Y77Inventory Management Model: A New EOQ Approach for Risk Management

Aly Mansour, PhD

Muath Eleswed, PhD

Athmar Al-Salem, D.Sc

Associate Professor of Management
College of Business & Economics
American University of Kuwait
P.O. Box 3323, Safat 13034
Kuwait

Abstract

The purpose of this study was to introduce the Yousef77 Inventory Management Model (Y77IMM) as a new economic order quantity EOQ approach for risk management enhancement. A mixed-method approach using grounded theory and descriptive statistics was utilized to develop the Y77IMM that was applied more than 4000 years ago. Results of the study show that the Y77IMM is efficient, flexible, adaptive, and efficiently able to forecast needed demands. Thus, the study suggests a full utilization of the Y77IMM. Finally, based on the results, implications and recommendations for further study were made.

Keywords:EOQ; Inventory Management; Risk Management; Grounded Theory

1. Introduction

The Arab World as well as most of the world suffered from economic and financial crises that lingered for over a decade in the early years of the twenty first century. Inventory management has been one of the key factors for the success of businesses, and thus, is a key factor for the success of any economy. According to Chase, Jacobs, and Aquilano (2004), economic crises are also a consequence of malfunctioning inventory systems. Therefore, in order to minimize such a consequence, this study intends to introduceYousef77 Inventory Management Model (Y77IMM) as a new Economic Order Quantity (EOQ) approach for risk management enhancement.

Over 4000 years ago, the Y77IMM was applied by Prophet Yousef (Joseph), peace be upon him, in Egypt. In the Quran–the Holy Book of Muslims, the story of Prophet Yousef is narrated in a whole chapter called "Surat Yousef" which is chapter 12. In this chapter, the Y77IMM was explicitlyrevealed in the Quranic verses 46 – 49that set the fundamentalbases for the Y77IMM development. In addition, the story of Prophet Yousef presented many real world lessons including management sustainability, planning strategies, economic crises survivals. Further, the Y77IMM consists of production, consumption, and revival cycles. Thetranslation of these verses is as follows:

12:46 [He said], "Joseph, O man of truth, explain to us about seven fat cows eaten by seven [that were] lean, and seven green spikes [of grain] and others [that were] dry - that I may return to the people; perhaps they will know [about you]."

12:47 [Joseph] said, "You will plant for seven years consecutively; and what you harvest leave in its spikes, except a little from which you will eat

12:48 Then will come after that seven difficult [years] which will consume what you saved for them, except a little from which you will store.

12:49 Then will come after that a year in which the people will be given rain and in which they will press [olives and grapes]."

Finally, the purpose of this study is to introduce Y77IMM and its application as a new approach to risk management enhancement.

In the subsequent sections of this paper, historical backgrounds, research methodology, results, discussion and implication, and conclusion and recommendation for further study will be furnished.

2. Historical Background

Geographically, Egypt is located at a central point between three continents of the old-world namely Africa, Asia, and Europe. Due to this fact, it might be interpreted why this society has been able to survive many upheavals throughout its rich history and renounced civilizations. Egypt has been repeatedly termed as the cradle of civilizations ever since the dawn of history. The importance of Egypt to the Afro-Asian and European regions may be similar to the importance of the European Union and China to the rest of the world in the current century.

Romer (2013) mentioned that the first wheat, barley, rye, and grain silos—underground grain bins—were invented by the ancient people of Egypt during Yousef's era. In addition, Romer indicated that modern archaeologists consider the ancient Egyptian grain storage bins as a revolution with nothing but local natural resources.

Archaeologists in the 1920s described the perfection of the ancient Egyptian wheat and grain underground silos and the wheat bins of Yousef's era by the fact that they have survived for more than 4000 years. This perfection was later on evident by the discovery of an archeologist who discovered one of those bins after 4000 years containing wheat grains that were dry and perfectly stored, but, did not germinate (Romer 2013).

Archaeologists described ancient Egyptian wheat grain bins as cylindrical with four feet in diameter and two feet in depth. Those wheat and grain bins were mud-plastered pits lined with rush-woven baskets that were sealed with a strong flat lid made from a mix of salt and sand after they had been filled with grain seeds in their kernels. The bins were located on high banks near a water lake some forty miles southwest of Cairo in an area called now Qaroon Lake in Fayum depression. Furthermore, around Qaroon Lake area, archaeologists discovered 300 of those ancient wheat and grain bins. Thus, it might be that the ancient Egyptians during Yousef's era stored the wheat, barley, and grains in hilly desert areas due to its dryness and temperature control factors (Romer 2013).

