



Financial Management and Planning
MSc International Innovation Management

Capital Project Appraisal

Duraflex 150mm Cavity Closer

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1. Introduction

Following changes to UK Building Regulations 2010, published in the 'Conservation of fuel and power' approved document L (ADL), major UK housebuilders were required to increase wall cavity width, from the standard 100mm to 150mm, to comply with new thermal requirements. Alongside these changes the method of calculation for determining thermal bridging also changed, as detailed in ADL 4.18.

To ensure compliance with the new methods of calculation, UK Window and Door Group (UKWDG) proposed a complete new design of a 150mm cavity closer, that will be required for both standard and check reveal construction details. The changes will take place from June 15th 2022, although any developments that started before this date will use the old method of calculation. Discussions with large house builders indicated that the new products will be required during Q2 2023.



Cavity closer – picture (UKWDG, 2022)

Currently, total market sales are based on construction of 180,00 houses per year and a potential requirement of 1.8 million cavity closers, split between 80% casement and 20% doors. Current meterage (2021 sales) gives UKWDG a 6% share of this market, which equates to annual sales of £477k.

The new tooling required to produce the 150mm profile, will consist of a newly designed die, calibrator and tanks and will be manufactured by Exelliq, with a lead time of around 6 months. Additional requirements include new ram structural insert and corner moulding tooling, BBA compliance certification and marketing of the product. The new tooling will also require tuning and commissioning before production begins.

The new design will ensure that the cavity closer range remains compliant with new UK building regulations, ensures the business can continue to support house builders following the increase in cavity width and will also help retain market share and help develop of business. This project falls outside the planned capex roadmap and is dictated by changes in building regulations.

2. Project timeline

Month		Oct-22 3	Nov-22 4	Dec-22 5	Jan-23 6	Feb-23 7	Mar-23 8	Apr-23 9	May-23 10	Jun-23 11	Jul-23 12	Aug-23 13	Sep-23 14	Oct-23 15	Nov-23 16	Dec-23 17	Jan-24 18
Investment	Purchase cost		31,171	31,171				62,342									
	Ram insert tooling							6,430									
	Marketing					833	833	833									
	Other - BBA Approval Certification							5,000									
	Total cash outflows		31,171	31,171	0	833	833	74,605	0	0	0	0	0	0	0	0	0
Return	Additional Margin		0	0	0	0	0	0	15,488	15,488	15,488	15,488	15,488	15,488	15,488	15,488	15,488
	Present value - Net Cash Inflow/(Outflow)		(31,171)	(31,171)	0	(833)	(833)	(74,605)	15,488	15,488	15,488	15,488	15,488	15,488	15,488	15,488	15,488
	Net Value- Cash Inflow/(Outflow) -per month		(31,171)	(62,342)	(62,342)	(63,175)	(64,008)	(138,613)	(123,125)	(107,636)	(92,148)	(76,660)	(61,171)	(45,683)	(30,195)	(14,707)	782
	Simple payback - no. of months	8.9	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0.9

Opportunity and feasibility studies and quotations were planned during August – September 2022. Capex approval from submission was planned in October, with approvals and orders scheduled during November 2022. The lead time for the new cavity tooling was 6 months with an expected delivery date of April 2023.

Following acceptance of tooling at Duraflex, a dedicated production line would be allocated for tuning and commissioning. The period was scheduled to last around 4 weeks during April 2023, during which the line will be rendered unavailable for production. To mitigate this issue, a suitable stock build was factored in during the month of March 2023, to bolster inventory and limit disruption to business as usual. A labour commitment was also required for the four-weeks, with one machine operator, a tool maker and a Exelliq technician redirected from normal daily activities to complete the task. The new tooling would be ready for production in May 2023.

The aim of the report is to analyse the project using simple payback, Net present value (NPV), initial rate of return (IRR), accounting rate of return (ARR) and profitability index (PI) techniques to evaluate the time value and profitability of the investment. Additionally, financing options available to the business will be reviewed and also how benefit-cost ratio (BCR) and capital rationing could also be used in project appraisals.

