery on net sales was ($p = 0.259$ and $t = 1.130$) shows that:

H15: On-time delivery has no positive significant effect on net sales.

Based on the overall indication from the analysis, the researcher concluded that there is a positive significant effect between number of labour, on-time delivery and net sales. There is also a positive significant effect between output and output accuracy; between work-in-process, output and output accuracy. The findings for all the hypotheses can be summarized in table 4.2 below.

Table 4.2
Summary of hypotheses findings

Hypothesis	Finding
H1: Labor has a positive significant effect on on-time delivery	Supported
H2: Labor has a positive significant effect on output	Not Supported
H3: Labor has a positive significant effect on output accuracy	Not Supported
H4: Labor has a positive significant effect on work in process	Not Supported
H5: Labor has a positive significant effect on net sales	Supported
H6: Work in process has a positive significant on on-time delivery	Not Supported
H7: Work in process has a positive significant effect on output	Supported
H8: Work in process has a positive significant effect on output accuracy	Supported
H9: Work in process has a positive significant effect on net sales	Not Supported
H10: Output has a positive significant effect on on-time delivery	Not Supported
H11: Output has a positive significant effect on output accuracy	Supported
H12: Output has a positive significant effect on net sales	Not Supported
H13: Output accuracy has a positive significant effect on on-time delivery	Not Supported
H14: Output accuracy has a positive significant effect on net sales	Supported
H15: On-time delivery has a positive significant effect on net sales	Not Supported

Thus, based on the analysis, it is proven that number of labour has a positive significant effect on the on-time delivery.

4.9 Conclusion

Analysis showed that the data were clean from missing values, outliers and nonlinear values, hence, all data were reliable and valid. The structural model specification was carried out to measure the predictive accuracy, predictive relevance, effect size and goodness-of-fit test. The bootstrapped method was

employed to reconfirm the significance of the dependent variable on the independent variables as it has shown that the number of labour has the most significant impact on on-time delivery.



CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.0 Introduction

Chapter five discuss and concludes the research findings on the significant level of impact of the number of labour, output, output accuracy and work-in-process on the on-time delivery and net sales as well as the impact of on-time delivery on net sales. This chapter also includes the study's contribution to the organization, academic circle and existing general corpus of knowledge in general and the aerospace industry.

5.1 Overview of the study

This section gives a bird eye view of the study. The main objective of the study was to examine the positive significant relationship between number of labour, output, output accuracy and work-in-process on on-timedeliveryand net sales. The resource-based view perspective is the basis for explaining the tested relationship. Based on the findings, the management will be able to prioritize the focus on which element to strategize the effort in deploying and optimizing resources and capabilities to meet on- time completion and delivery.

Chapter One provided some documented background of the Malaysian manufacturing industry in general and gradually moved into aerospace

manufacturing industry, which started around 1997 with the establishment of Malaysian National Aerospace Blueprint. It also elaborated on the research problem, fifteen objectives, research questions, scope of the study, significance of the study, contribution and the organization of the study as well as the key terms and definitions.

Chapter Two elaborated on a review of the aerospace industry in Malaysia, an introduction to the research location, a review of the literature relevant to resource-based view (RBV) theory assumptions and elements of the theory applied as the underpinning theory in the study. Also elaborated in chapter two are the RBV assumptions of resource and capabilities, application, limitation and advantages.

Aside from the RBV, other related theories elaborated in Chapter Two are theories that explain the impact of labour on output, output accuracy and work-in-process and significant relationship with on-time delivery and net sales. The operational definition of on-time delivery, labour, output, output accuracy, work-in-process and net sales is shared in Chapter Two. Also included in Chapter Two are the research framework and development, conceptual structural model and theoretical perspective explaining resources versus capabilities as core elements in resource-based view theory. Significance of company's key performance metrics (quality, delivery, value, safety and lean) are shared in Chapter Two as well in order to explore the contributions of each key performance indicator pertaining to company health and growth. Transformation of the manufacturing system explored the

evolution of the manufacturing system. Process flow, resource deployment and delivery process models explained the importance of understanding the process, resource and capability deployment to achieve on-time delivery.

Chapter Two continued with the introduction of systemic view of on-time delivery, systemic concept and system theory followed by key performance indicators, failure and success factors as well as research framework and framework development.

Chapter Three is all about methodology and how the study was framed and developed. This is a formative causal relation-type of study using a correlational approach. Secondary data were extracted from actual situation in the organization where the study took place. A formative-objective structural model was developed using the resource-based view approach (RBV theory), which focuses on deployment of resources and capabilities. Data reference in the study was based on the actual situation, which was valid and reliable as it was used in organizational decision-making in an operational and strategic manner.

Chapter Four consisted of data screening, cleaning, missing value imputation, outlier's treatment and the normality test. Data reliability and validity was confirmed as these data were used in actual decision-making. Collinearity test is not applicable on secondary objective data in this study. A coefficient path algorithm model was developed in Chapter Four to visualize the relationship

between measured variables and latent variables. Meanwhile, the structural model relates latent variable to another latent variable. Details of fifteen research questions were visualized in the structural and algorithm models to show the interaction between these variables systemically based on resource-based view perspective. Chapter Five is basically the discussions and conclusion of the findings.

5.2 Recapitulation of study findings

Lack of systemic strategy to optimize the utilization of resources and capabilities has resulted in the failure to meet on-time delivery, besides increasing air shipment costs, decreasing bonus ratings and demoralizing employees as well as damaging the company's reputation and jeopardizing new investments. High operational costs make the study very significant as the part moves along each process, increasing costs until final product is complete and sold. To resolve the problem of meeting the on-time delivery target, priority and focus must be on the right factors though it is not obvious in the organization.

Thus, the need arose to explore the situation and identify the factor(s) that caused the failure and eventually to examine the significant relationship between the number of labor, output, output accuracy and work-in-process on on-time delivery and net sales as well as the on-time delivery on net sales.

To proceed accordingly, a formative causal relation-type of study using a correlational approach was employed. The secondary objective data consisted

of four years (2012 to 2015) of data from an actual situation was collected and statistically tested to identify the variables (resource and capability) that have a significant impact level on on-time delivery. This enable the right priority setting to be implemented in order to optimize efforts in bundling and deploying of the right resources and capabilities to meet and sustain on-time delivery. A multivariate statistical analysis tool in Smart-PLS and SSPS were used to analyze the findings based on the predictive accuracy, effect size, predictive relevance size, goodness-of-fit test as well as the total effect.

Empirical findings suggested that labour as a value creator is to be the highest impact variable impacting on-time delivery. In this organization, without the right quantity of skilled labour, factory will not be able to produce the right part at the right time in the quantity needed, thus no on-time delivery or sales made. The relationship of the variables with on-time delivery and net sales are explained from the RBV perspective since there is a lack of systemic strategy in the deployment of resources and capabilities.

5.3 Research Findings Discussion

Discussion on the research findings is grouped into five main groups of variables. Discussion on the first group variables consisted of five relationships relate to the significant effect of the number of labour on on-time delivery, output, output accuracy, work-in-process and net sales. The second group consisted of four relationships, which was the significant impact of number of work-in-process on on-time delivery, output, output accuracy and net sales.

The third group of variables was the clarification of three significant impacts of output on on-time delivery, output accuracy and net sales. The fourth group of relationship involved two significant relationship of number of output accuracy on on-timedelivery and net sales; whereas the fifth group was the significant impact of the on-time delivery on net sales. Comparatively, the most significant impact of variables was identified as the most critical resources recommended for management team to strategize the deployment initiatives.

