

Financial Management and Planning

Assignment: Capital Project Appraisal Presentation

Course : MSc Industry 4.0 Advanced Manufacturing
Module Code : ACPA7002

Supervisor : Mr. Howard Davies

" Innovative process
AM (3D Printer) Investment "

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INTRODUCTION

In Recent years design for industry is the famous trends addressing the interconnection of product , people and machine.

The innovation is to creation of new high tech and performance material to reduce manufacturing cost by developing the production process . The product can be designed with new set design principals.. The new emerging technologies in smart manufacturing and analysis.

The design will be extended to innovative solution in which 3D printing technologies will be exploited for

-**Weight reduction** (originally part was in metal machining , with AM its material changed from aluminium to ULTEM and redesigned which reduced weight by 49%. Also Vac form parts manufactured from Additive manufacturing process.

-Tooling cost saving by new process development , in which existing VAC form parts can be manufactured in-house with AM . [[Troy McMillan](#) (2020)]

Project implications – value to business

The proposal for 3D printer (Based on requirement & costing plastic filament based model were approved). [3dgbire (2015)].

Its importance :

- Speed up the manufacturing process
- Time saving – to develop any prototype
- Cost saving : tooling cost saved .
- Reduce defect rates.
- Less waste
- Production on demand
- Easy to upgrade for metal filament in future



3DGBIRE

Metal 3D printing refers to the selective laser melting and direct metal laser sintering. These processes use metal powders to produce complex and one-piece metal parts.



Timeline for implementation

Timeline as per the project requirement ..

Need to implement before the design phase activity complete. So that we have make some prototype to finalised the design phase.

Discussion with higher management for this investment. Points like its need, technology understanding, and manufacturers were considered.

Sample prints were requested and evaluated to understand the cost factors which is very important in terms of financial discussion. (Ref Report page 5)

Approvals :

Internal resource
Project team
HSE team



[Karalia (2021)]

Improvement objective in SAFRAN

Development in team and business / no waiting for production printer.

Supplier lead time effects our delivery commitment to Aircraft customer. [\[Project finance. \(2012\)\]](#).

Revenue drive : Following point discussed and considered

cost per unit quotation

Count of units purchased

Month of purchase

Avg sales price of product that each type creates

Average monthly



3DGBIRE



Amortization duration : 3 years (process of repayment of debts through periodic instalments over period of time.)

Cost around : £15000 /per unit

Total 3(qty) : £45000

[3DGBIRE Ltd are experts in everything 3D printing. They supply the most innovative certified Additive Manufacturing equipment]

Project lifespan & funding

Process study and its importance

Example : Within one of the project due to clash between two parts (approx 3200 parts - 45 aircraft), supplier needs to modify metallic part and costing was pretty high when manufacturing / material and man hr included. Man hours €300K estimated.

Corrective action:

Placement of damper between the structural beam and bracket to avoid a clash. due to the lead time for VAC form parts, a customer might get a penalty. So the solution of additive manufacturing was introduced with minor lead time & easy installation which saved the man-hour cost per seat.

This process helps to minimize the industrial lead time with fast technical validation. Safran delivered the product on time and built healthy customer relations for future in-service solutions.

Project proposed & approved with company (internal funding), which further involves budget / project management / revenue streams.

Project life considered 5 years and looking fwd as long term investment prospective. The other option was externally Bank / Gov grant or Equity finance.

Project implementation issues

The following issues were studied during the implementation of this project.

Redundancy: There was no redundancy in the job, as all the machine was set up in the desired location. Instead, the company provided AM machine operation training to the design and industrialization team for performing the work in-house. External dedicated trainers were appointed and the cost of training was approved by higher management.

Disruption: In terms of reduction in vulnerability, additive manufacturing breaks all the links in the supply chain and will bring the manufacturing items produced close to the customer. [Ivanova, Olga (2013)].

Downtime: The organization does not experience short and long downtime. Another unplanned downtime is well controlled. In terms of servicing on time by performing preventive maintenance, and upgrading software or hardware if required. Invest in staff training/day after the setup



Business rationales

Business rationales:

- Payback i.e. less than 2 years
- IRR greater than 20%
- Positive NPV from a WACC of 15%
[Withers, Mark (2010)].
- Pay back mainly reflects the liquidity and risk of project... If shorter means project recovers initial cost faster. [PB = Initial investment / cash flow per year]
- Internal rate of return (IRR) : New profit / Cost of investment)*100
(Higher IRR means higher return on investment)
- Net present value (NPV) = Cash flow / $(1 + i)^t$ – initial investment

3D Printer (Additive manufacturing)					
Project	Investment	Year 01	Year 02	Year 03	Year 04
Present Value	-£45,000	£14,000	£16,000	£18,000	£20,000
Payback period	3 Years				
Discount Rate (WACC)	15%				
Denominator	1	0.87	0.756	0.658	0.572
Future Value	-£45,000	£12,180	£12,096	£11,844	£11,440
Results					
NPV Excel	£2,542.57				
IRR	18%				
PI	2.06				
BCR	1.06				

Note :

