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Increasing Production Rate of Gear Box Assembly Using SMED Concept

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Abstract: ***In This Paper The Purpose Of The Single Minute Exchange Die (SMED) Is To Eliminate Waste Of Time. Longer Setting Up Time Denotes That Production Line Is Not Very Productive. Nowadays, Everything Is Being Done Faster And Just-In-Time, Where Manufactures Need To Produce Product Fast And Without Neglecting The Quality And Deliver It To Customer In Right Time. In This Project, SMED Has Been Provided To Eliminate Waste Of Time (Lead Time) With Eight Technique Of SMED. In SMED, Molds Or Die Exchange Should Be Less Than 10 Minute And It Helps In Improvement Of Gear Box Assembly. The SMED Methodology Is Applied To Reduce The Setup Times Observed At The Beginning Of The Project. It Was Possible To Reduce Setup Times, Work-In-Process And Distances Walked By Operators With Developed Solutions. Also The Lead Time Of The Process Is Also Considerably Reduced. Further, The Setup Operations Were Standardized And As A Result The Process Has Become More Fast And Productive For The Workers. In This Project The Fixtures, Clamps And Holder Were Designed Using Creo Software.***
Keywords: Setup Time, Lead Time, Production Rate, Single Minute Of Exchange Die

I. INTRODUCTION

This Section Will Give A Full Explanation About The Basic Concept Of Manufacturing System And Discuss About Lean Production System Principle. It Will Be Focusing On Time Reducing Between Set-.Up Times In Gearbox Assembly Ashok Leyland Limited, Located At Ennore, Tamilnadu In North Chennai By Applying Single Minutes Exchange Of Die (SMED). This Project Will Be As A Lean Production System Tool That Can Be Introduced To Other Manufacturing Sectors That Give A Drastic Change In Reducing Die Set-Up Time.

II. LITERATURE REVIEW

Eric Costa, Rui Sousa" An Industrial Application Of The SMED Methodology And Other Lean Production Tools ,This Paper Describes The Improvement Of The Setup Process Of A Mechanical Press Machine In The Metal-Mechanic Area Of An Elevators Company. The Single-Minute Exchange Of Die (SMED) Methodology Is Applied To Reduce The Setup Times Observed At The Beginning Of The Project. With The Developed Solutions It Was Possible To Reduce Setup Times, Work-In-Process And Distances Travelled By Operators. Additionally, The Setup Operations Were Standardized And Consequently The Process Has Become More Fast And Intuitive For The Operators [1]. "Ana Sofia Alves, Alexandra Tener" Improving SMED In The Automotive Industry: A Case Study ,The Single Minute Exchange Of Die Is One Important Lean Tool To Reduce Waste And Improve Flexibility In Manufacturing Processes Allowing Lot Size Reduction And Manufacturing Flow Improvements. By Streamlining And Standardizing The Operations For Exchange Tools, Using Simple Techniques And Easy Applications, SMED Reduces The Non-Productive Time. The Applicability Of The Proposed SMED Approach Was Tested For Injection Machines Changeovers In The Automotive Industry. The Implementation Helps In Reduction Of Setup Time, Through Company's Resources Reorganizations Without The Need For Significant Investment [2]. "Mehmet Cakmakci" Process Improvement: Performance Analysis In The Setup Time Reduction-SMED, Generally Additional Time Is Needed For Setup Caused By Poor Design Of Equipment In The Automobile Industry. Here The Words Continuous Process Improvement And Single Minute Exchange Of Dies (SMED) Are Used. The Process Capability Analysis Technique Is Used By Using Minitab14 Software To Learn The Relationship Between SMED Methodology And Equipment Design. To Derive A Quantitative Measurement Of The Equipment Design By Applying SMED In Automobile Assembly, The Index Cpk Has Been Used In This Study. The Results Of This Research Indicated That SMED Is Still A Suitable Method For Equipment/Die Design Development [3]. "Nagaraj A Raikar" Reduction In Setup Time By SMED: A Case Study, To Thrive In Today's Globalization World, Manufacturers Need To Find Solutions To Decrease Production Time And Cost For Improving Operating Performance And Product Quality. It Is Generally Possible To Drastically Reduce The Setup Times. Better Results Are Achieved Through Good Teamwork, Better Planning And Normal Changes. Reducing Cycle Time Of The Operation By Using Single Minute Exchange Of Dies (SMED) Is The Main Objective Of This Paper. This Study Is Performed In The Automobile Industry. This Document Demonstrates The Need To Overcome Most Of Bottleneck Of Equipment's Unavailability