5.3.1 Relationship between number of labor and the on-time delivery

This section postulates the following hypothesis:

H1: Labour has a positive significant effect on on-time delivery.

Individually, labour contributed highly and together with output, output accuracy, work-in-process, it is still the biggest contributor to on-time delivery and net sales. Bootstrapped value revealed labour as having the strongest effect, concluded the theory of labour (Dooley, 2005), where labour is proven as one of the critical factor contributing most to the on-time delivery performance. Thus, it is not surprising when labour is considered as an asset in the organization. This finding confirmed the importance of many research and efforts by many organizations to nurture, develop, enhance and sustain the best level of human capital. Thus it is very critical for an organization to measure its labour performance (Banker, Devaraj, Schroeder, & Sinha, 2002) to assure a continuous supply of skilled productive labour particularly in

aerospace industry. In sum, this empirical finding proved the significant effect of number of labour on on-time delivery.

5.3.2 Relationship between number of labour and number of output

This section to discusses and concludes the following hypothesis:

H2: Labour has a positive significant effect on output

It was predicted that the number of labour have a positive impact on the number of output since the existence of labour in the manufacturing process is said to add value to the process and product. Labour is one of the important resources required to produce the right number of output at the right time to be delivered on-time in demand and supply chain (Dooley, 2005). Research finding showed individually labour has a low effect on output but increase when combined with other factors. A bootstrapped analysis result showed there was a low significant effect and low predictive relevance between number of labour and number of output in this aerospace composite manufacturing company. This finding confirmed there is a relationship between number of labour and number of output but with a low significance.

Majority of the manufacturing processes in this aerospace composite manufacturing organization is labour intensive, required manual effort and it is impacting the output quantity and quality in this industry. Since it is a highly technical kind of job, the skill of the labour is equally important as the number of head available. This fact drives the importance of initiatives on human capital development in term of skill and productivity. Thus, it is very

important that not only the number of labour required is fulfilled but well trained to equip labour with suitable skill and competency to meet process and product compliance. This finding confirmed that there was no positive significance impact between number of labour and output.

5.3.3 Relationship between number of labor and output accuracy

This section is to confirm the following hypothesis:

H3: Labour has a positive significant effect on output accuracy.

Stand alone, labour has very minimum impact on output accuracy but when combined with the other resources labour influence the output accuracy greatly. This empirically proven that even though low impact, the number of labour still played a significant role as a value creator when combined with other resources. Organization might need to look at the impact of labour from a different view, not only on the number of labour but the human capital (skill and capability). With medium level of predictive relevance, prediction could be made pretty close in forecasting future output accuracy performance. This finding confirmed there was no positive significant impact of number of labour on output accuracy.

5.3.4 Relationship between number of labor and work-in-process

This section postulates the following hypothesis:

H4: Labour has a positive significant effect on work-in-process.

The number of labour has a low significant influence on the number of work-in-process individually or combination with other variables in the study. With low predictive relevance on work-in-process, number of labour could be used for future prediction but with caution. Bootstrapped analysis confirmed the low significant effect between labour and work-in-process. A low predictive relevance and low significant effect between number of labour and work-in-process revealed that the company must not only focus on the number but also skills of the labour because the availability of labour whether skilled or no skill directly impact to the number of work-in-process creation and clearance (G. Miller, 2011). The finding confirmed there is no positive significant effect between labour and work-in-process.

5.3.5 Relationship between number of labor and the net sales

This section is to describe and confirm the following hypothesis:

H5: Labour has a positive significant effect on net sales

Individually and combined with other resources, labour contributed highly and has a medium predictive relevance in forecasting of future labour impact on net sales. Considering a significant effect of labour on net sales, it is crucial to measure labor performance and development (Dunford, Snell, & Wright, 2001). It was proven that labour is value added resource (Dooley, 2005). Thus, it is crucial for managers to obtain skills in resource bundling and deployment (A.Hitt, 2006) in order to fully utilize the resources and capabilities to maximize the return. The finding confirmed there was a positive significant effect of labour on net sales.

5.3.6 Relationship between work-in-process and on-time delivery

This section concludes the following hypothesis:

H6: Work-in-process has a positive significant effect on on-time delivery.

The shop-floor theory states that the amount of work-in-process does have a direct relationship with manufacturing lead time (Whybark, 1993) but does the level of work-in-process has a significant effect on the achievement of the number of on-time delivery? The statistical tests revealed that work-in-process has a low significant impact on on-time delivery but increases significantly when combined with other variables. The bootstrapped analysis results confirmed the least significant impact of work-in-process on on-time delivery.

In other words, disregarding the level of work-in-process, it has very little impact on on-time delivery, simply because it is the final complete product that is sold but not the work-in-process. Work-in-process is a “temporary buffer” to be processed and converted into the final output within the shortest time possible with no defect in order to meet the targeted completion date and achieve on-time delivery. The rate at which work-in-process is converted into output depending on the processing time or also known as “throughput time”, which requires thorough inspection to avoid loss time in waiting, inspection, queuing, transportation and other non-value add activities in the process. Reduction in processing, or specifically throughput time, will increase flexibility and reduce time to complete a product in order to meet customer delivery date (Raj Mohan R, 2013). Another study emphasized on the importance of low level of work-in-process in the reduction of lead time to expedite the completion and meet on time delivery(Wang, 2009). Thus, the rate of throughput time is more important than the number of work-in-process

when expediting to meet on-time delivery. The higher the number of work-in-process, the higher possibility that the on-time delivery will fail due to increase in manufacturing lead time (Lang, 2011).

5.3.7 Relationship between number of work-in-process and number of output

This section discusses the following hypothesis:

H7: Work-in-process has a positive significant effect on output.

Individually as well as combined with other resources, work-in-process contributed highly to output. The predictive relevance was also at highly significant level, which means that future forecast on the effect of work-in-process on output could be made based on this construct accurately. As further verification, the bootstrapped analysis revealed a large significant effect by work-in-process on output. Given the fact that work-in-process has a high impact on output, it is critical to manage the constraints and avoid delay in processing of work-in-process at every station in an organization (Saraswat, Kumar, & Kumar Sain, 2015).

Work-in-process is handled by labour that converts work-in-process into a final manufactured product. As proposed in the theory of constraints, the drum-buffer-rope concept is the invisible link created when work-in-process flows to smoothen the manufacturing processes from start to end. The identification and creation of the value stream mapping process, application of

the pull system, operating in small batches, running at a pace of the takt time (Goldratt Institute, 2009) and to expedite the work-in-process in an areas where a bottleneck exists will eventually reduce lead time and expedite completion to meet on-time delivery (Institute of Management Accountant, 1999). Labour refers to human capital's handling of the manufacturing process to transform work-in-process to be a complete saleable product in an organization and both can be treated as valuable assets or resources to the organization.

It can be concluded that to have maximum output, work-in-process should be managed as a priority compared to labour, which is a value added resource. The significant effect of work-in-process followed by labour on the number of output is confirmed valid, as supported by this finding. Treated as a critical resource in manufacturing, this result agrees with resource-based view theory which urges the well managed deployment of resource resulting in value added product (Gupta & Boyd, 2008). Thus, for management to strategically manage the output, work-in-process should be deployed and managed closely. As the drum-buffer-rope analogy described under Theory of Constraint, inconsistency of work-in-process is a bottleneck that will disrupt the flow of the process and by following the method suggested under the drum-buffer-rope process. Thus, work-in-process would be smooth and no broken linkage in the flow would emerge (Institute of Management Accountant, 1999), eventually resulting in on-time completion and delivery.