3. Project cost breakdown and sales projection

Project costs	
Item	Cost
150mm Cavity closer tool	£124,683
Structural Insert - tool	£1,500
Corner Moulding - tool	£5,380
Accreditations (BBA)	£5,000
Marketing cost	£2,500
Total Project Cost	£139,063

5 Year Sales Projection	Closers	mtrs	150mm	Cash Inflow
Year 1 - 6%	86,400	311,040	199,066	£185,856.00
Year 2 - 8%	115,200	414,720	265,421	£257,103.00
Year 3 - 10%	144,000	518,400	331,776	£335,006.00
Year 4 - 10%	144,000	518,400	331,776	£351,757.00
Year 5 - 10%	144,000	518,400	331,776	£369,344.00

4. Simple payback

Month		Feb-23 7	Mar-23 8	Apr-23 9	May-23 10	Jun-23 11	Jul-23 12	Aug-23 13	Sep-23 14	Oct-23 15	Nov-23 16	Dec-23 17	Jan-24 18
Investment	150MM Cavity tooling Purchase cost			62,342									
	Ram insert tooling			6,430									
	Marketing	833	833	833									
	Other - BBA Approval Certification			5,000									
	Total cash outflows	833	833	74,605	0	0	0	0	0	0	0	0	0
Return	Additional Margin	0	0	0	15,488	15,488	15,488	15,488	15,488	15,488	15,488	15,488	15,488
	Present value - Net Cash Inflow/(Outflow)	(833)	(833)	(74,605)	15,488	15,488	15,488	15,488	15,488	15,488	15,488	15,488	15,488
Net Value- Cash Inflow/(Outflow) -per month		(63,175)	(64,008)	(138,613)	(123,125)	(107,636)	(92,148)	(76,660)	(61,171)	(45,683)	(30,195)	(14,707)	782
Simple payback - no. of months		8.9			1	1	1	1	1	1	1	1	0.9

Simple payback is a financial metric, used to measure the time in which initial investment is recovered from net cash inflows, using the formula:

$$\text{Simple payback} = \text{Initial investment} / \text{Annual net cash inflow}$$

This method is widely used as a simplistic, quick decision maker, with many organisations defining a maximum acceptable period for payback. Projects or investments with a shorter payback period, are viewed as more attractive than those with longer payback, especially to businesses with liquidity issues (Atrill and McInaney, 2018, p.421). There are many benefits to using the simple payback method, including simplicity of calculation and ease of interpretation, emphasis of early stages of a project which simplifies forecasting, improving accuracy of cash inflow predictions and helping businesses assess liquidity impacts for different projects. The drawbacks are simple, payback makes no allowance for the time value of money and also ignores cash inflows for periods beyond payback (Arnold, 2013). This method is widely regarded as inferior to other tools, such as Net Present Value (NPV) and Initial Rate of Return (IRR). It fails to consider the effects of inflation, or complex investments with unequal cash flow over time (Kagan, 2023), so is often used in conjunction with other tools in project appraisals.

The 150mm cavity closer project, offered an extremely attractive payback of around 9 months. This was largely due to the fact that the project rational was driven by changes in legislation, meaning that although this project required a new tooling design and product launch to market, there would already be an established customer base and full order book from when production started. This reduces the commercial impacts and results in increasingly high cash inflows for the five-year period following the product launch.

5. Discounted Cash Flow (DCF)

DCF is a financial valuation method that factors in the time value of money and estimates the value of a project or investment, by discounting its estimated future cash flows to represent their present value.

6. Net Present Value (NPV)

Unlike simple payback, the NPV appraisal calculation method considers the time value of money, factoring in impacts such as inflation and interest rates. The method uses a discount rate known as Weighted Average Cost of Capital (WACC), which is applied to the future cash inflows for the project lifespan, to estimate future values against their present values. Discounted cashflows (DCF) are then combined and initial investment deducted.

150mm Cavity closer- NPV analysis						
	Year					
	Investment	1	2	3	4	5
Present Value	-138613	185856	257103	335006	351757	369344
Payback (Years)	0.74					
Discount Rate (WACC)	10%					
Denominator	1	0.909	0.826	0.751	0.683	0.621
Future Value	-138613	168943.1	212367.1	251589.5	240250	229362.6
NPV	£963,899.34					
NPV (Excel)	£964,112					

NPV is regarded as one of the most popular methods of analysis used in appraisals. It can be used as a decision-making tool to evaluate the profitability of a project or investment. If an NPV is positive, then the project may be regarded as commercially viable. Other benefits include ease of calculation and interpretation and its direct relation to shareholders' wealth objectives (Atrill and McInaney, 2018, p.421). The drawbacks of NPV are the lack of consideration towards project size or return on investment (ROI) (Fernando, 2023) and the difficulty in establishing cost of capital within an organisation.

