

Down time Investigation of Lock Manufacturing MSME Unit: A CaseRajeev Rath^{1*}, Mahipal Singh^{2*}^{1,2}Assistant Professor, School of Mechanical Engineering, Lovely Professional University,
Punjab, India-144411rathi.415@gmail.com, mahip.lamboria@gmail.com**Abstract**

In current industrial scenario, every organization wants to escalate their production rate to cope with existing market demand. One of the major hurdle with most of the industries to increase production rate is their down time. The term downtime refers means when system is unavailable and downtime or outage duration refers to a period of time that a system fails to provide or perform its primary function. The unavailability is the proportion of a time-span that a system is unavailable or offline. This is usually a result of the system failing to function because of an unplanned event, or because of routine maintenance. Present study mainly focused on downtime estimation way with consideration of a case of lock manufacturing MSME unit. Research results revealed that down time is the major concern for the lower productive capacity of the industries.

Keywords: Down Time, MSMEs, Productivity Improvement, Manufacturing Environment.

Introduction

Micro, small and medium enterprises is classified in two parts, manufacturing enterprises: In this enterprise it is occupied with the manufacturing or production of goods to any industry specified in the Development and regulation act, 1951. It is defined as in terms of investment in plant and machinery. service enterprises are defined is in terms of investment in equipment. It is engaged in providing the services. Present study mainly focused on downtime estimation of assembly line of lock manufacturing MSME unit, where a case study of a lock factory which produce different types of locks. Here we will find the error which is related to the production and production rate of the company and we will try to give the perfect reason and will give the idea to estimate that problems. The term downtime applies to the malfunction of a process. Downtime or breakdown time is a cycle during which a process does not perform the primary function or perform it. Related concepts are reliability, accessibility, recovery and unavailability. The unavailability is the proportion that is not usable or offline for a device. This is usually a result of the system failing to function because of an unplanned event, or because of routine maintenance (a planned event). Mean Time to Failure (MTTF) is the time how much the system is available or working before the failure. It is the uptime of the industry or enterprise. In other words, it can refer it as the time before the failure from the normal operating condition of the system. Mean Time to Repair (MTTP) it is the time required by the technician or a worker to repair the equipment to become available for the normal working condition. It is also defined as the time when the system fails and it resumes normal operation. Repairs usually doesn't take a long time as most of the machines of new technologies and updated equipment have less chance of getting failed or damaged. But the outdated machines or equipment which are operated by unskilled workers have a chance of getting damaged slightly more than the updated equipment. If a machine is failed or damaged sometimes it can take much more time to repair than expected.

Sometime, we need to estimate and control the downtime in industry. In industry estimation and control of downtime is very important as it causes reduction of materials in an industry.

This increases the rate of failure by which production is effected badly. The downtime can occur in various time intervals like short intervals, medium intervals and long in Travels. As in short term intervals the time duration estimate is from 3 to 10 minutes, the medium interval can take up to 1 to 2 hour, in long term intervals the time is much more than medium likewise can take up to 1 to 2 days or more. In this case this affects the manufacturing production of the industry which finally affects the profit estimate. As the number of required units is less as per the demand the cost price and selling price has not much difference in them. So ultimately the entire factor affecting downtime leads to non-profit or less. So in all the terms downtime is the lead factor affecting the production. As the downtime refers to the stoppage of the equipment's used to manufacture the materials every single machine when it stops for certain time by default the next operation will be stopped as the work done to be completed by that machine is done and it will have to wait for the previous machine to complete its job so that next operation could be done. Due to the failure of one machine leads to another ideal time of machine or equipment. There for ultimately that down time of even 5 to 10 minutes will cause an over all, if more than 20 to 30 minutes depending upon the work and number of units and equipment's present in the industry. So it is much more of importance to reduce the downtime estimate the causes and remedies to control the downtime. The reasons of the breakdown can be due to technical machine at adjustment, maintenance or non-availability of inputs such as material lab or power supply. Mean Time between Failure (MTBF) it is the time between the failure and the next failure. Mathematically, we can calculate it as the sum of MTTF and MTTR, the total time required to fail and to get repaired. Much equipment can be repaired rather than replacing it, MTBF is useful in measurement. For example, the oil of automobile engine has to change after completion of the 300hr of driving, it has to be changed, and this is MTTF. To replace the engine oil, it takes nearly 2hr is required, this is MTTR, and then MTBF is 302hr. The main aim of present study is to understand the concept of downtime and Estimation of downtime with collection and analysis of the breakdown data of different sections of plant.