5.3.8 Relationship between number of work-in-process on output accuracy

This section concludes the following hypothesis:

H8: Work-in-process has a positive significant effect on output accuracy.

The predictive relevance of the work-in-process to output accuracy is at medium level of significance and can be used as reference when doing forecasting in the future. A P- value and T-statistic confirmed a high significant impact between work-in-process and output accuracy. Work-in-process is also one of the resources that need to be managed wisely to produce maximum profit and least cost (Institute of Management Accountant, 1999). A technique proposed is through the drum-buffer-rope concept under the theory of constraint (Institute of Management Accountant, 1999). A manufacturing company's ultimate production target is to produce optimum output within the shortest time using the most optimum resources (Kingsman, 2000).

As generally believed, the more days the work-in-process stay on the shop floor, the greater the cost and more expensive the product becomes due to its handling and storage costs. The right part become more and more difficult to move as the pool of work-in-process keeps piling up on the shop floor resulting in wrong part produced, which eventually leads to long lead time, missed completion as well as on-time delivery dates. Even though the results showed work-in-process has a low impact on the accuracy of the output in this study location, the critical nature of working on the right work-in-process is crucial to avoid the wrong part completed and delays in delivery. The

significance of the right part produced at the right time was a lesson learned the hardest way by Boeing in its 787 Dreamliner model where the wrong priority on work-in-process resulted in millions of dollars lost (Leach, 2009).

5.3.9 Relationship between work-in-process and net sales

This section concludes the following hypothesis:

H9: Work-in-process has a positive significant effect on net sales.

Statistical findings about the relationship between work-in-process and net sales showed work-in-process had low significant impact on net sales and the predictive relevance for the construct between work-in-process and net sales is low. Individually, work-in-process has a low impact but together with others resources, work in process contributes highly to net sales. The bootstrapped analysis confirmed that there was a low significant impact between work-in-process and net sales. Work-in-process is a cost to the organization until it is completed and sold to customer. However, work-in-process is one of the resources that need to be managed together with labour. Work-in-process need to be processed as complete output accurately and shipped on-time to customers (Duranik, T; Ruzbarsky, J & Stopper, 2012).

5.3.10 Relationship between number of output and on-time delivery

This section postulates the following hypothesis:

H10: Number of output has a positive significant effect on on-time delivery.

The statistical test had shown that there was a low significant level of impact by output and on-time delivery, but it does not mean that it is not required. Medium predictive relevance means that the construct could be used to forecast future trends but with caution. The number of output does not impact greatly on on-time delivery simply due to the fact that production can be running at maximum to produce maximum output but if the customer does not place an order to buy, then there will be no delivery made, thus no sales. In such a case, production might run for make-to-stock requirement rather than for shipment. The empirical results denied the hypothesis that number of output significantly affects the on-time delivery.

5.3.11 Relationship between number of output and number of output accuracy

This section postulates the following hypothesis:

H11: Output has a positive significant effect on output accuracy.

The statistical result revealed the number of output greatly contributed to output accuracy either individually or combined with other variables. Thus, there was a high significant level of impact between output and output accuracy. Furthermore, there was a high predictive relevance in forecasting future impact of output on output accuracy. Output quantity produced by production team was based on the plan provided by planning team. Thus, the accuracy of the output or part produced is definitely very highly accurate.

5.3.12 Relationship between number of output and net sales

This section discusses and concludes the following hypothesis:

H12: Output has a positive significant effect on net sales

The statistical tests showed that number of output has a low effect on net sales and there was a low level of predictive relevance between number of output on net sales. Thus, number of output cannot be used as a predictive variable to forecast net sales in the future in this study location. P-value and T-statistic values also revealed a significantly low impact by output on net sales. Output is simply the number of product produced whereas net sale is the value of product sold after minus all expenses. It does not matter how many goods are produced as output, if it does not sell, no sales are made. However, balancing between demand, production planning and production of the right output is really a key to maximizing sales or net sales through optimization of resources.

5.3.13 Relationship between the number of output accuracy and on-time delivery

This section postulates the following hypothesis:

H13: Output accuracy has a positive significant effect on on-time delivery.

The findings on output accuracy effect on on-time delivery showed there was lack of significant effect by the output accuracy on on-time delivery. The predictive accuracy was also weak. The bootstrapping value analysis confirmed that there was a significantly low impact of output accuracy and on-time delivery. It is commonly understood that output accuracy is a necessity to

meet the on-time delivery target in terms of the right part produced. However, the portion of the accuracy of part produced played no significant role in the construct.

Number of output and output accuracy are highly related. A similar explanation on output and on-time delivery was applied for output accuracy impact on on-time delivery. Production can produce the maximum quantity per the plan to drive high output accuracy but not necessarily to be shipped. Production might run to built stocks instead of aiming to ship. This empirical finding denied the hypothesis that output accuracy has a significant impact on on-time delivery.

5.3.14 Relationship between the number of output accuracy and net sales

This section discusses and concludes the following hypothesis:

H14: Output accuracy has a positive significant effect on net sales.

Output accuracy had a medium level of significance effect on net sales with a predictive relevance value indicating a lower level of accuracy, which means the forecasting trend could be made but with caution due to its low level of accuracy. The right product must be produced within the planned time frame guarantees the on-time completion and delivery. Sales are made when the right product is sold but not necessarily on-time. A high number of output does not necessarily end up in sales, but in order to make sales, the right part must be produced. Should the product produce is not the right product, company is at

risk of losing sales as what happen to Tesla who missed the delivery due to failure to produce the specified car model as planned (Bhuiyan, 2016). On the contrary, customer might accept a different product, hence sales are made. Thus, it explained the effect of output accuracy was not significant on net sales.

5.3.15 Relationship between on-time delivery and net sales

This section postulates the following hypothesis:

H15: On-time delivery has a positive significant effect on net sales

The statistical test results revealed there was no significant impact by on-time delivery on net sales. On-time delivery alone showed low contribution level to net sales but when combined with other resources, contributed highly to on-time delivery. The bootstrapping analysis revealed no significant effect by on-time delivery on net sales. The logic is true because sales is generated even though delivery is made late but at the expense of air shipment cost or penalty put up by customers. Labor producing the right product in the right quantity at the right time contributed to on-time delivery but yet sales are made despite late delivery, although net sales could be lower due to penalties. Organizations need to look into the on-time completion if it wishes to achieve full sales from the product sold.

5.4 Contribution

The research findings would significantly contribute, not only to the organization but also within theoretical and knowledge among academic

practitioners and practical among the industry particularly the aerospace industry players.

5.4.1 Theoretical Contribution

Theoretically, apart from being a collaborative partner in the academic community, a documented industrial research finding has added value to the current corpus of knowledge and literature in operations management, specifically in operational strategy in aerospace composites manufacturing practices. The research findings had actually added some knowledge to the limited number of literatures on the application of the resource-based view theory in aerospace manufacturing industry since there is very limited reference of the documented application of the resource-based view theory applied in the aerospace manufacturing organization (Mills et al., 2003).

Resource-based view critics pointed out that the literature has been focusing on general guidelines for the identification of distinctive competencies rather than the practical side of the theory, particularly in the public sectors. Bryson & Ackerman (2007) suggested a mechanism for applying the resource-based view theory in the public sector by picking a case study at the training and consultancy unit in United Kingdom's National Health Service to become a case study. There has also been a study on the resource-based view theory in the area of innovation in Italy's food industry (Carraresi et al., 2012) and supply chain. Thus, with this study carried out in a real objective scenario in Malaysia, it has proven to be a real and most practical way to test and confirm

the literatures. This empirical finding of labour's significant impact to on-time delivery in an aerospace manufacturing industry has added more value to the corpus of knowledge in the resource-based view theory applications in the real world.