A positive NPV of £964,112 for the 150mm cavity closer project, indicates that even after factoring in the business' 10% WACC, the total future inflow is 595% higher than the initial investment. This would be regarded as an extremely attractive investment if analysing a traditional revenue generating project. As the main driver for this project is due to regulation change, it could be argued that the net cash flow forecasts would look the same manufacturing with the existing 100mm tool, meaning the project is not as attractive as it appears, when comparing with the current tool in use.

7. Accounting Rate of Return (ARR)

ARR is a metric used in financial appraisal to assess the profitability of a project or investment, by working out the average net income from the project and expressing as a percentage of the average investment (Atrill and McInaney, 2018, p.421). ARR can be calculated using the formula:

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

This method factors in the depreciation of assets over their lifespan and also considers any residual value an asset may hold at the end of its useful working life. ARR does not consider time value of money, however unlike payback, which focusses on cash flow, ARR concentrates on net profit. The method is relatively simple to calculate, easily interpreted and can be used as a decision rule when comparing against a minimum return set by an organisation. The drawbacks of ARR is accuracy when calculating future residual value, failure to factor in the time value of money and lack of consideration, to increased risk and uncertainty, associated with projects over long periods (Murphy, 2022).

Depreciating and amortising assets at a value of £27812.60 each year, over 5 years and estimating a residual value of £500 for tooling at the end of its useful working life, the 150mm cavity closer project's ARR was calculated at 391%. The residual value was based upon historic scrap values received for similar tooling, however this may vary with fluctuations in scrap metal value. The ARR highlights the project as an extremely attractive investment option, with sizable returns throughout the lifespan and a small residual return afterward.

150mm Cavity closer -ARR analysis		
Investment	138613	
Residual Value	500	
Period	Net Cash Flow	Depreciation
Year 1	185856	27812.6
Year 2	257103	27812.6
Year 3	335006	27812.6
Year 4	351757	27812.6
Year 5	369344	27812.6
Years	5	
Total Cashflow	1499066	
Depreciation	138563	
Net Income/profit	1360503	
Initial Investment	138613	
Residual Value	500	
Average Investment	69556.5	
Total Net Income	1360503	
Average net income	272100.6	
Average investment	69556.5	
Payback	0.89	
ARR	391.19%	

8. Initial Rate of Return (IRR)

IRR is the discount rate that, when applied to the future cash flows, produces an NPV of zero. It is used to assess the profitability of a project or investment. Described by Fernando "as the rate of growth that an investment is expected to generate annually" (2023), IRR can be used by organisations as a decision making tool to plan capital budgets or compare projects.

By calculating positive and negative NPV values, then establishing the difference between the discount rates and NPVs, this allows you to understand the percentage movement every 1% NPV. Dividing the positive NPV by the movement per percentage point, shows the percentage movement to zero. IRR value is obtained when combining movement to zero with the positive NPV percentage.

150mm Cavity closer - IRR analysis		
	%	NPV
Movement	151%	£963,922.29
Movement per %		£6,383.59
Positive NPV	10%	£964,112.11
% to NPV Zero		151.03
IRR (Rough calc)		161.03
IRR (Excel)		160.80%

If the IRR is greater than the organisation's required rate of return or the cost of capital, then the project should be deemed feasible. The higher the IRR percentage, the more desirable the project is to investors. IRR can be used to consider the time value of money and also evaluates liquidity impacts of projects and investments. The drawbacks of using the method is the somewhat laborious calculations (although this can be simplified using excel) and the lack of consideration to the size of different projects.

Focusing on the 150mm Cavity closure project, a healthy 161.03% IRR indicates the extremely attractive potential returns that could be generated against the cost of capital. The figure indicates an annualised return of around 161% over the lifetime of the project. This figure is subject to fluctuations in net income. Net income could be affected by the project's time to market. If a competitor already has a 150mm closer solution in their products offering, while Duraflex is still in the development stages, then there is a risk of losing customers and sales volume which could negatively impact IRR.