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For Resources Utilization And To Run The Process More Effectively. The Project Goal Is Achieved By Reducing The Setup Time To 24.5% And Hence The Productivity Is Increased.[4]. "Bikram Jit Singh, Dinesh Khanduja" Reflective Practice SMED: For Quick Changeovers In Foundry SMED, The Objective Of The Paper Is To Reveal The Importance Of Fast Changeovers In Die-Casting Foundry Industries. The Paper Gives Set-Up Instructions And Guidelines To Prepare The Standardized Set-Up Procedure Without Ignoring Actual Constraints In Foundries. It Involves A Case Study In A Small Scale Piston Foundry To Produce A Well Derived Set-Up Reduction Approach, Using Single Minute Exchange Of Die Based Industrial Engineering Tools To Attain Faster Set-Ups. It Describes The Feasibility Of Quick Changeovers In Foundry Small And Medium Enterprises Based On A "SMED" Approach. Set-Ups Are An Important Part Of The Production Lead-Time In Any Product And So Influence Overall Product Cost. Pareto Analysis, Root-Cause Analysis And Method Study Are Used To Analyse The Current Procedure Of Set-Ups. Other Tools Such As 5s, Poke-Yoke And Specific Tool-Kits Are Also Involved Here To Even More Reduce Set-Up Times [5]. "Jonathan David Morales Mendez, Ramon Silva Rodriguez" Set-Up Reduction In An Interconnection Axle Manufacturing Cell Using SMED, This Document Is About How To Reduce Set-Up Time Using Single-Minute Exchange Of Die On An Actual Production Process Of Interconnection Axles, Starting With A Production And Indicators Analysis, Followed By Time Studies, And Then The Rolling-Out Of All The SMED Stages. The First Activity Carried Out Was Observation, Second Assessment, And Followed By Implementation Leading To Standardization And The Generation Of Standard Manufacturing Documents. Training Was Carried Out By Using The Validation And Assessment Of The Versatility Matrix. At Last, The Productivity Of Manufacturing Cell Was Analysed By Looking At The New Overall Equipment Effectiveness Indicator To Explain The Result Of SMED In Reducing Start-Up Times And The Fine-Tuning Of Machinery [6]. "Rushikesh Gavali, Shrikant Chavan, Prof. Dr. Ganesh.G.Dongre" Set-Up Time Reduction Of A Manufacturing Line Using SMED Technique, This Research Shows The Improvement In The Set-Up Time Process Of A Straightening Cell On Axle Beam Line. SMED Is One Of The Main Lean Production Techniques For Decreasing Waste In A Manufacturing Process. The Single-Minute Exchange Of Die (SMED) Methodology And Other Lean Production Tools Were Applied To Reduce The Setup Time. By This Process The Setup Time Was Lowered From 52 To 24 Minutes. The Percentage Reduction In The Set-Up Time 53.85% [7]. "S. Palanisamy, Salman Siddiqui" Changeover Time Reduction And Productivity Improvement By Integrating Conventional SMED Method With Implementation Of Mes For Better Production Planning And Control, In This Paper SMED Integration With Mes (Which Deals With Planning System Interface) Is Presented That Has Been Developed Specifically For An Automotive Supplier. The Result Was Done Through Implementation On Radiator, Compressor And Hvac. The Company Achieved Much Reduction On Changeover Time Which Led To The Increase In High Productivity, By Using The SMED With Mes Improvement Programme [8]. "Vipan Kumar, Amit Bajaj" The Implementation Of Single Minute Exchange Of Die With 5's In Machining Processes For Reduction Of Setup Time, In This Paper We Describe That How The SMED Technique Is Used And How It Helps To Reduce The Time And Increasing The Productivity. The SMED Techniques Implemented On 3 Mechanical Press Machines And The Results Are Drafted For Before And After Implementation Of SMED [9]."Sara Bragança, Rui Sousa, Anabela Alves" Benefits From A SMED Application In A Punching Machine Eric Costa, This Paper Presents An Application Of The Single Minute Exchange Of Die Methodology To A Turret Punching Machine In An Elevators Company, In Portugal. The Lean Production Tool SMED Was Applied To Reduce Setup Times In Order To Improve The Production Flexibility Of The Machine. The Main Results Obtained Were A Reduction Of 64% In Setup Time (From 15.1 To 5.4minute), 50 Percentage Is In Work-In-Processing Amount And 99% In The Distance Travelled By The Operator During The Internal Period. These Improvements Correspond To Gains Of About 499372.97rupees Per Year [10]. "Rubayet Karim" Impact Of Changeover Time On Productivity: A Case Study, This Paper Addresses The Application Of Lean Manufacturing Concepts To The Mass Production Sector With A Focus On Sewing Section Of The Studied Garments Industry. How Lean Manufacturing Tools Can Be Used To The Discrete Manufacturing System And To Learn Their Benefit On A Specific Application Instance Is The Aim Of This Research Work. The Need For Lean Manufacturing Concept Is To Eliminate Waste. This Research Paper Tries To Find The Scenario Of Readymade Garments Sector Of Bangladesh By Utilizing The Existing Condition Of Sewing Section. However, This Paper Suggests Some Ideas For The Studied Garments Industry To Increase The Performance Of The Sewing Section [11]. "Saif Benjaafar, Joon-Seok Kim "On The Effect Of Product Variety In Production–Inventory Systems, In This Paper, We Examine The Effect Of Product Variety On Inventory Costs In A Production– Inventory System With finite Capacity Where Products Are Made To Stock And Share The Same Manufacturing Facility. Opposite To Inventory Systems Which Originate Externally Lead Times, We Find That Inventory Costs Increase Almost Equally In The Number Of Products. Also, We Show That The Rate Of Increase Is Affected By Various Parameters Such As Demand, Process Variability, Capacity Levels And Setup Times. The Effect Of These Are Unavoidable. For Eg, We Find That Increase In Cost Due To Product Variety Is Lowering In Demand And Process Variability. Also