2 Review of Literature

Review of literature is the text of the scholarly paper which includes the technical, methodological, theoretical and practical knowledge of the topic. Literature reviews also include the current knowledge and a new research is published based on the experimental data. Reviews are provided to give an idea of new research on the topic. So we have various reviews about downtime in industries.

Jingshan Li et al., (2005), reported to be often less than 1 for the coefficient of improvements in the uptime and inactivity of production equipment. This technical paper attempts to explain this phenomenon analytically. In particular, it shows that the uptime and downtime distributions have less than 1 variance coefficients if the downtime and the repair rate increase time functions. [1].

Martijn N. Rooker et al., (2007), reported the preconditions for this dream and new technologies for reconfigurable structures and their adaptations. Without such approaches, industrial process measurement and control (IPMCS) technology changes will by far surpass the price of manufacturing systems and equipment reuse will become ineffectual. In addition, it is not sufficiently solved to reconfigure the control applications. This paper provides an overview of the specification for reconfiguration of timeless system development applications based on IEC 61499 Standard [2].

D Babb's et al., (2008), Through an effort known as 300 mm Prime, the semiconductor

industry is continuing to reduce cycle times and costs. One important area is increasing the accessibility of system resources. The failure of the equipment causes production disruptions, loss of productivity and higher costs, and particularly unscheduled downtime. This paper focuses on changes in efficiency due to the reduction of machine downtime. The risk of unplanned downtime can be reduced by preventive maintenance. The relationship between downtime variance and the total cycle time in traditional 300 mm factories with batch equipment is explored by discrete event simulation. The reduction in variability is calculated by reducing the standard time deviation for repairing a failed equipment and increasing the device part. Downtime reserved for preventive maintenance scheduled daily. In addition, the effect of reservation capacity is assessed and compared to reduced downtime variability as additional tools [3].

JP Fox et al., (2008), Intuitive downtime for manufacturing companies, whether planned or unplanned, is difficult to quantify, however. In manufacturing organisations, costing processes rarely occur. Eighty per cent of industrial installations have previously been estimated inability to accurately cost downtimes, and many installations have underestimated total costs by 200-300% (Crumbing and Post 2006). It was also recognized that the absence of practical guides prevented the easy implementation of costing procedures of any nature (Dale and Plunkett 1995). Existing models rarely take more into account than a subset of identified costs. Furthermore, the cost concepts have not previously been properly established as reliable methodologies for assessing and quantifying individual costs. The goal of this study was to establish an initial systematic methodology for estimating downtime costs, with a specific application to the automatic mail processing machines of Australia Post. [4].

Jose A. Faria., (2009), this paper sets the basis of a combined cost / quality analysis for the evaluation and development of industrial manufacturing systems. A number of activities are taken into account to accomplish the operation of a production method which is each compatible with the economic efficiency of the production and delivery of certain quantities of goods within a certain duration. The paper shows that it is not a linear function of a cumulative production downtime to achieve the mission successfully and that conventional Markov-based techniques can this time not be used [5].

AL Pattiv et al., (2010) calculated of total time lost (i.e. length of frequency times) is intuitive. it is useful. Nevertheless, an endless number of frequency / duration combinations will create the same maximum downtime. This study reports the results of a computer simulation analysis on the effect on the quality of serial production systems of differing combinations of downtime / duration pairs [6].

Q Chang et al., (2012), Downtime is probably the only major contributor in a multi-stage manufacturing system to system inefficiency. The ultimate goal of plant production management was to reach near-zero downtime. Precise evaluation of the effect of each downtime event is important for determining where limited resources should be distributed between different production stages. In this article we focus on quantitative analysis of the effects of the permanent loss of production and the financial costs of each single event [8].

Chowdury M. L. Rahman et al., (2014) Total manufacturing maintenance (TMM), since it is an integral part of lean production, has now become one of the most popular maintenance strategies to guarantee the highest machine reliability.

