Many companies and organisations have an Enterprise Risk Management (ERM) program where they identify, evaluate and decide on action to take on key risks to the company/organisation. For some this is a very systematic and well documented approach using scientific methodologies etc. – for others it is a collection of managerial perceptions. In most all process, some decisions are taken, and the organisation believes it executes well on ERM.

Alas, in my experience talking to and working with organisations, this process is far from providing the efficiency and value it could. The key issue is that the ERM process is a siloed/standalone process which is not linked to business decisions or organisational/business design. ERM is part of the risk management system, not the business management system despite the ISO 31000 call of "integration".

For most companies/organisations, there is further the issue of "single-point estimates". Some may leverage data, others may ask specialists or leaders about likelihood and impact – but when it comes to collecting the data, only one set of likelihood and impact is used – often depicted in a risk matrix or heatmap.

In this article, I will show how easily the massive insights collected in the ERM process can be used for business decision making.

Step 1 – Quantify, quantify, quantify

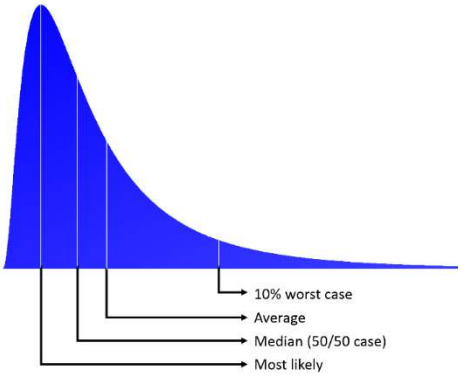
In many organisations, ERM "data" on impact and likelihood are qualitative such as "very low" likelihood and "severe" outcome. These are not data, these are opinions with no backing in facts – and most often using personal perceptions as scaling, i.e. I will upgrade my assessment when I am more afraid.

"You manage what you measure" is essentially a re-wording of Lord Kelvins original statement for the need of measurements and has since become rather well known in business.

You need to quantify your likelihood as a percentage or frequency covering some defined timeframe and you need to define your impact in terms of some performance metric (e.g., profit). Douglas Hubbard has described this in "The Failure of Risk Management" and "How to Measure Anything" and I have nothing to add to these excellent books.

Step 2 – Define impact as ranges

Using single point estimates can be outrageously dangerous. Any risk will have an expected or most likely impact if it materializes – fine, but they also have extreme outcomes. A fire in a building may lead to a partial closing of some parts for a day or two – but it may also destroy the entire building. These are not the same scenario.



If you base your risk management decisions on the most likely outcome, you will be in severe trouble if the next turns out like a 10% worst case.

Now, reverting to your ERM program, you probably in Excel or some software have a list of risks which looks somewhat like the below example where the risks are defined with descriptive scenarios and expected impact on company profits:

Risk Number	Name	Description of expected case	Likelihood	EBIT Impact	Owner	Actions Tak
1001	New competitor in key market	A strong new competitor emerges in a key market, and reduce our market share and revenue	10%	180	CM	Close marke Competitive
1002	Vendor disruption	A key vendor is unable to deliver, and halts manufacturing for 4 weeks	20%	96	PO	Close monitc Duplication c
1003	Strike	Main facility hampered by strike over a period of 3 weeks. Union agreements up for renegitiation	10%	72	CO	Careful negc
1006	Chinese market close-down	For political reasons, the Chinese market is "closed"	5%	250	MO	Close monitc
1007	Reputational revenue loss	Being caught on bad behaviour, we loose revenue	7%	100	RD	Ethics appro
1007	Reputational fine	We are fined based on being caught in bad behaviour	9%	100	RD	Legal monitc Ethics appro
1008	Key component shortage	A key component cannot be procured, leading to a 6 week halt of manufacturing	3%	144	CO	Market moni Dual sourcin
1009	Labour cost increase	Based on negitiations, labour costs/rates exceed budgeted level	16%	40	MH	
1011	Price competition	Significant price competition leads to lower revenue	5%	150	PO	Close marke Action plan t
1012	Material transport stalled	Shipment from vendor to us is stalled, leading to a 2 week loss of capacity	10%	48	LO	Inventory pol Duplication c
1012	Shipment costs increase	Shipment capacity shortage leads to 20% higher shipment prices/costs	8%	12	LO	Hedging/Lon
1015	Overhead overload	Organisational overload leads to added fixed costs	17%	100	FO	Change load

This is a very good starting point. You know the likelihood and the most likely impact – but as stated, we need more to be able to describe the outcome range of each risk.

