

Written Report

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Introduction

This investment appraisal will present a project proposal to improve the bottleneck in the current workflow process, which blocks the development design in the company where there are no improvements to solutions for customers due to the prolonged time required to get prototypes and trials. For manufacturing industries, Product Design is a crucial phase in the workflow process to achieve a good product and how that product will be assembled using multiple parts to give the best result of the final product. This is why this project proposal focuses on improving the current process, which shows many inefficiencies affecting costs, timelines, waste of material, and achievable quality, (Eswaran, Bahubalendruni 2022).

The evidence shown here is not only from a financial point of view that will help the company to have the right decision on choosing this project as the next one to be approved because the benefits received from time and waste of material reduction are huge. Also, the payback finance method will be analysed and used to define how long it will take to the company to have the refund investment. Another essential point will be understanding virtual reality technology and how this can help reduce the current physical tests used in the company processes.

Process identified into the business to be improved

The design department has identified one of the main blockers to having a faster flow process from the New Product Development until the Critical Design Review (CDR) is achieved. CDR is used to present and agree with the customer on the final assembly product and integrators to get its acceptance. During this event, the integrators and customers could raise concerns and pick up issues that will be transformed into actions once all parties approve them. There is a short time to introduce changes, modify parts, and release the final products once this CDR event has been finalised.

The company is concerned about the high percentage of issues raised by the customers and integrators during the CDR events, added to the ones that could not be resolved earlier by the internal departments due to the lack of time, resources, and current manual tests for all projects across the business. During the product development phase, the designers are responsible for the product's design and validation, which requires methods like prototyping and physical tests in collaboration with the Industrialisation Department (IND). Moreover, it is here where the flow process is being stopped due to the long lead times to get the prototypes and physical tests done if the IND department could have enough people to run the tests. Equally important are the high prices paid to get the prototype and the parts required to run the tests due to the small quantities and short lead times requested. As the parts used for those tests can not be used for the production phase, the waste material is enormous and another blocker to keep moving forward to have an environmentally friendly company.

VR Technology

Virtual Reality (VR) is the technology chosen to improve the current process and give the advantage to go further to get better assemblies for CDR.

VR is the combination of 3D models with the interaction of graphics in real-time, where the users can manipulate and interact with a simulated world. There are two main ways to use the VR system. An immersive system is the first one that uses the orientation and position of the user to create the interactive world by using a Head Mounted Display (HMD) and sometimes with gloves or other devices. The second one is Desktop VR, which only requires a VR application installed on a computer with a monitor. These days where companies work more flexibly, and people can work from different places, this option helps allow different engineers to make decisions or analyse 3D models by sharing a virtual space, (Joshi 2022).

Introducing this VR technology into the manufacturing industries is helping them to improve productivity, quality and product design, reduce training cost and time, reduce errors, optimise inventory management, and minimise maintenance cost, time, and material waste, (Eswaran, Bahubalendruni 2022).

Efficiency improvements

What will be the benefits of this project?

- This can reduce time during the product design and development process because physical trials are not required before a detailed design review, and rapid prototyping will be used instead (DDR)
- More time for the design team to find better results
- (Improve Operational efficiencies) reduce workload for manufacturing teams (machining, sheet metal, vacuum, 3D printing, industrialisation) where they can be more focused on production parts to reduce the current delays or the necessity of using external suppliers when it is not required.
- Avoid high-risk areas that can be highlighted at DDR. This is related to tool access, electrical routing, line replaceable units (LRU) (explain it) or maintenance.
- Geographical location is not a barrier to using this technology, as it can be used with the current system anywhere in the world.
- Learning the tool that will add lots of knowledge to the design office while the assembly process and production results improve.
- Conclusion: The implementation of this technology is not only to solve or improve the issues presented here; it is only the beginning of how the business will jump into a cycle of productivity improvements due to the range of opportunities and processes that will be

automatised from now. (step forward to train employees in the assembly line for new products and avoid the wrong way to install parts; train new staff required without disturbing the current production line and the risk-free environment with hands-on, realistic experiences)

What is the risk level?

Considering that:

- This VR technology is already successfully used by other manufacturing companies, and it will not be a disrupted technology
- It will be an improvement to the existing processes
- The integration will be gradual in a short period of time (four weeks maximum)
- Training and support for existing employees are available

It can be said that this project is considered low-risk for the company.

Implementing this VR technology will gradually support the current projects, which is another strong point because there will not be disruptions from what the business is currently doing. This integration at the beginning will add value to the existing process where the business can learn, test, practice and develop procedures.