One of TPM's main goals is to raise the overall efficiency of equipment with a modest maintenance investment. Companies worldwide invest a lot of money in buying new machinery, but a little is done about getting 100% of the machines output [9].

Shekhar Sahu., (2015), provided a suitable way in today's highly stiff market, so 5S and OEE can be synergistic in improving industrial performance. The aim of the integrated

concept is to create a systematic, clean and smooth workplace and to improve equipment efficiency, quality and employee satisfaction to improve industry manufacturing productivity [10].

ASM Moohialdin., (2016), Unintended disruptions usually cause machinery infrastructure to stop. This paper analyzes possible failures to improve production facilities ' performance, including machinery. These include failure modes, downtime periods, work shifts and products. Experimental designs models were employed in this paper, based on the analysis of variance (ANOVA) test and the Kruskal-Wallis test in combination with Tukey's method for pairwise comparisons. Analysis ANOVA identifies the durations of various failure types influenced by [11].

SC Nwanya et al., (2017), Reduced downtimes have a major impact on productivity growth and are a requirement for sustainable and scalable production. This study estimated a total production downtime per turn and developed an algorithm for the maximization of the uptime for each production line. One of Nigeria's leading plastics manufacturers has undergone a case study that showed a decrease in productivity. The data on machine efficiency and process stoppage have been evaluated and self-criticism about results weaknesses has been followed. A multiple regression analysis was also used to compare downtime and other variables such as cycle time, capacity, weight, overall equipment [12].

Nallusamy., (2017), In today's market, companies are constantly working towards satisfying customer request, but it is found that it has become difficult to meet this on a timely basis because of problems like machine breakdown, machining and installation delays. The purpose of this article is to examine the production losses caused by these problems by giving priority to the root causes using the Pareto graph and finally proposing a solution. Initiating practice via TPM, a case study was conducted to show the use of machine tool and manpower as a basis for lean production. [13].

Illenia Zennaro., (2018), Automated flow line production systems, particularly in the food and beverage sectors, are becoming increasingly relevant to the industry. The central goal is to improve efficiency of automated flow line systems if the overall equipment efficiency index (OEE) tests all companies. The purpose of the paper is to conduct an innovative micro inactivity collection and statistical analysis in the food and beverage industry, to estimate the performance improvements in investment activity and implement a quantitative indicator called "Cost Quality Indicator-CPI." [14].

