M8L4a. Simulation Decision Options

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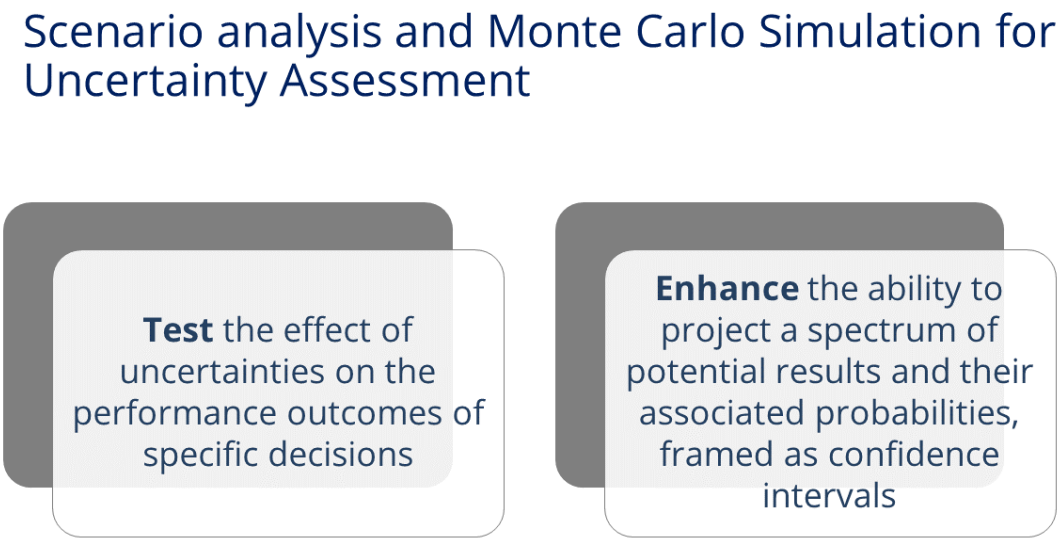
Slide #2



We've explored how scenario analysis and the Monte Carlo simulation method can be utilized to assess the impact of uncertain business conditions on our decision to invest in additional machines to accommodate demand growth.

Essentially, these analytical models test the effect of uncontrollable business uncertainties on the performance outcomes of our specific decisions.

These analytical outcomes enhance our ability to project a spectrum of potential results and their associated probabilities framed as confidence intervals.

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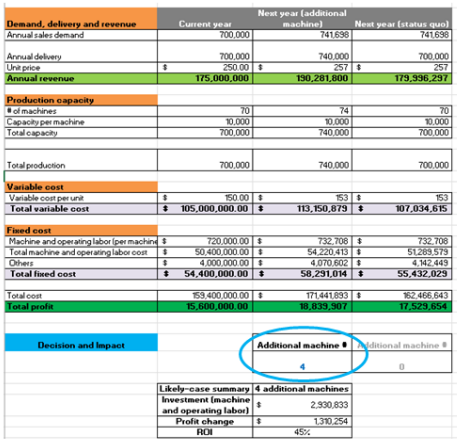
Business Economic Model

Business variables (example 1)

Uncertain variables (forecast)	Likely case	Recession	Strong economy
Sales demand growth	6%	2%	8%
Unit price growth	2%	1%	4%
Material price growth	2%	1%	4%
Fixed cost price growth	2%	1%	4%

Four additional machines provide the significant average profit.

Questions: how does the number of additional machines impact the profit?



Demand, delivery and revenue	Current year	Next year (additional machine)	Next year (status quo)
Annual sales demand	700,000	741,698	741,698
Annual delivery	700,000	740,000	700,000
Unit price	$ 250.00	$ 257	$ 257
Annual revenue	**175,000,000**	**190,281,800**	**179,996,297**
Production capacity			
# of machines	70	74	70
Capacity per machine	10,000	10,000	10,000
Total capacity	700,000	740,000	700,000
Total production	700,000	740,000	700,000
Variable cost			
Variable cost per unit	$ 150.00	$ 153	$ 153
Total variable cost	**$ 105,000,000.00**	**$ 113,150,879**	**$ 107,034,615**
Fixed cost			
Machine and operating labor (per machine	$ 720,000.00	$ 732,708	$ 732,708
Total machine and operating labor cost	$ 50,400,000.00	$ 54,220,413	$ 51,289,579
Others	$ 4,000,000.00	$ 4,070,602	$ 4,142,449
Total fixed cost	**$ 54,400,000.00**	**$ 58,291,014**	**$ 55,432,029**
Total cost	159,400,000.00	$ 171,441,893	$ 162,466,643
Total profit	**15,600,000.00**	**18,839,907**	**17,529,654**

