

# Fortune Favours the Bold



*"It takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"*

- The Red Queen, Through the Looking-Glass

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## Introduction

In 1970, manufacturing accounted for 27% of total UK output (GVA). By 2018 it had fallen to 10% (Rhodes, 2020). Manufacturing as a % of GVA can fall over time as productivity increases and goods become cheaper. However, the UK stands alone as a nation whose manufacturing fell significantly when measured against either current prices or constant prices (Chang, 2014). This was a strong indicator that UK manufacturing had fallen behind in the productivity race.

That hasn't always been the case. Between 2000 and 2005, manufacturing productivity in the UK grew by almost 4%/yr. Higher than in France, Germany, Italy and Spain. These impressive results were attributed to organisational change rather than technological change (Marsh, 2007).

In 2007/8, the global financial markets crashed. In the following decade, the whole UK economy experienced its worst decade of average annual productivity growth (0.3%) since the 1800's. A fact so noteworthy that the Royal Statistical Society made it a statistic of the decade (RSS, 2019). If the UK manufacturing sector performed any better, it was marginal (Figure 1). By 2019, total manufacturing output had failed to recover to pre-financial crisis levels (Figure 2).

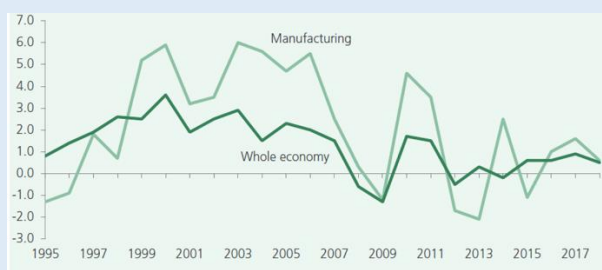


Figure 1 – UK Productivity Growth (Annual % Change) – Output/hr worked (Rhodes, 2020)

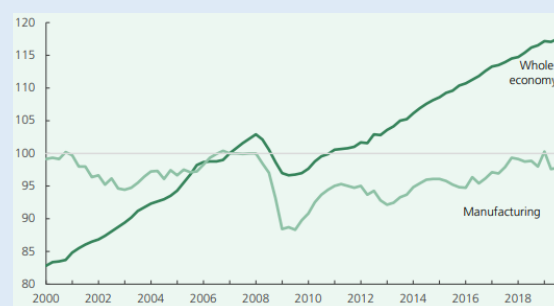


Figure 2 – Economic Output, GVA (Rhodes, 2020)

The global financial crisis hit all nations, but alarmingly, UK productivity fell significantly behind that of its peers (Figure 3). Like the Red Queen in Lewis Carols 'Through the Looking Glass', the UK manufacturing sector was running fast to stand still (Carol, 2004).



Figure 3 – UK Productivity versus Peers (Strauss, 2021)

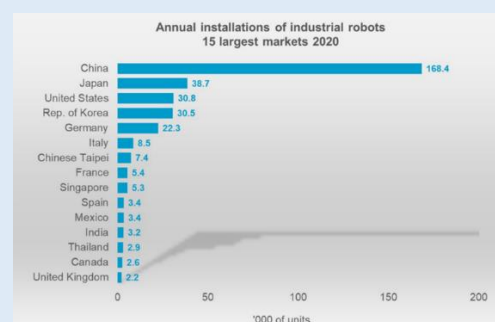


Figure 4 – Global Installations (Robotics, 2021)

Economists hypothesised that a lack of UK investment in both Technology (private sector) and Research, Development & Innovation (public sector) was to blame. The league table for annual installations of industrial robots placed the UK in 15<sup>th</sup> place in 2020 (Figure 4) (Robotics, 2021). The league for robot density per 10,000 employees did not place the UK in the top 20 countries.