Denominator to capture from present value table % as specified. (Refer next slide)

Business rationales

NPV

The value for NPV is calculated as per the excel formula : £2542.57

Formula entered into the gray NPV cell is: =NPV(green cell, yellow cells) + blue cell

=NPV(C3, C6:C10) + C5

	A	B	C	D
1				
2				
3		Discount Rate	15%	
4				
5		Initial Investment	-£ 45,000.00	
6		Year 1	£ 14,000.00	
7		Year 2	£ 16,000.00	
8		Year 3	£ 18,000.00	
9		Year 4	£ 20,000.00	
10				
11		NPV	£ 2,542.57	
12				

Periods (n)	Interest rates (r)									
	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833
2	0.812	0.797	0.783	0.769	0.756	0.743	0.731	0.718	0.706	0.694
3	0.731	0.712	0.693	0.675	0.658	0.641	0.624	0.609	0.593	0.579
4	0.659	0.636	0.613	0.592	0.572	0.552	0.534	0.516	0.499	0.482
5	0.593	0.567	0.543	0.519	0.497	0.476	0.456	0.437	0.419	0.402
6	0.535	0.507	0.480	0.456	0.432	0.410	0.390	0.370	0.352	0.335
7	0.482	0.452	0.425	0.400	0.376	0.354	0.333	0.314	0.296	0.279
8	0.434	0.404	0.376	0.351	0.327	0.305	0.285	0.266	0.249	0.233
9	0.391	0.361	0.333	0.308	0.284	0.263	0.243	0.225	0.209	0.194
10	0.352	0.322	0.295	0.270	0.247	0.227	0.208	0.191	0.176	0.162
11	0.317	0.287	0.261	0.237	0.215	0.195	0.178	0.162	0.148	0.135
12	0.286	0.257	0.231	0.208	0.187	0.168	0.152	0.137	0.124	0.112
13	0.258	0.229	0.204	0.182	0.163	0.145	0.130	0.116	0.104	0.093
14	0.232	0.205	0.181	0.160	0.141	0.125	0.111	0.099	0.088	0.078
15	0.209	0.183	0.160	0.140	0.123	0.108	0.095	0.084	0.079	0.065
16	0.188	0.163	0.141	0.123	0.107	0.093	0.081	0.071	0.062	0.054
17	0.170	0.146	0.125	0.108	0.093	0.080	0.069	0.060	0.052	0.045
18	0.153	0.130	0.111	0.095	0.081	0.069	0.059	0.051	0.044	0.038
19	0.138	0.116	0.098	0.083	0.070	0.060	0.051	0.043	0.037	0.031
20	0.124	0.104	0.087	0.073	0.061	0.051	0.043	0.037	0.031	0.026

Denominator to capture form present value table % as specified.

Business rationales

IRR

The value of IRR is calculated by considering the sum of yearly present value in excel

= IRR(C4;G4)
= 18%

C12							
	A	B	C	D	E	F	G
1							
2		3D Printer (Additive manufacturing)					
3		Project	Investment	Year 01	Year 02	Year 03	Year 04
4		Present Value	-£45,000	£14,000	£16,000	£18,000	£20,000
5		Payback period	3 Years				
6		Discount Rate (WACC)	15%				
7		Denominator	1	0.87	0.756	0.658	0.572
8		Future Value	-£45,000	£12,180	£12,096	£11,844	£11,440
9							
10		Results					
11		NPV Excel	£2,542.57				
12		IRR	18%				
13		PI	2.06				
14		BCR	1.06				
15							

Business rationales

PI (Profitability Index)

The value of IRR is calculated by considering the(sum of future value + investment) / Present value. As shown in the excel image.

$$PI = (SUM(D8:G8)+45000)/-C4$$

$$= 2.06$$

C13		=SUM(D8:G8)+45000)/-C4					
	A	B	C	D	E	F	G
1							
2		3D Printer (Additive manufacturing)					
3		Project	Investment	Year 01	Year 02	Year 03	Year 04
4		Present Value	-£45,000	£14,000	£16,000	£18,000	£20,000
5		Payback period	3 Years				
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9							
10		Results					
11		NPV Excel	£2,542.57				
12		IRR	18%				
13		PI	2.06				
14		BCR	1.06				

BCR (Benefits cost ratio)

The value of BCR is calculated by considering the (sum of future value) / Present value. As shown in the excel image.

$$BCR = SUM(D8:G8)/-C4$$

$$= 1.06$$

C14		=SUM(D8:G8)/-C4					
	A	B	C	D	E	F	G
1							
2		3D Printer (Additive manufacturing)					
3		Project	Investment	Year 01	Year 02	Year 03	Year 04
4		Present Value	-£45,000	£14,000	£16,000	£18,000	£20,000
5		Payback period	3 Years				
6		Discount Rate (WACC)	15%				
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14		BCR	1.06				



Designed component is sustainable / Recycle , low carbon .

The Additive manufacturing process itself provides a more sustainable means of production. In this process, 3D printing eliminates the excess material. Also, the ability to create generative shape designs. Also its time saving and eliminates long transport and storage areas thus reducing carbon footprint. [\[Safran \(2022\)\]](#).