Decision and Impact	Additional machine #	Additional machine #
	4	0

Likely-case summary	4 additional machines
Investment (machine and operating labor)	$ 2,330,833
Profit change	$ 1,310,254
ROI	45%

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For instance, in the previous business uncertainty simulation example, the investment of four additional machines generated a return ranging between a loss of 0.5 million dollars and a profit of 1.3 million dollars with 90% confidence.

These tools serve an unbiased role in enabling businesses to evaluate their decisions and set realistic expectations for their outcomes.

A subsequent question then arises.

Is it possible to leverage the Monte Carlo method to assess the outcomes of varying decision options?

For example, investing in two, three, four, or five machines on profitability.

These decision options are within our sphere of control, and as such, the simulation results can be directly incorporated into our decision-making process.

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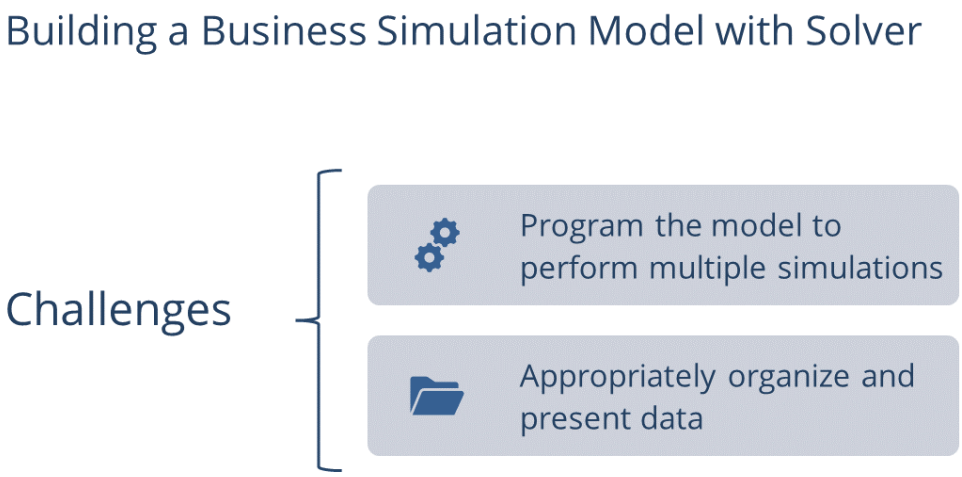

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Build a simulation model for decision options.

To achieve this objective, we must tackle two technical challenges.

First, it's essential to program the model to automatically perform multiple rounds of business uncertainty simulations, each tailored to a specific decision option.

Second, there's a need to organize and present the substantial amount of simulation data in a way that clearly demonstrates the impacts of both the decision options and the uncertainties involved.

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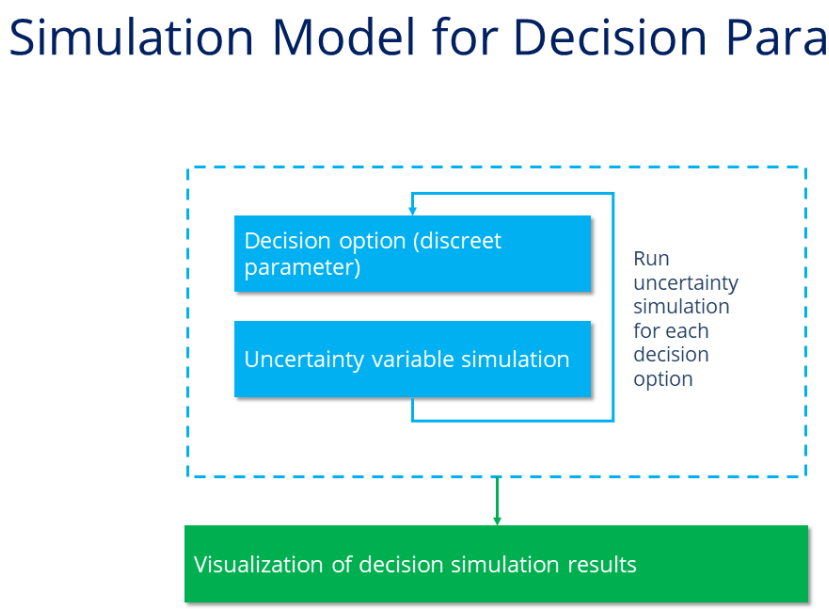

Solver offers an effective solution for these requirements.

