

Financial Management and Planning

PROJECT APPRAISAL ASSIGNMENT

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Introduction

The purpose of this report is to highlight the financial benefits of changing a manual over-moulding process to an automated process. There are four parts that this initiative could be applied too but the report will identify those parts with the highest return and focus on those. Data has been analysed in order to model the cost of each part and give an accurate sum of the project cost benefit. The report will also include methods of financing the projects and a realistic implementation plan, taking into account the management of associated risks.

Background

There are four parts feasible for the project, these are:

- MLA Secondary Gaiter
- L551 Secondary LH Gaiter
- L551 Secondary RH Gaiter
- 80 Way PHEV Subframe grommet

Each part has two moulding operations, a rigid plate and a flexible over-mould. Presently, the second (over-moulding) process is carried out by an operator, usually a skilled cell leader, each time they perform this operation they must open the machine door and insert the rigid moulded part into the mould tool. Opening the machine door extends the cycle time and adds non-value added steps into the process. In order to reduce the cost of these parts it is essential to remove as much waste as possible.

Figure 1 - Existing cell layout, shows the existing cell layout:

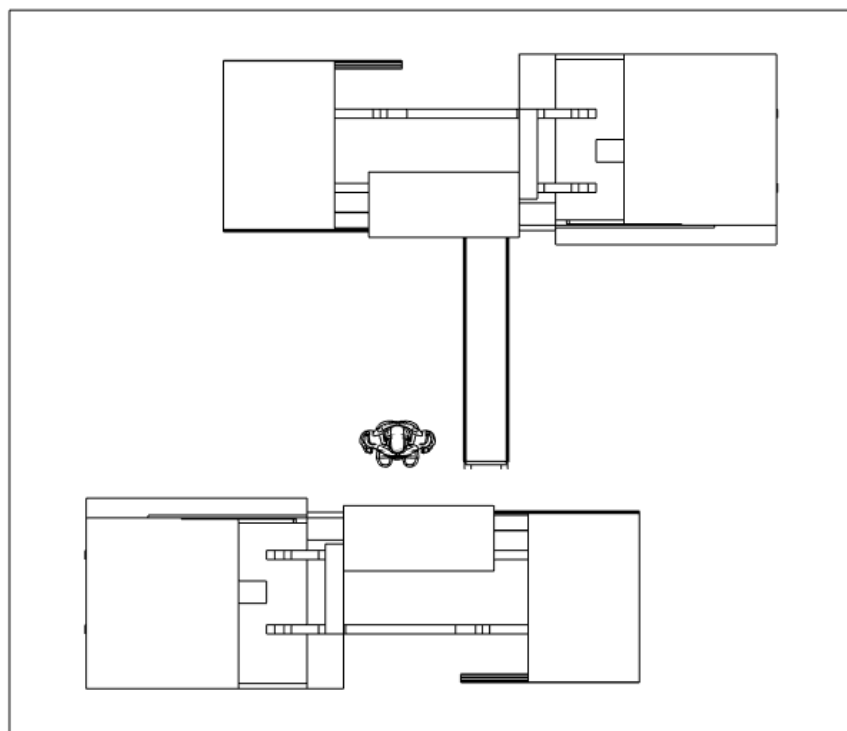


Figure 1 - Existing cell layout

Using the 7 types of waste, as defined in The Toyota Way (Liker, 2004), a simple table can be used to highlight the types of waste encountered in the current process.

7 wastes:

- Defects
- Overproduction
- Transportation
- 'Extra' or Non-Value Added' Processing
- Motion
- Waiting
- Inventory

Since Taiichi Ohno of Toyota introduced the 7 wastes, an additional 8th waste has been added the widely adopted Lean Principles of Six Sigma Management (Skhmot, 2017).

