Robustica Case Study: The Purchase of MPCastings and the Funding of a New Technology

Background

MPCastings

Michael Page had started his casting business MPCastings some 30 years ago. He had developed a technique to produce castings at a reduced cost while working for another small casting firm. The concepts were ideal for the medium batch sizes and the complex shapes that a number of customers in the market wanted, but due to the scale of the necessary investment and the risk-adverse nature of the business owner, Michael's idea was not considered. This prompted Michael to raise the funds himself and start his own business. Things were lean for a while, he had a lot to learn about the business side the castings industry, but his lower overheads saw him through. Now in his 60's Michael wanted to 'get out' and enjoy the retired life while he could. He had always loathed the idea of gradual retirement; if he was going to do something, he did it properly. Giving his all to the business had seen it grow, but also meant that there were many things he wanted to and never got the chance to. It seemed that retired life was going to be just as busy as business life; just how Michael wanted it. But: how to 'get out'?

Selling the business

The valuations (using various methods) of similar business in the region that had been sold in the last three years were used to estimate the market value of MPCastings. These valuations suggested that MPcastings would have a market value of around $2.5M. Combined with other investments that Michael had, this would provide sufficient resources for the retirement he had planned. Still, there were things that he would like to do that could burn a lot of cash, and who says *no* to more money.

The biggest problem now was finding someone to buy the business. Michael was suspicious of business dynasties, and he had encouraged his children to take the lead in their own lives. While he would not have prevented any of his children from becoming involved in the business, they had all chosen other paths. Still, Michael did have a sentimental attachment to the business and he wanted to leave it to someone who would 'treat it well'.

Enter Terry & Morgan, and Peter

Terry and Morgan had each been working at MPCastings for over 5 years now in marketing and engineering roles respectively. Recently, an ex-classmate of Morgan's, Peter, had approached Morgan with an idea. Peter had been working for a research organization for the past 10 years. During that time he developed the basics of a new casting operation. The operation allowed for the use of high pressures with magnesium, up till now this had not been possible. These higher pressures produced a stronger and lighter casting than what was previously possible. Casting was currently out of the scope of Peter's organization, and little interest had been shown. Because Peter wanted to commercialize the operation he had developed, he looked for other commercialization avenues. It should be noted that Peter's method was not the only one being developed, and there would be others introducing similar operations to their foundries. Still, Peter's method had some advantages in speed, and he felt that it would offer a competitive edge to any company that wanted to pursue high pressure magnesium casting right form the very start. This had brought him to Morgan.

While the research organization Peter worked for was not interested in the operation, they owned the rights and would only allow Peter to pursue external parties to implement the process if the organization received 1% of the sales attributed to the process. Peter too, wanted a proportion of each sale (2%) and in return would assist with further development to bring the process to a state suitable for commercial use.

Terry could see the benefits that the process and the castings would offer to their customers and also felt that this technology could help MPCastings to gain a much larger presence in the Auto and Aero markets. While the value and potential were clear, the further development needed to make the casting operation suitable for commercial use was estimated by Morgan to be about

$1.5M. Further, Morgan felt that this could be done in no less than six months. However, the project had the potential to give MPCastings a much larger share the new HP market than what it had of the current casting market. Therefore, both Terry and Morgan felt that this was worth pursuing, and planned to take the idea to Michael.

When Michael had informed Terry and Morgan that he wanted to sell, they were both caught off guard. However, after considering the potential of the new process, they decided that they wanted to buy the business together and develop the new high pressure casting process. The problem was that they did not have $2.5M in cash, and they would need to source extra financing.

Financing options

Terry and Morgan would now need to finance both the purchase of MPCastings and the development of the new casting process make it suitable for commercial use.

Both Terry and Morgan had $30k each that they would invest. In addition, they could acquire $500k through personal loans from the Masonry Bank by using their private assets as collateral at a rate of l0%.

A local bank, Hargraves, had also been approached. While they were prepared to loan the amount equal to 80% of the independent valuation of the factory equipment $1.5M at 15%, they would not directly finance the development project.

Currently, there was $300k in cash in the MPCastings' bank account. MPCasting's bank, Imperial, was prepared to offer a credit account with an interest rate of 25% pa to a limit of $100k.

This provided slightly more than the $2.5M dollars needed to buy MPCastings, which would allow for a safety margin. However, cash was still needed to complete the development of the new casting process. One option was to use the cash generated from the business. This would potentially extend the development period. This would also reduce revenue and make it difficult to repay the acquired debt. Another option to consider was venture financing.