It has a simulation parameter feature that lets users specify discrete decision options, including the range and the number of runs.

Solver also presents the outcomes in various formats.

For instance, its trend chart displays crucial outcome statistics, such as the mean value of the outcome, and percentage bands.

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Example #2: Simulate Decision Options

Four independent business uncertainty variables

Uncertain variables (forecast)	Likely case	Recession	Strong economy
Sales demand growth	6%	2%	8%
Unit price growth	2%	1%	4%
Material price growth	2%	1%	4%
Fixed cost price growth	2%	1%	4%

Number of additional machines (1,2,3,4,5,6)

Range of additional machines
1
6

6

To ensure clarity regarding the inputs of the simulation model, it's crucial to differentiate between two categories of variables.

Initially, the model includes four variables that represent market uncertainties.

To further refine the model, we plan to introduce decision options, which Solver identifies as simulation parameters.

Our objective is to have the model simulate six decision options, involving the addition of one to six machines.

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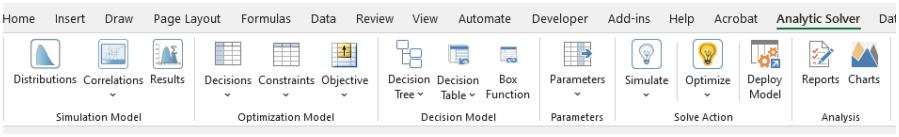
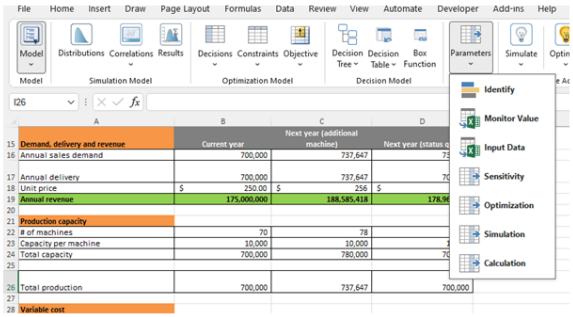
Analytic Solver Simulation Model





to define “machine options”

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Upon accessing the solver add-in, navigate to the Parameters icon found within the Parameter menu.

Here, you can configure the simulation, which specifies the number of additional machines you're considering.

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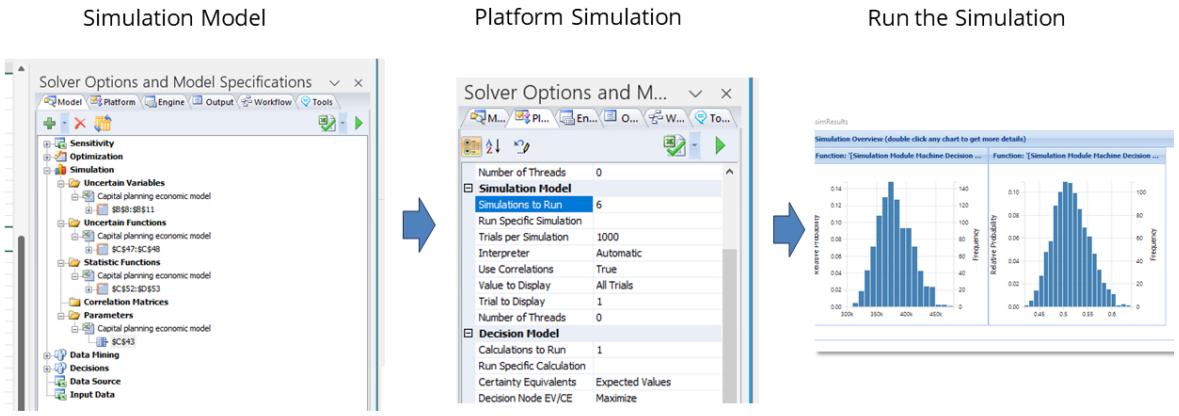
Simulation Model



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Setting up and executing a simulation model involves three main steps.