3. Methodology used

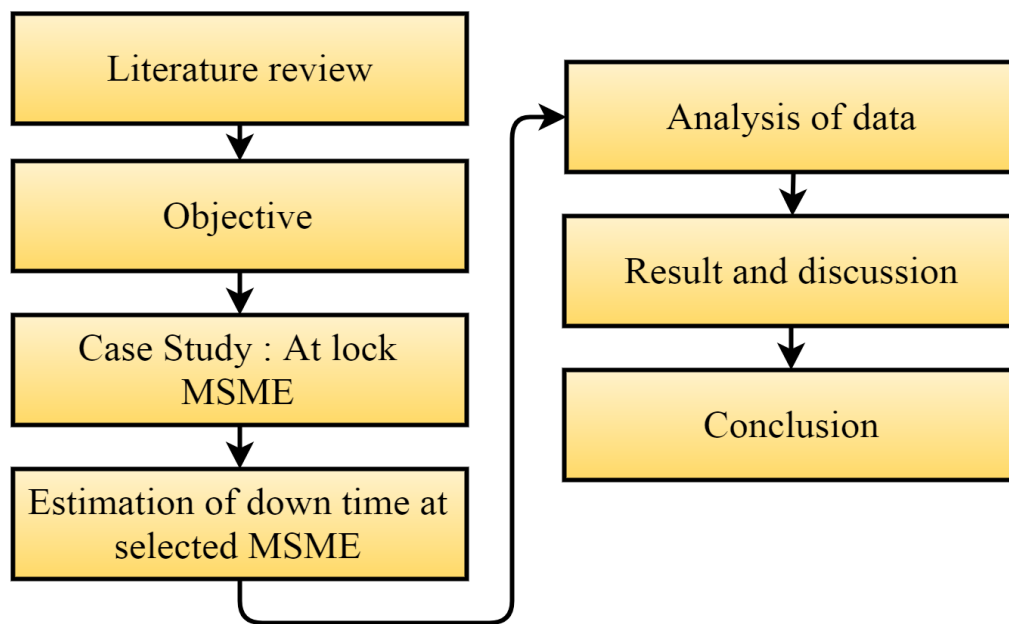


Figure 1: Flow chart of Methodology adopted

3.1 Downtime in Manufacturing

When the machines or equipment of a manufacturing process stops due to an unplanned event for a certain time it is called downtime in manufacturing, which affects the rate of production. It can be defined as the equipment failure or breakdown in machine due to an unplanned event. For example, down time can be triggered by material issues, shortage of operators, or unscheduled maintenance.

3.2 Serviceability of machinery

To minimize or reduce the downtime in manufacturing we have to prevent it from malfunctioning. Nowadays, to increase the production new machines should be updated by the manager, as the old ones slow down the rate of production due to the technology used is old in that machines. Also, the machinery jams, dislocation or breakdown reduces the production. Regular maintenance is necessary rather than installing new machinery.

3.3 Explain down time to employees

If there is a good relationship between managers and employees helps in increasing the rate of production and efficiency. This would result in healthy environment in the area and the employees will work efficiently. Employees also have certain measures and suggestion about how to reduce downtime. When managers treat the employees well they also feel part of it and if the downtime is explained to them they also take steps to reduce it.

3.4 Regular Evaluations

Regular employee evaluation and machinery inspection are measures of standard, but should be wisely administered. The point of regular evaluation is to check the maintenance and the employee knowledge to the machinery. If an employee is unaware of certain process, workshops can be held to provide them the knowledge. The evaluation should be confidential

as other employees help their friends to get passes the evaluation as they have fear of the salary cut.

3.5 Monitoring the Efficiency of Manufacturing Process

For monitoring the efficiency all the department should work together. If any department has an issue it will lead to delay the other process. For this not to happen the supervisors should check and evaluate all the departments, if maintenance is required then it should be done at a proper time.

3.6 Establish Incentives and Goals

When the employees work hard to reduce the downtime and increase the rate of production they should get awarded for it, after all it's our benefit that they work properly and complete the work in time to increase our profit shares. A proper body should be made to monitor each and every employee, after a month the best employee and other categories the best employee should be rewarded. This will boost the morale of the employees which will keep the motivated to work hard s to get the incentives and increase our production rate.

3.7 Plant Downtime for Lower Casing

Plant downtime is defined when the plant is off line during this period of time plants are not able to produce or manufactured any product so that they cannot add the value to the customer or they cannot add the value to the business. It is also known as the idle time downtime. It is counted in daily basis to the common operation and management of production. Generally, it will work to reduce the amount of downtime in production line and directly affected to the management, so that it is advantage of management department of the plant. It also helps to calculate the OEE of equipment and plant production unit total cost, planning of production total capacity planning, and to keeping the safety stock level. Excess downtime shows unreliable equipment and supply chain of manufactured products.

3.8 Plant downtime can also be split up into different reasons or sub- classifications are

In plants, when production process is running at close to plant downtime can say it is very important issue in planning of production or management. As we know during the downtime period we do not supposed to products any products or output so that loss occurs and result is directly affect in profit of the plant when the total target of manufacturing product will not have reached. So at that time we can work on lean manufacturing principle and technique and also we can work on start-up, production checklist, identify problems area, maintenance, bottleneck and other item.

3.9 Breakdown maintenance

Breakdown maintenance is the term which we can directly define as per its name, the maintenance or repair the reason of breakdown which is generally happens in machines, component solving of that problems quickly, so that the product line does not effect for the chart period of time called the breakdown maintenance. Breakdown generally happens completely so we have to ready to solve that problem in a short period of time.

As we know it is unplanned events which affect directly to the plant production quantity, sometime quantity and directly strikes the cost of product or cost on order, factor lost production so that budget of maintenance also effect. So to reduce these things management force worker to do overtime work, uncertainly calls technician, urgent delivery fess for spare

parts also increase the cost of maintenance.

3.10 5S Principle

5S principle is most effective Lean Manufacturing tools and foundation of any successful implementation. It is a tool for making work place clean, safe, and effective to increase productivity, and make sure of standardizing work. All type of work and working area have benefits of 5S principle. Generally, it manufactures that which comes randomly in our minds with greater efficiency. It provides benefits to any manufacturing company, any hospitals, or any professional businesses of their area and their department inside the organization or work by implementation of 5S principle.

