Faculty of Manufacturing Engineering

CHANGEOVER TIME IMPROVEMENT OF PRESSURE DIE CASTING MACHINE BY SINGLE MINUTE EXCHANGE OF DIE IMPLEMENTATION

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CHANGEOVER TIME IMPROVEMENT OF PRESSURE DIE CASTING MACHINE BY SINGLE MINUTE EXCHANGE OF DIE IMPLEMENTATION

MOHAMMAD AFIF BIN EMBOK RESA

A thesis submitted

in fulfilment of the requirement for the degree of Master of Manufacturing Engineering (Industrial Engineering)

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DECLARATION

I hereby declare this thesis entitled “Changeover Time Improvement of Pressure Die Casting Machine by Single Minute Exchange of Die Implementation” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Manufacturing Engineering (Industrial Engineering).

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Date : 5/10/2020

APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfilment of Master of Manufacturing Engineering (Industrial Engineering).

Signature : _____

Supervisor's Name : Associate Prof. Ts. Dr. Effendi bin Mohamad

Date : 5/10/2020

DEDICATION

To my adored mother, Saliza binti Roslan

Thank you so much for the infinite support, motivation, inspiration, financial and most importantly understands me.

ABSTRACT

Globally, the manufacturing sector has undergone a turbulent period due to the growing in the competition to the existing market. Therefore, companies should improve their productivity by implementing Quick Changeover to cater the issues. With that, a door hardware company in Melaka, Malaysia has implemented Single Minutes Exchange of Die (SMED) to reduce the changeover time of its Pressure Die Casting 2 machine. The objectives of this study were to study the existing changeover process, to propose new Standard Operating Procedure (SOP) by streamlining the steps of the existing changeover process and designing quick coupling hoses, and then to validate the new Standard Operating Procedure (SOP) of the changeover process. This study was only attentive on the Pressure Die Casting 2 machine. The complications were identified by using 6-steps of Problem-Solving Method. The wastes of the changeover process were eliminated by implementing SMED which consists of Classification Phase, Separation Phase, Conversion Phase and streamlining all aspects. The internal and external tasks of the changeover process were identified then separated by using a checklist. Some of the internal tasks have been converted to external tasks by execution of pre-preparations of tools. Radical improvements comprise quick coupling hoses, marking at the crane, organize the unused hoses and the improvements of hoses line connections have contributed to the reduction of changeover time. After slight adjustment during SMED implementation, Task 1 (setter) has been eliminated as it was considered as the external task meanwhile Task 17 (setter) has been shifted to Task 8 (operator). As a result, there were 16 tasks done by the setter and 8 tasks done by the operator. After the implementation of SMED, the changeover time reduced as much as 25 minutes from 117 minutes to 92 minutes which is equivalent to 21.37% therefore achieved the initial target of 20% reduction. It is proven very clearly that SMED methodology able to reduce the time of changeover process in Pressure Die Casting 2 machine.