5.4.2 Organization Contribution

From a managerial point of view, this study's findings are inputs for the composite manufacturing company in the form of optional for operational strategy for achieving and sustaining on-time delivery. Management must look at these factors and strategically integrate the resources and capabilities using the mix and match method so that resources and capabilities are deployed for optimum utilization.

Consistency in meeting the on-time delivery will improve shareholders' confidence in future investments. This sustainability in meeting on-time delivery is one of the reasons for increasing rate for bonus, which lead to increasing morale among the employees. Furthermore, more and more savings have been made as less and less AIR shipments are needed every month. Being the sole manufacturer of several Boeing composite panels, the credibility of this manufacturing company has eventually been internationally recognized. This makes the study finding seven more critical in a sense that it actually boosts up the recognition of its operational strategy in meeting customer's expectation (Hallgren, 2007) with regards to on-time delivery.

The most focus and strategy should be directed towards maximizing the deployment of labour as a rare, value added resource. The fact the direct labor and work-in- process are considered as costs to the organization (Institute of Management Accountant, 1999), it is highly significant for the management to optimize the deployment of these critical resources at the lowest possible cost in order to always operates within ten percent or less overtime costs. Employing multi-skilled labour and job rotation are other options to operate as lower costs, such as that being internally practiced by the operation and quality department, as well as all support departments in the organization.

Another important contribution of this study to the organization is the practicality of the study, which took place in an actual manufacturing company; thus, it will not only serve as an approach to problem solving but also improve managerial skills of the researcher and team members as the study made use of the subject matter experts in an organization as the participant and the researcher is part of the team. This action eventually resulted in a benchmark for current practices, increased awareness in areas of management choice and finally, increased the understanding of the dynamics of conceptually-based collaboration among researchers and managers (Coughlan &Coughlan, 2002). The real finding has actually confirmed the literature concerning the collaboration that resulted in increased awareness and improved managerial skills.

This study also has become an eye opener for the management team on the importance of focusing on the right variables in order to obtain maximum output to meet on-time delivery.

This study is also significant as it can promote the company as a benchmark for systemic management of resources aimed to achieving the on-time delivery for aerospace manufacturing industry's player in Malaysia.

5.4.3 Practical Contribution

Practically, the research findings could be a contribution to the industry in Malaysia as there is very limited number of manufacturing company that is specialized in aerospace composite manufacturing in Malaysia. With its uniqueness, this organization will be a benchmark for other similar industries by providing documented benchmarking on operational strategy in order to achieve and sustain the on-time delivery performance.

The findings would definitely be another reference for the industrialists and academicians on how the aerospace manufacturing industry is managed in order to stay competitive in the industry. The study location has been until today a practical training ground for university students where action learning takes place. Thus, creating potential employment opportunities for Malaysian, specifically northern Malaysia community, has been strongly supported by the encouraging statement made by ACM former General Manager, Mr. Robert Moray at the MOU signing ceremony between ACM and University Malaysia Perlis (UNIMAP) as reported by Standards Malaysia (MOSTI) in January 2011:

“It is imperative for students to be equipped with the industry related knowledge and skills. This is achievable with the assistance from industry and giving them an opportunity to get the necessary experience and information.

This relationship can only be achieved by strong collaboration from both parties (industry and education institutions)”.
Source: (MOSTI, 2011).

To the academic industry, the research will be a bridge between the industry and educational institution. This is supported with an ongoing collaborative initiative with the nearest universities and technical colleges to support these institutions in preparing future graduates with the right industrial technical knowledge to provide employment sustainability among the graduates when they become part of the industrial community. Furthermore, the current Managing Director, Mr. Daniel Park is also emphasizing on the collaborative effort between the organization and universities, with the Asian School of Business as the latest addition.

The research findings will be another positive step for the organization to further develop its resources and capabilities to enable the organization to continuously improve towards being a world class composite manufacturing organization in the region and the world.

5.5 Limitation of current study

This research was done within the scope of an aerospace composite manufacturing company in Malaysia where there is very limited number of similar manufacturing companies in the same industry. The research was merely to investigate the significant impact of the identified resources as variables and constructs affecting on-time delivery performance in the

aerospace composite manufacturing organization. It did not explore how to effectively and efficiently deploy these resources and capabilities to consistently achieve on-time delivery.

This study did not provide a method to manage low or high impact resources and capabilities in this aerospace composite manufacturing company. This topic could be another area for research that could potentially contribute to the organization and industry.

The researcher performed this study on a part-time basis, where the location and scope of the study was limited to the actual work place and the priority and urgency tended to be aligned to work place requirements rather than the academic world. The limitation of the aerospace industry reference in Malaysia is another shortcoming that researcher had to endure. There was a lack of reference sources from similar culture, economy, social and political backgrounds that result in tendency to always refer to the same reference source.

5.6 Recommendation for future study

Area for future studies should focus on finding ways to measure direct labour utilization since direct labour is the main contributor to on-time delivery in this organization. It is such a waste if the resources that are critical are not managed and measured for utilization and further developed for better capability and capacity optimization.

The importance of labour (human capital) as an organization's asset should be taken very seriously. Direct labour utilization must be measured objectively to assure optimum utilization of resources and as baseline reference for further development of human capital in the organization. Absence of direct labour utilization measurement is an area that need to be explored and improved (Banker et al., 2002) in this organization.

The scope of work-in-process management is another potential area for future research to further improve and define the way work-in-process could be deployed and digested to support the achievement of on-time production and delivery.

This study revealed that the number of work-in-process has a major effect whereas number of labour has a low effect on number of output. This means added value by labour in creating work-in-process (Dooley, 2005) is equally important but work-in- process is too critical not to be considered when producing output (Institute of Management Accountant, 1999). How to manage the weakest link is a challenge that leaders and managers need to be proficientat. Unfortunately, this study did not provide a method to manage this weakest link in this manufacturing company. This topic could be another area of study or improvement that the researcher can look into in future, which could be another potential contribution to the organization and industry.

5.7 Conclusion

To conclude, this study was implemented and responded to the research questions and objectives. The main objective of the study was to examine the significant effects of number of labor, output, output accuracy and work-in-process on on-time delivery and net sales and the influence of the on-time delivery on net sales based on resource based view perspective. Thus, to identify the most significant resources and capabilities to be managed strategically in order to achieve and sustain the on-time delivery.

To summarize the findings, the results from the study suggested that labour was a major contributor to on-time delivery compared to output, output accuracy and work-in-process. This confirmed that the theory of labour, which proposed that labour is value added resource (Dooley, 2005), was supported by resource-based view theory in regards to deployment of resources and capabilities in order to achieve efficient utilization of resources and capabilities (Francisco, 2015).

Labour has a major effect on on-time delivery compared to number of output, work-in-process and output accuracy. Even though labour is required to produce work-in-process in order to create output, research findings revealed labour contributes most to on-time delivery instead of work-in-process, output or output accuracy itself. Acknowledging the labor-intensive nature of the manufacturing work in this aerospace composite manufacturing organization, it is confirmed that labour plays a major role in the value creation process to achieve on-time delivery continuously. The collective knowledge and

expertise learnt and developed as employees grow with the organization becomes the rarely, intangible competency owned by the organization and the industry. The closest example is the NDT Level-3 expert in the study location. He is one of the very small numbers of competent experts in the world. Another example is the discipline and the lean culture imbedded among the skilled employees who produced the right output in the right quantity, at the right time, which is capabilities that not everyone can easily gain without specific training or certification.