Weight optimisation

Lighter Material implementation.

New manufacturing techniques (AM)

Re-use of existing parts .

Recycle material to use on other parts

Organizational Benefits



This research analysis helps my organisation to design and develop there seating components from following points.

- Light weight seating system.
- Advance material implementation for circularity.
- Cost reduction AM processes
- New learning financial attributes towards investment.

Innovative Ideas development for organisational growth of the systems

Conclusion

During 2023 Safran has delivered significant achievements across all aspects of Environmental, Social, and Governance ('ESG'). In terms of sustainability, the material used within additive manufacturing will eliminate the excessive use of filament (material). The supplier cost and the transport cost will be reduced resulting in less CO₂ emission.

This project increased the efficiency and accuracy to build the product with minimum lead time to satisfy the customer's requirement. Implementing the new process reduced the tooling cost required in the previous manufacturing process. Looking at the ratios & performance everything is within the plan and budget. SAFRAN organization investment is highly productive to new material and process innovation with this technology now available in-house.

This project report & this supporting presentation concludes that additive manufacturing is an important technology in digital production. Plays a key role in global manufacturing, digital transformation, and supply chain resilience. The role of this Industry 4.0 technology in the environment and society is significant.

This module outcome helped to learn financial and accounting concepts & its application on investment projects to take financial decision accordingly. Also upgraded myself as a team to bring this concept of process development in seating & providing adequate reference to prove this investment will be beneficial for the organization in the long-term prospective.

References

1. Safran (2023), "*Safran group information*", Available at : <https://www.safran-group.com/companies/safran-seats>. (Accessed 21 May 2023).
2. Beau Jackson (2019), "*3D printing in planes*", Available at : <https://3dprintingindustry.com/news/british-airways-posts-top-ten-predictions-for-the-use-of-3d-printing-in-planes-166149/>. (Accessed 21 May 2023).
3. The Essential Team (2020), "*The Financial impact of 3D printing*", Available at : <https://essentium.com/the-financial-impact-of-3d-printing>. (Accessed 22 May 2023).
4. Withers, Mark (2010), "*The Business Rationale*". 10.1016/B978-1-85617-546-3.00006-2.
5. Karalia (2021), "*3D-Printed Oral Dosage Forms: Mechanical Properties, Computational Approaches and Applications*". Pharmaceutics. 13. 1401. 10.3390/pharmaceutics13091401.
6. 3dgbire (2015), "*3D printer*" Available at <https://3dgbire.com/pages/about-us>. (Accessed 27May2023)
7. Project finance. (2012), "*Euromoney Institutional Investor Publications plc*". Available at : <http://www.euromoneyplc.com/>, (Accessed 25 May 2023).
8. Safran (2022), "*Safran inaugurates the safran additive Manufacturing Campus , a new center of excellence*". Available at : <https://www.safran-group.com/pressroom>. (Accessed : 10 May 2023).
9. Young, Son K. (1991) "*A Cost Estimation Model for Advanced Manufacturing Systems.*" International Journal of Production Research. 1991. 29(3): 441-452.
10. Ivanova, Olga (2013), "*Additive Manufacturing as a Disruptive Technology*": Implications of Three-Dimensional Printing. Technology and Innovation. 15. 67. DOI : 10.3727/194982413X13608676060655.
11. Troy McMillan (2020), "*3D Printed Airplane C152 Part 1 - Printer Setup*". Available at: <https://www.youtube.com/watch?v=r8nRSr-eyaM>. (Accessed 26 May 2023).

Thank You



Module : Financial Management and Planning
[ACPA7002]

Assignment
Capital Project Appraisal Report on
" Innovative process
AM (3D Printer) Investment "

Course : MSc Industry 4.0 Advanced Manufacturing

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1. Summary / Overview

The overview of the following report consists of the analysis of accounting and financial concepts which are applied in business for improvement and new innovation. The main theory of finance in the company is described with process innovation which helped the organization to grow and save manufacturing costs and increase efficiency. While implementing the investing project various implications were noted, studied the investment problems to make appropriate discussions.

Also, the report consists of calculations of business rational like NPV, IRR, and payback to analyze the company situation due to implementation of this project. Wide range of references specified to support this investigation.

The organization which I have considered for the innovation project work is my employer "SAFRAN" which is into aerospace seating. Safran is a French multinational company that develops and designs and manufactures businesses and first class seats. It has headquarter in France & employing more than 92,000 people worldwide. It design and certifies innovative products specialized in business class and first class seating. [\[Safran \(2023\)\]](#)

Furthermore, the report shows the financial calculation in the appendix section. The formulas learned during this task to calculate the payback, NPV, and IRR which the key element to concentrate while investing in any business.



Fig 1: Business process improvement

2. Introduction

Safran seats are a company based in the UK and have many subsidiaries branched all over. The key business is designing and manufacturing aircraft seating systems.