According to Al-Gogary (2007) who was inspired by Dr. Mahatir Muhammad—former Malaysian Prime-Minister—the Association of Southeast Asian Nations (ASEAN) has been able to spread prosperity on all members of their economic regional community. Moreover, about, 4000 years ago, a unique inventory risk management model was applied successfully within the central part of the Arab-World by Prophet Yousef. At that time, Prophet Yousef was able to envision a real catastrophe about to occur locally in Egypt and regionally in societies who were merely depending on the grain and wheat production in the Nile valley of Egypt.Further, Yousef's envision was based on his careful observation of the style of life despite the prosperity, wastefulness, and extravagance the people of Egypthad enjoyed back then.

2.1Yousef's Childhood: The Era of Resourcefulness and Rationalization

Prophet Yousefwas the son of Prophet Yacoub(Quran 12).Further, Yousef was born and raised in Palestine until he was nearly twelve years old. Yousef's childhood was spent in a rural nomadic environment where people have been resourceful and had the ability to rationalize their usage of water and food. Yousef was favored by his father and subsequently, instigated a jealousy among his brothers (Quran 12:8). Due to this jealousy, the brothers concluded to abandon him in a water well speculating that would divert the father's love towards them (Quran 12:10).However, later on, a group of merchants on their way to Egypt found Yousef and sold him for a reduced price – a few dirhams (coins) (Quran 12:20). Finally, Yousef was bought by a wealthy family that eventually adopted him and treated him as if he was their own son (Quran 12:21).

2.2Yousef's Adolescence: The Era of Wastefulness and Extravagance

Upon moving to his new adopted home in Egypt, Yousef started to experience a complete different life style. Moreover, during his years as an adopted sonof that wealthy family, he lived a rather lavish life observing the extravagance of certain social classes within that society. Then, Yousef realized the lack of sense of belonging that those social classes had towards their own society (Quran 12).

As he reached his late-teens and due to a false accusation, Yousefwas unjustly jailed for approximately seven years. While serving his jail sentence, Yousef was constantly analyzing the extravagance and wastefulness that the people of Egypt were practicing through a lavish life-style unaware of any calamity or natural disaster that might occur.

Further, his fellow inmates realized his insightfulness, strong analysis, critical thinking, and clear vision regarding the outside world. Additionally, Yousefwas gifted to interpret dreams and dreams of others and thus, he accurately forecasted the destiny of two of his fellow inmates based on the input they gave him regarding their dreams. For example, he told one of his fellow inmates that he would be crucified, while he told the second one that he would work at the royal palace (Quran 12:41).

Furthermore, Yousef had requested from the second fellow inmate that while working at the royal palace to mention his case to the king. Unfortunately, the fellow inmateforgot to do so, and therefore, Yousef remained in prison for several years (Quran12.42).

2.3 Yousef's Adulthood: The Era of Justice and Dignity Restoration

While Yousef was serving his jail sentence, the king requested a dream interpreterto interprethis unclear dream. Once the king's request was made, Yousef's former fellow inmate remembered to mention Yousef impressmentto the king (Quran 12:43), and subsequently, he was sent to Yousef seeking an interpretation. After Yousef interpreted the King's dream, the Kingrequested that Yousef be released and brought to the royal palace. However, Yousef did not accept to be released untilhis innocence was proven, injusticebe dispersed, and his dignity be restored. Consequently, the king investigated Yousef's case and eventually he was proven innocent and his dignity was restored. Finally, upon his release Yousef was appointed as the Minister of Treasury and Supplies by the king (Quran12.51-55).

2.4 Economic Order Quantity (EOQ): An Inventory Management Model as a Modern Concept

Griffin (2014) defined inventory control as managing organization's raw materials, work-in-process (WIP), finished goods, and products in transit. Volberda, Morgan, Reinmoeller, Hitt, Ireland, and Hoskisson (2011) stated that strategic controls are largely subjective criteria intended to verify that a firm uses appropriate strategies for conditions in external environment. Barnes and David (2008) mentioned that one of the main decisions for all users of raw material is what level of inventory to hold. Heizer and Render (2011) indicated that problems would be inevitable if long-term planning is poorly done. According to Heizer and Render,disaggregation has been defined as "the process of breaking an aggregate plan into greater detail". Evans, James, and Collier (2007) mentioned that "inventory management involves planning, coordinating, and controlling of acquisition, storage, handling, movement, distribution, and possible sale of raw materials, component parts and subassemblies, supplies and tools, replacement parts and other assets that are needed to meet customer wants and needs". Bozarth and Handfield (2008) stated that supply uncertainty is mainly the risk of flow of supplies interruption from upstream suppliers. According to Bozarth and Handfield (2008), a major inventory driver is conditions that would force a company to hold inventory to be able to continue its production and operations processes. Bozarth and Handfield defined "Hedge inventory" as safety stock needed for the uncertainty in supply or demand and their impact on continuation of production. According to Schermerhorn (2010), EOQ orders are needed whenever inventory level falls to a predetermined point in order to replace depleted amounts. Slack, Chambers, and Johnston (2010) added that EOQ approach decides when to order, or rather reorder, whenever an existing stock needs to be replaced, thus, it calculates the best balance between advantages and disadvantages of holding stock. According to Heizer and Render (2008), it is preferable to use EOQ when relatively constant independent demand exists. Finally, it is worth noting that virtually, all of the EOQ inventory management models literature reviewmay be compared with the Y77IMM. However, the fact of the matter is that how much of the Y77IMM has been applied by modern research? Thus, the authors call upon economists, strategists, and other entities of concern to visit this model and try to benefit from its application in local and regional societies.