The 8th waste:

- Unused Talent

For the purpose of highlighting these wastes in process map they've been colour coded as follows:

Type of Waste	Colour Code
Defects	Blue
Overproduction	Orange
Transportation	Yellow
Extra Processing	Green
Motion	Pink
Waiting	Red
Inventory	Purple
Unused Talent	Grey

Table 1 - 8 Wastes colour coded

Below are the process steps included time taken and the attached waste:

Process Step	Time Taken (s)	Waste 1	Waste 2	Waste 3
Rigid moulding cycle	36			
Deliver parts to operator by conveyor	10			
Operator places parts in over-moulding tool	10			
Over-moulding cycle	32			
Operator packs parts	5			

Table 2 - Process steps and waste

Key notes:

- All operator related tasks have 'unused talent' waste as they are over-skilled for the task
- Extra processing happens each time the operator opens the machine door
- The rigid moulding cycle runs faster and so over produces and creates inventory each cycle
- There is motion waste each time the operator carries out a process
- The operator incurs significant waiting time during the over-moulding cycle

Proposed Solution

The proposed solution would be to replace the operator with a universal robot, The robot would pick the parts from the conveyor and place into the tool with the aid of a vision system. The machines would be rotated 180 degrees allowing unimpeded access for the robot, reducing the placement cycle time by up to 6 seconds. Only 1/3 of a less skilled operator would then be required to pack parts. Table 3 - Proposed Process waste shows the process wastes after the changes.

Process Step	Time Taken (s)	Waste 1	Waste 2	Waste 3
Rigid moulding cycle	36			
Deliver parts to operator by conveyor	10			
UR places parts in over-moulding tool	4			
Over-moulding cycle	32			
1/3 Operator packs parts	5			

Table 3 - Proposed Process waste

Key Notes:

- The reduction in cycle time will allow both processes to run at the same speed removing the over processing and inventory waste from the rigid moulding cycle
- A robot placing parts has reduced the non-value added activity by 60%
- Motion waste is still present, but the cost has been reduced significantly by using less valuable resource
- All 'unused talent' waste has been eliminated

- All waiting time has been eliminated from the over-moulding process

Figure 2 - Proposed process layout below shows the layout of the proposed cell.

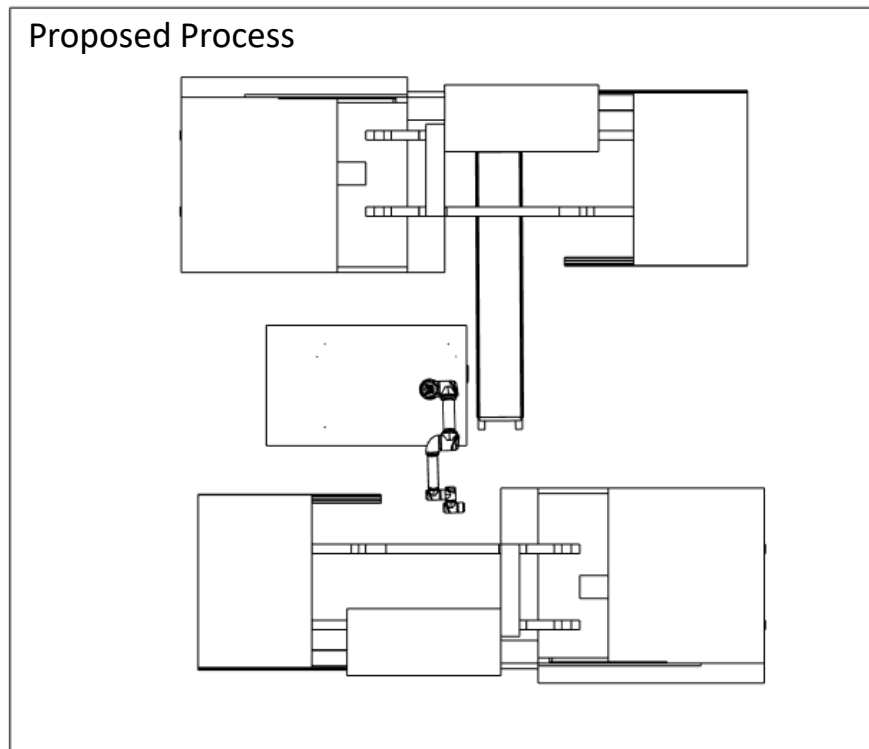


Figure 2 - Proposed process layout

Data analysis

Input required for existing state analysis were retrieved from various sources relative to the current production scenario.

