DIRECTLINK: STRATEGIC SPARES MODEL

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1) Economic Concepts

The Strategic Spares Strategy only applies to critical spares. A critical spare is one where the failure of that sub asset will result in one or more systems going offline.

An investment in spares should only occur where it has the lowest long term economic cost. Spares have the lowest long term economic cost where no other alternative economic cost is lower cost (replacement of sub asset or reengineering of sub asset to take different spares).

The model works by assessing the cost of spares against the next best alternative.

The business case outlines three different approaches to analysis:

1. Business as Usual
2. Growing Lead Times
3. High Obsolescence Risk

2) Business as Usual and Growing Lead Times

The model doesn't distinguish between Business as Usual and Spares with Growing Lead Times because the next best alternative is the same in both cases - the asset goes offline for the lead time duration.

The model uses the estimated failure rate to calculate the number of spares to maintain the critical level of spares, the level at which a failure in the sub asset will not result in long outages of Directlink.

It then compares the cost of the required number of spares against the present value cost of market value of the outage the duration of the lead times. The model uses the daily revenue of Directlink as the measure of market value. Where the cost of the spares are less than the cost of the outage to consumers.

While the best forecast has been used there is uncertainty around failure rates and lead time the model also does sensitivity analysis based on a 50% higher failure rate.

3) High Obsolescence Risk

a) Concept

At a high level the model works out whether it is better to buy enough spares to last until the end of the asset life or to replace the sub system when the last currently owned spare fails.

The model calculates three types of spares with a high obsolescence risk:

- Flat failure rate
- Mean time to failure (Original)
- Mean time to failure (Replacement)

A mean time to failure is the expectation that 50% of subcomponents will have failed by the mean time to failure date.

b) Stable Failure rate

The assumption is that the failure rate of spare parts is consistent throughout the life of the sub system. The model calculates, based on the **forecast failure rate**, the number of spares that are necessary to reach the end of life. It then calculates a minimum number of spares to protect for unexpected failures (**critical number of spares**). This calculated the **Required Spares** for the lifetime of Directlink.

The number of **Spares Held** are deducted off the **Required Spares** to calculate the number of spares to purchase. This is multiplied by the cost per unit to calculate the **Purchase Cost**.

The length of time the current level of spares is forecast to last is then calculated to determine if the spares are not acquired when the alternative will be required.

The forecast of alternatives is undertaken at a high level so a range is used in the analysis. The Draft Determination WACC is used to calculate the **Net Expected Value** of the alternative if the alternative takes place at the time when the asset runs out of spares.

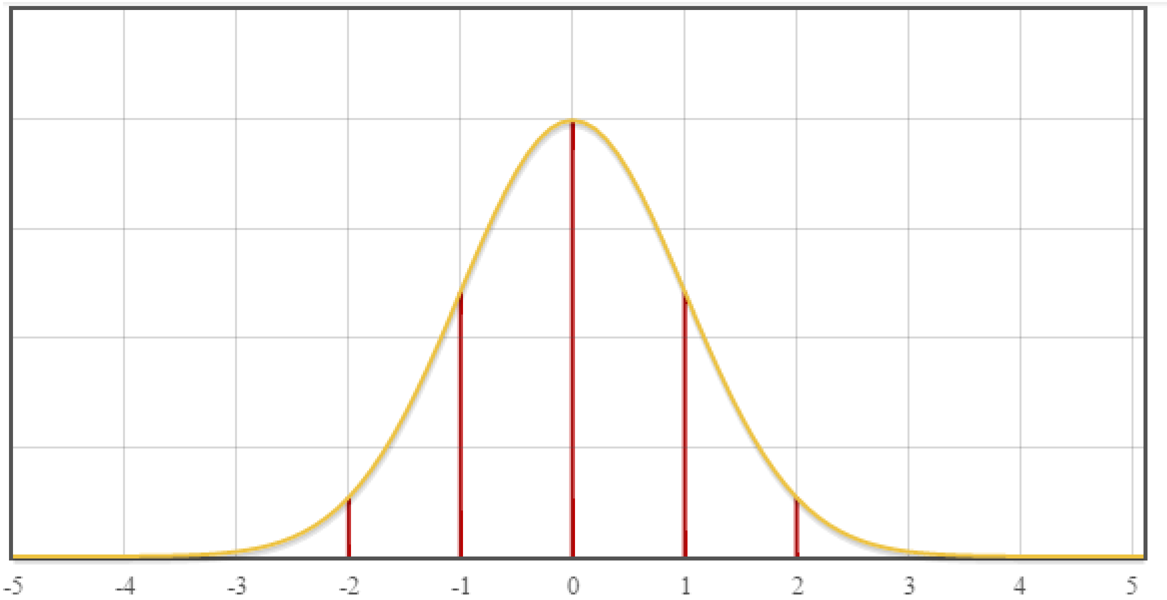
If the cost of acquiring the spares is less than the present value of the alternative then the spares are the economically efficient outcome, if not the spares will not be acquired.

c) Mean time to Failure

The concepts in the Mean Time to Failure workbooks is the same as the flat failure rate work book however the profile of failures is different.

In the model we assume that the mean time to failure is normally distributed. That is the distribution of failure is higher around the mean.

Figure 1: Normal Distribution



Under a normal distribution 96% of data points are within 3 standard deviations of the mean. This means that nearly all failures will occur around the mean with less failures occuring earlier and later in the life of the asset.

Due to the relative rarity of these spares compared to more widely used assets at other TNSPs the standard deviations are unknown so we have assumed 10% of the mean for 3 standard deviations ie 96% of data points are captured.

Mean Time to Failure (Original)

There is only limited data about the early failures of spares on Directlink. Therefore, it is assumed that any asset that has a mean time to failure of greater than 22 years was installed at the time of construction. It is likely this is correct for the vast majority of spares.

The model works out a **Critical Failure Threshold** to work out a risk acceptability to determine the timing of the alternative. This is used to work out the Point of Failure (being the point where the cumulative risk reaches the **Critical Failure Threshold**). This is then used to determine the timing of the alternative for the **Present Value of Alternative**.

A conservative approach has been adopted with the spares assumed to last the mean time to failure plus 3 standard deviations. This is used to calculate the number of spares for the **Residual Life of Directlink**. The number of spares held is deducted to calculate the number of spares to acquire. This is multiplied by the unit rate to calculate the **Purchase Cost**.

The cost of spares is then deducted from the **Net Present Value of the Alternative**. If the result is positive the **Purchase Cost** is included in the forecast.

Mean Time to Failure (Replacement)

There is only limited data about the early failures of spares on Directlink. It is assumed that any asset that has a mean time to failure plus 3 standard deviations has been completely replaced and all assets have been in operation since the last expected failure. This is the **Expected life for Complete Replacement**.

The model calculates the value of delay produced by an additional spare. This is done by deducting the present value of the alternative delayed by an additional spare from the cost of the alternative. The **Outcome for Obsolescence** is to buy if the value of the delay is greater than the cost of the spare.

If the value of delay is greater than the cost of spares then the spreadsheet calculates the number of spares necessary to get the sub system to last until the end of Directlink's operating life. This is multiplied by the cost per spare to calculate the **Purchase Cost**.