Solidus Ventures was interested in the new process and appreciated the market potential, and were prepared to offer up to $4M with a required return of 55%

pa prior to tax. However, Solidus Ventures was still uncertain about the 'predicted' market size, and the cost and time required for the development project. Because of this uncertainty, they demanded a share of ownership that would gain them control. Neither Morgan nor Terry cared for losing control, but liked the idea of having access to extra cash if the development project ended up costing more than was expected. This raised the question: how to get the best of both options?

While this was being considered, Michael made a proposal. He thought that that the new casting process had potential and he also had a great deal of faith in Terry and Morgan. Therefore, he wanted some way of investing in the project. However, he was also concerned that he might be getting to close to be objective and he couldn't afford to put too much at risk. Michael offered to delay $750k of the payment without any ownership of MPCastings required. This was on the following conditions:

- That within 5 years he would receive a return of:

    o 70% per annum if the project was completed within 6 months

    o 30% per annum if the project was completed within 3 or more years

    o Or, a an interpolated rate between the above two

- That Solidus Ventures would commit at least an equivalent amount. By requiring a commitment by Solidus Ventures he could rely on their objectivity, and not his own.

With the above, Michael's returns were dependent upon the success of the project and he could rely on the objective assessment of Solidus. He also felt that by making it an investment, he would not be too involved in the company while still getting his chance to increase his wealth.

Terry and Morgan now had financing enough to fund the purchase of MPCastings and the development project. Now the only problem they had was the determination of the best investment strategy.

The problem

Put simply, Terry and Morgan had to find the best investment strategy. Such a strategy would properly deal with four major issues:

- The whole point of the venture was to provide a return to Terry and Morgan. There is always a risk that this will not happen. The risk associated with the returns in this venture came from the uncertainty in the market and the costs of the new technology. Such uncertainty cannot be controlled: what could be done to limit these effects?

- A particular concern with the new technology was the completion of the project. Because it completion date could be uncertain and drawn out, it might delay entry and thus reduce market share, sales and returns to Terry and Morgan.

- A delay in the project could also exacerbate another potential problem: cash out. Once the project was completed and MPCastings entered the new market the sudden increase in sales would likely require more equipment. If there were not sufficient funds to acquire this equipment then sales would be missed and the returns could be significantly reduced.

- The final issue was Solidus. Terry and Morgan appreciated the perceived need on the part of Solidus to have a reasonable share. They also fully appreciated the benefits of the venture financing path. However, they did not want to los control and they felt that Solidus was overestimating the risks (which Solidus used to justify their required share) with the venture.

In summary, Terry and Morgan wanted a strategy that would ensure the timely completion of the project, allow for entrance into the market without any cash hindrance, and maximize their likely returns.

The solution

It was decided to use Robustica to optimize the investment strategy. The aim was to increase the returns to Terry and Morgan while finding a strategy that reduced the likelihood of any event that would limit the success of the venture. To do this, the business financials were modeled in Microsoft Excel. The model

was created to produce all of the standard statements (P&L, cash flow, balance sheet etc.), to reflect the business plan that Terry and Morgan had put together, and to take account of the possible investment strategies.

Model assumptions

The model for the venture that was used for the investigation can be seen in the accompanying file 'Casting_Venture.xls'. Below is a summary of the assumptions that were used to make the model.

Starting financial position

The current annual sales figure for the regular castings at the time of the purchase was $2M. The assets and liabilities at the same time were as shown below.

Assets	
Cash	$ 300,000.00
Accounts receivable	$ 131,000.00
Equipment	$1,875,000.00
Total	$2,306,000.00

Liabilities	
Debt	NA
Accounts payable	$ 41,000.00
Total	$ 41,000.00

Development project

All cash available was to be allocated to the project. This would be unless that allocation would correspond to a completion time less than six months. Therefore, the allocation made to a the project in a given period would be the minimum of the cash available in that period and the cost of the project divided by six months and multiplied by that period (in months). While Morgan felt that the project would probably cost around $1.5M he also new that development project costs were highly variable. In his experience the variability was around 12 percent. Therefore, he set the standard deviation at $30k. Because he also expected that the project was more likely to cost more than less, a Gumble (or Extreme Value) distribution was allocated.