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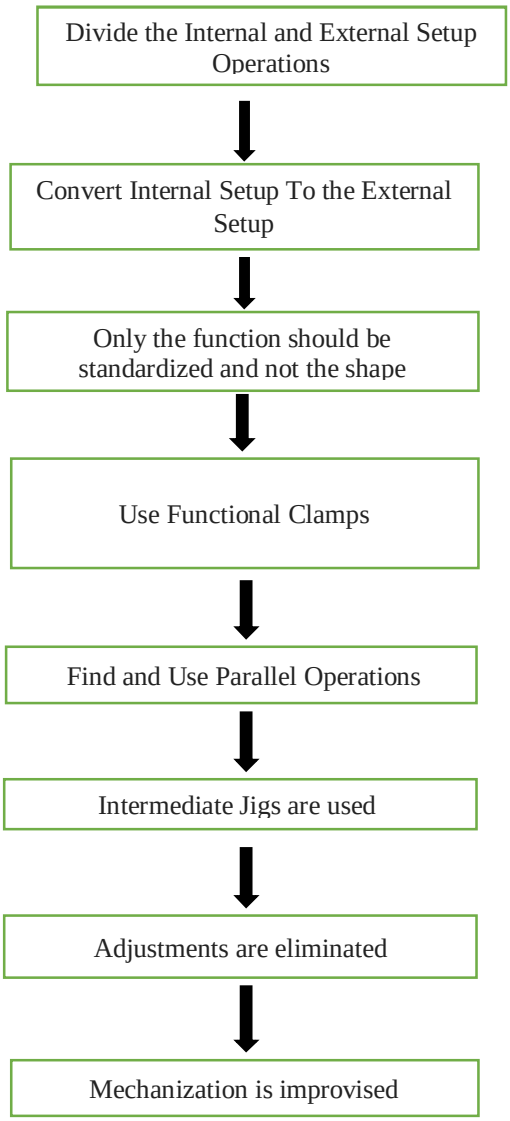
There Is Decrease In Expected Production Time. We Also find That The Relative Cost Is Increasing Steadily In Setup Time, Setup Time Variability And Aggregate Demand Rate. We See Various Models To Draw Several Graphs Regarding The Value Of Variety-Reducing Strategies Such As Product Consolidation And Delayed Differentiation [12]. "Pallavi A. Gade, Roshan G. Chavan, Dhananjay N. Bhavsar" Reduction In Setup Time By Single Minute Exchange Of Dies Methodology, If We Have To Increase The Frequency Of Delivery Without Compromising The Quality Single Minute Exchange Of Dies Is The Answer. Single Minute Exchange Of Dies Is Not Only Apply To Bottleneck Machines It Is To Be Implemented Company Wide And Aim Must Be To Bring All Setup Time To Less Than Ten Minutes In This Paper Some Techniques, Basic Procedure, Problems Faced By Companies Are Discussed And Solution For Them Are Suggested[13]."

