MGT530 – Operations Management

Reliability and Decision Theory

Module Introduction

Readings

Note: The following readings may require you to be logged in to the Saudi Digital Library. You may do that here (https://lms.seu.edu.sa/bbcswebdav/xid-27610786_1).

Required

Supplements to Chapters 4 & 5 in *Operations Management*.
Chapter 4 PowerPoint slides (https://lms.seu.edu.sa/bbcswebdav/courses/MGT-530-MASTER/Presentations/Stevenson_13e_Chapter_04.pptx) – *Operations Management.*
Chapter 5 PowerPoint slides (https://lms.seu.edu.sa/bbcswebdav/courses/MGT-530-MASTER/Presentations/Stevenson_13e_Chapter_05.pptx) – *Operations Management.*
Jiao, L., Pan, Q., Liang, Y., Feng, X., & Yang, F. (2016). **Combining sources of evidence with reliability and importance for decision making (https://link-springer-com.sdl.idm.oclc.org/article/10.1007%2Fs10100-013-0334-3)**. *Central European Journal of Operations Research, 24*(1), 87-106.
Nowak, M. (2017). **Defining project approach using decision tree and quasi-hierarchical multiple criteria method (http://www.sciencedirect.com.sdl.idm.oclc.org/science/article/pii/S1877705817306318)**. *Procedia Engineering, 172*, 791-799.

For Your Success

In this module, the mathematical properties of reliability and the nature of decision theory as it relates to the operation of an organization will be examined.

This Week:

Complete the Critical Thinking Assignment. You will create a decision tree for a work or personal decision.
Complete the graded quiz, covering Modules 5 and 6.

Learning Outcomes

1. Define reliability and decision theory.

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2. Perform simple reliability computations.
3. Describe the different environments under which operations decisions are made.
4. Describe techniques that apply to decision-making under uncertainty.
5. Apply the expected value approach.
6. Apply sensitivity analysis.

1. Reliability

A product, service, part, or system is considered reliable when it does what is intended given the conditions for which it was made (Stevenson, 2018). If there is a 90% probability that a product works as intended, we would be describing its reliability. That means that 10% of the time, or one in 10 times, the product would fail. Is that 90% level of reliability acceptable? In some cases, it may be, depending on the item's importance or cost, while in other cases a 90% reliability would not be acceptable. In the case of the spring in a retractable ball point pen, we might find that a 10% failure rate is acceptable if the pen is inexpensive. Still, in the case of a **Mont Blanc (http://www.montblanc.com/)** pen, a reliability of 90% for any part may be unacceptable.

In determining reliability, we focus on either one point in time, or length of service (Stevenson, 2018). The **one point in time** case is often referred to as the probability of functioning when activated. We might think of a light bulb for the one point in time case, because we want the light to function properly when activated to do so. With this type of occurrence, where we must have light every time it is required, we might design the product so that there is redundancy with backup light bulbs to increase reliability.

View this video about redundancy and resiliency.

Understanding Redundancy vs Resiliency: Physical Design

(Source: https://www.youtube.com/watch?v=QEWEFwZfOVU)

From a physical perspective, the video explains the difference between redundancy and resiliency.

We can calculate the reliability of three light bulbs in a product functioning when activated with probabilities of 90%, 80%, and 70% using the following formula:

1 – [(1 – 0.90) X (1 – 0.80) X (1 – 0.70)] = 0.994 or 99.4% reliability

View this video example on calculating reliability:

OM Calculation: Reliability

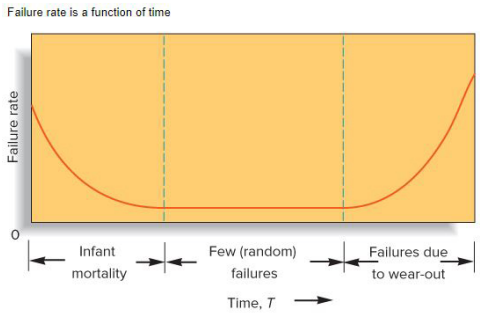
(Source: https://www.youtube.com/watch?v=oItz2M-xgWk)

Considers how reliability is calculated.

Your required reading by Jiao, Pan, Liang, Feng, and Yang (2016) proposed the use of a combination of sources of evidence with both reliability and importance.