Thus, it is significant that labour is continuously nurtured and developed to a maximum, with optimum skill and full utilization. To support this human capital asset development, organization must focus on the skills training and enhancement among manufacturing technicians to ensure the required skills and requirements are up to date with dynamic changes in technology particularly in the aerospace industry.

Instead of focusing on the labour, organizations should also prioritize the management of work-in-process. Work-in-process has the highest effect on the number of output. However, it has no significant effect on output accuracy, net sales and on-time delivery. To further improve the work-in-process management, the organization consistently forms a team of employees to continuously review and change towards a better system to manage constraints and requirements to reduce the throughput time. Work-in-process balances and expedites within the agreed lead time to complete on-time is an assurance to meet on-time delivery in this study location. Recently, through

collaborative efforts between employees from ACM and students from the Asian School of Business (ASB), coached by Professor James Womack, both had jointly launched a throughput time reduction project to reduce the time taken to expedite completion and ship on-time (January 2017).

Number of output is the result of resources and capabilities (labor and work in process) deployment in manufacturing activities. As mentioned by Kingsman (2000), target for production is to produce the required parts using the available resources and capabilities (Kingsman, 2000), whereas the theory of constraint (Institute of Management Accountant, 1999) suggests that the way to produce maximum output in a system is through the application of drum-buffer-rope concept, which is the invisible link that ties processes together to create a smooth synchronous flow. The idea, which states that the output is determined by the capability of the weakest link in the system is actually true, as being observed in the operations at this study location. The number of output which is the result of the value added contributed by the number of labour on work-in-process in the manufacturing processes has the highest significant effect on output accuracy.

Aerospace Composite Manufacturing company is a living example of a dynamic capabilities practitioner. From a small aerospace manufacturing operation with 100 employees producing 100s of flat wing panels, it is now operating with 1,000 plus employees producing more than 10,000 flat and contoured wing panels monthly. It is a living proof that the organization is capable of integrating, building and reconfiguring its human capital

(resources), skills and processes (capabilities) to continuously grow and sustain fierce competition in the aerospace manufacturing industry locally in Malaysia and internationally. As shareholders, Hexcel and Boeing are strongly confident of this company's capability and competency to handle additional works, especially with the expansion of the current building(Hexcel, 2013).

The latest development in the aerospace quality standard is risk management. Among the elements that need to be managed is "people". When talking about labour or 'people' and manufacturing performance, it is very difficult to avoid mentioning factors such as employee participation, productivity, throughput and sustainability, which focus on employees' participation and involvement in the manufacturing of the right product at the right time, as well as completion and on-time delivery to customer (Curry & Kadasah, 2002). The importance of labour in the organization's performance was clearly shared by another study comparing the significance of having direct labour measured or not measured, where those measured direct labour showed an improvement in performance, thus, suggesting that it is important to have measured direct labour performance (Banker et al., 2002) as it directly impacts the on-time delivery performance. Thus, it has been substantially shown that labour is a resource that must be nurtured, developed, deployed and monitored to consistently create added value in the product to generate sales in an organization no matter how big the impact it is individually because as a whole it is still labour that creates the value in the process (Dooley, 2005).

To conclude this study, it is empirically proven and supported by statistical analysis that labour plays major role in achieving the on-time delivery in the aerospace manufacturing organization. This study statistically proven that all resources and capabilities combined strategically will provide the greatest achievement.



REFERENCES

- Aberdeen, G. (2012).
- Adams, K. M., & Mun, J. H. (2005). The Application of Systems Thinking and Systems Theory to Systems Engineering. *26th ASEM National Conference Proceedings*, (pp. 493-501).
- Alfred L. Guiffrida, M. Y. (2007). Managerial and economic impacts of reducing delivery variance in the supply chain. *Science Direct* , 2149-2161.
- Althoff, & Werhane, K. (2011). *Leadership, Gender and Organization* (Vol. 27). (P. H. Werhane, & M. P. Morland, Eds.) Springer Dordrecht Heidelberg London New York.
- Arthur, K. (1967). *The Ghost in The Machine*.
- Babbie, E. R. (2010). The Practice of Social Research. *Doing Quantitative Research in Education with SPSS*. (12). London: SAGE Publications.
- Barney, J. B. (2001). Is The Resource-Based "View" A Useful Perspective For Strategic Management Research? Yes. *Academy Of Management Review* , 41-55.
- Behrens, A. (2010). Managing the supply chain across the aerospace lifecycle. *Taxal* , pp. 1-10.
- Berk, J., & Associates. (1984). Retrieved 2018, from <http://www.jhberkandassociates.com/>.
- Black, J., & Boal, K. (2007). Strategic Resources: Traits, Configurations and Paths to Sustainable Competitive Advantage. *Strategic Management Journal* , 131-148.

- Boyd, M. C. (2008). Theory of constraints: a theory for operations management. *International Journal of Operations & Production Management* , 991-1012.
- Bradford, G. (2015, August 24). *The 5 Types of Manufacturing Processes*. Retrieved from www.machinedesign.com.
- Breyfogle, F. W. (2014, November 3). Fiive Techniques Reducing Manufacturing WIP - Lean Six Sigma Project Opportunity. *Quality Manual* .
- Bryson, J. M., Ackermann, F., & Eden, C. (2007). Putting the Resource-Based View of Strategy and Distinctive Competencies to Work in Public Organizations. *Public Administration Review* , 702-714.
- BusinessDictionary. (2018). Retrieved June 4, 2018, from <http://www.businessdictionary.com/definition/systemic.html>
- Cambridge, D. (2018). (Cambridge University Press) Retrieved 2018
- Cao, G., Clarke, S., & Lehaney, B. (2000). A systemic view of organisational change and TQM. *The TQM Magazine* , 186-193.
- Carraresi Laura, X. M. (2012). Strategic Capabilities and Performance: An Application of Resource-Based View in Italian Food SMEs., (pp. 186-209).
- Castanias, & Helfat. (2001). The managerial rents model: Theory and empirical analysis. *Journal Of Management* .
- Christo, C., & Cardeira, C. (2006). Trends in Intelligent Manufacturing Systems. *IEEE Explore* .
- Clardy, A. (2013). Strengths vs. Strong Position: Rethinking the Nature of SWOT Analysis. *Modern Management Science and Engineering* , 1-23.

- Coghlan, C. &. (2002). Action Research for operationsmanagement. *International Journal of Operation and Production Management* .
- Collis, D. J., & Montgomery, C. A. (2005). *Corporate Strategy: A Resource-Based Approach*. Boston: McGraw-Hill/Irwin.
- Daily Express. (2015). Malaysia needs stronger aerospace players.
- David G. Sirmon, S. G. (2008). Resource Management in Dyadic Competitive Rivalry: The Effects Of Resource Bundling and Deployment. *tAcademy of Management Journal*, 51 (5), 919-935.
- De Vaus, D. A. (2001). *Research Design in Social Research*. London: SAGE Publications.
- Degan, R. J. (2011). Fordism and Taylorism are responsible for the early success and recent decline of the U.S. motor vehicle industry . 1-30.
- Denzin, N. K. (2005). *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage Publication .
- Dierickx, I., & Cool, K. (1989). Asset Stock Accumulation And Sustainability. *Management Science* , 1504-1511.
- Dooley, P. C. (2015). *The Labour Theory of Value: Economics or Ethics?* Retrieved from <http://copejournal.com>.
- Dumitrache, I., & Caramihai, S. I. (2010). The Intelligent Manufacturing Paradigm in Knowledge Society. 36-56.
- Dunford, B. B., Snell, S. A., & Wright, P. M. (2001). Human Resources and the Resource Based View of the Firm. *Cornell University, School of Industrial and Labor Relations, Center for Advanced Human Resource Studies*.