Generically, we can describe the range if/when we have the low- and the high-end outcome as well as the most likely. However, imagining the extreme high-end impact can be academic and very difficult to do. Leverage plausibility and decide that you will ask your experts or analyse your data for e.g., a 5% best case (5th percentile) and a 5% worst case (95th percentile) outcome of the risk.

Now, your ERM list cover 100 or more risks, and making this step of analytics may appear to big an endeavour, just to get started – and here I suggest “shortcutting” with a proxy approach. Define a factor – I suggest 4, but it could also be 10. Based on my experience, I do not recommend a factor of less than 4, and I have never seen the need for a factor of 10. Use this factor to proxy define your ranges:

- Expected or most likely outcome is known – e.g., 180 as for risk 1001
- Minimum or best-case impact is hence 1/4 of the most likely, i.e., 45
- Maximum or worst-case is now 4 times the most likely, i.e., 720

With this, some of your ERM tale will look like this:

			Risk Assessment		Proxy Impact Range		
Risk Number	Name	Description of expected case	Likelihood	Expected	Min	Exp	Max
1001	New competitor in key market	A strong new competitor emerges in a key market, and reduce our market share and revenue	10%	180	45	180	720
1002	Vendor disruption	A key vendor is unable to deliver, and halts manufacturing for 4 weeks	20%	96	24	96	384
1003	Strike	Main facility hampered by strike over a period of 3 weeks. Union agreements up for renegitiation	10%	72	18	72	288
1006	Chinese market close-down	For political reasons, the Chinese market is "closed"	5%	250	63	250	1.000
1011	Price competition	Significant price competition leads to lower revenue	5%	48	12	48	192

Now, your risk portfolio can be consolidated using Monte Carlo simulation, and becomes a lot more valuable than a detached standalone list have ever been.

Step 3 – Link to performance

The ISO 31000 standard is adamant about the need for risk management to affect decisions to make any sense – and surely, if you imagine your risk management does not lead to or affect decisions, why have it?

Nevertheless, only a few companies I know of, have ever made any attempt to integrate ERM into performance management such as e.g., budgeting. It puzzles me, but here is how I suggest doing this:

You take an extract of your Profit/Loss budget – there is no need for all the details, just the very top highlights like this:

Item	Budget
Revenue/Demand	2.000
Variable costs - % of revenue	40%
Variable costs	800
Fixed Costs	1.000
Profit	**200**

You address your budgeted revenue and demand (I will get back to this later).

Some costs are variable and will fluctuate with actual demand/revenue, whereas other costs will be irrespectively of short-term fluctuations on revenue.

In this example, a company is making a 10% profit and have 40% of their cost base as variable costs.

We now look at the different risks in our ERM and allocate them to the above model by giving them a designator:

- D (demand) i.e., what may happen which depletes demand for our products and hence our revenue. These may be new competitors, failed product launches, loss of customers etc.

  When assigned to the P/L model, the impact is “recalculated” to be a revenue number rather than the EBIT impact it was defined by.

- C (capacity), i.e., what may happen which will us render us unable to fulfil the demand and hence reduce revenue. This can be vendor disruption, manufacturing breakdowns or the like

  When assigned to the P/L model, these are also recalculated to be revenue numbers and included in the model in a way, where the risk-based revenue it the smallest of demand and capacity, i.e., assuming we cannot sell, what we cannot deliver.

- V (variable costs). These will affect the variable cost share and can be issues like component /material costs, labour rates, shipment costs etc.