3. Methodology

This study used a mixed methods methodology. It started with Hermeneutics that is, interpreting historical and scriptural text that involves correcting all prejudices or setting them aside and making sense of what the text wants to convey (Patton, 2002). Further, the study continued by using a grounded theory qualitative methodology. Thus, the researchers had to set aside as much as possible all theoretical ideas in an attempt to allow the analytic substantive theory/model to emerge (Creswell, 1998). Finally, a quantitative methodology was used to quantify/operationalize the narrative of the Quranic verses 47-48 that were used to develop theY77IMM. Additionally, the study proceeded by analyzing the economic and production crisis that faced Egypt about 2000 BC. And, finally, numerical and graphical demonstration showing how the model was applied successfully over a fourteen year period including both the years of prosperity and droughtwas generated.

3.1 Assumptions and Operationalization

The Y77IMM assumes three pre-requisites including observance, analysis, and critical thinking of the EOQ are needed for the fourteen years to come. Further, these fourteen years are divided into two equal cycles. The first cycle includes the seven years of prosperity(year 1-7) and the second cycle includes the seven years of drought (year 8-14). From an EOQ point of view, both cycles assume equal economic productionand thus, equal economic storage. Moreover,according to the Quranic verse 12: 47—[Joseph] said, "You will plant for seven years consecutively; and what you harvest leave in its spikes, except a little from which you will eat—Y77IMM assumes that in the seven years of prosperity 10%—a little from which you will eat—of annual production will be consumed and 90% will be stored. Where in the seven years of drought, according to the Quranic verse 12:48— Then will come after that seven difficult [years] which will consume what you saved for them, except a little from which you will store)—Y77IMM assumes 10%—a little from which you will store—will be stored again to be utilized in subsequent cycles and 90% of the annual inventory stored will be consumed.According to anIslamic scholar, A. Al-Assal, personal communication, April 4, 2015, the word "little" in this context can be quantified as 10. Finally, Y77IMM acknowledges the fact that there are two seasons of production per year. Thus, the annual production quantity is two hundred metric tons (200MT).

3.2 The Research Questions

The study attempts to answer the following research question:

Is it possible to build an inventory risk management model to optimize a

1. Production process prior to an economic crisis?
2. Consumption process prior to an economic crisis?
3. Storage process prior to an economic crisis?

4. Results

Table 1 shows the production, consumption, and storage figures for the first cycle that includes the seven years of prosperity. These figures are based on an annual production capacity of 200MT,of which, 10% is consumed and 90% is stored. Thus, it shows for example, in year one, 200MT was produced, of which, 20MT (10%) was consumedand 180MT (90%) was stored. Further, it shows, that the cumulative production capacity at the end of year seven was 1400MT, of which, 140MT (10%) was consumed and 1260MT (90%) was stored.Chart 1 on the other hand, shows the same information listed in table 1 but in a graphical representation for better illustration purposes.

Table 2 shows the start inventory, consumption, and storage figures for the second cycle that includes the seven years of drought. These figures are based on an annual start of inventory capacity of 180MT, of which, 90% is consumed and 10% is stored. Thus, it shows for example, in year eight, 180MT is the start of inventory, of which, 162MT (90%) was consumed and 18MT (10%) was stored. The start inventory figure (180MT) was calculated by dividing the end of inventory figure in year seven (1260MT) by seven(the seven years of drought). Table 2 also shows that at the end of year fourteen, the cumulative inventory reached zeroindicating that the inventory capacity was sufficient along with a cumulative storage capacity of 126MT. Chart 2 however, shows the same information listed in table 2 but in a graphical representation for better illustration purposes.