- Economist, T. (2008). Retrieved from <https://www.economist.com/node/12510632>
- Farid, A. M. (2004). *A Review of Holonic Manufacturing Systems Literature*.
- Ford, D. N., & Mahieu, L. A. (1998). Operationalising The Resource- Based View Of The Firm. *International System Dynamics Conference, Quebec* , (pp. 1-16).
- Forrester, J. W. (1989). *The Beginning of System Dynamics*. Stuttgart, Germany.
- Fowler, A. (1999). Feedback and feedforward as systemic frameworks for Operations Control. *International Journal Of Operations and Production Management*, 19 (2), 182-204.
- Francisco, J. (2015). *Resource-Based View and Dynamic Capabilities: Achieving Competitive Advantage Through Internal Resources And Competences*.
- Gaya, H. J., Struwig, M., & Smith, E. E. (2013). Creating a sustainable competitive advantage at a high performing firm in Kenya. *African Journal of Business Management* , 2049-2058.
- Gaya, H. J., Struwig, M., & Smith, E. E. (2013). Creating a Sustainable Competitive Advantage at a High Performing Firm in Kenya. *African Journal of Business Management* , 2049-2058.
- Giachetti, R. E. (2005). *Formation Of An Electronics Manufacturing Supply Chain Via Information Models*.
- Goodson, R. E. (2002). *Operations Management Glossary*. University of Michigan Business School.
- Grant, R. M. (1991). Resource- Based Theory Of Competitive Advantage: Implications For Strategy Formulation. *California Management Review* , 114-133.

- Gunasekaran, A. C. (2004). A framework for supply chain performance measurement. *International Journal Of Production Economics* , 333-347.
- H.T. Papadopoulos, C. H. (1996). Queueing theory in manufacturing systems analysis and design:A classification of models for production and transfer lines. *European Journal of Operational Research* , 1-27.
- Hallgren. (2007). Manufacturing Strategy, Capabilities and Performance.
- Hitt, A. (2006). Resource Bundling and Deployment. *Academy of Management Journal* .
- Hsien-Ming Chang, C. H.-C. (2013, April). Lean Production Implement Model for Aerospace Manufacturing Suppliers . *International Journal of Innovation, Management and Technology* , 248-252.
- Institute Goldratt. (2009).
- Investopedia. (n.d.). Retrieved May 17, 2018, from <https://www.investopedia.com/terms/n/netsales.asp>.
- Islam, M., Hamid, A. A., & M.A.Karim. (2007). Manufacturing Practices and Performances: A Malaysian Study. *International Review of Business Research Papers*, 3 (2), 147 - 161.
- Ismail, A. I., Rose, R. C., Uli, J., & Abdullah, H. (2012). The Relationship Between Organizational Resources, Capabilities, Systems And Competitive Advantage. *Asian Academy Of Management Journal*, 17 (1), 151-173.
- Jie, D. F. (2011). Australian Lamb Supply Chain: A Conceptual Framework. *55th Annual Australian Agricultural and Resource Economics Society Conference*. Melbourne Australia.

- John M. Bryson, F. A. (2007, July-August). Putting the Resource-Based View of Strategy and Distinctive Competencies to Work in Public Organizations. *Public Administration Review* , pp. 702-717.
- John Mills, K. P. (2003). Applying resource-based theory: Methods, outcomes and utility for managers. *International Journal of Operations & Production Management* , 148-166.
- Johnson, D. J. (2003). A Framework for Reducing Manufacturing Throughput Time. *Journal Of Manufacturing System* .
- Kallet, R. H. (2004, October). How to Write the Methods Section of a Research Paper. Univrsity of Southern California . Retrieved from <http://libguides.usc.edu/writingguide/methodology>.
- Kamboj, S., Goyal, P., & Rahman, Z. (2015). A resource-based view on marketing capability, operations capability and financial performance: An empirical examination of mediating role. *XVIII Annual International Conference of the Society of Operations Management*, (pp. 406-415).
- Kostal, P., & Holubek, R. (2012). The Intelligent Manufacturing Systems. *American Scientific Publishers* , 1-5.
- Kwecien, B. J. (2008). Queueing systems and networks. Models and applications. *BULLETIN OF THE POLISH ACADEMY OF SCIENCES TECHNICAL SCIENCES*, 56 (4), 379-390.
- Library Olin Uris. (2012). <https://olinuris.library.cornell.edu/content/seven-steps-research-process>. (O. U. Library, Producer) Retrieved from <http://vivo.cornell.edu/display/individual22712>.

- Lippman, S. A., & Rumelt, R. P. (2003). A bargaining perspective on resource advantage. *Strategic Management Journal* .
- Long, R., Mohtar, S., & Ahmad, F. (2016). Systemic Perspective Of Work In Progress and On-Time Delivery. *Journal of Technology and Operations Management*, 11 (2), 99-106.
- Madhusudhana, R. C., Prahlada, R. K., & Muniswamy, V. (2011). Delivery Performance Measurement in an Integrated Supply Chain Management: Case Study in Batteries Manufacturing Firm. *Serbian Journal of Management* , 205-220.
- Madhusudhana, R. C., Rao, K. P., & Muniswamy, V. (2011). Serbian Journal Of Management. 205-220.
- Mahoney, J. T. (1995). The Management of Resources and the Resource of Management . *Journal of Business Research* , 91-101.
- Mahoney, J., & Pandian, J. R. (1990). *The Resource- Based View Within the Conversation of Strategic Management*. University of Illinois Urbana-Champaign.
- Martyn, F. (2002). *Holonic Manufacturing Systems: Some Scenarios and Issues?*
- Matthews, C. (2015, May 6). Retrieved May 20, 2018, from <https://chargeback.com/top-10-reasons-for-a-product-return/>.
- Mete, E. S., Sokmen, A., & Biyik, Y. (2016). The Relationship between Organizational Commitment, Organizational Identification, Person-Organization Fit and Job Satisfaction: A Research on IT Employees. *International Review of Management and Business Research* , 5 (3), 870-901.

- Miller, D., & Shamsie, J. (2008). Resource-Based View of The Firm in Two Environments: The Hollywood Film Studios From 1936 to 1965. *Academy Of Management Journal* , 519-543.
- Morel, G., Panetto, H., Zaremba, M., & Mayer, F. (2003). Manufacturing Enterprise Control and Management System Engineering: Paradigms and Open Issues. *IFAC Annual Reviews in Control* , 199-209.
- Nickols, F. (2007). Understanding Work & Work Control Systems: The Key To Making Work Productive. *BP Trends* , 1-15.
- Peteraf, M. A. (1993). The Cornerstones Of Competitive Advantage: A Resource-Based View. *Strategic Management Journal*, 14, 179-191.
- Porter, M. E. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: Free Press.
- Priem, R. L., & Butler, J. E. (2001). Is The Resource-Based "View" a Useful Perspective For Strategic Management Research? *Academy Of Management Review* , 22-40.
- Qudrat-ullah, & Lee, J. (1997). The Value Cycle Model: Understanding the Dynamics of Value Based Management., (pp. 1-14).
- Ricardo, M., George, R., & Batocchio, A. (2009). Extending Holonic Manufacturing Systems To Achieve The Virtual Supply Chain Domain. *Journal Of Operations and Supply Chain Management*, 2 (2), 47-55.
- Rittel, H. (1968). System Thinking . In *Resilience by Design* (pp. 19-32).
- Robinson, S. M. (2008). Understanding the Resource-Based View: Implications of Methodological Choice and a New Creative Context. (pp. 1-294). School of Management Faculty of Business Queensland University Of Technology.