  When assigned to the P/L model, these are recalculated to be percentages of (budgeted) revenue. Using the above example, a 50 mio impact becomes 2,5% percentage to be added to the variable cost share. This will allow for the actual impact to follow the revenue

- F (fixed costs). These will affect the cost base and may be issues like project cost overruns, increased rent costs, marketing spending costs etc.

  When assigned to the P/L model, these are taken as face value as added costs will deplete the profit directly.

The above designation is the reason for the “type” column in the table below.

				Risk Assessment		Impact Range		
Risk Number	Type	Name	Description of expected case	Likelihood	Expected	Min	Exp	Max
1001	R	New competitor in key market	A strong new competitor emerges in a key market, and reduce our market share and revenue	10%	100	-667	-167	-42
1002	C	Vendor disruption	A key vendor is unable to deliver, and halts manufacturing for 4 weeks	20%	90	-600	-150	-38
1003	C	Strike	Main facility hampered by strike over a period of 3 weeks. Union agreements up for renegitiation	10%	70	-467	-117	-29
1006	R	Chinese market close-down	For political reasons, the Chinese market is "closed"	5%	150	-1.000	-250	-63
1011	R	Price competition	Significant price competition leads to lower revenue	5%	150	-1.000	-250	-63
1012	C	Material transport stalled	Shipment from vendor to us is stalled, leading to a 2 week loss of capacity	10%	50	-333	-83	-21
1012	V	Shipment costs increase	Shipment capacity shortage leads to 20% higher shipment prices/costs	10%	12	0,2%	0,6%	2,4%
1015	F	Overhead overload	Organisational overload leads to added fixed costs	10%	100	25	100	400

The example company has 40% of variable costs and hence it is assumed that they have a 60% flow-through profit which means that if/when revenue drops (or increases) 100 mio compared to budget, the profit will decline or grow with 60 mio. Hence the recalculation of all R (revenue) and C (capacity) elements.

Risk 1012 is a variable cost with an expected impact of 12 mio. Based on a 2.000 mio budgeted revenue, this translates to an impact of 0,6% of revenue.

Risk 1015 is a fixed cost risk, and the expected impact is maintained as is.

Step 4 – Complete the model

Now, we have all the risks ready to be linked to the P/L and our budget – but we are not quite done yet. Only adding risks will provide an overly negative perspective of the future, and hence we need to add two elements as well.

- Uncertainties, i.e., the things we KNOW for certain will happen, but we do not know what the outcome of that will be. This could be:
  - General demand forecasting uncertainty (type D)
  - Capacity uncertainty (type C)
  - Material cost rates (type V)
  - Currency variations (type F – for simplicity)

  As well as many others

- Levers or opportunities. In any given year, good things happen as well and needs to be taken into consideration. Ideally, you should have a systematic identification and evaluation of these to the same extent that you have with risks – but again, this may be more cumbersome than justified.

  Talk to managers and specialists, and ask for the good things that may happen, and define a dozen levers or two – with likelihood an expected outcome, and add these to your performance model.

- Validate your model logic ensuring calculations are correct

With these things added – our budgeting ERM may look like this:

Risk Number	Type	Name	Description of expected case	Likelihood	Expected	Min	Exp	Max
1001	R	New competitor in key market	A strong new competitor emerges in a key market, and reduce our market share and revenue	10%	100	-1.000	-250	-63
1002	C	Vendor disruption	A key vendor is unable to deliver, and halts manufacturing for 4 weeks	20%	90	-900	-225	-56
1003	C	Strike	Main facility hampered by strike over a period of 3 weeks. Union agreements up for renegitiation	10%	70	-700	-175	-44
1004	F	Currency Impact	Net currency impact	100%		-40	0	40
1005	V	Material costs	Market shortage leads to change in material costs which cannot be relayed to sales price	100%		-2,5%	0,0%	5,0%
1014	R	Competitor "drop-out"	A key competitor is bankrupt and drop out of the market, leaving a bigger market for us	3%	-50	31	125	500
1015	F	Overhead overload	Organisational overload leads to added fixed costs	10%	100	25	100	400
1016	C	Productivity boost	Engineering project leads to a 5% of overall productivity and hence capacity	20%	-48	30	120	480
1017	F	Project savings	Projects are, overall, unable to deliver targeted savings	20%	100	25	100	400

In the example above I have added two uncertainties (with a likelihood of 100%) - where the data are shaded grey as well as couple of levers/opportunities where the data are shaded green. My full example model is slightly larger.