III. STEPS FOR SMED TECHNIQUES



A. Step 1 Divide the Internal and External Setup Operations

Internal Setup Operations Are Done Only When The Machine Is Not Running. External Setup Operations Are Done When The Machine Is Running. Examine And Identify Which Of The Current Setup Operations Must Be Performed While The Machine Is Shut Down And Which Can Be Performed When The Machine Is Running. For E.G., Transportation Of Dies, Jigs And Fixtures To And From The Machine Can Be Performed While The Machine Is Operating. Any Preparatory Activity On The Die To Be Setup Can Be Done Without Stopping The Machine. Internal Setup Is For Removing The Old Die Or Tool And Placing The New Die Or

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Tool. By Separating External And Internal Operations, Internal Setup Time Can Be Minimized By 30 To 50 Percent.

B. Step 2 Convert Internal Setup to the External Setup

There Are Provisions To Convert Internal Operations To External Operations. For Example, One Can Avoid The Internal Setup Time Involved In Shut Height Adjustments For The Press Dies, By Standardizing The Die Height And By Attaching Blocks Or Shims To Smaller Dies. Another Step Is Eliminating The Heating Of The Die By Trial Shot After It Was Placed In The Machine. Shut Height Is The Distance Between The Upper Dead Centre And The Lower Dead Centre In A Die.

C. Step 3 Only the Function should be Standardized and not the Shape

Standardizing The Shape And Size Of Dies Can Reduce Setup Times Considerably. Shape Standardization Is Wasteful Because All Dies Would Have To Confirm To The Largest Size Used. This Results In Increase Of Cost. Function Standardization Requires Uniform In The Parts And Features Necessary For Setup Operations. For Example, Adding A Plate Or Block To The Attachment Edge Of The Die Standardizes The Dimensions Of That Part Only And Makes It Possible To Use The Same Clamps In Different Setups. The Functions Identified Are Clamping, Centering, Dimensioning, Expelling, Grasping, And Maintaining Loads. The Industrial Engineers Must Study Various Dies And Maintain The Features Of The Die That Requires Changes.

D. Step 4 Use Functional Clamps

Bolts Are Most Commonly Used To Attach The Die To Ram And Machine Body, But Tightening Bolts Can Be Very Time Consuming. About With Fifteen Threads Must Be Turned Fourteen Times Before It Is Tightened Fully On The Final Turn. But Shingo's Theory Is That Only The Last Turn Tightens The Bolt And The First Turn Loosens It And The Other Thirteen Are Waste Of Motion. The Purpose Of The Bolt Is To Fasten Or Unfasten. A Bolt With Just One Turn Tightening Is Called A Functional Clamp. One-Turn Functional Clamps Include I- Slot Method And The External Clamp. Threaded Screws Are Waste To Secure Items. There Are Various Methods. One Touch Methods Uses Wedges, Cams, And Clamps Reduce Setup Times. Also Interlocking Improvements Fit And Join Two Parts Together. These Methods Are Useful In Reducing Setup Times To Seconds. In Clamping Methods, The Direction And Magnitude Of Force Required In The Situation Are Critical Considerations. An Analysis Is Required To Find What Is Needed To Design The Clamp. At Mitsubishi Heavy Industries, Stoppers Were Screwed To Spindles Of A Boring Machine. It Is A Difficult And Time-Consuming Way. These Are Not Necessary. This Was Increased By Cutting Grooves Near The Spindles And Attaching Three Springs Around The Edge Of Each Stopper. When The Stopper Is Placed Above Spindle, The Springs Connected Into The Groove, And The Spring Tension Hold The Stopper In Place. This Reduced The Time For Securing And Removing Stopper.

E. Step 5 Find and Use Parallel Operations

While The Work Piece Attached To One Jig Is Being Processed, The Next Work Piece Is Centred And Attached To A Second Jig That Is Easily Mounted On The Machine For Processing. Using A False Jig To Load The Middle The Work Piece As An Outer Operation. For Example, Blocks For Television Picture Tubes. Marking Off For Concurring And Setting Heights For The Template And The Material Was Done As Internal Setup On The Bed Of The Machine. Due To Many Curves In The Blocks, It Is Complicated And Time Consuming Process. Two Jigs Were Created. When One Is Machined, A Template And Another Work Piece Is Attached To The Next Jig, Then Kept Centre And Set For Correct Height. Clamps Are For Mounting The Jigs Above On The Table. Intermediate Jigs Are Also Used In Large Methods With Many Dies Of Various Heights And Sizes. By This, They Are Used To Move Inside Centering And Closing Operations Off The Machine. Due To This Process Improvement, The Press Is Turned Off Only While A Forklift Activates The Middle Jigs With Dies Already Mounted.