Simulation model.

Specify uncertain variables, uncertain functions, statistic functions, and parameters in the simulation model.

Simulation platform.

Define the number of simulation runs to represent the decision options and the number of trials per simulation for the uncertain variables.

Run the simulation.

This step produces results showing how the uncertain variables and decisions affect profit or ROI.

By following these steps you can leverage the solver ad in to make informed decisions by evaluating the impact of adding additional machines to your operation, taking into account both uncertainty and different decision options.

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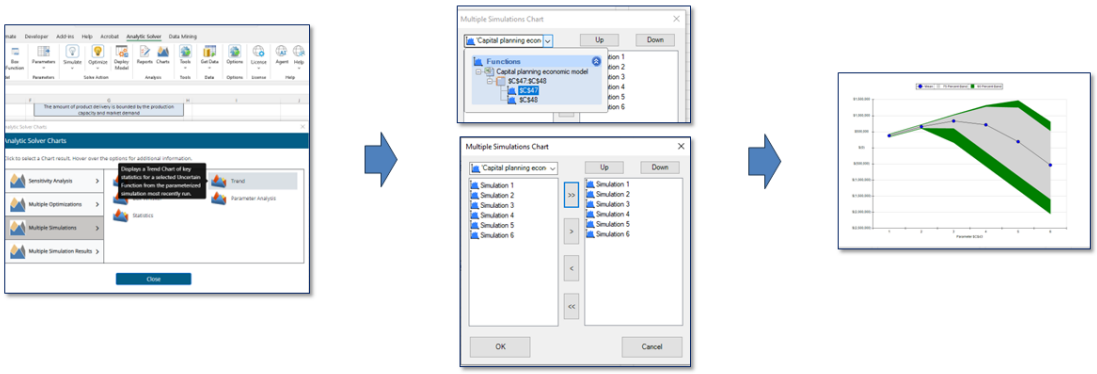
Visualize Simulation Results



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Visualize and interpret decision simulation results.

To effectively assess the impact of capital investment decisions amidst uncertain market conditions, visualizing the statistical outcomes is crucial.

A particularly insightful tool for this purpose is the trend chart, which allows for an in-depth trend analysis.

Here's how to visualize the results using the analytic solver add-in.

One, initiate the trend analysis.

Navigate to the charts menu located in the analysis section of the analytic solver add in tab.

From there, select multiple simulations and then choose the trend function.

2. Configure Analysis.

From the drop-down menu, select an outcome metric, either profit or ROI, to consider all your decision options.

Ensure you select all simulation runs, which include the six decision simulations, by using the Move All button.

This process offers a hybrid outcome statistics chart showcasing the average profit value derived from each machine addition option.

Furthermore, the chart illustrates profit percentage bands or intervals at confidence levels of 75% and 90% represented as distinct areas on the chart.

This comprehensive visualization of the chart offers invaluable insights into the average expected profit, associated risks, and optimistic opportunities for each decision option, empowering you to make well informed decisions.

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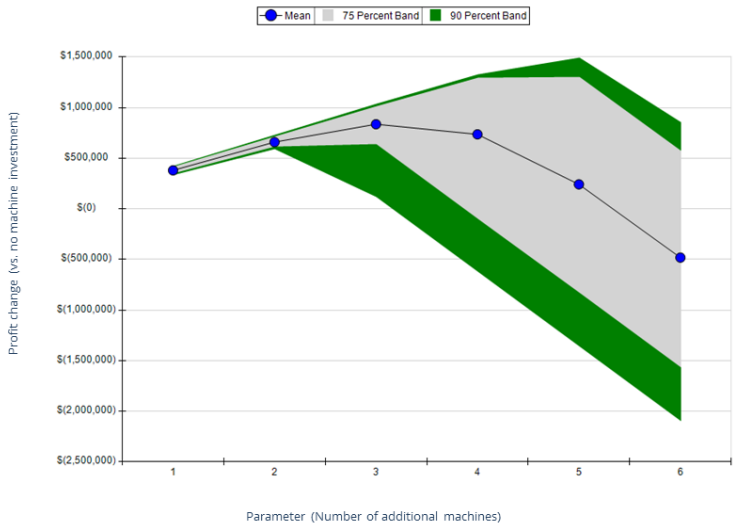
Decision Simulation



What decision will you make?