9. Profitability Index (PI)

PI is used in financial appraisals to measure the profitability and liquidity of a project or investment, by measuring the ratio between the present value of future cash flows, against the initial investment outlay. The index can be a useful tool when conducting capital rationing and project ranking, to establish optimum returns against budgets. Unlike NPV which does not consider the size of projects, PI shows the value created per unit of investment (Corporate finance institute, 2023). If the project generates a PI greater than one, then the project will return value for its investment and would be deemed feasible. A PI ratio below one, indicates the project should not proceed.

150mm Cavity closer - PI analysis						
Investment	138613	Year				
		1	2	3	4	5
Present Value	-138613	185856	257103	335006	351757	369344
Payback (Years)	0.74					
Discount Rate (WACC)	10%					
Denominator	1	0.909	0.826	0.751	0.683	0.621
Future Value	-138613	168943.104	212367.1	251589.5	240250	229362.6
NPV	963899.343					
NPV (Excel)	£964,112					
Total Future value	£1,102,512.34					
Profitability Index	7.95					

The method is simple to calculate and takes into account the time value of money. Drawbacks of PI include the lack of consideration to the size of project and reliance on accurate forecasting, which can be difficult to predict. PI also focuses on initial investments and ignores potential investments that may be required over a longer timeframe (Corporate finance institute, 2023). PI can be calculated using the formula:

$$\text{Profitability index} = \text{Gross present values} / \text{Initial investment}$$

The PI ratio calculated for the 150mm cavity closer, showed a healthy return of £7.95 for every £1 of investment. This is a very attractive return and indicates that the project is feasible and should proceed. Although the project rational centers around legislation change, PI still provides Duraflex with a useful measure to assess if the investment is financially sound, as we can focus on the equipment cost and the tooling selected. Traditionally Duraflex has purchased only Exelliq tooling and machinery to improve standardisation within the factory, however if the PI returned a ratio below one, then alternative suppliers and designs would need to be considered to attempt to reduce tooling cost and the total initial investment to improve PI.

10. Benefit Cost Ratio (BCR)

Like PI, BCR is used as a cost-benefit analysis tool, that shows the relationship between the relative costs and benefits of an investment or project. Expressed in monetary or qualitative terms (Hayes, 2022) BCR offers an alternative measure to PI and is calculated using the formula:

$$\text{Benefit cost ratio} = \text{Net present value} / \text{Initial investment}$$

A BCR greater than one indicate that the project is feasible. Projects with a BCR less than one should be abandoned.

11. Capital Rationing

Capital rationing is a process used by an organisation to allocate limited capital to projects that offer the greatest return of investment. If a business has multiple projects but limited funds, rationing can be applied to assess ranking and the potential combination of projects, to deliver optimum profitability. Unlike NPV, Capital Rationing takes into consideration project size. This may result in combinations of smaller projects delivering a greater return of investment than larger ones. There are three types of capital rationing:

- **Hard rationing** – occurs when external influences such as shareholder or creditors limit the amount of capital investment or impose restrictions on how it used. Hard rationing is a particular problem for smaller, less profitable and higher-risk firms (Arnold, 2013). It limits the company's ability to invest in future projects and may even result in reducing spending on current ones (Hayes, 2020).
- **Soft rationing** – is internal management-imposed limits on investment expenditure and may be linked to an organisation's financial control policy (Arnold, 2013).
- **One time rationing** – is regarded as the simplest form of capital rationing. Limitations are placed on capital investments, for a period of only one year. All other years are unlimited. Projects selected as part of a one time rationing can be split into the following categories:
 - **Divisible projects** – can be split into fractions and do not need to be fully completed from start to finish in one go. This allows funds to be redistributed to other projects.
 - **Non divisible projects** – once started, must be carried out fully. The choices of a non-divisible project must be to either undertake fully, or not to start at all.

Capital rationing was not used during the cavity closer appraisal as the business was obligated to complete the project, to comply with changes in legislation. Although historically during a normal tool replacement or design project, one time rationing has been employed with projects classed as non-divisible.

12. Finance options

When considering finance options for a project, it is important to assess the the following factors:

- The project timeline, how quickly cash is needed, what are the payment terms of the project? (cash outflow) and over what period is the finance required?
- How the business is geared?
- Risk vs reward
- How much is required?

Businesses must also consider if finance will be sourced internally, which could speed up investment decisions, or externally from sources such a banks, private investors or financing companies, which could extend approval processes.