Length of service is a second situation where reliability is important in operations management. You can think of this type of reliability as related to product warranties. **Product failures** are calculated over time

to determine a typical profile. The **mean time between failures** (MTBF) calculation takes into account the average length of time between failures. We find that MTBF follows a curve where new components have a higher failure rate (infant mortality), than products that have been functioning for a while. Toward the end of a product's life due to wearing out, MTBF increases again. The curve is described as resembling a bathtub.



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(Source: Stevenson, 2018, p. 177)

2. Decisions and Decision Trees

The decisions that operations managers make are dependent on reliability data that help them select alternatives to fix problems in the organization. ***Decision theory*** is dependent on a formal process as shown below.

Download Transcript (media/SEU_MGT530_Interactive_Mod06_P02.pdf)

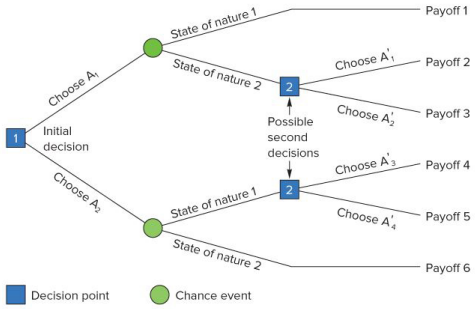
View more about decision theory in this video tutorial.

Decision Theory Basics

(Source: https://www.youtube.com/watch?v=r7HEKtockRs)

Several basic decision theory techniques are highlighted in this tutorial.

Sometimes it is easier to visualize alternatives and the impact of what one decision means for processes and systems downstream than it is to rely on calculations that do not capture consequences. Decision trees are an excellent way of capturing both the possible alternatives and the consequences. Decision trees can be coupled with the expected monetary value of an alternative, making the graphical representation of the decisions and alternatives easier to evaluate.



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(Source: Stevenson, 2018, p. 226)

View the following video to learn more about decision trees in risk analysis.

Using Decision Trees for Risk Analysis

(Source: https://www.youtube.com/watch?v=-f5I99Q9hwY)

Review the decision tree in the required reading by Nowak, 2017. You will have an opportunity to show your understanding of decision trees in your written assignment this week.

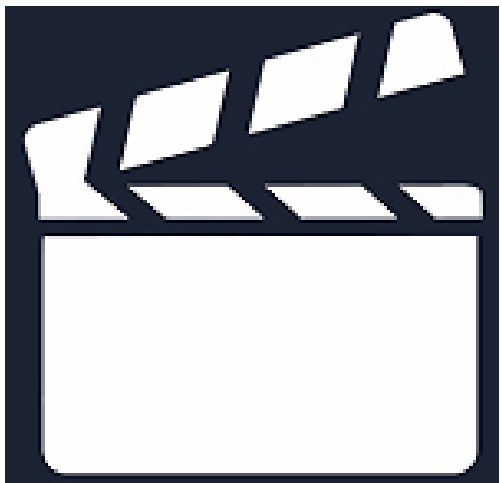
3. Uncertainty and Sensitivity

The different environments under which operations decisions are made involve cases where relevant information is known, which is known as **certainty**, and cases where it is impossible to determine the likelihood of an event occurring, which is referred to as **uncertainty**. In cases where the probability of an event occurring can be determined, risk can be evaluated.

Let's take a closer look at these environmental scenarios:

Certain Alternatives	**Uncertain Alternatives**
If acting in a case where future alternatives are certain, decisions are simple: You choose the best alternative using the criteria defined in the decision theory process.	

Explore



Click on the following link to learn more about decisions analysis – **Operations Management 101: Introduction to Decision Analysis (https://www.youtube.com/watch?v=Hy48AFKEepo)**.

Check Your Understanding

Test your knowledge of some of the key terms covered in this module.

Check Your Understanding

Click Here to Begin

References

Liang, Y., Feng, X., & Yang, F. (2016, Mar). Combining sources of evidence with reliability and importance for decision making. *Central European Journal of Operations Research, 24*(1), 87-106.

Nowak, M. (2017). Defining project approach using decision tree and quasi-hierarchical multiple criteria method. *Procedia Engineering,* 172, 791-799. Retrieved from http://www.sciencedirect.com/science/article/pii/S1877705817306318

Stevenson, W. (2018). *Operations management* (13th ed.). New York, NY: McGraw-Hill Irwin.