3.10.1 Sort

Sort is a physical organization in the work place. it consists of number of the steps which helps to identify the items which at the wrong place in the workplace. For simplification, it can be considered as the large area for gauges or tools, which are required regularly and some are used irregularly. The needed items are not available due to which the time is wasted in searching the things, so if the things which are used frequently are in particular position then it would same sometime. When too many gauges are held, then they are not calibrated on time, which bring some quality issues. Problem for communication and making around arises due to racking and locking in the work place. The 5s implement the inventory and reduction. The extra materials inventories are considered as wastes. The significant part of sort involves the cross- functional teams, items are provided will tag which defines its location and it was identified in this location. The items which are to be dispersed of as they have not been used. So, as a first step, an area is created thoroughpin away the items, recycling them or selling them. But used irregularity, so another location can be found.

3.10.2 Set

The optimum organization which is defined by the series of step in the first pillar of sort is defined as set. The organization of the essential materials in an order is setting. Setting is the continuation of the sorting process. The discarded items are eliminated or an alternative space is created. Equipment is relocated in the work area rather moving all. During cellular manufacturing this is undertaken. In order to execute few operations, the work content is restructured. The continuous way of doing things involves all the items for setting out. This involves standard equipment tooling, standard drawing, standard manufacturing, and design for manufacturing, consistency in drawing and standardization in the crucial process. These all are the approach for the basic total quality, and involves the error profiling all area in the work place.

3.10.3 Shine

The cleanliness of the area is done in the shine phase. Which delivers clean productive and bright equipment and results in immediate use of material at time? As an instrument with high precision should be dirt free, so if they are covered in grease then it might introduce some error as the free impurity might set into the pneumatic or hydraulic fitting. The working of PCB assembly is also compromised by the metallic dust and unclean work surface by the operators, which make them ready for use.

3.10.4 Sustain

For sustain which means heavily about review program to ensure their benefits to approach things are maintained directly. “The discipline is the final stage of sustain”. We should make people aware about that for applying practice in various field like shop organization etc. In this sense the sustain means to force people to do the work with successive penalties if they will not do that work. There are so many elements for improvement of any business because an organization success with the history and their culture of that organization. So it is totally depending on the organization or company that how to maintain these principles or from and when they implement. We have separate people or organization to take care these disciplines washing equipment. As earlier said, use good old common sense to guide us through LEAN initiative and 5s principle.

3.10.5 Standardization

Mean which is responsible for the maintenance as 1st three (3) 5s is considered as Standardization. There is some bad effect in any improvement activity when attenuation get distract from one and given priority the another work. In that situation the things situated again where it comes from. For presentation of these 5s, we have to make schedule by which all the work is revised continuously. Standardization is only to control over 5s and maintain it regularly. We should tag the red areas so that people involve from other department also for check balancing system. A proper register should maintain where by the external visitor can mark the area according to the key certain of the outset of the working program will there ok in storage area, does the total storage area have clear outlines for individually in storage, does area clean or not everything we have to check before implementation.

4. Case Explanation

The present work is carried out at the MICO Product which is situated in Aligarh, U.P. This company is engaged in manufacturing of various types of locks, ranges from household to commercial use. This is the premier company in related field. Its overall production is 13, 81,804. The company has different divisions according to type of locks. In this industry we focused our path on the PAD lock division. MICO PRODUCT is a well-known name in lock industry, which was established in the year 1996. From the past two decades it has made his mark with its excellent quality. Pad lock division consists of different section for their manufacturing process. The machines used in this section are hand press, drilling machine, power press, hand bender, key cutting machine, punching machine, etc. it is known from the company officials that in the pad lock section downtime is more so we analyzed its section. So we have introduction about lock and their units.