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The mean value represents the average profit from a machine investment decision across the entire spectrum of market uncertainty.

The lower boundary of the area can be interpreted as the risk associated with the decision, such as if market growth ends up at the lower end of the forecasted range.

Conversely, the upper boundary represents the optimistic opportunity when favorable market conditions unfold.

For example, if the market grows rapidly approaching the upper end of the forecasted range.

This approach to visualizing and interpreting the data ensures that you, as a business decision maker, can clearly comprehend the potential outcomes of your investment decisions without getting bogged down in overly technical details.

It's all about making the complexities of data analysis accessible and actionable, allowing you to navigate through uncertainty with confidence.

For instance, the trends chart might reveal that the range of potential profits expands as the number of additional machines increases.

The average incremental profit peaks at the addition of three machines.

Adding two machines yields a slightly lower mean profit than three machines. $662,000 versus $834,000.

However, the risk associated with adding two machines is significantly lower than that with adding three machines.

This analysis paves the way for an informed dialogue about the tradeoffs between potential profit and associated risks, guiding you toward making choices that best fit your business objectives.

What decision would best align with your strategic goals and risk tolerance?

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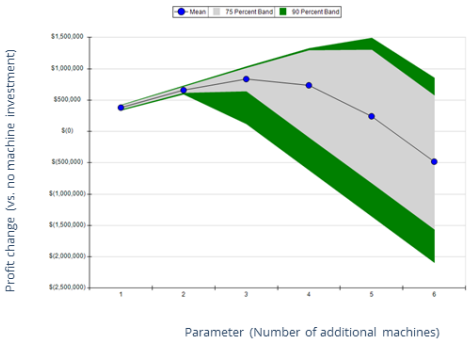
Upper boundary represents full potential of the capital equipment investment.



Conduct Detailed Analysis

Create Targeted Action Plans

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Leveraging the confidence interval chart derived from simulation results can help formulate actionable plans aimed at achieving business excellence.

By understanding the implications of both the upper and lower boundaries of this chart, businesses can strategize effectively to optimize returns and mitigate risks associated with capital equipment investments.

Here's how these insights can be utilized.

Upper boundary.

The upper boundary of the confidence interval indicates the maximum potential value businesses can achieve from capital equipment investment under favorable conditions.

To tap into this full potential, businesses should consider the following steps.

Conduct a detailed analysis.

Distinguish between controllable and uncontrollable variables that affect your profit.

Understanding these factors can help you leverage the controllable aspects.

Create targeted action plans.

Businesses can create targeted action plans focusing on controllable variables that directly contribute to reaching the full potential of the investment.

This could involve optimizing supply chains or enhancing marketing strategies.

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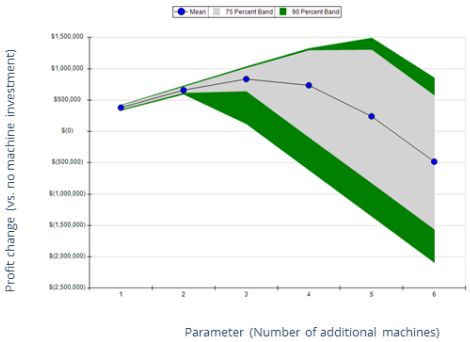
Lower boundary presents risks of the investment.



Identify Controllable Aspects

Implement a Monitoring System

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Lower boundary.

The lower boundary of the confidence interval highlights the risks associated with the investment.

Considering worst case scenarios or less favorable market conditions to manage these risks effectively.

Identify controllable aspects.

Determine which aspects of the uncertain conditions you can control and develop strategies to mitigate associated risks.

This could include cost management or strengthening the sales force.

Implement a robust monitoring system.

Track the performance of your investment against predefined benchmarks.

This will enable you to identify trends early and take corrective actions early and take corrective actions as needed to avoid reaching the lower boundary of your projections.

By strategically focusing on both the upper and lower boundaries of the confidence interval chart, your business can develop comprehensive action plans.

These plans aim not only to reach the full potential of your investments, but also to mitigate associated risks, thereby driving toward overall business excellence.