F. Step 6 Intermediate Jigs are Used

Processes On Plastic Molding Machines And Large Presses Involve Setup Work On Both Sides Of The Machines Or At Both The Front Side And Back Side Of Machine. If Only 1 Worker Performs Various Process, More Time Is Wasted As He Moves From Side To Side Of The Machine. But When 2 People Perform The Same Operations Simultaneously, Setup Time Is Reduced By More Than Half. The Assistance For These Process Can Be Provided By Anyone.

G. Step 7 Adjustments are Eliminate

Adjustments And Trials Cause 50 To 70 Percent Of Inside Setup Time. The Eliminated Products Results Tremendous Time

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Savings. The Assumption That Adjustment Is An Unavoidable Leads To Unnecessarily Lengthy Internal Setup Times And Requires A High Level Of Skills And Experience On The Part Of The Operator. Adjustments Can Be Cancelled, But If A Gauge Is Used To Extensively Determine The Accurate Position Of The Limit Switch. The First Setup Is Performing Away With It Is To Make Calibration Which Deletes The Need To Thrive On Intuition. If Only An Approximation Is Required, A Gradated Scale May Be Enough, But It Can't Do Away With Adjustments Fully. Greater Accuracy Is Gained Using A Dial Gauge Magnescale, Or Numerical Control Device. The Best Kind Of Adjustment Is No Adjustment. In A Plant, A Limit Switch Is Used To Set The Final Point In Machine Performing Shaft. As There Are Five Shaft Lengths The Switch Had To Be Moved To Five Places. It Couldn't Be Kept Correctly Without As Many As Six Trial Each Time The Set Up Changed. By Installed Limit Switches At The Five Sites, Each Equipped With An Electrical Switch That Is Supplied With Current Independently Of The Other Switches, This Problem Was Eliminated Now Setup Is Performed By Flipping A Switch. In Another E.G. This Operation, A Drill Was Used To Nullify A Hole For A Stationery Screw In A Motor Core Shaft. Stoppers Were To Be Again Positioned For Nine Different Lengths Which Created Repeated Test Runs And Necessary Adjustments. The Adjustments Were Deleted By Placing Stopper Plugs Of Nine Different Heights On One Plate. For Changing Operations, The Plate Is Simply Rotated To Set The Stopper At The Desired Height And Tightened. This Reduced Internal Setup To A Matter Of Seconds. The Lcm Approach, One-Touch And Interlocking Methods Makes Simple The Setting Or Positioning And Eliminate Adjustment. This Doesn't Mean, Companies Operate With Dies Of Varying Heights. The Companies Should Either Fix A Standard Heights Or Purchase Presses For Their Needs. The Faculty Logic Is Evident When Costly Presses Are Used With Motorized Adjustable Heights And Very Great Adjustment Functions.

H. Step 8 Mechanization is Improvised

Although Changing Small Blades, Jigs, Dies And Gauges Does Not Pose Much Of A Problem, Mechanization Is Often Essential To Efficiently Move Large Dies, Casting Dies, And Plastic Molds. Oil And Air Pressure Are Used For Easy One-Touch Attachment Of Dies. Investment In Mechanization Should Be Done Very Precisely. Recently, Many Companies Have Standardized The Dimension Of Clamping Plates And Finished Them To A High Degree Of Precision. One-Touch Clamping Is Then Performed By Inserting These Plates Into Special Clamping Fixtures. Only The Die Actually Forms The Product Considering The Use Of The Process, It Is Waste To Finish Clamping To A High Degree Of Accuracy. Mechanization Should Be Considered Only After Every Effort Has Been Made To Improve Setups Using The Techniques Described. The First Seven Principles Can Reduce A Two-Hour Setup To Three Minutes, And Mechanization Will Probably Reduce That Time Only By Another Minute. SMED Is An Analytical Approach To Setup Improvement Of Which Mechanization Is Only One Component. One Should Attempt To Mechanize Setups After They Have First Been Thoroughly Streamlined By Applying The SMED Principles.