- Rosnay, J. d. (1978). The Macroscopic A New World Scientific System. In J. d. Rosnay, *The Macroscopic A New World Scientific System* (pp. 3-222).
- Rouse, W. B. (2010). Understanding Complex Product and Service Delivery Systems.
- Ryan, A. J. (2011). *Applications of Complex Systems to Operational Design*. Retrieved from <http://necsi.edu/events/iccs2011/papers/40.pdf>
- Schmitt, J. F. (2006). A Systemic Concept for Operational Design.
- Shaha, R., & T.Ward, P. (2002). Lean Manufacturing: context, practice bundles and performance. *Jurnal Of Operations Management* .
- Shigeo, S. (1989). *A Study of the Toyota Production System From an Industrial Engineering Viewpoint*.
- Shingo, S. (1989). A study of the Toyota Production System from an Industrial Engineering viewpoint.
- Shishko, R., Aster, R., & Cassingham, R. C. (1995). *NASA systems engineering handbook*. National Aeronautics and Space Administration.
- Sirmon, D. G., Gove, S., & Hitt, M. A. (2008). Resource Management In Dyadic Competitive Rivalry: The Effect of Resource Bundling and Deployment. *Academy Of Management Journal*, 1 (5), 919-935.
- Star, T. (2012, October). Changlun may be made into aerospace centre. *The Star* .
- Sussland, W. A. (2003). Align your management processes for effectiveness. *THE TQM MAGAZINE*, 15 (2), pp. 108-116.
- Tanaka, N. (2003). Resource Based View and Core Competence Assessment. *Departmental Bulletin Paper* , pp. 199-244.
- Teece, D. J. (2017). Retrieved from www.davidjteece.com/dynamic-capabilities/.

- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities And Strategic Management . *Strategic Management Journal* , 509-530.
- The Star. (2014). Malaysia service sector to contribute more to economy. *The Star* .
- Trochim, W. M. (2006). Research Methods Knowledge Base. London: SAGE Publications.
- V.V.S Nikhil, B. P. (2015). A Review On Lean Manufacturing to Aerospace Industry. *International Journal of Engineering Research and General Science*, 3 (4), 429-439.
- Warhane, P. H., & Morland, M. P. (2011). Leadership, Gender and Organization.
- Wernerfelt, B. (1984). A Resource-Based View of the Firm. *Strategic Management Journal* , 171-180.
- Wikipedia. (1998). *Society of British Aerospace Companies*.
- Wikipedia, c. (2018, April 14). (T. F. Wikipedia, Producer) Retrieved from https://en.wikipedia.org/w/index.php?title=Resource-based_view&oldid=835221617.
- Willey, J. (2002). The resource-based view of strategy and its value to practising managers.
- Williams, T., Maull, R., & Ellis, B. (2002). Demand chain management theory: constraints and development from global aerospace supply webs. *Journal Of Operations Management* , 691-706.
- Wu, L.-Y. (2007). Entrepreneurial resources, dynamic capabilities and start-up. *Journal Of Business Research* , 549-555.

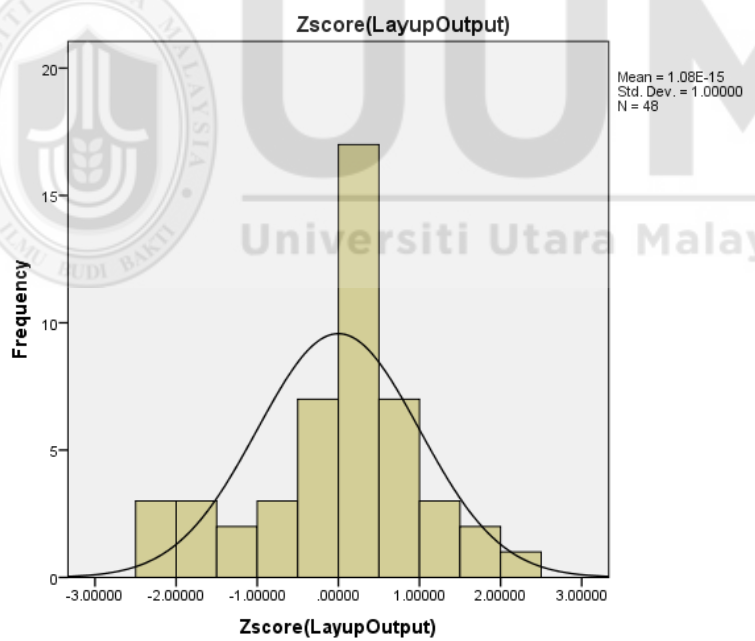
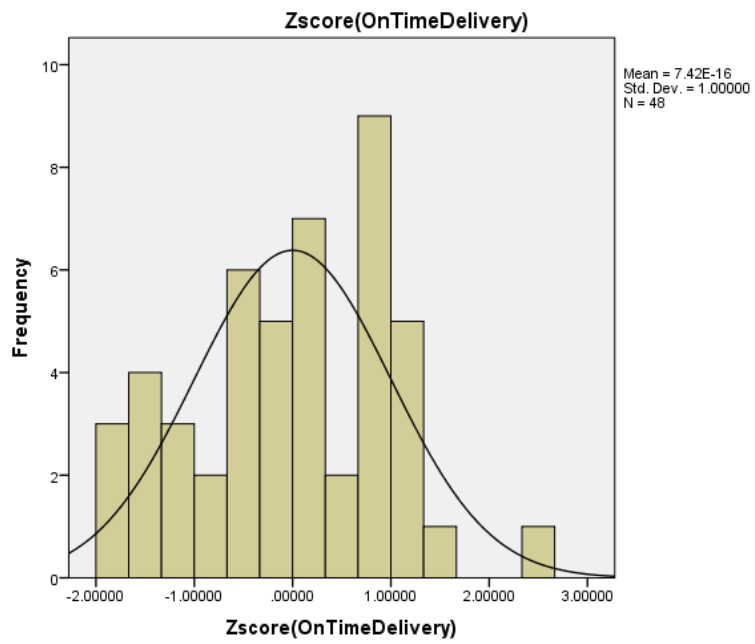
Zahra, S. A., & George, G. (2002). Absorptive Capacity: A Review, Reconceptualization, and Extension.