5. Discussion and Implications

Yousef applied the first known documented economic order quantity (EOQ) inventory risk management model that mankind has ever documented and possibly had ever known. Moreover, most of the surrounding region of Egypt during the years of prosperity grew grains during their rainy seasons excluding summer time, yet, they depended partially on Egypt's grains due to scarcity of rain during those summer seasons.

Yousef applied his model to the first cyclethat included the seven years of prosperity which was known as years of production where water and grain/wheat surplus existed and thus, seven economic production quantities EPQwere applied in that cycle. Prior to applying the model, Yousef had planned to store most of the harvested grains with the exception of a small portion that is needed for the daily consumption of the Egyptian society at that time.Thus, Y77 model assumed that the stored portion to be equivalent to 90% of the harvested quantity and the rest which is 10% to be consumed in every annual production period. These assumptions were based on Yousef interpretation of the king's dream (Quran 12: 46-47).

In the second cycle which included the seven years of drought, the Y77IMM was continued to be applied as an economic consumption quantity EOQ approach. Given this fact, the Y77IMM applied the same percentages of 90% and 10% but in a reversal fashion. That is during the seven years of drought, 90% of the stored quantity that were stored in the seven years of prosperity will be consumed and 10% of the same quantity will further stored to be used in subsequent cycles (Romer 2013).

According to the results, the Y77IMM was able to storea small portion of the inventory even after the seven years of drought. On the fifteenth year in particular according to the Quranic verse 49, there was an abundance of water, however, re-growing wheat and grains would not have been possible without the amount of seeds stored within their kernels at the end of the fourteenth year. Thus, it was evident that the Y77IMM had a long term planning ability that lasted beyond fourteen years.

Y77IMM was able to efficiently managed raw materials, use appropriate inventory control strategies, adapt to environmental changes, decide on levels of stock to be held, and manage the overall inventory related issues.

Moreover, in terms of planning which involves acquisition, storage, handling, and distribution, the Y77IMM was able to meet local and regional societal needs, manage a safe amount of hedge inventory, and was able to calculate the needed amounts to satisfy local and regional demands. Furthermore, Y77IMM was able to forecast a constant demand cycles, and perhaps, it was responsible for the existence and survival of all races and nations locally and regionally including the eastern Mediterranean and Nile valley in eastern Africa and the Arabian Peninsula.Finally, these results suggest that the Y77IMM is capable of optimizing the production, consumption, and storage processes prior to economic crises.

## 6. Conclusion and Recommendations for Further Study

Prophet Yousefwas, perhaps, the first to introduce what is known today as risk inventory management (RIM). This introduction was eventually transformed into an application that was utilized efficiently about 4000 years ago. This application is what the authors call it Y77IMM. While applying this model, the authors discovered that the Y77IMM, has an efficient long term planning ability, uses appropriate inventory control strategies, adapts to environmental changes, able to determine the levels of stocks to be held, and has the ability to forecast different demands. Thus, as a new EOQ approach for risk management enhancement, the study suggests a full utilization of the Y77IMM.

Lastly, for further study, the authors suggest validating the model by using different consumption and storage capacities in order to reach optimum figures for resources allocation and inventory displacement. Additionally, it is suggested to apply the model in different contexts.

Table: 1 Y77IMM - Years of Prosperity

Years of Prosperity (1-7)						
Year (2 seasons/year)	Produced	Consumed (10%)	Stored (90%)	Cumulative Produced	Cumulative Consumed	Cumulative Stored
1	200	20	180	200	20	180
2	200	20	180	400	40	360
3	200	20	180	600	60	540
4	200	20	180	800	80	720
5	200	20	180	1000	100	900
6	200	20	180	1200	120	1080
7	200	20	180	1400	140	1260