- Current cycle times were retrieved from recent production runs.
- Hourly rate for resource was taken from the commercial guidelines for costing.
- Annual volume taken from the projected platform forecasts.
- Resource allocation taken from existing process allocation.

Input data required for the proposed state calculation were partly retrieved from existing data and partly made on assumption of what will be expected from the proposed state.

- Expected cycles time based on previous developments and known cycle excluding operator intervention.
- Hourly rate again taken from commercial guidelines
- Annual volume assumptions are again based on platform forecast
- Resource allocation made on assumption based on reduced operator allocation and a less operator.

The cycle time and annual volume were used to identify the annual production hours required. This was then multiplied by the hourly cost of each resource element and the allocation of that element.

$$\text{Annual Cost} = (\text{Annual Machine hrs}) \times (\text{resource cost per hr}) \times (\text{resource allocation})$$

This analysis was carried out for each component and the savings calculated from the difference between the annual cost before and after the proposal:

$$\text{Annual Cost Saving} = \text{Annual Cost Before} - \text{Annual Cost After}$$

Part	Before	After	Annual Savings	Cumulative Savings
L460	£71,005.00	£39,083.00	£31,922.00	£31,922.00
L551 LH	£41,598.89	£22,897.11	£18,701.78	£50,623.78
L551 RH	£21,533.88	£11,852.81	£9,681.07	£60,304.85
D8 Subframe	£5,973.33	£5,434.00	£539.33	£60,844.18

Table 4 - Potential Annual Savings

This full cost analysis is available in Appendix A.

Cost of Investment

To cover the complexities of the project, considering the skill level available internally, the preferred option would be to approach this project as a turn-key solution. The supplier would supply, test and develop, install and commission all equipment, including hardware and software. This is also a good training opportunity for existing staff already up-skilling in these areas. They would be involved in the development and implementation learning how to produce and maintain a complex automation system.

In order to establish a fair cost of investment 3 quotations were obtained from 3 suppliers. One supplier we've worked with previously, one supplier not previously worked with, and one supplier who were introduced within our network. The latter was the lowest cost supplier as were also the ones most keen to work on the project. Find quotations in Appendix B.

Based on the itinerary of equipment offered it was possible to choose items at a lower cost or remove items that provide functionality that we either do not require or can add on at a later date for more advanced functionality.

The cost of Equipment/ Hardware: £47,850

The costs of Labour, i.e. Design, Development and Installation: £23,500

Total cost of investment: £71,350

Find breakdown of required Equipment and Labour in Appendix C

Project Screening

To ensure that the profit from the investment is maximised and the time invested in the development is most efficient the project was screened to identify the most valuable parts. Although payback doesn't necessarily answer which part will turn the most profit it is often used as tool to eliminate low value projects, narrowing down the ones worth spending further time evaluating (Plewa, F. J., Friedlob, G. T. , 1996).

There was a possible 4 parts that could be invested in, therefore to perform this analysis the total investment was divided into 4, equalling £17,838 per part. The target for payback on investment was within 2 years. The Payback achievable per part was as follows:

- L460 Gaiter = 0.56 Years
- L551 LH Gaiter = 0.95 Years
- L551 RH Gaiter = 1.84 Years
- D8 Subframe Grommet = 33 Years

Three of the four parts payback within 2 years. Based on this, moving forward the D8 Subframe Grommet will be excluded from the project and the larger cost model.

Find payback model in Appendix D.

Cost Model

The cost model uses a discount rate known as WACC (Weighted Cost of Capital) to assess the project value based on the discounted future value of money. By taking the sum of the discounted cashflow and subtracting the initial investment cost it is possible to identify the real Net Present Value of the investment (Fernando, 2022).

Using this method, the NPV calculation is as follows:

	2022	2023	2024	2025	2026	2027	2028
Year	1	2	3	4	5	6	7
Investment	(71,350)	0					
Return		60,305	60,305	60,305	60,305	31,922	31,922
Net Value	(71,350)	(11,045)	49,260	109,565	169,869	201,791	233,713
Payback	1.18	Years					
Discount Rate (WACC)	10.00%						
Denominator	1.00	1.10	1.21	1.33	1.46	1.61	1.77
Future Value	(71,350)	54,822.59	49,838.72	45,307.93	41,189.02	19,821.05	18,019.14
NPV	157,648	Net Present Value = Sum of future value (incl. cost of investment)					

Figure 3 - NPV Calculations

Due to the end of the L551 platform in year 6 the value of returns decrease. In year 7 production the L460 platform is due to end, however the cost of investment will have already paid back 14 months into the project and by the end of the project the Net Present Value will be £157,648.