This business report is based on the innovation process developed within this organization by investing in a 3D printing machine used to produce seating-related parts with weight optimization, manufacturing process change by introducing Industry 4 technology (Additive manufacturing) for producing aircraft seating parts by introducing this method of manufacturing. This will replace the method (vacuum forming). The parts will be manufactured in-house with min cycle time and reducing tooling cost.

The recent project was about British Airways which is exploring 3D printing for cabin efficiencies. British Airways says that 3D printing can help reduce a part's weight by up to 55 percent. Even with small components, the effects can be significant, as every kilogram removed saves tons of CO2 emissions during the lifespan of an aircraft. The parts which can be manufactured with this process are Tray tables, in-flight entertainment (IFE) & other vacuum-forming parts. [\[Beau Jackson \(2019\)\]](#).

Based on the customer need and new process involvement, an additive manufacturing machine will be very much beneficial for the organization's proposal were proposed. This machine will be placed onsite at different units as required to support the ongoing project and further upcoming projects for weight optimization and cost saving in tooling.

The below image shows the different areas where AM can be implemented in aircraft. Also studied the 3D printing setup for fighter aircraft to get an idea about its working principle [\[Troy McMillan \(2020\)\]](#).

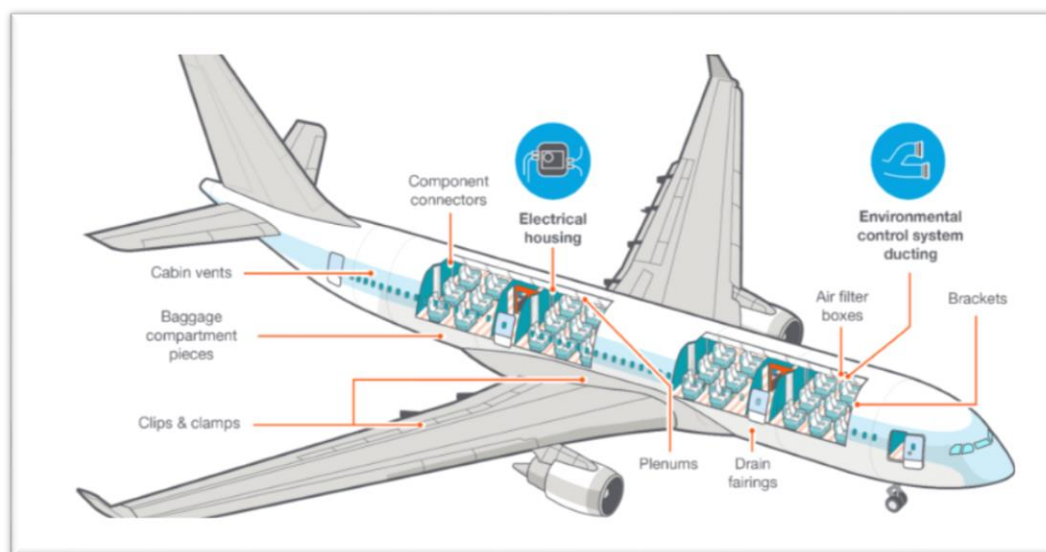


Fig 2: AM components in Aircraft

3. Project Implications

Additive manufacturing (AM), also known as 3D printing. As it's been used to prototype for the past many years, it has reached an inflection point. AM is improving the development efficiency of any product, the execution of the process, and also its performance.

The drawback of this process before opting to use this process is as listed below [\[The Essential Team \(2020\)\]](#).

- Minimum material
- Size of the ,manufacturing part is restricted
- Specific material and its specification to use under AM
- Restricted Build Size. (some machine cant used for bigger parts)
- Manufacturing jobs accuracy.
- Issues related to copy write etc
- May lead to potential danger in aspect of terrorism..

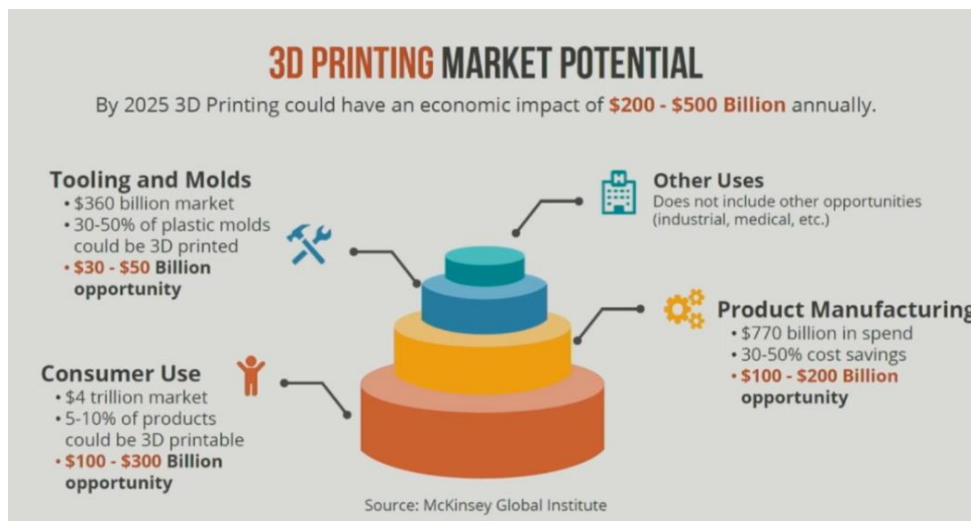


Fig 3 :Market potential

To implement this project in SAFRAN we have gone through the following requirement.