PENAMBAHBAIKAN WAKTU PERTUKARAN MESIN TEKANAN

PENUANGAN ACUAN DENGAN MENGGUNAKAN MINIT TUNGGAL

PERTUKARAN ACUAN

ABSTRAK

Di peringkat global, sektor pembuatan telah mengalami masa yang bergelora kerana persaingan yang semakin meningkat ke pasaran yang ada. Oleh itu, syarikat harus meningkatkan produktiviti mereka dengan melaksanakan Pertukaran Pantas untuk mengatasi masalah tersebut. Dengan itu, sebuah syarikat perkakasan pintu di Melaka, Malaysia telah melaksanakan Single Minute Exchange of Die (SMED) untuk mengurangkan masa peralihan mesin Tekanan Penuangan Acuan 2. Objektif kajian ini adalah untuk mengkaji proses peralihan yang ada, untuk mencadangkan Prosedur Operasi Piawai (SOP) baru dengan menyederhanakan langkah-langkah proses peralihan yang ada dan merancang selang gandingan cepat, dan kemudian untuk mengesahkan Prosedur Operasi Piawai (SOP) baru proses pertukaran. Kajian ini hanya diberi perhatian pada mesin Tekanan Penuangan Acuan 2. Komplikasi tersebut dikenal pasti dengan menggunakan 6 langkah Kaedah Penyelesaian Masalah. Pembaziran proses peralihan dihapuskan dengan menerapkan SMED yang terdiri dari Fasa Klasifikasi, Fasa Pemisahan, Fasa Penukaran dan merampingkan semua aspek. Tugas dalaman dan luaran proses pertukaran telah dikenal pasti kemudian dipisahkan dengan menggunakan senarai semak. Sebilangan tugas dalaman telah diubah menjadi tugas luaran dengan pelaksanaan pra-penyediaan alat. Penambahbaikan radikal merangkumi selang gandingan cepat, menandakan di kren, mengatur selang yang tidak digunakan dan peningkatan sambungan saluran selang telah menyumbang kepada pengurangan masa pertukaran. Setelah sedikit penyesuaian semasa pelaksanaan SMED, Tugasan 1 (setter) telah dihapuskan kerana dianggap sebagai tugas luaran sementara Tugasan 17 (setter) telah dialihkan ke Tugasan 8 (operator). Hasilnya, terdapat 16 tugas yang dilakukan oleh setter dan 8 tugas yang dilakukan oleh operator. Setelah pelaksanaan SMED, waktu pertukaran berkurang sebanyak 25 minit dari 117 minit menjadi 92 minit yang bersamaan dengan 21.37% oleh itu mencapai sasaran awal pengurangan 20%. Dibuktikan dengan sangat jelas bahawa metodologi SMED dapat mengurangkan masa proses pertukaran di Mesin Tekanan Penuangan Acuan 2.

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TABLE OF CONTENTS

DECLARATION **i**

APPROVAL **ii**

DEDICATION **iv**

ABSTRACT **v**

ABSTRAK **vi**

ACKNOWLEDGEMENTS **vii**

TABLE OF CONTENTS **viii**

LIST OF TABLES **xi**

LIST OF FIGURES **xii**

LIST OF ABBREVIATIONS **xii**

CHAPTER 1: INTRODUCTION **1**

1.1 Background of Study 1

1.2 Problem Statement 2

1.3 Objective of Study 5

1.4 Scope of Study 5

1.5 Significance of Study 6

1.6 Organization of Report 6

CHAPTER 2: LITERATURE REVIEW **8**

2.1 Changeover Process 8

2.1.1 Condition of Changeover 9

2.1.2 Changeover Technique 11

2.1.3 Rapid Changeover 12

2.2 Lean Manufacturing 13

2.2.1 Type of Wastes 14

2.2.2 Lean Manufacturing Tools 16

2.2.3 Changeover Time Reduction via LM Tools 19

2.3 Single Minute Exchange of Die (SMED) 24

2.3.1 Basic Principles 25

2.3.2 Traditional vs SMED Approach 26

2.4 Implementation of SMED 27

2.5 Time Study 29
2.5.1 Procedure 29

CHAPTER 3: METHODOLOGY 30
3.1 Relationship Between Objectives and Methodology 30
3.2 Project Flowchart 31
3.3 Problem Solving Method 32
3.3.1 Problem Identification 33
3.3.2 Root Cause Analysis 33
3.3.3 Idea Generation 33
3.3.4 Choose the Best Fit Solution 33
3.3.5 Action 34
3.3.6 Outcome Evaluation 34
3.4 Study of Existing Activities in the Changeover Process Relating the Pressure Die Casting Machine 34
3.4.1 Direct Observations of the Existing Changeover Process 35
3.4.2 Interview the Setters and the Operators 35
3.4.3 Videotaping the Changeover Process 35
3.4.4 Conducting Time Study in the Changeover Process 36
3.4.5 Ishikawa Diagram 37
3.4.6 Brainstorming Session and Idea Development 38
3.4.7 Finding Literature Review 38
3.5 Propose New Operating Procedures by Streamlining the Steps of the Existing Changeover Process and Designing Quick Coupling Hoses 39
3.5.1 SMED Methodology 39
3.5.2 Designing and Dimensioning Quick Coupling Hoses 41
3.6 Data Collection, Processing and Analysis 42
3.6.1 Approaches of Data Collection 42
3.6.2 Sources of Data 43
3.7 Report Writing 46

CHAPTER 4: RESULT AND DISCUSSION 47
4.1 Existing Changeover Process 47
4.1.1 Layout 48
4.1.2 Machine 49

