INHOUSE OR BUREAU ?

AN APPRAISAL OF RETURN ON 3D PROTOTYPING AND LOW VOLUME MANUFACTURE INVESTMENT

PROJECT EVALUATION

A financial and environmental evaluation of project value

Jo Edwards (2117195)

FDM SLA SLS

- Fused Deposition Modelling (FDM) – lowest cost _ low resolution
- Stereolithography (SLA)- low cost _high resolution
  - Selective Laser Sintering (SLS) – higher cost _medium resolution solid parts

- FDM and SLA
  - require build supports and significant post processing. Neither create parts in materials suitable for deployed products
- SLS
  - Does not require build supports
  - Creates parts in several nylon powders with fiber fill options
  - parts are solid and suitable as components in deployed products

Introduction

- The business has a requirement for agile management of component parts manufacture in its core NPD initiative
- Currently two 3D printing tools are available inhouse
  - SLA and FDM

Requirements

- The next development phase requires higher quality prototype parts and a timely turnaround for design iteration evaluation
- The preferred solution must also be suitable for small scale manufacture
- Ease of install
- Low postprocessing labour
- Low energy consumption
- Zero to low waste

Selective Laser Sintering

Sourcing options and benefits

In or out ?

- *Generates structural components*
- *Available powder choices provide desired structural characteristic options*
- *Bureau outsourcing*
  - *IP risk*
  - *5-7 working days turnaround*
  - *Relative high cost per part*
  - *Little inhouse effort*
  - *No capital investment or maintenance issues*
- *Inhouse capability*
  - *Preserves design confidentiality*
  - *Generally, 24hr production turnaround*
  - *Significantly lower cost per part*
  - *Investment in capital equipment*
  - *Powder inventory required*
  - *Post processing of batches by staff*
  - *Breakdown risk – service costs*

Impact on capital reserves

If ‘Out’ then -

- Order, pay in advance and wait 5-7 WDs for delivery

If ‘In’ then -

- Order Fuse1+ workflow system
- Delivery lead-time of 21 days
- Installation one day
- Cost £46,893 inc. delivery (ex VAT)
  - Inc. one day training

Product	Quantity	Price
Fuse 1+ 30W High Efficiency Package £46,393.00 Includes ▲	QTY - 1 + Remove	£46,393.00 GBP

Fuse 1+ 30W High Efficiency Package Includes

- 1 x Fuse 1+ 30W Printer 230V
- 1 x Fuse Series Build Chamber 230V
- 1 x Fuse Series Build Chamber 230V
- 2 x Fuse Series Powder Cartridge
- 1 x Fuse Series Printer Stand
- 4 x Nylon 12 Powder 6 kg
- 1 x Fuse Sift 230V
- 1 x Industrial Vacuum 230V
- 1 x Fuse and Sift Premium Service 2 Years

Assumptions

MEASURING TOOL ASSEMBLY

Complex 16-part measuring tool assembly by REEKON Tools.

PART DIMENSIONS	PART VOLUME
258 x 154 x 110 mm	280 cm^3

PARTS PER YEAR	PARTS PER MONTH
600	50

- SLS workflow solution has a 5-year working life with a zero residual value
- Example part assembly for manufacture is a complex 16-part assembly shown in Fig. 1
- At maximum throughput the SLS workflow solution can produce 600 part sets per annum.
- Year 1 requirement for prototyping is 30 part sets
- Year 2 to year 5 annual requirements for small scale production is 325 part sets
- Contract bureau cost per part set is £168

Selective Laser Sintering : Project modelling

Project Fuse SLS		Year				
	Investment	1	2	3	4	5
Present Value	(49,000)	£4,159	£45,052	£45,052	£45,052	£45,052
			Simple_Payback	1 yr 11.9mth	IRR	52.06%
Discount Rate (WACC)	10.00%					
Denominator	1.00	0.909	0.826	0.751	0.683	0.621
Discounted project revenue	(49,000)	3,780	37,213	33,834	30,770	27,977
			Discounted Payback	2 yr 2.8mth		
NPV	84,574		84,605		PI (profitability index)	2.73
Discounted NPV	84,605.27				BCR	1.73
ARR	55.25%					

In or out ?

Project Appraisal Matrix

Appraisal Tools		pass/fail ?
Simple Payback	1 yr 11.9mth	pass
Discounted Payback	2 yr 2.8mth	pass
Discounted NPV	£ 84,605.27	pass
ARR	55.25%	pass
IRR	52.06%	pass
BCR	1.73	pass
PI (profitability index)	2.73	pass

- **Hurdles**
  - **Payback is ideally < 2 years**
  - **IRR > 2*WACC (20%)**
  - **PI>1**
  - **BCR>1**
  - **NPV > investment**

- Relatively low first year SLS system utilization skews the payback periods
- Negative influence on each of the supplementary appraisal methods though the low yr1 discounted future cashflow

Funding options

- **Internal financing**
  - No credit charges
  - Super Deduction for Capital Allowances of 130% (to 2023) –claim back 25p for every £1 invested
  - Uses liquid cash reserves
  - Opportunity costs of investing cash in a depreciating asset
  - May fail or experience service outages
- **External financing –bank loan**
  - Borrow instead of buying assets frees up working capital
  - Loan terms tailored to asset life and type
  - Similar CT Cap. Allowances to internal financing
  - May fail or experience service outages
- **External financing – equipment leasing**
  - Lease period tailored to project period
  - CT relief on lease payments
  - Early buy- back option
  - Lease equipment may come fully serviced and maintained
  - **No** Super Deduction for Capital Allowances

Conclusions and Recommendations

Apart from the tangible financial justifications, below the line intangible benefits include

- Rapid evaluation of prototype iterations through reduced iteration cycle periods
- On demand small scale manufacturing, agile response to demand
- Zero investment in hard tooling
  - Agile response to part design changes to enhance or correct part performance in small scale manufacturing
- Reduction of manufacturing ‘miles’
  - Limited drops of bulk raw materials as opposed to multiple single part deliveries
- Near zero inventory requirement
  - Zero waste in deprecated parts held in stock, Just in Time (JIT) manufacturing
- Near zero raw material waste
  - High rate of unused powder recovery for reuse in manufacture
- Preservation of knowhow and intellectual property

Questions please