IV. METHODOLOGY

A. Present Methodology

This Study Is On Single Minutes Exchange Die And Also Other System That Support Or Make Improvement To The Exchange Die System For The Company. The Study Will Be Focused On Gear Box Assembly Department. Based On Customer Demand, Most Of Them Want The Suppliers To Deliver The Product Right After The Order Is Valid. Back In Few Years Ago, Customer Wants The Suppliers To Deliver The Product After One Or Two Weeks. Now, Customer Wants The Product To Be Delivered Three Or Four Day After The Order Was Confirmed. This Also Makes Change On The Total Of Order; Because We Must Bear That The Customer Also Practicing Lean Manufacturing System, So Every Ordered Product Must Be In Small Lot To Reduce The Waste.

Because Of The High Order From Customer, So Production Planning And Control Had Difficult Task To Make A Details Planning Because Of The Lack Of Inventory Information. We Have To Check The Inventory Twice Every Day. We Can See How Difficult To Finish All This Work, Not Once A Week, But Every Day.

Various Concept Involved in the Study

Designing Fixture For Ball Pin Pressing In Fork

Reduction Of Flange Clamps In Gearboxes

Reduction Of Input Shaft Mounting Holder In Testing Of Gear Boxes

1) *Designing Fixture for Ball Pin Pressing Machine in Fork:* Based On The Overview Of The Process Carried Out In The Area Of The Fixture For Ball Pin Pressing In The Fork, Every Series Of Gear Box Requires A Different Fixture For Ball Pin Pressing. Using Different Fixture For This Process Consumes More Time, Which Results In The Delayed Production.

a) Different Fixture For Different Series Of Gear Box

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b) Time Delay In Changing Fixture
c) Production And Maintenance Cost Of Fixture
d) Low Production Rate

2) *Reduction of Flange Clamps in Gearboxes:* There Are Basically Four Types Of Different Flanges Mounted In Gearboxes. Every Type Of Flange Serves Different Purposes. It Was Observed That While Performing Operations On Pressing A Flange By Using Pneumatic Machines, For Each Type Of Flange, Separate Holders Are Used For Holding The Flange Rigidly On To The Gearbox. This Is Done Because When A Flange Is Fixed, Each Flange Is Of Varying Dimensions. We Found Through Our Observations That A Single Holder Could Be Used For Holding Three Types Of Flange.
3) *Reduction of Input Shaft Mounting Holder in Testing of Gear Boxes:* The Basic Problem Which Was Encountered During Our Observations Were Same As The Previous Project I.E., During Testing Of Gearboxes, The Operator Mounts The Input Shaft To A Separate Hollow Cylindrical Holder Or Clamp Which Is Then Connected To The Motor By Which The Gearbox Is Operated. By Our Observation We Found That There Is An Unnecessary Usage Of Different Clamps For Different Types Of Input Shafts.

B. Proposed Methodology

1) *Designing Fixture For Ball Pin Pressing:* In Fork The New Design Of The Fixture For Ball Pin Pressing, Enclosed With All Three Types Of Gears (1/2,3/4,5/6) Of A Single Series Can Be Done With A Single Fixture, Which Reduces The Time And Helps In Increase Of Productivity, Which Serves Easy For The Employees. The Picture Shows The Design Of New Fixture, Where All Process Of The Single Series Can Be Done In A Single Fixture. The Bed Is Made Large, Which Comprises Of Holes And Slip Gauges That Are Fitted Into Them. These Slip Gauges Helps In The Vertical And Horizontal Movement Of The Fixture. By This We Can Fix All The Forks For Ball Pin Pressing Of Same Series In The Same Fixture. The Base Of The Bed Is Designed With Large Thickness To Make The Adjustments In The Fixture. This Fixture Helps In Increasing The Productivity.

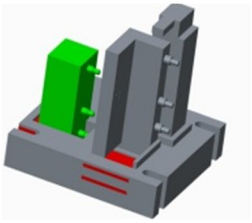

Fig1. 3d Assembly Diagram Of Fixture

2) *Reduction of Flange Clamps in Gearboxes:* This Is Achieved By Measuring The Dimensions Of The Holder Disc. This Disc Mainly Consists Of A Square Plate Of About 1cm Thickness. This Square Plate Is Of 27*27 Cm In Cross Section. It Consists Of Two Vertical Pin Holders Fixed For Arresting The Degrees Of Freedom While The Bolt Is Tightened. From Observations, We Are Able To Find That Three Types Of Flanges Could Be Holed Rigidly By Just Varying The Diameter Of The Crossly Welded Holes As Seen Below In The Cross Section.