4.1.3 Mould 50
4.1.4 Standard Operating Procedure (SOP) 50
4.1.5 Changeover Time 57
4.1.6 Root Cause Analysis 59
4.2 Propose new Standard Operating Procedure (SOP) by Implementing SMED and Designing Quick Coupling Hoses 61
4.2.1 Preliminary Stage: Classification Phase 61
4.2.2 Stage 1: Separation Phase 62
4.2.3 Stage 2: Conversion Phase 63
4.2.4 Stage 3: Streamlining All Aspects of the Changeover Process 65
4.2.5 New Standard Operating Procedure (SOP) of the Changeover Process 72
4.3 Validation of New Standard Operating Procedure (SOP) in the Changeover Process of the Pressure Die Casting 76

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS 79
5.1 Conclusion 79
5.2 Recommendations 81

REFERENCES 82

LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1: Changeover Technique		11
Table 2.2: Category of Waste (de Souza & Carpinetti, 2014)		15
Table 2.3: LM Tools		17
Table 2.4: Changeover Time Improvement via LM tools		20
Table 2.5: Conceptual Stages of SMED Activities (Díaz-reza et al., 2017)		25
Table 2.6: SMED Implementation in the World		27
Table 2.7: SMED Implementation in Malaysia		28
Table 3.1: Relationship between Objectives and Methodology		31
Table 3.2: Approaches of Data Collection		43
Table 4.1: Setter's SOP		52
Table 4.2: Operator's SOP		55
Table 4.3: Changeover Time for Operator		57
Table 4.4: Changeover Time for Setter		58
Table 4.5: Separation of Internal Tasks and External Tasks		63
Table 4.6: Description of Tools Preparation		64
Table 4.7: Design of Quick Coupling Hoses		67

Table 4.8: New SOP for Setter 73

Table 4.9: New SOP for Operator 75

Table 4.10: Changeover Time Evaluation of the Setter 77

Table 4.11: Changeover Time Evaluation of the Operator 78

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1.1:	Production lines make different products one after another	3
Figure 1.2:	Changeover Time for Pressure Die Casting 2 Machine	4
Figure 2.1:	Changeover Process (Dave & Sohani, 2012)	9
Figure 2.2:	SMED Conceptual Stages and Practical Techniques (Díaz-reza et al., 2016)	26
Figure 2.3:	Conventional vs SMED Approach	26
Figure 3.1:	Project Flowchart	32
Figure 3.2:	Ishikawa Diagram	38
Figure 3.3:	SMED Methodology Phases (Moreira et al., 2011)	40
Figure 3.4:	Research resources from UTeM Library website	44
Figure 3.5:	Research resources from Google Scholar website	44
Figure 3.6:	Research resources from Sci-hub website	44
Figure 3.7:	Research resources from Scopus Elsevier website	45
Figure 3.8:	Research resources from Science Direct website	45
Figure 3.9:	Search Engine	46

Figure 4.1: Company Visit 48

Figure 4.2: PDC Facilities Layout 49

Figure 4.3: Fix side and Moving side of PDC 2 machine 49

Figure 4.4: Type of cores 50

Figure 4.5: Position during changeover process 51

Figure 4.6: Ishikawa Diagram 59

Figure 4.7: Hose Clip 60

Figure 4.8: Water Hoses Dimensioning 65

Figure 4.9: Schematic Diagram of Female Part 68

Figure 4.10: Schematic Diagram of Male Part 68

Figure 4.11: Marking at Crane 69

Figure 4.12: Additional Marking 69

Figure 4.13: Untidy Hoses 70

Figure 4.14: Grouping System 71

Figure 4.15: Hose Line Improvement 72

LIST OF ABBREVIATIONS

ABBREVIATIONS		TITLE
LM	-	Lean Manufacturing
PDC	-	Pressure Die Casting
HVLV	-	High Variety Low Volume
NVA	-	Non-Value Added
WIP	-	Work-In Progress
SMED	-	Single Minute Exchange of Die

CHAPTER 1

INTRODUCTION

Introduction is the primary part of the study and allows the readers to get the broad theory of what the study is about. This chapter introduces the background of the study as a key information to resolve the present problems faced by the industry. The problem(s) being studied then its importance and validity being revealed. Next, it informs the readers with the objectives that have been set to be accomplished and the scope of the study which emphasizes on the particular machine in the door hardware industry. It is important to remember that the research objectives stated in the study should equivalent to the results/findings of the study. Lastly, the significant of the study is also unveiled.