Table 1: Monthly Analysis of Capacity of Machines

Month	Installed capacity	Actual capacity	Wastage
April	143000	103000	27.97 %
May	169000	127090	25.80%
June	162500	120645	26.86%
July	156000	115070	27.34%
August	156000	116030	26.73%
September	149500	113708	23.94%
October	136500	101165	25.88%
November	162500	129000	20.62%

December	156000	112056	28.16%
January	156000	114020	26.91%
February	162500	126040	22.43%
March	143000	103980	27.28%

The table 1 shows the monthly analysis of capacity of machines. This includes the total installed capacity, actual capacity and the wastage of the parts in percentage monthly. The wastage of each month is above 20 percent. This means the loss is more than expected. In the month of December, the wastage was highest 28.61% as compared to other month.

4.1 Downtime estimation of Pad Lock Division

Table 2: Downtime estimation

Machine	Capacity	Number of Machine	Total working time of all Machine	Breakdown time per Hour	Breakdown time per Day	Reasons of breakdown
Power Press	20 Ton	2	16 Hour	7 min	49 min	Dislocate die & axle break
	3 Ton	11	88 Hour	28 min	210 min	
Hand press	3 no	8	64 Hour	9 min	66 min	Fatigue allowance & Dislocate die
	2 no	4	40 Hour	5 min	43 min	
	1 no	3	24 Hour	5 min	36 min	
Hand Bender	-	1	8 Hour	-	-	Disarrangement alignment
Drill Machine	1 no	1	8 Hour	0	15 min	Break/Change drill bit
Total Breakdown	-	30	248	54 min	419 Min	-

The above table (table 2) shows the down time estimation of pad lock section. This shows the capacity of machines, total number of machines, total breakdown per day & hour. The company shift is of eight hours daily. For ex- there are two power press machine, if the shift is of eight hours then the total working time of all machine is sixteen hours. Similarly, for other machines same calculations are made for calculating the total working time of the machines. The breakdown time of machines per hour and day is estimated. The total number of machine used in the pad lock division is 30. The total working time of the entire machine is 248 hours. The breakdown time per hour for all the machines is 54 min. the breakdown time per day for all the machine is 419 min. This breakdown time includes the machines which are used is of different capacity.

Identified reasons of breakdown are:

- Dislocation of die and axle break
- Fatigue allowance and dislocation of die
- Disarrangement of die
- Breaking or changing of drill bit

Table 3: Downtime estimation of Pad Lock division

Month	Machines	Total working Hours	Total Breakdown Time (hrs)
April	P. Press, H. Press, H. Bender	6448	151.6
May	P. Press, H. Press, H. Bender	6448	174.5
June	P. Press, H. Press, H. Bender	6448	166.2
July	P. Press, H. Press, H. Bender	6448	152.6
August	P. Press, H. Press, H. Bender	6448	169.3
September	P. Press, H. Press, H. Bender	6448	159.4
October	P. Press, H. Press, H. Bender	6448	146.6
November	P. Press, H. Press, H. Bender	6448	172.5
December	P. Press, H. Press, H. Bender	6448	154.8
February	P. Press, H. Press, H. Bender	6448	161
March	P. Press, H. Press, H. Bender	6448	149.4

Down time data of selected division has been collected and investigated for 12 months as shown in table 3. The machine used, total working hours and breakdown time is given in the table. Mainly the machines used are power press, hand press and hand bender. The total working hours of the machine monthly is 6448 hours. The breakdown time is estimated as per the different machine used and the breakdown of each machine is calculated. According to the data collected and the calculation made the breakdown time is shown month wise in hours. The data collected includes the holiday and the number of shifts taken month wise. This analysis shows that there is a serious problem of capacity waste inside the plant and needs immediate monitoring.

Conclusions

The MSME unit which was finalized for the downtime estimation is MICO product. This unit has many divisions among them we selected Pad lock division for further analysis as it is most commonly used for household purpose. The pad lock division consists of five sections. The prime aim of present study was to estimate downtime of selected division of particular unit. For this, a case study has been executed regarding downtime assessment in selected lock unit. During analysis, total thirty machines were considered those engaged in manufacturing of particular lock. Thorough analysis of their manufacturing process has been made and made data regarding downtime of available machines has been collected and investigated. After analysis, this is concluded that total average downtime of this division is 160.31 hours. Apart

from that, this is estimated that section one possess the average down time of 151.6 hours per month. Finally, after going through deep analysis of selected unit, this is concluded that, there is huge problem of breakdowns, which should be immediately monitored for improving productivity.

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