1. Internal and external resource requirement which includes the following departments
 - Engineering team
 - Compliance to health and safety requirement
 - Contracting and issuing of purchase order to supplier
 - Network cable setups.
2. Project team which will include the project manager , Technical support & HSE lead

4. Timeline and management

In terms of timeline, the proposal was in place at the start of the seating project. Prove this will definitely help the process to streamline and cost-saving for the future, the prototype was developed on different sites to show its effectiveness. General timeline of 3D printing process in shown below for reference. [\[Karalia \(2021\)\]](#)

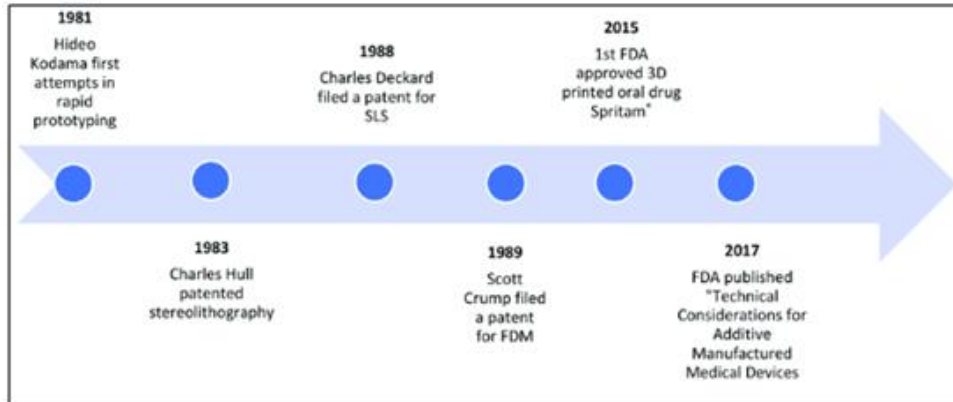


Fig 4 :AM Time line in industry

Time management and the process followed in SAFRAN to implement this project are :

1. Business case need to be defined for 3D printer purchase

Discussion with higher management for this investment. Points like its need, technology understanding, and manufacturers were considered. Sample prints were requested and evaluated to understand the cost factors which is very important in terms of financial discussion. Financial costing shown in appendix section (refer to page 12)

2. Types of 3D printer (Technology)

Based on company requirement, printer type material extrusion was selected which has typically plastic filament which further solidifies and form a solid part. Very useful to select the plastic material for weight reduction scope in aircraft seating components. with a dimensional accuracy of $\pm 0.5\%$ and great strength. [\[3dgbire \(2015\)\]](#).

The flow chart represents the procedure followed during this additive manufacturing to finish the product as per the requirement. (refer fig 5)

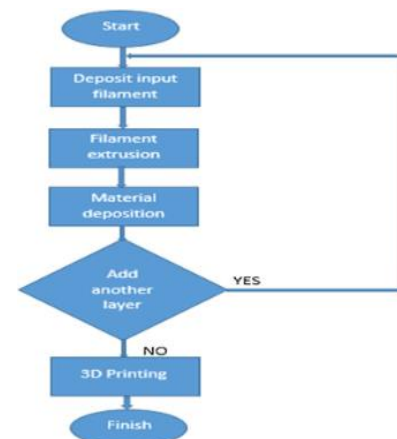


Fig 5 :AM process flow chart

5. Project cost & Estimation

The tentative format of capital expenditure followed as per the below shown sheet.

Estimation : £15000 / Qty : 3 / Total : £45000

(Please note : Below table shows company's tentative format . Other calculations explained in the appendix - refer page 12)

1. INVESTMENT DETAIL		PROJECT PROFILE			Summary Returns		
	TOTAL	2023	Outline Yrs		2023	2024	2025
Capital Expenditure	-	-	-	Sales	-	-	-
Less: Capital Grant	-	-	-	ROC	-	-	-
Less: Fixed Asset Disposal Proceeds	-	-	-	Margin %			
NET Capital	-	-	-	Cash (PreTax)	-	-	-
One Off Revenue Costs	-	-	-	Project Title:	Engineering 3D Printer		
Working Capital	-	-	-				
Revenue Re-Orig / Rest Costs	-	-	-				
NET CASH INVESTMENT	-	-	-				

2. RISK & RETURN		
NPV	-	IRR
		Payback (Yrs)
		-

Table 1 : Capital expenditure outline

Project Funding / Financing:

The above-stated project is company funded (internally). Basically, the project payback is done from the cash flow generated by this project. The other option was externally Bank / Gov grant or Equity finance. [\[Project finance. \(2012\)\]](#)

Project management budget design analysis done to understand the flow which includes the following factors.