1.1 Background of Study

Globally, the manufacturing sector has undergone a turbulent period due to the growing in the competition to the existing market. Majority large emerging economies sprung into the first tier of manufacturing nations, a major recession choked off demand, and manufacturing jobs in developed economies plummeted at an accelerated pace. Nevertheless, manufacturing continues crucial to both the advanced and developing world.

Currently, manufacturing is not just about producing actual objects anymore. Changes in market demand, the design of goods, industrial economy, and supply chain economics have resulted in a profound change in the way companies do business. Customers are demanding personalization and customization, as the line between the consumer and the creator is blurring.

Furthermore, the role of manufacturing is changing. In today's developed economies, the way it leads to economic changes as nations evolve, manufacturing encourages more creativity, efficiency, and trade than development and employment. Manufacturing in these countries has also started consuming more services and relying heavier on them to run.

By 2025 a new global customer class will emerge, with most demand in developed economies. That will generate rich new opportunities for the business. Therefore, companies should improve their productivity in order to cater the issues. Productivity can be enhanced by improving the changeover time which will leads to better flexibility.

This study is a collaboration between university and industry as it being held at a door hardware company in Melaka. The main product of the company is door hardware comprise electrified door hardware, panic hardware, fittings, locks, emergency exit systems and door closers. The key points of this study are to assess the changeover process of Pressure Die Casting and advocate SMED methodology that can improve the changeover time as it is crucial to the company’s productivity.

1.2 Problem Statement

Recently, the company have numerous issues regarding the changeover process which resulting in slow changeover. Usually, changeover process would affect the productivity as it requires downtime. This is due to the condition for the machine to be

stopped from any production for any part of them to be removed or replaced either. Other problems arise when the company involves the High Variety Low Volume (HVLV) manufacturing that necessitate frequent changeovers of mould.

HVLV manufacturing implies to a wide range of small amounts of products. This leads to rapidly shifting routings, fast and regular changeover, and lack of continuity. One HVLV-characterized manufacturing system is a workshop facing an unprecedented degree of volatility, a dynamic climate, highly fluctuating demand, and high variability in delivery dates.

There is a lot of diversity in this group of industries with respect to the flow of orders on shop floor and the diversity can cause some misunderstanding in a discussion on HVLV environment. Some products in a HVLV production unit may have regular demand while some other products may have sporadic demand. The demand for each product may or may not be stable over time.

In many cases, it is possible to group most of those products into product families based on process requirements. All products within a family have the same process requirements. In some HVLV units, it is economically viable to create separate production cells (with dedicated resources) for product families.

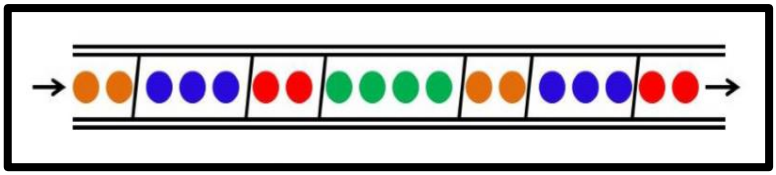

Figure 1.1: Production lines make different products one after another

Indeed, there are two type of mould cavity in the Pressure Die Casting machine; single mould cavity weighted at 340 tonnes and twin mould cavity weighted at 530 tonnes. The changeover process involves both mould cavity interchangeably which come up with four distinct variations such as Single-Single, Single-Twin, Twin-Single and Twin-Twin. Figure 1.2 below shows the existing changeover time for each variation; Single-Single with 60 minutes and the other variations with 120 minutes.