The length of the project could also influence finance options. Short term, internal projects may be managed by cash flow improvement measures, such as collecting invoices quicker, where as short term, external investments, may be be managed through smaller finance options, such as overdraft facilities. Longer term, internal projects may be financed through retained profits in capex budgets, while long term projects may require finance such as bank loans, leasing or hire purchase. It is important for businesses to assess finacing options and determine the correct one for each unique project.

The finance options for the 150mm closer were financing internally, through annual capital expenditure (capex) budget, which required other projects on the roadmap to be re-prioritised, or an external loan option from Hilco (investment firm/owners). The most viable finance option for the project should be through the 2023 capex budget. The high interest offered on investor loan is not favourable amongst senior managers , also there is KPI target, agreed by senior management to reduce the amount of borrowing from investors and manage within the business.

13. Recommendations

The legal and commercial aspects are the main drivers for project approval. Credit terms agreed with the tooling supplier means cash outflows are staggered improving cashflow. The project requires allocation of a production line for commissioning, which means a stock build will be required to minimise disruption to business as usual. Minimal reallocation of labour is required. If the product time to market aligns with the timeline, the orderbook should not be affected, maintaining predicted cash inflows and achieving a quick payback of 8.9 months.

An attractive NPV of £964,112 indicates solid future cash inflow. The 391% ARR shows impressive return after depreciation, with tooling also holding some residual scrap value after 5 years. A healthy 161.03% IRR indicates the extremely attractive potential returns that could be generated against the cost of capital. The PI ratio also showed a healthy return of £7.95 for every £1 of investment. Considering these factors I would recommend that other projects are re-prioritised and this investment is approved with immediate effect.

14. Appendix

NPV Calculations

150mm Cavity closer- NPV analysis						
	Year					
	Investment	1	2	3	4	5
Present Value	-138613	185856	257103	335006	351757	369344
Payback (Years)	0.74					
Discount Rate (WACC)	10%					
Denominator	1	0.909	0.826	0.751	0.683	0.621
Future Value	-138613	168943.1	212367.1	251589.5	240250	229362.6
NPV	£963,899.34					
NPV (Excel)	£964,112					

IRR calculations

150mm Cavity closer - IRR analysis						
	Year					
	Investment	1	2	3	4	5
Present Value	-138613	185856	257103	335006	351757	369344
Payback	0.74					
Discount Rate (WACC)	10%					
Denominator	1	0.909	0.826	0.751	0.683	0.621
Future Value		168943.1	212367.078	251589.5	240250.0	229362.6
NPV (excel calc)	£964,112.11					

150mm Cavity closer - IRR analysis						
		Year				
	Investment	1	2	3	4	5
Present Value	-138613	185856	257103	335006	351757	369344
Payback	0.74					
Discount Rate (WACC)	161%					
Denominator	1	0.38315	0.14679	0.05624	0.02154	0.00825
Future Value		71210.726	37740.149	18840.737	7576.846	3047.088
NPV	189.82					

150mm Cavity closer - IRR analysis		
	%	NPV
Movement	151%	£963,922.29
Movement per %		£6,383.59
Positive NPV	10%	£964,112.11
% to NPV Zero		151.03
IRR (Rough calc)		161.03
IRR (Excel)		160.80%

PI & BCR Calculations

150mm Cavity closer - PI analysis						
Investment	138613	Year				
		1	2	3	4	5
Present Value	-138613	185856	257103	335006	351757	369344
Payback (Years)	0.74					
Discount Rate (WACC)	10%					
Denominator	1	0.909	0.826	0.751	0.683	0.621
Future Value	-138613	168943.104	212367.1	251589.5	240250	229362.6
NPV	963899.343					
NPV (Excel)	£964,112					
Total Future value	£1,102,512.34					
Profitability Index	7.95					
IRR (Excel)	161%					
BCR	£6.96					

ARR Calculations

150mm Cavity closer -ARR analysis		
Investment	138613	
Residual Value	500	
Period	Net Cash Flow	Depreciation
Year 1	185856	27812.6
Year 2	257103	27812.6
Year 3	335006	27812.6
Year 4	351757	27812.6
Year 5	369344	27812.6
Years	5	
Total Cashflow	1499066	
Depreciation	138563	
Net Income/profit	1360503	
Initial Investment	138613	
Residual Value	500	
Average Investment	69556.5	
Total Net Income	1360503	
Average net income	272100.6	
Average investment	69556.5	
Payback	0.89	
ARR	391.19%	

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