A recent study by the Bank of England found that the return on capital investment for UK businesses was typically 12% (Harford, 2022). Robot technology is straightforward to implement in many manufacturing processes that involve predictable environments. Its wide adoption could add

approximately 1% to global GDP (McKinsey&Company, 2017). So why are businesses reluctant to invest in advanced manufacturing technology such as Robots?

Barriers that are often cited include: labour market dynamics, social acceptance and an understanding of the economic benefits (Manyika, et al., 2017). This report looks at a method of supporting businesses to better quantify the economic benefits of investments in technology - through project cost evaluation methods such as Pay Back Period, Net Present Value, Internal Rate of Return, Annual Rate of Return, Profitability Index and Benefit-Cost Ratio's. The Food and Drink sector is used as an example because the sector is recognised as a low investor in new advanced manufacturing technology (Poole, 2021).

## Food & Drink Sector

The Food & Drink Sector is the largest contributor to manufacturing GVA – 16%  
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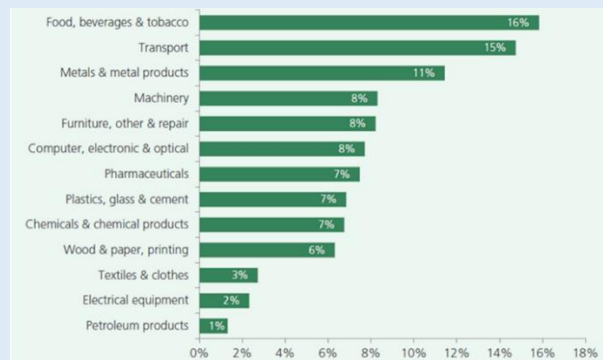


Figure 5 – Output of manufacturing industries as % total

Production in the sector is often labour intensive and in 2020, 33% of the workforce were non-UK EU nationals. It is unsurprising that post Brexit, there are several thousand job

vacancies that are proving difficult to fill (FDF, 2022).

Margins in the sector are small – 1% in not untypical. Hence the industry has struggled to invest in technology – see the Pigs in Blankets production line below (FDF, 2022).



Figure 6 – A Pigs in Blankets production line

## Pigs in Blankets – The Traditional Approach

The process of making Pigs in Blankets (PiB) involves the wrapping of bacon around a small sausage and the placement of the assembly in a tray for packaging. There are 40 million packets of PiB sold every year (average packet size = 12 pieces) (Glover, 2021). There is a heavy reliance on labour rather than technology – mainly because of the high level of dexterity required to wrap bacon around a sausage (robot end effectors can struggle with such complex manipulation).

## Pigs in Blankets – A New Approach

Two projects are considered:

**Project A** – Determines the cost benefit for the implementation of a 'Pick & Place' robot cell (Figure 7). **Initial investment required = £532,000 (see Appendix A) – replacing 6 people from the process.**

**Project B** - Determines the cost benefit for the implementation of a 'Wrap, Pick & Place' robot cell. **Initial investment required = £1,272,000 (see Appendix B) – replacing 12 people.**



Figure 7 – Project A – Pick and Place Robot Cell

### Cost versus Yearly Benefit is shown in (Appendix A and Appendix B)

The process of wrapping bacon around a sausage involves a robot that has a high level of 'end effector dexterity'<sup>1</sup>. The cost for this additional functionality is not proportional to the reduced headcount. Project cost appraisal techniques (Pay Back Period, NPV, IRR, AAR, PI etc.) can be used to gauge the financial impact of Project A and Project B (see Appendix A and Appendix B).

## Discussion (Reviewing Appendix A and B)

The Weighted Average Cost of Capital of 8% is taken from a KPMG study of industry norms (see Appendix C – Weighted Average Cost of Capital (WACC) for more detail).