- Project delivery = Install system / Project review / Material requirement
- Project management = Internal meeting/configuration management / Quality
- Internal funding / Dept budget / Customer billing invoicing / Existing Revenue streams.

Studies show that the production cost can be differentiated into two types first is well structured such as man power, material, and machine cost & second ill-structured which deals with build failure, setups, and inventory. due to additive manufacturing cost savings in ill-structured may be hidden & the concept of lean production might be useful. [\[Young \(1991\)\]](#).

Cost Analysis / AM proposal:

Before implementing this proposal, some analysis were carried out within the organization to show the cost-effectiveness in terms of financial benefits.

Example : Within one of the project due to clash between two parts (approx 3200 parts - 45 aircraft), supplier needs to modify metallic part and costing was pretty high when manufacturing / material and man hr included. Man hours €300K estimated.

Corrective action:

Placement of damper between the structural beam and bracket to avoid a clash. due to the lead time for VAC form parts, a customer might get a penalty. So the solution of additive manufacturing was introduced with minor lead time & easy installation which saved the man-hour cost per seat. This process helps to minimize the industrial lead time with fast technical validation. Safran delivered the product on time and built healthy customer relations for future in-service solutions.

6. Project life span

The life span/lifecycle of the project is the phases through which the project progress. this mainly includes the starting initiation, planning, progressing / execution, and ending / closure. The below fig states the points that to be considered. This project considered for 5 years & looking fwd as long term perspective.

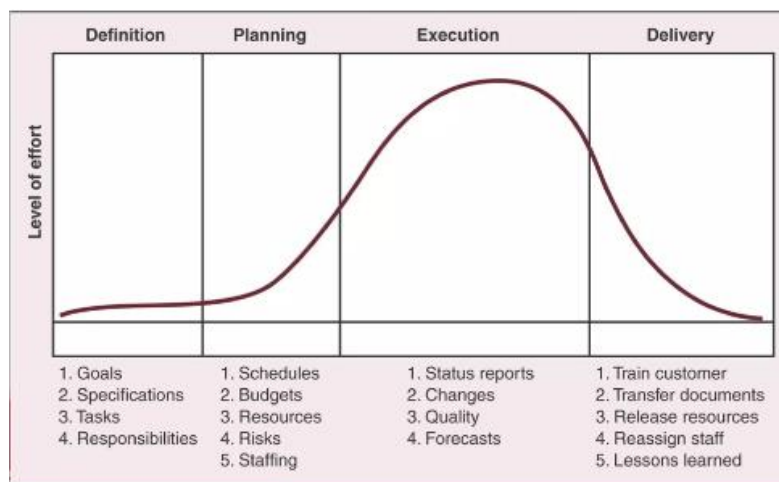


Fig 6 :Project lifecycle

This project will be very useful in terms of new material & process development in existing and upcoming projects. SAFRAN management has considered this an excellent investment to achieve sustainable products for the customer. [\[Safran \(2022\)\]](#).

This project implementation had a minimum lead time where we need to order the parts required for the prototype. In-house production of additive manufacturing parts helped us to perform critical design review activities with the customer before time so that the robust design can be built to inline with the aircraft regulations.

	Material extrusion	Material jetting	Binder jetting	Vat photopoly- merization	Sheet lamination	Powder bed fusion	Directed energy deposition
Polymers and polymer blends	x	x	x	x	x	x	
Composites		x	x	x		x	
Metals		x	x		x	x	x
Graded/hybrid metals					x		x
Ceramics			x	x		x	
Investment casting patterns		x	x	x		x	
Sand molds and cores	x		x			x	
Paper					x		

Table 2 : AM process and material combination

7. Project implementation issues

The following issues were studied during the implementation of this project.

Redundancy: There was no redundancy in the job, as all the machine was set up in the desired location. Instead, the company provided AM machine operation training to the design and industrialization team for performing the work in-house. External dedicated trainers were appointed and the cost of training was approved by higher management.

Disruption: In terms of reduction in vulnerability, additive manufacturing breaks all the links in the supply chain and will bring the manufacturing items produced close to the customer [\[Ivanova, Olga \(2013\)\]](#).

Downtime: The organization does not experience short and long downtime. Another unplanned downtime is well controlled. In terms of servicing on time by performing preventive maintenance, and upgrading software or hardware if required. Invest in staff training/day after the setup

8. Business rational

Business rationales can be defined as case which provides justification for the project requirement, program, or portfolio. it gives an idea about the risk involved and options, requirements and the organization's benefits. [\[Withers, Mark \(2010\)\]](#).

This report shows the investment in process development by investing in additive manufacturing machines for organizational growth and saving manufacturing costs with new process development. The key theme of a business case is the return achieved on our investment for the transformation. With the help of these, HR can get engage with the program for shaping future services. The three most important approaches to selecting the project are payback (PB), internal rate of return (IRR), and the net present value (NPV). the period helps the company to determine how long the company can take enough cash flow to recover the investment made originally.