Market

The high pressure magnesium market was only just starting to grow, and the final size and time to maturity were uncertain. To model the growth a modified Bass model was used. This model is shown below and was developed by Lawrence and Lawton[1].

$$S(t) = \frac{N + No}{1 + \frac{N}{No} e^{-p^*t}}$$

Where:

N is the market size ($/year) found using the formula below

No is the effective number of prior sales ($/year)

p^* is a rate parameter

$$No = \frac{N\,S_1\,e^{-p^*t}}{N\left(1 - e^{-p^*t}\right)S_1}$$

Where S_1 is the sales at the end of the first year

Utilizing Terry's expertise and consultation with various other people in the industry, the market size was estimated to be between 2.7 and 3.3 billion dollars per year. Therefore, N was assigned a Normal distribution with a mean of 3 billion and a standard deviation of 100 million. The initial market size, which was less certain, was also estimated to be between 21 million dollars and 49 million dollars; therefore, it was allocated a Normal distribution with a mean of 35 million and a standard deviation of 4.5 million.

According to Lawrence and Lawton[1] the rate for commercial products is between 0.65 and 0.68. Therefore, p was assigned a Normal distribution with a mean of 0.65 and a standard deviation of 0.01.

Sales

The sales for the high pressure casting were dependent upon the market size and the share that MPCasting would capture. While the market size had been

[1] *Applications of Diffusion Models: Some Empirical Results* in *New-Product Forecasting* by Wind Mahajan and Cardozo

modeled, there was still the question of market share. Terry felt that if the project could be completed within six months, then the market share that could be gained would be between 4 percent and 6 percent. However, for every year the project was delayed the market would grow without them and the share would drop by 1.5 percentage points. Terry thought that this would only happen for 2 years after which the share would flatten out to around 2 percent. Based on this, the market share (if the project was finished within 6 months) was given a Normal distribution with a mean of 5 percent and a standard deviation of 0.3 percentage points.

At this time, the sales for the regular castings had been growing at an average of 5 percent per year and with a standard deviation of 0.1 percentage points. It was assumed that this would continue, and the growth rate was given a Normal distribution with a mean of 5 percent and a standard deviation of 0.1 percentage points. However, once the HP casting started to sell it was anticipated that the regular castings sales would start to drop by about 15 percent per year. The drop per year was given a Normal distribution with a mean of 15 percent and Terry expected a standard deviation of 0.2 percentage points.

COGS

For some time MPCastings had contracted out the actual casting process while taking care of the commercial side, tool design and tool manufacture. MPCastings still paid for power, labor, and material etc. but the casting supplier added an excess to each item. The end effect was that MPCastings needed fewer employees, it was able to focus on it key activities, and the business ran more smoothly.

After discussing the new HP technique with the casting supplier and considering the costs that had been paid for the regular castings up to that date, Morgan came up with the following for the castings costs (a Normal distribution was chosen for each).

Regular Castings	Mean	StdDev
Material	6.00%	0.10%
Power	8.00%	0.15%
Maintenance	1.50%	0.02%
Tooling	3.00%	0.05%
Operators' wages	2.00%	0.02%

HP Castings	Mean	StdDev
Material	6.00%	0.20%
Power	13.00%	0.50%
Maintenance	2.00%	0.08%
Tooling	7.50%	0.25%
Operators' wages	2.50%	0.06%
Research org' license	1.00%	NA
Peter's commission	2.00%	NA

These costs also included the license fee and Peter's commission. It will be noted that there is more uncertainty in the HP casting and that costs themselves are higher. This is because of two reasons:

1. The process was new, and it was not yet known how difficult it would be to produce tooling or operate the machine.

2. The high pressure required more power.

Acquisitions

In the past the casting supplier has amortized the cost of all new equipment through their fees; however, they were uneasy about doing the same for the new process. If the HP casting industry did not take off or if MPCastings went under then they would be left with potentially valueless equipment. For this reason they required MPCastings to provide some payment (40%) when new equipment was needed. The end effect was that each time the annualized sales of HP castings increased by $300k MPCastings would need to purchase around $55k worth of equipment. In addition, because this share of the equipment would effectively be owned by MPCastings there were able to claim depreciation. Finally, because this was a new casting technique the $55k was only the estimated cost. Morgan and the casting supplier figured the cost would be

between $50k and $60k, and a Normal distribution with a mean of $55k and a standard deviation of $1.5k was allocated.

It was not expected that any equipment would need to be disposed of within the period considered. Further, it was expected that there would be cash available when the equipment was needed. A shortfall of cash would therefore be a failure mode; this will be covered in more detail later.

Financing

The repayment of debt proved to be a source of conflict between Morgan and Terry. Terry was reluctant to let the debt grow, and wanted to pay off the interest from the start. Morgan on the other hand wanted all cash available to be directed toward the development project and the acquisition of new equipment, which would be necessary soon after the development project was completed. Terry was sympathetic to the need to acquire the equipment; it was possible that once MPCastings entered the HP market it would not have enough cash to acquire the necessary equipment. This would be especially true if the project was delayed, and the market had grown even more before MPCastings entered. The final compromise on the loans was that interest would be paid to Masonry, Hargraves and Imperial before money went into the development project. However, in the first year after completion of the development project all free cash would be put aside for the acquisition of equipment. After this time the debt would be paid off as soon as possible. This tactic would reduce the debt growth and also maximize the ability of MPCastings to capitalize on their new technology.