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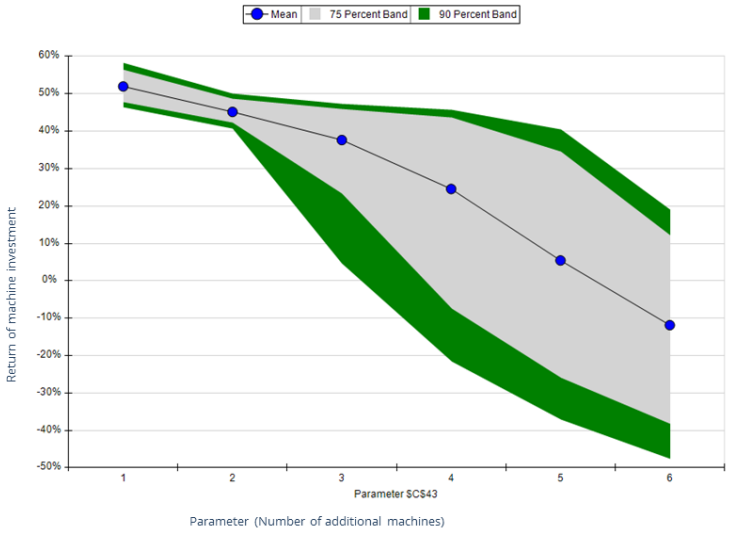
Decision Simulation



How will the additional insights enhance or weaken your decision?

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A complementary analysis of decisions involves examining the return on investment, ROI, a metric widely used by businesses to assess the effectiveness of monetary investments.

From the simulation, we can derive the following insights.

The range of return on investment expands as the number of additional machines increases.

The average return on investment decreases as the number of machines increases.

The risk associated with adding one or two machines is significantly less than that associated with adding three or more machines.

How will these additional insights enhance or potentially complicate your decision-making process?

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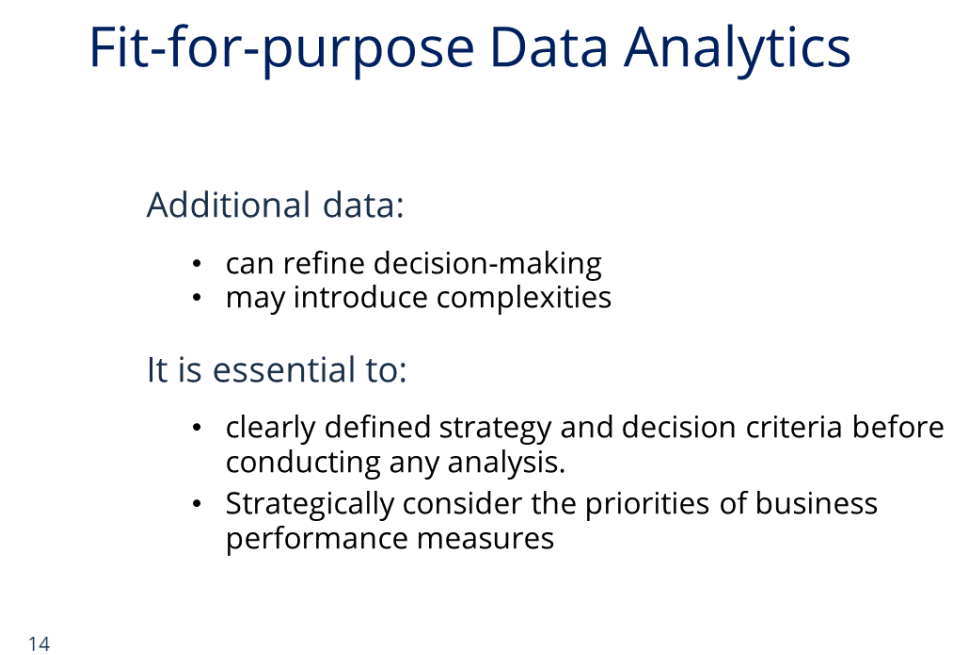

Additional data can sometimes refine your decision making by providing deeper insights.

However, it may also introduce complexities due to conflicting insights from different perspectives.

This underscores the importance of having a clearly defined strategy and decision criteria before conducting any analysis.

By understanding the priority of different business performance measures, you can appropriately consider them in situations where your decisions result in conflicting impacts on these measures.