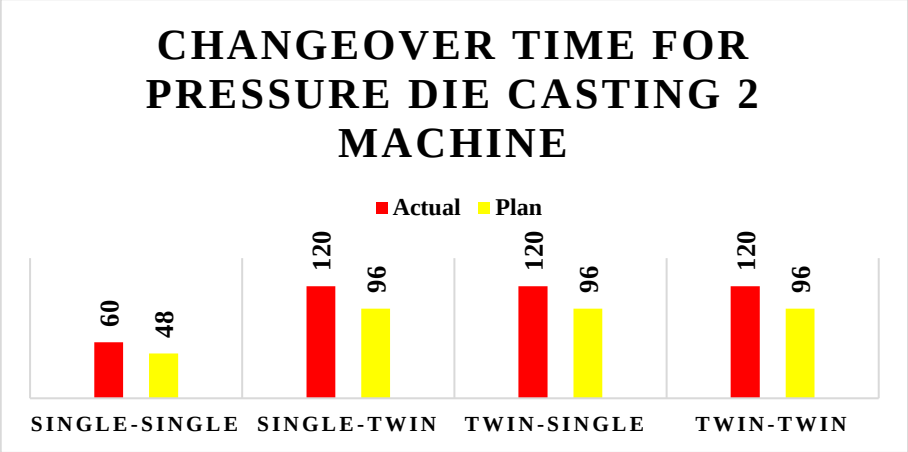

Figure 1.2: Changeover Time for Pressure Die Casting 2 Machine

There are four types of core in PDC machine and each number of cores have its own changeover time. The higher the number cores, the longer the changeover time. Thus, the aims for this study is to improve the changeover time up to **20%**.

The main approach that has been used for this study is SMED that was originally developed by Shigeo Shingo. This method is applied to achieve reduction in set-up time which subsequently improve the manufacturing performance. The time saved can be re-invested in more frequent changes from one job to another with smaller batch sizes. In turn, this led to a reduction in manufacturing lead time, with all the attendant advantages of lower inventory and work in progress (WIP).

1.3 Objective of Study

The objectives of this study are as follows:

a) To study the existing activities in the changeover process relating the Pressure Die Casting machine
b) To propose new Standard Operating Procedure (SOP) by streamlining the steps of the existing changeover process and designing quick coupling hoses
c) To validate the new Standard Operating Procedure (SOP) in the changeover process relating the Pressure Die Casting machine

1.4 Scope of Study

This study is being held at the Pressure Die Casting department of the door hardware company in Melaka. There are five units of Pressure Die Casting (PDC) machine and this study only emphases on the Pressure Die Casting 2 (PDC 2) machine. The main reason why the PDC 2 being chosen is because it has the longest changeover time compared to other PDC machine. The researcher did not undertake study for the remaining PDC machine because the time given to complete the study is considerably short, which only around six months. Since the changeover process comprises numerous procedures, it is quite troublesome to emphasize on more than one machine. Due to a confidentiality, the basic information of the company is not stated.

This study is mainly concerning the changeover time improvement on the PDC machine by implementing Single Minutes Exchange of Die (SMED). SMED is well known as an influential tool to lower the machine downtime because of setup and changeovers. Researcher used SMED as the core method for this study because its effectiveness to improve the changeover time on the previous study held by many researchers.

1.5 Significance of Study

The significance of this study as follows:

a) Changeover process might achieve the optimum changeover time when LM tools being applied. Hence, this study is established to assess the usefulness of SMED methodology to improve the changeover time.
b) To generate scientific information and deep understanding on the role of SMED methodology. Useful findings of the changeover process can be gathered later
c) To gain new knowledge behind the experimental research by improving the changeover time and bring the door hardware industry to a higher level.
d) To develop a new standard of changeover process to make it more flexible and to boost the productivity of the industry.
e) To reduce the reliance to buy more and more machine to cater the flexibility issues thus the company can save the inventory cost.

1.6 Organization of Report

Based on the Master Project (MP), the project organization was established to provide brief description on the whole project. The organization of report are as follows:

Chapter 1: Introduction

Chapter 1 start with the background of the study, problem statement, objectives, scope and the significance of the study. The section is outlined in order to provide better view on the particular aspects of the changeover process addressed in this study.

Chapter 2: Literature Review

Chapter 2 discuss a literature review on the background, theme and fundamental information that consists of previous study or research about the changeover process, LM tools, SMED methodology and time study. The information gathered via quite a few resources for example internet, books, articles and journals.

Chapter 3: Methodology

Chapter 3 elaborates precisely concerning the experimental methodology of the study. This will incorporate the relationship between objectives and methodology, project flowchart and method used to collect and analyse data about the changeover process.

Chapter 4: Result and Discussion

Chapter 4 particularises on the results/findings acquired during the experimental methodology. The progress of the experimental analysis and testing is mentioned briefly in this chapter. New operating procedure of the changeover process being applied after the SMED implementation. The changeover time is recorded before and after for validation.

Chapter 5: Conclusion and Recommendation

Chapter 5 draws important conclusions from the experimental study, and it summarize the whole project. Equally important, some recommendations for future study, sustainable design and development, and complexity were also being delineated.