Michael's investment was handled differently because in a sense he was part owner and because his return would not be known until the development project was completed. Therefore, payments would not start until the project was completed, and the IRR known. Still, the interest was calculated to minimize tax at the start. If the interest was over estimated, then any excess could be treated as income in the following year. Also, provision had to be made for the debt to be arrested in the fifth year of operation.

Solidus had mad their terms clear. They required 55 percent pa and would take a share in the company that they felt would provide sufficient certainty. During optimization, the share that would be needed would be determined by predicting

the amount the business could be sold for when Terry and Morgan sold MPCastings.

Miscellaneous costs

Along with the above there were various miscellaneous costs that also needed to be considered.

<u>Salaries</u>: The total annual salary drawn by both Terry and Morgan would be no less than $70k and no greater than $500k. Otherwise it would be 0.5% of the sales.

<u>Depreciation</u>: According to local tax law this is15% pa.

<u>Rent</u>: A long term contract has been signed and the rent was going to increase by 4.5% each year starting from $100k per year.

<u>Selling, General and Administration</u>: based on past experience SG&A costs have on average been 11% of the sales with a standard deviation of 1.5 percentage points. A Normal distribution was assumed.

Harvesting

Based on various considerations such as the time to pay off Michael and what each wantsedto do with their own lives, it was decided that MPCastings would be sold after 5 years. The IRR for Terry and Morgan would be based on their share of the company's sale and their original investment. Terry and Moragn had researched the sales of similar companies over the past 10 years. They found that on average a company was sold for 1.35 times the annual sales and that the multiplier had a standard deviation of 0.1. Therefore, a Normal distribution with a mean of 1.35 and a standard deviation of 0.1 was allocated for the multiplier of the sales to determine the sale price of MPCastings.

Optimization

Ultimately Terry and Morgan wanted to insure the likelihood of high returns. This would be hampered by a delay in the development project, a high/controlling share taken by Solidus and the inability to make sales due to insufficient funds to purchase equipment. To take these into account an output

sheet was added to the model. This included the outputs that would be specified to Robustica for optimization.

IRR: the IRR is calculated using the value of the business in the fifth year and the initial $60k that Terry and Morgan invested. It was decided to not include their salaries. After trying the various investment options in the model it was found that IRR was typically around 200% to 250%. Therefore, the target value was set at 300% so that Robustica would try maximizing the return while also trying to reduce the negative effects of variability. The loss coefficient was chosen to be 10; after some preliminary investigation it was found that this made quality cost sufficiently high when compared to the other failure modes.

Time to complete the development project: This was chosen as an output for interest and to provide more insight as opposed to an actual output that needed to be controlled. Therefore, no failure modes or quality costs were specified.

Available cash: Initial investigations found that the cash balance in the period after the project was completed might become negative if the necessary equipment was acquired. This would mean that MPCastings would not be able to meet sales, which in turn meant that the returns could be much less. Terry and Moragn wanted to ensure that this did not happen so the minimum allowable value was set at zero and the cost of failure was set at $2M (roughly the cost to purchase the business).

Solidus' equity: It was desired to minimize the share that Solidus would take. Therefore, it was treated as an output. However, it was only to be used to provide evidence that Solidus could still expect a reasonable chance to gain their return with a smaller share.

Extra cost function: An alternative to reducing the relative share that Solidus would demand was to reduce the venture funding that would be required in the first place. Preliminary investigations also found that the model would allow an impractical strategy where no financing was sought in the beginning and the cash balance in the first period was let below zero. To deal with these two issues the following formula was entered in the output sheet and treated as an extra cost function during robustification.

$$EC = \frac{VF}{4\ 000\ 000\ 000} - \text{Min}(CB_1, 0)$$

Where:

EC is the extra cost

VF is the maximum venture funding that will be provided

CB_1 is the cash balance after the first period

This function normalized the venture funding that would be sort and ensured that enough financing would be utilized (effectively removing the potential for Robustica to consider the impractical strategy with a negative cash balance in the preliminary periods of the venture).