To further analyse the project and assess the value against the investment it's possible to use both the profitability index and benefit-cost ratio (Pasqual, Padilla, & Jadotte, 2013). Profitability index calculates that for every pound spent, how many are returned. Benefit cost is calculated by dividing the profit by the investment value.

Profitability Index	2.21	PI = NPV / Investment Value				
BCR	3.21	Benefit-Cost Ratio = Future Value Profit / Investment Value				

Figure 4 - PI and BCR

The project already shows a healthy return, but the investment can be reduced further by assuming that some value of the assets purchased will still be remaining or salvageable at the end of the project life (BAXTER, 1970). It is difficult to identify an exact scale of depreciation but, 10 years is widely accepted assumption on asset depreciation for plant/ machinery in manufacturing.

Depreciated over 10 years the reclaimed value at the end of the project, year 7, is £19,140. This reclaimed value reduces the project investment to £52,210 and gives a revised NPV of £176,788.45.

	2022	2023	2024	2025	2026	2027	Project End 2028
Year	1	2	3	4	5	6	7
Asset Depreciation (10% YOY)	0	0.9	0.8	0.7	0.6	0.5	0.4
Asset Value	£47,850.00	£43,065.00	£38,280.00	£33,495.00	£28,710.00	£23,925.00	£19,140.00
Reclaimed Asset Value	£19,140.00	Asset Value at project end					
Reclaimed Investment	-£52,210.00						
Future Value Returns	(52,210)	54,822.59	49,838.72	45,307.93	41,189.02	19,821.05	18,019.14
NPV	£176,788.45						

Figure 5 - Asset Depreciation and Revised NPV

Using the revised NPV it's possible to calculate the Accounting Rate of Return and show the average return per year over the life of the project. The ARR can be determined by using the following calculations (Arnold, 2007):

Average Annual Investment	£7,458.57	Reclaimed investment/ Project Life	
Average Annual Profit	£25,255.49	NPV/ Project Life	
ARR	339%	Average annual profit / Average annual investment	

Figure 6 – ARR

Find the full cost model in Appendix E

Risk management

As with any project there are a numbers of risk that require addressing, reducing, and mitigating where possible. Such as follows:

Potential Risks	Action to Reduce Risk
Risk to product supply during installation and testing	Build a mock testing area of site to develop and trail solutions before on-site installation
Risk of impacting supply of shared line products	Identify secondar machines which affected parts can run on for the duration of the installation
Risk of over-allocating resource to the improved state and de-valuing the cost evaluation	Update production planning systems to reflect the new resource allocation
Risk of creating redundancies	Use gained resource to deploy on more value-added tasks and upskill to suit

Risk of poor quality caused by the introduction of process changes that are unproven or uncontrolled	Carry our capability studies on new process elements to prove the operations are controlled, meet cycle time targets, with a low scrap rate and document new processes to ensure consistency.
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Table 5 - Risk Management

Project Timing and Implementation

The project consists of 3 main phases: Design, Manufacture, and Installation.

To reduce the lead time the programming and manufacture phases will run simultaneously.

Testing will be carried out throughout the build process at an off-site location to prepare a streamlined integration.

The supply of equipment needs to be carefully considered, this is the most likely roadblock to on-time delivery as the supply chain is currently volatile.

Considering all elements under control the total project lead time is 20wks

See Appendix F for full project timing plan.

Conclusion

In summary the project should be carried out, considering a number of positive elements and mitigated risk factors the key points are:

- The project to be carried out over 3 parts
- Payback on investment within 14 months
- 7-year lifetime project profit of £176,000
- Re-allocation of resource to other value-added tasks
- Significant manufacturing waste reduction supporting an increase in Operating Efficiency
- Risk reduced in off-site testing and use of alternative machines for shared line items
- Spare capacity to integrate further product opportunities

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