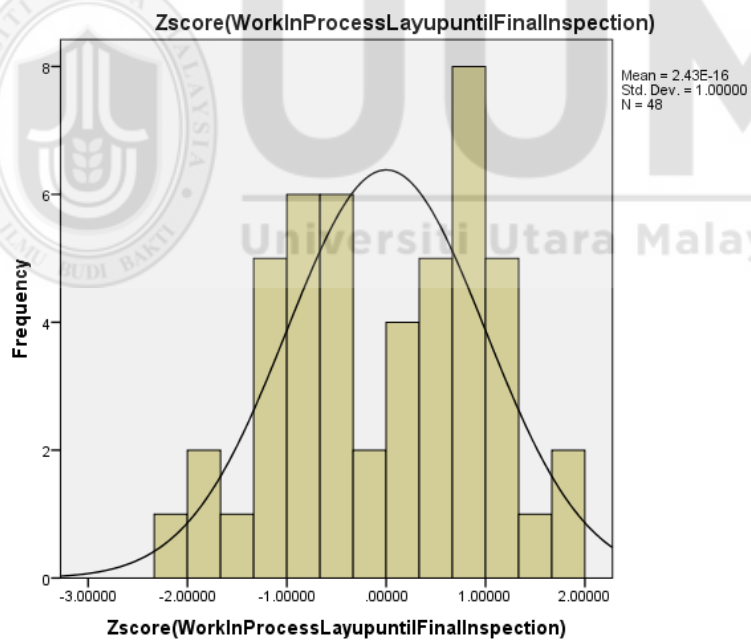
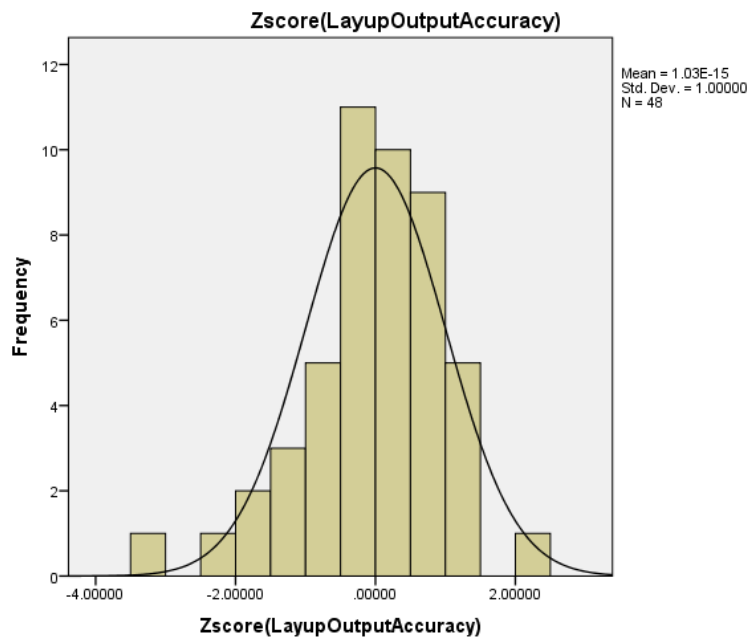


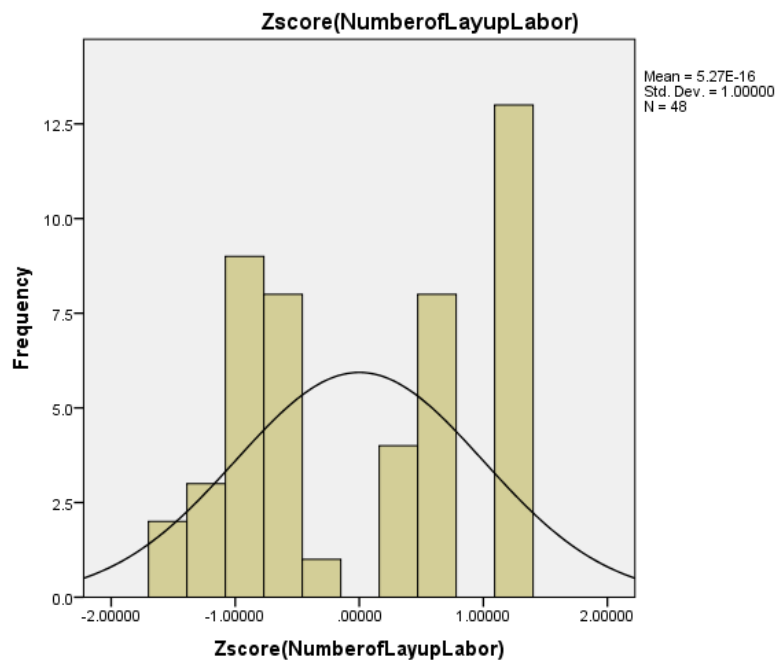
APPENDICES

Appendice1 *Missing value*

On Time Delivery	Output	Output Accuracy	Work in Process	Labor	Net Sales	Z on Time Delivery	Z Output	Z Output Accuracy	Z Work in Process	Z Labor	Z Net Sales
640	3456	3146	1370	55	15424282	-1.88793	-0.21601	-0.18837	-0.65537	-1.04764	0.39995
718	2192	2140	1675	50	13009867	-1.8048	-2.43808	-1.89585	-0.21199	-1.35767	0.00412
739	3662	3219	2103	93	725499.5	-1.78242	0.14613	-0.06446	0.41018	1.30859	-2.00982
1023	2689	2599	870	50	13679426	-1.47975	-1.56437	-1.11679	-1.3822	-1.35767	0.11389
1058	2660	2546	1058	55	15405939	-1.44245	-1.61535	-1.20675	-1.10891	-1.04764	0.39694
1066	2591	2319	1160	47	14010113	-1.43393	-1.73665	-1.59203	-0.96064	-1.54369	0.1681
1139	3429	3170	1205	54	16039967	-1.35613	-0.26348	-0.14763	-0.89522	-1.10965	0.50089
1205	3477	3353	1204	55	14436703	-1.28579	-0.17909	0.16298	-0.89668	-1.04764	0.23804
1320	3703	3594	1100	55	14829177	-1.16323	0.21821	0.57203	-1.04786	-1.04764	0.30238
1377	3342	2761	510	93	4261554	-1.10248	-0.41642	-0.84183	-1.90553	1.30859	-1.43011
1507	3653	3383	1294	55	18226694	-0.96394	0.13031	0.2139	-0.76585	-1.04764	0.85939
1646	2942	2532	1024	47	14370852	-0.8158	-1.11961	-1.23051	-1.15834	-1.54369	0.22725
1846	3823	3484	2049	60	15876040	-0.60265	0.42916	0.38532	0.33168	-0.73761	0.47401
1965	4862	4679	2762	92	4081163	-0.47583	2.25569	2.4136	1.36815	1.24658	-1.45968
1977	3005	2874	1487	81	17119140	-0.46304	-1.00885	-0.65003	-0.48529	0.56451	0.67781
2062	3965	3557	2183	55	17031884	-0.37245	0.6788	0.50923	0.52647	-1.04764	0.6635
2082	4183	4135	2482	60	17364700	-0.35114	1.06203	1.49027	0.96112	-0.73761	0.71807
2086	3300	3095	1350	76	16041520	-0.34688	-0.49025	-0.27493	-0.68444	0.25448	0.50114







UUM
Universiti Utara Malaysia

Appendices 2

Articles published derived from this thesis(Fowler, 1999)

Rozita Long, Shahimi Mohtar, Fakhrorazi Ahmad. (2016). Systemic Perspective Of Work In Progress and On-Time Delivery In Aerospace Manufacturing Company In Malaysia. Article published in *Journal of Technology and Operations Management* Vol 11, Issue 2, page 99-106 in 2016.

Rozita Long, Shahimi Mohtar, Fakhrorazi Ahmad. (2016). Resource Based View Perspective of the on Time Delivery in Aerospace Composites Manufacturing Company in Malaysia. Article published in *International Journal Of Modern Engineering Research (IJMER)* Vol 6, Issue 2, page 15 -19 in 2016.