Financial Appraisal

Project Cost

The project cost will be divided into two parts. The first part will include the expenses for purchasing the equipment required for virtual reality technology. The second part will cover the costs of the elements essential for the technology to function correctly. To determine the total cost of the project, we will need to add up the expenses from these two components.

VR TECHNOLOGY REQUIRED	Cost
VR Headset	£500
Controllers	£100
Workstation	£2,000
Total Cost	£2,600

VALIDATION COST (per year)	Cost
Design Engineer	£40,000
VR training	£1,397
Workstation Electricity	£1,165
VR Electricity	£13
VR Software	£8,500
Total Cost	£51,075

Total Investment	£53,675
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Cost Analysis

To analyse costs, it will utilise two tables. The initial table will compare the time, employees, and expenses involved in the current process versus those required for virtual technology. Based on the first comparison's outcomes, which indicate that VR technology can complete 15 trials in just 4.2 weeks, the second table will illustrate the number of trials that can be completed in one year and the final cost per trial.

VR TECHNOLOGY COST ANALYSIS				
	Current Method 1 Trial	VR Technology 1 Trial	Current Method 15 Trials	VR Technology 15 Trials
Physical Trial time (per week)	3.5	0.28	52	4.2
Employees Required	3	1	3	1
Physical Trial Cost	£14,083	£3,405	£211,250	£51,075

VR COST-SAVING ANALYSIS		
	VR Trials	Current Trials
Physical Trial time (per year)	157	15
Employees Required	1	3
Cost per Trial	£325	£14,083
Total Savings per Trial	13758	

Payback Period

The time that a company takes to receive the accumulated reimbursement that equals the money invested in a project is what is considered the payback period (PBP) of financial appraisal.

It is known that although payback (PB) does not show or measure all the dimensions covered by profitability, this is a reasonably sensitive and fast method used by companies to determine if a project is economically viable when there are not many risks.

In contrast to the advantages of the rapid result that the PB can teach when making an investment decision, it must also be considered that there are two drawbacks of using this method, which are; the timing of the returns is missed and does not take any considerations of returns after the PBP. Numerous variations of the payback method have been developed over the years, all striving to eliminate some of its drawbacks while, at the same time, preserving the method as simple as possible (PB method on discounted cash flow figures), (Lefley 1996).

The table below shows how the investment interacts with the money to analyse through the Payback period method if this investment would benefit the company in terms of when the total investment payment would be completed and the benefits that the company will receive until the project is finished in the timeline of three years.

YEARS	Cash Flow Detail	Cash Flow £	Cumulative Cash Flow £	Payback
0	Investment (cash flow)	-53,675	-53,675	No
1	Net Cash Inflows	211,250	157,575	Yes
2	Net Cash Inflows	211,250	368,825	Yes
3	Net Cash Inflows	211,250	580,075	Yes

In this case, the formula below can be used because the net cash flow is equal for the three years of the project.

Payback Period =	<u>Initial Investment</u>	
	<u>Annual Cash Inflow</u>	
Payback Period =	53,675	
	211,250	
Payback Period =	0.25	Years

Discussion

It is essential to highlight that rapid prototypes made with additive manufacturing have been an incredible advance within manufacturing companies to try to reduce or eliminate physical tests. As a result, it has been possible to reduce the waiting times in manufacturing the parts used in the tests, but the cost of many parts is still relatively high, as are waiting times according to the high demand required. In the product life cycle, the design phase accounts for approximately 70% of the cost of producing large items. These expenses are closely tied to the assembly process and the time needed to ensure quality assemblies. For this reason, virtual reality technology is being more researched and used by manufacturing companies, where in most situations, assemblies/disassemblies, integrations and evaluations can be simulated with the interaction of virtual designs and assembly simulation. This allows designers to develop better products and their validation to be done in shorter times, (R D M D Jayasekera, X Xu 2019).

As this is a simple investment to analyse based on the issues the company is currently having, the PAYBACK method has been chosen to analyse whether this is a worthwhile project. The PAYBACK period is the time it takes for this project to repay its initial investment.

Conclusion

To conclude, there are many benefits that the company would obtain with the acceptance of this project. The cost analysis presented together with the PBP shows the great benefits from the financial point of view, and the short time in which the investment would be amortised is only the tip of the iceberg because the reduction of time to receive the results of the tests is unbelievably huge. Time is money, but it also becomes product quality and a more competitive company because the product development team would have more time to do more tests and therefore find better answers to customer needs.

Equally important is the excellent help to the environment with the reduction of the waste of material used in all these tests as all those parts can not be used for production assemblies. This waste reduction will push the company to be a more sustainable business.

References

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