Step 5 – Draft simulation

With this, we can now run a Monte Carlo simulation and calculate the risk/uncertainty/lever-based outcome of demand, revenue, costs and profit as well as see the most impactful issues to address further.

We will get a result like shown here

Demand has been defined to have a 100 mio downside and a 300 mio upside – as we tend to budget cautiously.

In this particular scenario, we had a demand of 1.989 mio, but were on top of that we have an added demand of 457 mio.

Supply capacity is designed to meet, even the high-end of expected demand, and in this scenario none, of the supply chain risks have materialized. As such capacity is 2.413.

Item	Min	Budget	Max	MC
Revenue/Demand	1.900	2.000	2.300	1989
Demand uncertainty impact				457
Net Demand				**2.446**
Supply Capacity	2.300	2.400	2.500	2413
Supply uncertainty impact				0
Net supply capacity				**2.413**
Capacity constraint				33
Likelihood of capacity constraint				24%
Net Revenue				**2.413**
Variable costs - % of revenue	38%	40%	43%	41%
Variable costs		800		984
Variable costs uncertainty impact				3
Gross Contribution		**1.200**		**1.426**
Fixed Costs	950	1.000	1.100	1017
Fixed cost uncertainty impact				-6
Profit		**200**		**415**

With this, the net revenue is still stifled by capacity and the company revenue end up with the 2413 supply chain can deliver.

Variable costs fluctuate between 38% and 43% of revenue, and in this scenario is was 41 and additional variable costs were very limited (3 mio). Somewhat the same has been the case with the fixed costs base

As such, profit ends up with 415 mio, more than twice the budgeted 200 mio.

This is just one scenario, but Monte Carlo simulation allow us to run 10.000 scenarios in a matter of a minute or two. We look at this, and address the outcome:

- Does it make sense to us – if not, we should revisit the model carefully as our general business understanding is often better than our modelling skills
- Look at the key issues emerging out of sensitivity analysis, and have the proxy ranges verified. Focus on those 5-10 issues which are most important. Do we have data or insights to challenge the low- and high-end calculated by the proxy factor If/when you do – change the low- and high-end ranges and be ready to calculate again

Based on your validation and embedding whatever changes needed - recalculate the budget model and address the results emerging.

Step 6 – Read the results

With the validations and corrections applied, we can now re-simulate the model and look at the results. The methodology allows us to measure performance against defined tolerance levels. Having asked management, we may have this set of decision guides:

For demand and revenue, good performance is exceeding the 2.000 mio budget. Acceptable but below target down to 1.900 mio is "so-so" whereas a revenue below 1.520 is seen as a disaster. A revenue between 1.520 and 1900 mio is "unacceptable".

Performance Frames	Disaster below	So-So Above	Good Above
Demand & Revenue	1520	1.900	2.000
Capacity	25%	5%	0%
Profit	0%	5%	200

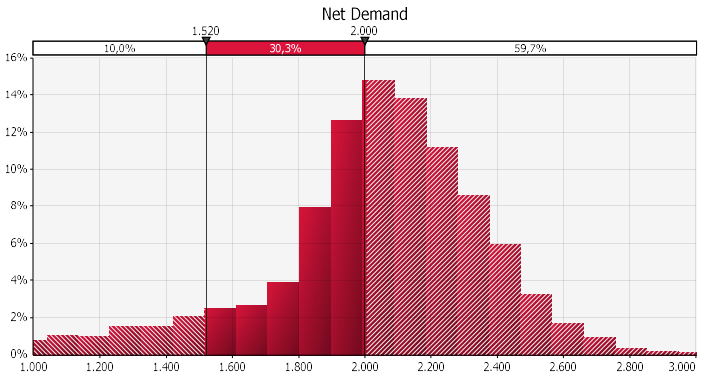
For capacity, being able to meet demand is good, losing 5% of demand is "so-so" and more than 25% is disastrous. For profit, a negative outcome is disastrous etc.