8.1 Payback

The terminology payback period is the time taken to recover the cost of investment. Corporations always do investments to get the payback which is also defined as the investor breakeven point. If the payback value is shorter than the investment is more attractive. The value is calculated by dividing the amount of the investment by cash flow. The accounts department uses this value to decide whether to go with the business or not. Actual calculation of this project showing the investment on additive manufacturing machines with payback period of 3 years calculated in appendix section (refer to page 12).

$$\text{Payback Period (Formula)} = \frac{\text{Cost of Investment}}{\text{Average Annual cash Flow}}$$

8.2 IRR

The Internal rate of return (IRR) is mainly used by the company to check the profit center and decide between the Capital project. This terminology also helps us in our own life budgeting like - mortgages and investments. Discounted rate is another term for IRR. This is an important tool in finance to evaluate the new plant w.r.t the existing one. The projects which are considered should produce higher IRR than the company's cost of capital. It is mainly useful. The general formula for calculating IRR is as shown below. The good amount is around 18 to 20 %. Internal rate of return can help you determine the break-even cash flow level of investment.

Actual calculation of this project showing the investment on additive manufacturing machines explained and calculate in appendix section (refer to page 12). [\[Withers, Mark \(2010\)\]](#).

$$NPV = \sum_{t=0}^n \frac{CF_t}{(1+r)^t}$$

where:

CF_t = net after-tax cash inflow-outflows during a single period t

r = internal rate of return that could be earned in alternative investments

t = time period cash flow is received

n = number of individual cash flows

8.3 NPV

NPV, or net present value, determines the value of the investment whether its worth throughout its lifetime, discounted to today's value. The formula for NPV is often used in investment banking and accounting to get an idea of an investment, project, or business will be profitable in the long run. Its value if greater than zero that it is considered as good.

$$NPV = \text{Cash flow} / (1 + i)^t - \text{initial investment}$$

In this case, i = required return or discount rate and t = number of time periods.

calculation shown in appendix section (refer to page 12)

8.4 Other learning's : ARR

This tool measures the annual percentage rate of return . It is commonly used on multiple project ARR is commonly used when considering multiple projects, as it provides the expected rate of return from each project.

$$\text{Annual rate of return (Formula)} = \frac{\text{Average Annual report}}{(\text{Initial investment} + \text{Future residual value}) / 2}$$

9. Project model and sustainability

The Additive manufacturing process itself provides a more sustainable means of production. In this process, 3D printing eliminates the excess material. Also, the ability to create generative shape designs. In addition not only it saves time but also eliminated long transport and storage areas thus reducing carbon footprint. [Safran (2022)].

10. Organizational benefits

The benefits that organization achieved are :

- Executed the weight optimization project by changing the material of the seating component.
- Additive manufacturing parts are made in-house to reduce supplier costs.
- Time management improved, due to in-house availability parts can be made quickly.
- Customization is possible as per customer requirements.
- Sub-level component managed.



Fig 7: AM benefits

11. Conclusion & Recommendation

During 2023 Safran has delivered significant achievements across all aspects of Environmental, Social, and Governance ('ESG'). In terms of sustainability, the material used within additive manufacturing will eliminate the excessive use of filament (material). The supplier cost and the transport cost will be reduced resulting in less co2 emission. Recommend this to implement in every manufacturing organization if excessive prototyping is involved in product development.

This project increased the efficiency and accuracy to build the product with minimum lead time to satisfy the customer's requirement. Implementing the new process reduced the tooling cost required in the previous manufacturing process. Looking at the ratios & performance everything is within the plan and budget. SAFRAN organization investment is highly productive to new material and process innovation with this technology now available in-house.

This project report also concludes that additive manufacturing is an important technology in digital production. Plays a key role in global manufacturing, digital transformation, and supply chain resilience. The role of this Industry 4.0 technology in the environment and society is significant. This module outcome helped me to learn financial and accounting concepts to apply to specific investment projects in any organization to take the financial decision accordingly.

Also, highlighted me in my organization as a team to bring this concept of process development in seating & providing adequate reference to prove this investment will be beneficial for the organization in the long-term prospective.

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12. References:

1. Safran (2023), "Safran group information", Available at : <https://www.safran-group.com/companies/safran-seats>. (Accessed 21 May 2023).
2. Beau Jackson (2019), "3D printing in planes", Available at : <https://3dprintingindustry.com/news/british-airways-posts-top-ten-predictions-for-the-use-of-3d-printing-in-planes-166149/>. (Accessed 21 May 2023).
3. The Essential Team (2020), "The Financial impact of 3D printing", Available at : <https://essentium.com/the-financial-impact-of-3d-printing>. (Accessed 22 May 2023).
4. Withers, Mark (2010), "The Business Rationale". 10.1016/B978-1-85617-546-3.00006-2.
5. Karalia (2021), "3D-Printed Oral Dosage Forms: Mechanical Properties, Computational Approaches and Applications". Pharmaceutics. 13. 1401. 10.3390/pharmaceutics13091401.
6. 3dgbire (2015), "3D printer" Available at <https://3dgbire.com/pages/about-us>. (Accessed 27May2023)
7. Project finance. (2012), "Euromoney Institutional Investor Publications plc". Available at : <http://www.euromoneyplc.com/>, (Accessed 25 May 2023).
8. Safran (2022), "Safran inaugurates the safran additive Manufacturing Campus , a new center of excellence". Available at : <https://www.safran-group.com/pressroom>. (Accessed : 10 May 2023).
9. Young, Son K. (1991) "A Cost Estimation Model for Advanced Manufacturing Systems." International Journal of Production Research. 1991. 29(3): 441-452.
10. Ivanova, Olga (2013), "Additive Manufacturing as a Disruptive Technology": Implications of Three-Dimensional Printing. Technology and Innovation. 15. 67. DOI : 10.3727/194982413X13608676060655.
11. Troy McMillan (2020), "3D Printed Airplane C152 Part 1 - Printer Setup". Available at: <https://www.youtube.com/watch?v=r8nRSr-eyaM>. (Accessed 26 May 2023).