Results

Preliminary

Before any optimization was carried out, the three strategies were first evaluated in Robustica to determine the effects of uncertainty on each of them. The three strategies were:

- Equity (from Solidus)

- Equity from Solidus plus financing from Michael page

- Debt financing

In each case, Robustica provided warning about the accuracy of the predicted moments. Therefore, a Monte Carlo simulation was also performed. It was found that the predicted moments did disagree with those from the Monte Carlo simulation. However, the predictions were close enough for use in optimization and the predicted moments post-optimization would be verified with another Monte Carlo simulation.

Equity

Output	Nominal	Mean	StdDev
IRR for Terry and Morgan	208%	203%	25%
Time to complete the project (years)	0.50	0.50	0.00
Cash available in period following completion	$ 1,344,732.80	$ 1,317,238.28	$ 66,966.85
Equity for Solidus	59%	60.9%	9.3%

Equity plus Michael Page

Output	Nominal	Mean	StdDev
IRR for Terry and Morgan	228%	225%	18%
Time to complete the project (years)	0.50	0.50	0.00
Cash available in period following completion	$ 2,136,348.95	$ 2,108,854.42	$ 66,966.85
Equity for Solidus	44%	45.3%	6.9%

Debt

Output	Nominal	Mean	StdDev
IRR for Terry and Morgan	243%	242%	11%
Time to complete the project (years)	1.39	1.39	0.06
Cash available in period following completion	$ 110,488.47	$ 126,612.47	$ 54,773.33
Equity for Solidus	0%	0.0%	0.0%

A consideration of the results for the three strategies revealed the following to Terry and Morgan:

- The equity option would allow for the speediest completion of the development project as would the equity option combined with the investment from Michael.

- Solidus would need a 60% equity share for a 50% chance of gaining their required returns if they provide all financing. However, the variability was so high that with a 50% share there was still about a 16% chance (assuming a Normal distribution) that they would gain their returns.

- Considering the high risk nature of venture capitalism Terry and Morgan thought they might be able to use this to convince Solidus that there were being unreasonable to ask for a controlling share. However, the benefits of utilizing the financing offered by Michael (lower share to Solidus, higher returns and less uncertainty) they thought it would be more productive to focus on developing a better investment strategy.

- Returns for the debt strategy appeared to be even better; it offered both higher returns and less volatility. However, the cash balance in the period after the project was completed revealed a problem. While nominally there would be enough cash on hand, the predictions made by Robustica showed that there was around a 3% chance (assuming a Normal distribution) that they would not be able to meat the potential sales. This effectively increased the volatility associated with this strategy, and was that strategies major weakness.

- Terry and Morgan felt that they could increase their returns with the debt strategy if they could complete the project sooner. Obviously more cash for the project was needed: but what was the best way to source it? It was hoped that the optimization with Robustica would provide the answer.

Optimized

The table below shows the optimum strategy after Robustica was run for 45 minutes. Along with the optimum proportion to be taken from each source of financing the respective actual amount of financing is also shown.

Institution	Optimum proportion	Actual amount
Masonry	94%	$ 565,721.30
Hargraves	100%	$1,500,000.00
Imperial	54%	$ 53,730.36
Solidus	15%	$ 612,442.73
Michael Page	87%	$ 652,816.50

The table below shows the outputs and their moments for this strategy as predicted by Robustica. Once again Monte Carlo simulation was used for confirmation and Terry and Morgan were satisfied with the results.

Output	Nominal	Mean	StdDev
IRR for Terry and Morgan	264%	263%	11%
Time to complete the project (years)	0.50	0.50	0.00
Cash available in period following completion	$ 669,556.45	$ 642,061.93	$ 66,966.85
Equity for Solidus	6%	5.9%	1.1%

The improved optimized strategy uses less financing from most of the sources and still allows for the completion of the project in six months. This has the result of increasing the returns while keeping the volatility to a low level. What's more, the risk of not having enough cash to fund the acquisition of new equipment is now virtually non-existent, and the total volatility has been reduced. Finally, the share required by Solidus is now significantly smaller, and Terry and Morgan can retain control. In summary, the new strategy has given Terry and Morgan exactly what they want: highest possible returns, minimum volatility and control.

Conclusion

The above case has shown that the use of probabilistic methods allows entrepreneurs to do more than simply identify risks (such as a cash-out) with new ventures; they can quantify the risks and gain insight into the volatility of the investment. Further, it has shown that by using Robustica an entrepreneur can find the strategy that will both maximize their returns and minimize the risks and volatility associated with their ventures. However, as shown here, to do this the entrepreneur must create a model of the financials of the venture that is flexible enough to try various strategies and be able to predict the failure modes that the entrepreneur has identified. Finally, the case has shown that at times Monte Carlo must be used to confirm results, but that Robustica is still essential for optimization, and of great value to those wishing to minimize the risks associated with their ventures.