With these frames set, we can now report on the budget, demonstrating the likelihood we will meet defined targets. In the example model, we get a reporting like this

The chart shows that despite the fact there is a 60% likelihood demand will exceed the budgeted 2.000 mio, there is only a 31% likelihood profitability will exceed the budgeted 200 mio. In fact, there is a 32% likelihood we will end up in "red figures".

Looking at delivery or capacity, we note a 73% likelihood supply can meet demand, but thereby also a 27% likelihood demand will be unable to meet demand and hence deplete revenue.

The Monte Carlo software allows you to look further into the outcome ranges of e.g., demand, which will look like this.

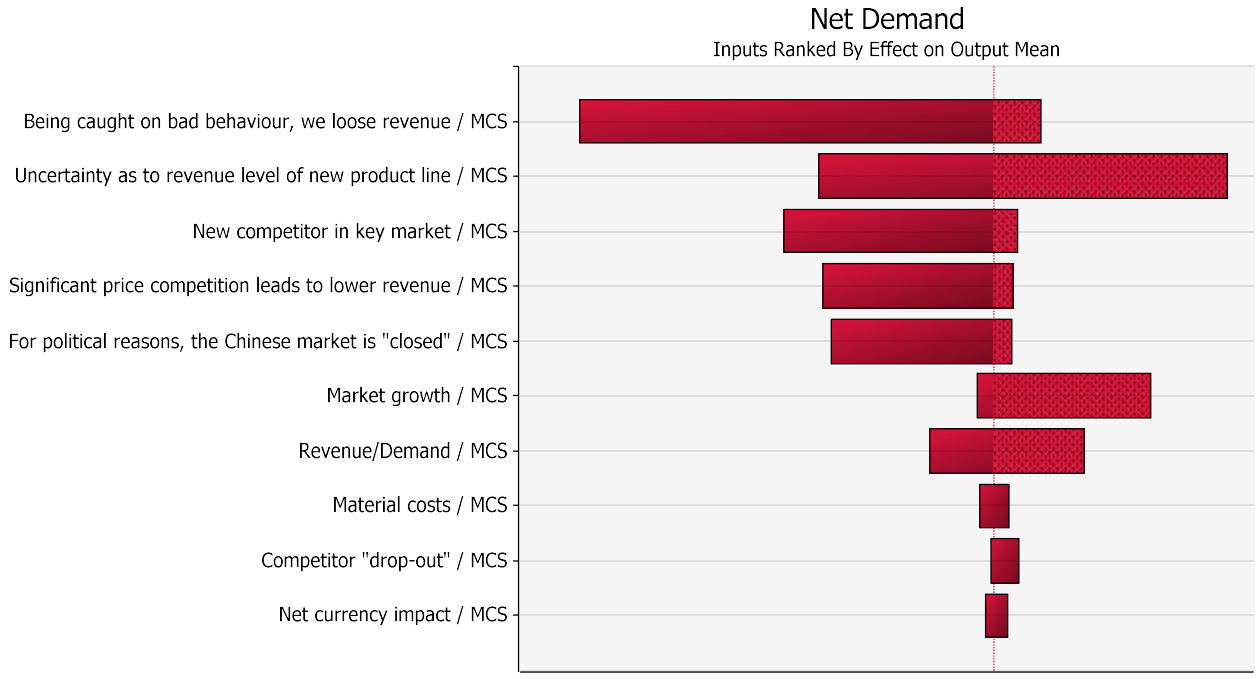


This shows a rather wide range – and shows the 60% likelihood of exceeding the 2.000 mio target.

This chart may provide valuable insights, but from a performance perspective, it is not the most valuable to look at.