13. Appendix

13.1 Calculation of Ratios

3D Printer (Additive manufacturing)					
Project	Investment	Year 01	Year 02	Year 03	Year 04
Present Value	-£45,000	£14,000	£16,000	£18,000	£20,000
Payback period	3 Years				
Discount Rate (WACC)	15%				
Denominator	1	0.87	0.756	0.658	0.572
Future Value	-£45,000	£12,180	£12,096	£11,844	£11,440
Results					
NPV Excel	£2,542.57				
IRR	18%				
PI	2.06				
BCR	1.06				

Table 3 : Financial ratio calculations

Project : Investment in 3D printer

Total cost printer = £15000 x 3 = £45000

Qty ordered = 3 Qty considered.

13.1.1 Payback :

The value of payback is considered for the company details @ 3 years with a discount of 15% (WACC). With ref to these two values, Denominator is calculated from the present value chart as shown below.

13.1.2 NPV :

The value for NPV is calculated as per the excel formula : £2542.57

Formula entered into the gray NPV cell is: =NPV(green cell, yellow cells) + blue cell

$$= \text{NPV}(\text{C3}, \text{C6:C10}) + \text{C5}$$

	A	B	C	D
1				
2				
3		Discount Rate	15%	
4				
5		Initial Investment	-£ 45,000.00	
6		Year 1	£ 14,000.00	
7		Year 2	£ 16,000.00	
8		Year 3	£ 18,000.00	
9		Year 4	£ 20,000.00	
10				
11		NPV	£ 2,542.57	
12				

13.1.2 IRR,

The value of IRR is calculated by considering the sum of yearly present value in excel

$$= \text{IRR}(C4:G4)$$

$$= 18\%$$

C12		fx =IRR(C4:G4)					
	A	B	C	D	E	F	G
1							
2		3D Printer (Additive manufacturing)					
3		Project	Investment	Year 01	Year 02	Year 03	Year 04
4		Present Value	-£45,000	£14,000	£16,000	£18,000	£20,000
5		Payback period	3 Years				
6		Discount Rate (WACC)	15%				
7		Denominator	1	0.87	0.756	0.658	0.572
8		Future Value	-£45,000	£12,180	£12,096	£11,844	£11,440
9							
10		Results					
11		NPV Excel	£2,542.57				
12		IRR	18%				
13		PI	2.06				
14		BCR	1.06				
15							

13.1.3 PI

The value of IRR is calculated by considering the(sum of future value + investment) / Present value. As shown in the excel image.

$$\text{PI} = (\text{SUM}(D8:G8)+45000)/-C4$$

$$= 2.06$$

C13		fx =(SUM(D8:G8)+45000)/-C4					
	A	B	C	D	E	F	G
1							
2		3D Printer (Additive manufacturing)					
3		Project	Investment	Year 01	Year 02	Year 03	Year 04
4		Present Value	-£45,000	£14,000	£16,000	£18,000	£20,000
5		Payback period	3 Years				
6		Discount Rate (WACC)	15%				
7		Denominator	1	0.87	0.756	0.658	0.572
8		Future Value	-£45,000	£12,180	£12,096	£11,844	£11,440
9							
10		Results					
11		NPV Excel	£2,542.57				
12		IRR	18%				
13		PI	2.06				
14		BCR	1.06				

13.1.4 BCR

The value of BCR is calculated by considering the (sum of future value) / Present value. As shown in the excel image.

$$\text{BCR} = \text{SUM}(\text{D8:G8}) / -\text{C4}$$

$$= 1.06$$

C14		=SUM(D8:G8)/-C4					
	A	B	C	D	E	F	G
1							
2		3D Printer (Additive manufacturing)					
3		Project	Investment	Year 01	Year 02	Year 03	Year 04
4		Present Value	-£45,000	£14,000	£16,000	£18,000	£20,000
5		Payback period	3 Years				
6		Discount Rate (WACC)	15%				
7		Denominator	1	0.87	0.756	0.658	0.572
8		Future Value	-£45,000	£12,180	£12,096	£11,844	£11,440
9							
10		Results					
11		NPV Excel	£2,542.57				
12		IRR	18%				
13		PI	2.06				
14		BCR	1.06				