Fig.3d Diagram Of Clamp

3) *Reduction of Input Shaft Mounting Holder in Testing of Gear Boxes:* This Could Be Achieved By Making A New Modal Of The Holding Clamp Using Different Dimensions. There Are Totally Three Types Of Input Shafts Manufactured In Ashok Leyland, Ennore In Which The Types Of Holders Could Be Greatly Reduced.

a) One Type Of Input Shaft Is Which Is Smaller Shaft Length And With Larger Grooves Made In It.
b) Another Type Which Is Smaller In Shaft Length And With Smaller Groove Separation
c) Last Type With Smaller Groove And Larger Shaft Length.

Our Idea Is To Make Holes Along The Surface Of The Shaft Holding Clamp In Order To Use The Same Holder For All Three Types Of Shafts.

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The Usual Dimensions Of The Holder Are Of 13.5 Cm In Length For 1st And 2nd Types Of Input Shaft. And 18cm For The Third Type Of Longer Shaft.

The Outer Diameter Of The Holder Is About 7cm And Id Is Of 4.5cm Considering The Internal Splines.

Our Project Is To Design A New Holder Of 18cm In Length And Od Of 7cm And Id Of 4.5cm Along With Holes Along The Bottom Part Of The Holder In Which Separate Bolts Could Be Tightened While In Operation.

Fig 3. 3d Diagram Of Holder

V. RESULT AND DISSCUSSION

A. *Fork Ball Pin Pressing Machine*

By Using SMED Concept The Time Has Been Considerably Reduced. This Can Be Learned From The Below Table Where The Time Taken For Fork Ball Pin Pressing Machine Is 321 Seconds Without Using SMED Concept And The Same Process Can Be Completed In 211 Sec Using SMED Concept.

Table I Fork Ball Pin Pressing Machine

Process Study	Process: Ball Pin Pressing		Product: Gear Box
Process Step	Work Element	Time Taken In Sec	
		Without SMED	With SMED
1/2fork	Fixture Fixing Time	45	45
	Fixing Fork In Fixture	15	15
	Ball Pin Fixing Time	03	03
	Machine Cycle	24	24
3/4 Fork	Fixture Fixing Time	60	05
	Fixing Fork In Fixture	30	30
	Ball Pin Fixing Time	03	03
	Machine Cycle	24	24
5/6 Fork	Fixture Fixing Time	60	05
	Fixing Fork In Fixture	30	30
	Ball Pin Fixing Time	03	03
	Machine Cycle	24	24
Total Time		321	211

B. *Flange Bolt Tightening*

We Can Observe That By Using SMED Concept For Flange Bolt Tightening The Time Required For The Setup Is 62 Sec. When this Process Followed Without Using SMED, The Time Required Is 82 Sec. Thus By The Project We Are Able To Save A Great

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Deal Of Time.

Table II Flange Bolt Tightening

Process Study	Process: Flange Bolt Fixing	Product :Gear Box	
Process Step	Work Element	Observed Time In Sec	
1.	Fixing The Flange On The Gear Box	15	10
2.	Fixing The Bolt In The Flange	07	07
3.	Fixing The Clamp In The Gear Box	10	10
4.	Tightening The Bolt	25	25
5.	Removing The Clamp From The Gearbox	10	10
6.	Fixing The Flange In The Other Type Of Gearbox	15	00
Total Time		82	62

C. Gear Box Testing

By Using SMED The For Gear Box Testing The Time Period Taken Is Derived As 142 Sec. But Without SMED The Time Period Required Is Derived As 158 Sec. This Change Of Time Periods Results To Great Varying In The Production Rates.

Table 3 Gear Box Testing

Process Study	Process: Gear Box Testing	Product : Gear Box	
Process Step	Work Element	Observed Time In Sec	
		Without SMED	With SMED
1.	Fixing Of The Gear Box In The Chamber	05	05
2.	Fixing Of The Holder In The Motor	10	04
3.	Fixing Of The Holder In The Gear Box Input Shaft	10	04
4.	Testing Time	120	120
5.	Removing The Gearbox Input Shaft From The Holder	04	04
6.	Fixing Of The Gearbox In The Chamber Other Type Of The Gearbox	05	05
7.	Fixing The Holder In The Motor	04	00
Total Time		158	142

VI. CONCLUSION

We Were Able To Finish Our Study By Perfect Planning Within The Specified Time Period. The Increase Of Production Rate Of Gear Box Assembly Using SMED Concept Is Providing Satisfactory Conditions. We Can Understand The Difficulties Of The Worker In Gear Box Assembly. We Have Given Our Best Effort To Minimize The Stress And Difficulties Of The Worker.