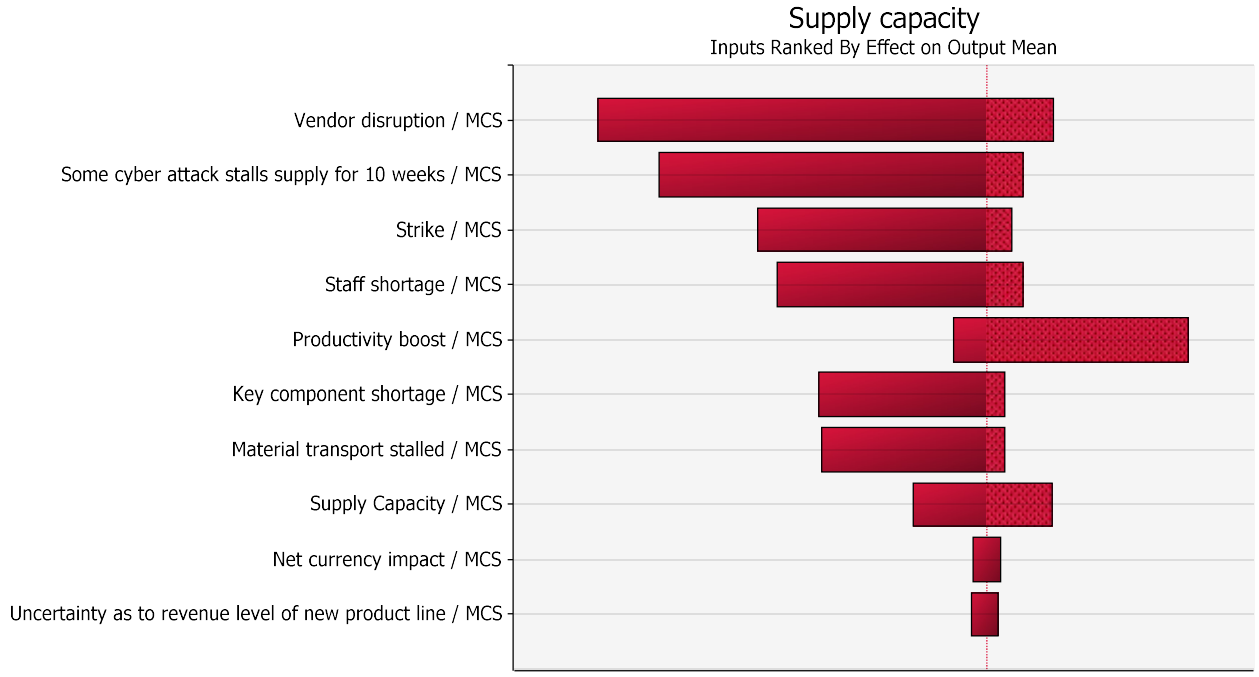
Better and more directional value comes from the "Tornado" diagram. A tornado diagram is the risk sensitivity analysis, which is also provided from the Monte Carlo simulation. The name emerges from the typical shape of the graphics as shown below.

Looking at our example demand, that chart looks like the below chart. Note that I have (deliberately) taken out all scales and data of this. There is math behind this – the vertical centre line is the average outcome and the length of the bars (left and right) is the impact of a change of one standard deviation. I for one, would hate to have to explain that in any detail to a non-mathematician – so I simply go by "bigger bars = bigger sensitivity"