### Project A

#### Initial Screening

Payback Period – 3.3 years

Annual Rate of Return (ARR) – 28%

#### Deeper Dive

Net Present Value (NPV)- £212,849

Internal Rate of Return (IRR) – 20.3%

Profitability Index (PI) – (+) 1.4

Benefit-Cost Ratio (BCR) – (+) 0.4

### Project B

#### Initial Screening

Payback Period – 4.9 years

Annual Rate of Return (ARR) – 9%

#### Deeper Dive

Net Present Value (NPV) – (-) £70,131

Internal Rate of Return (IRR) – 6.2%

Profitability Index (PI) – (+) 0.94

Benefit-Cost Ratio (BCR) – (-) 0.06

- Project A gives a reasonable payback period and ARR. Clearly Project B gives a much poorer payback period and ARR. From the initial screening, Project A is the most favourable.
- The NPV looks at future cashflows discounted to the present. Project A has a reasonable positive NPV whereas Project B has a negative NPV which is a red flag.
- Looking at the growth of an investment, IRR is a reverse concept to NPV. It gives the annual rate of return required to get to the break-even point (the higher the better). Project A has a much higher IRR.
- The PI for Project A says that for every £1 invested in the project, £1.40 is returned. The BCR says that the benefit is 40p for every £1 of cost. Clearly Project B scores very poorly.
- Projects are vital for helping businesses with their strategic goals. High quality information to support project decisions is important, but the benefits from a heuristic approach to front-end decision making should not be dismissed lightly (Williams, Samset, & Sunnevag, 2009).

## Conclusion

Project cost appraisal methods are a very useful tool to help businesses assess the impact of investments in technology. Project A is the only project that should be considered for implementation. Importantly, this example demonstrates that enhanced technology does not always pay. Businesses must invest in robots to become globally competitive and resilient to labour shortages, but they should choose their robots carefully (comparing cost of additional functionality against benefit).

<sup>1</sup> No consideration is given to a Project C that looks at the cost benefit of installing a Wrap robot cell

only, due to the higher levels of technology risk associated with the complexity of the task.

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## Appendix A – Project A (Pick & Place Robot Cell)

| Project A               |            | Year                |         |         |         |         |         |
|-------------------------|------------|---------------------|---------|---------|---------|---------|---------|
|                         | Investment | 1                   | 2       | 3       | 4       | 5       | 6       |
| Present Value           | (532,000)  | 161,118             | 161,118 | 161,118 | 161,118 | 161,118 | 161,118 |
| Payback                 | 3.3 years  | Manually Calculated |         |         |         |         |         |
| Discount Rate ( WACC)   | 8.00%      |                     |         |         |         |         |         |
| Denominator             | 1.00       | 0.926               | 0.857   | 0.794   | 0.735   | 0.681   | 0.630   |
| Future Value            | (532,000)  | 149,195             | 138,078 | 127,928 | 118,422 | 109,721 | 101,504 |
| NPV                     | 212,849    | PI                  |         |         |         |         |         |
| NPV ( Excel Calculated) | 212,829    | BCR                 |         |         |         |         |         |
| IRR                     | 20.3%      |                     |         |         |         |         |         |
| Residual Value          | £100,000   |                     |         |         |         |         |         |
| ARR                     | 28%        |                     |         |         |         |         |         |

| COST                      | £        | BENEFIT/Yr         | £        |
|---------------------------|----------|--------------------|----------|
| Pick & Place Robot        | £410,000 | 6 wages x 3 shifts | £113,400 |
| Conveyor & Stack          | £25,000  | Utility (3kWh)     | -£3,942  |
| Installation              | £12,000  | Reduced Waste (3%) | £63,860  |
| Service/Maintenance/Parts | £75,000  | 3 month mothball   | -£6,000  |
| Training                  | £10,000  | PPE                | £1,800   |
|                           |          | Cleaning           | -£8,000  |

£.03 Profit on every P in B

|       |          |       |          |
|-------|----------|-------|----------|
| Total | £532,000 | Total | £161,118 |
|-------|----------|-------|----------|

7.1E+07 - P in B produced on this cell

4.8E+08 - Total UK Consumption (40 x 10<sup>6</sup> packets)