We Analysed Various Idea To Increase The Production Rate Of Gear Box Assembly And Minimize The Fatigue Of The Workers.

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Finally Using SMED Concept We Were Able To Successfully Minimize The Setup Time And Lead Time, And Thus Achieve The Target Fixed In The Company By Increasing The Rate Of Production. As The Setup Time Is Decreased We Can Gradually Increase The Production Rate. From Our Study We Strongly Recommend To Adopt And Use SMED Concept To Various Industrial Applications Which Proves To Be Very Effective In Increasing The Production And Also Reduce Various Losses Occurring In The Machining And Various Assembly Process.

VII. ACKNOWLEDGMENT

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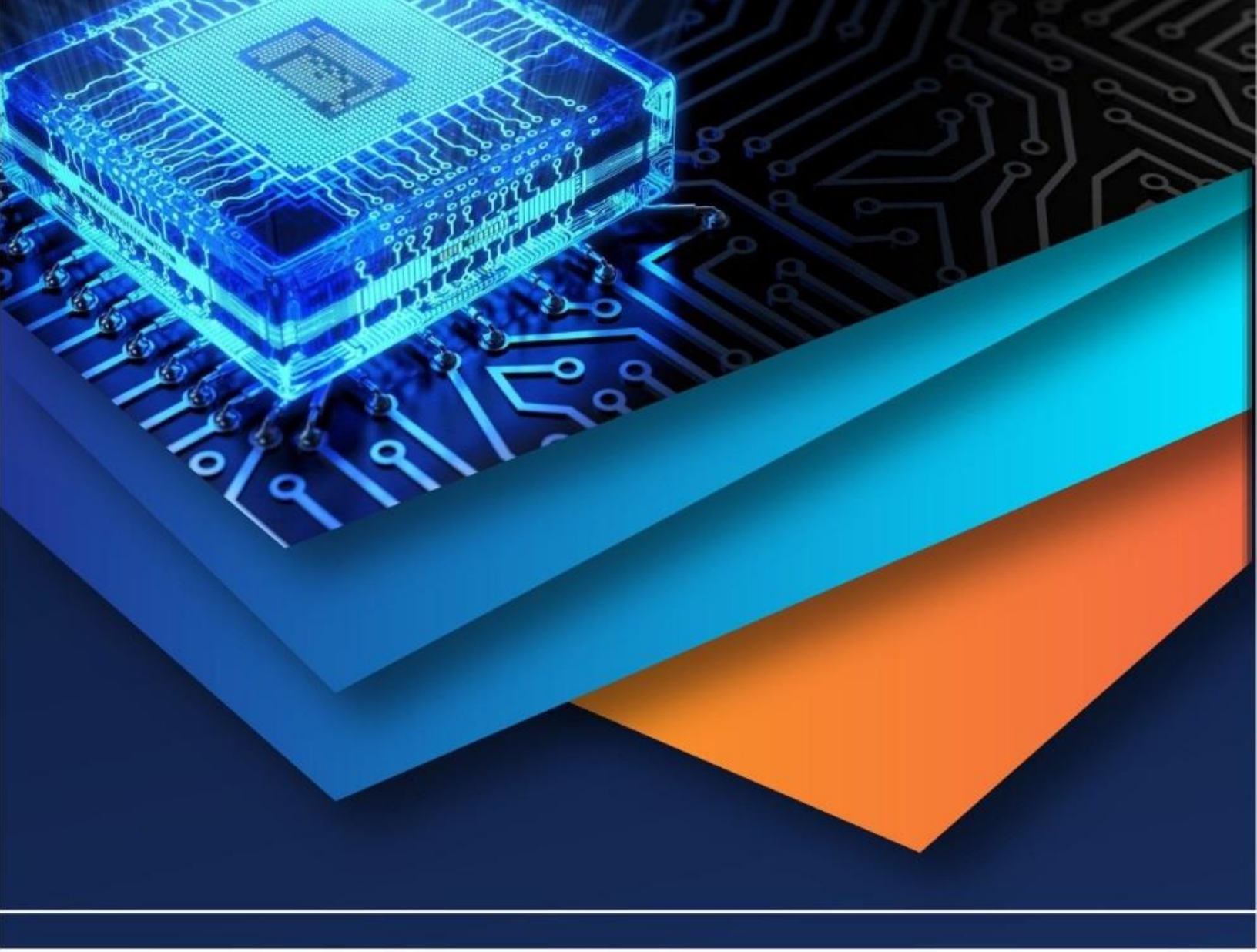

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