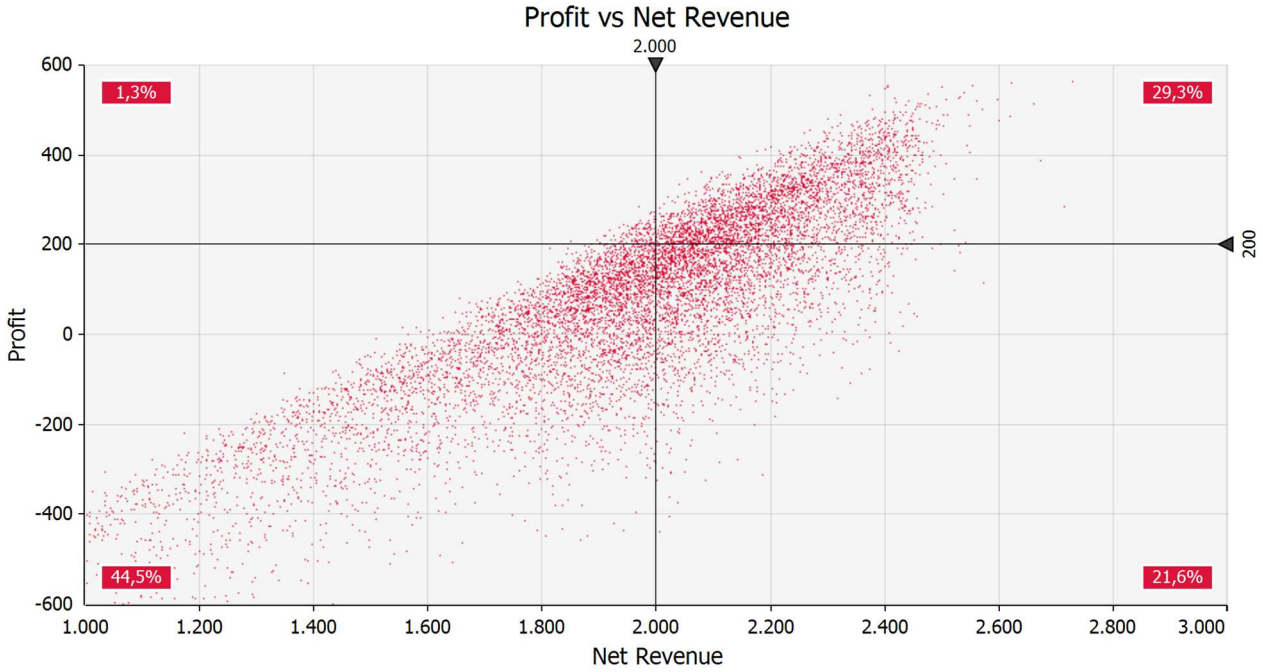
Here, we note than the most prominent reason for a lower demand is "being caught on bad behaviour…", then comes the uncertainty is related to a new product line, the emergence of a new competitor etc. This may, easily direct management to enhance actions to improve on this.

Similarly, looking at capacity, we get:



So, vendor disruptions top the list. Supply Chain planning and procurement can easily pinpoint which vendors and components, and direct actions to improve on this. Then the risks of cyber-attacks, a strike and staff shortage are to be addressed. Quite tangible for a Chief Operating Officer to address.

As a final possible chart, we are able to take a combined look at the interlink between revenue and profit. The below scatter chart shows the position of all (here, 10.000) simulations.



The vertical line is positioned at the targeted revenue of 2.000 mio, and the horizontal line at the budgeted profit of 200 mio.

44,5% of the simulations ended up below target on revenue AND profit, whereas 29,3% have both revenue and profit above target. What is truly interesting however is, that in the top left “quadrant” we have 1,3% of outcomes, where we deliver on the targeted profit – without meeting target demand.

I did this type of analysis with a company once, and their image was even more extreme. Even with 50.000 simulations the upper-left quadrant was completely empty, indicating the company was totally depending on sales exceeding budget, if they were to deliver targeted profits. That DID lead to managerial attention and actions.

Closing comments

Dear risk manager, I challenge you to present this article and the potential reporting opportunities to your executive team, and ask them, if this will help them see/capture real value out of the ERM and risk management activities. If they do – the steps described could be steps you should embark on. Naturally, if they do not want this, then do not bother.

Risk managers tend, naturally, to focus on risks. General managers focus on performance, and in my perspective – if you wish risk management to be a valuable and treasured part of company management, you need to demonstrate the value of linking these directly – perhaps as shown her. Should you have an interest, get back to me, and I will send you the reference model.

The example I have shown has been 100% financial, assuming businesses are in it for the business. Needless to say, any other defined metric can be used with parallel approaches.

All the best