15% of total UK consumption produced on this cell

## Appendix B – Project B (Wrap, Pick & Place Robot Cell)

| Project B               |             | Year                |         |         |         |         |         |
|-------------------------|-------------|---------------------|---------|---------|---------|---------|---------|
|                         | Investment  | 1                   | 2       | 3       | 4       | 5       | 6       |
| Present Value           | (1,272,000) | 259,976             | 259,976 | 259,976 | 259,976 | 259,976 | 259,976 |
| Payback                 | 4.9 years   | Manually Calculated |         |         |         |         |         |
| Discount Rate ( WACC)   | 8.00%       |                     |         |         |         |         |         |
| Denominator             | 1.00        | 0.926               | 0.857   | 0.794   | 0.735   | 0.681   | 0.630   |
| Future Value            | (1,272,000) | 240,738             | 222,799 | 206,421 | 191,082 | 177,044 | 163,785 |
| NPV                     | (70,131)    | PI 0.94             |         |         |         |         |         |
| NPV ( Excel Calculated) | (70,162)    | BCR -0.06           |         |         |         |         |         |
| IRR                     | 6.2%        |                     |         |         |         |         |         |
| Residual Value          | £100,000    |                     |         |         |         |         |         |
| ARR                     | 9%          |                     |         |         |         |         |         |

| COST                      | £          | BENEFIT/Yr          | £        |
|---------------------------|------------|---------------------|----------|
| Pick & Place Robot        | £1,150,000 | 12 wages x 3 shifts | £226,800 |
| Conveyor & Stack          | £25,000    | Utility (3kWh)      | -£7,884  |
| Installation              | £12,000    | Reduced Waste (3%)  | £63,860  |
| Service/Maintenance/Parts | £75,000    | 3 month mothball    | -£12,000 |
| Training                  | £10,000    | PPE                 | £3,600   |
|                           |            | Cleaning            | -£14,400 |
| Total                     | £1,272,000 | Total               | £259,976 |

£.03 Profit on every P in B

## Appendix C – Weighted Average Cost of Capital (WACC)

In their 2021 study ‘The Cost of Capital’, KPMG determined the average WACC to be 7.5% for the Industrial Manufacturing sector (from 7.1% in 2019/20) - Figure 8. The sector had a comparatively high WACC because of political, regulatory and technological induced risk (KPMG, 2021). WACC helps investors to gauge the return that they should demand for their capital investment – the higher the rate, the riskier the investment (Investopedia, 2022).

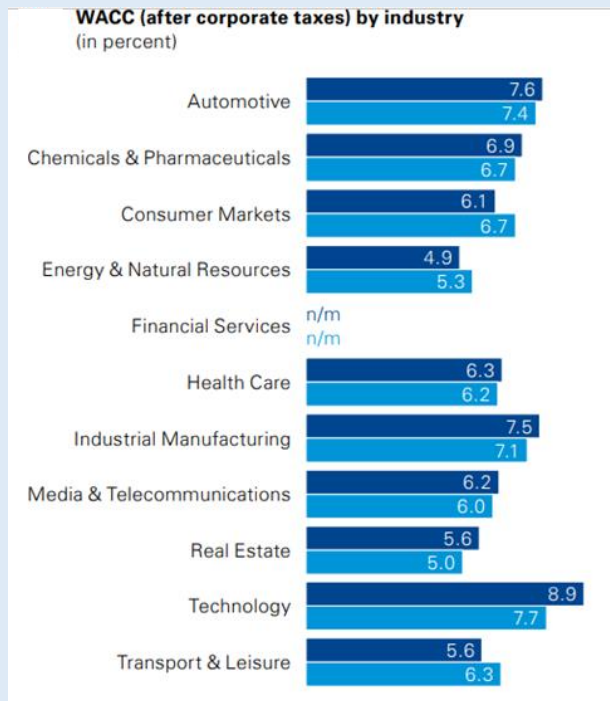


Figure 8 – WACC by Industry [source (KPMG, 2021)]