Chart: 1 Y77IMM - Years of Prosperity

Y77 IMM
10% consumed & 90% Stored from year 1-7
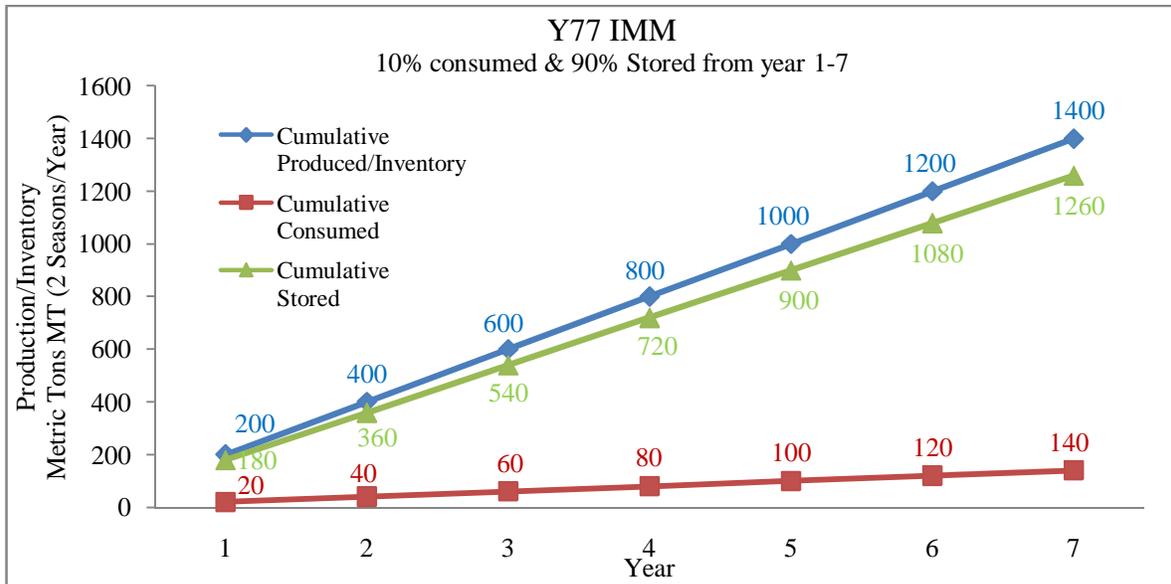
Table: 2 Y77IMM - Years of Drought

Years of Drought (8-14)						
Year	Start Inventory	Consumed (90%)	Stored (10%)	Cumulative Consumed	Cumulative Stored	Cumulative Inventory
8	180	162	18	162	18	1080
9	180	162	18	324	36	900
10	180	162	18	486	54	720
11	180	162	18	648	72	540
12	180	162	18	810	90	360
13	180	162	18	972	108	180
14	180	162	18	1134	126	0

Chart: 2 Y77IMM - Years of Drought

Y77 IMM
90% consumed & 10% Stored from year 8-14
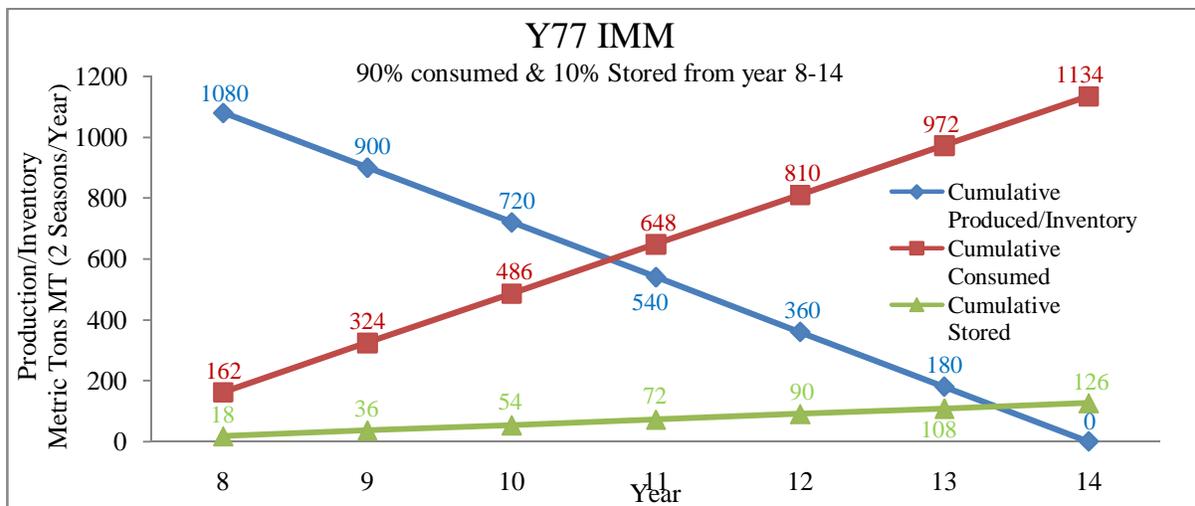
References

Al-Gogary, A. (2007). Mahatir Muhammad: The Asian Tiger. Cairo-Damascus: Dar-Al-Kitab Al-Araby.

Barnes, D. (2008). Operations Management: An International Perspective. UK: Thomson.

Bozarth, C., & Handfield, R. (2008). Introduction to Operations and Supply Chain Management. NJ: Pearson Education.

Chase, R., Jacobs, F., & Aquilano, N. (2004). Operations Management for Competitive Advantage. Irwin: McGraw-Hill.

Creswell, J. (1998). Qualitative Inquiry and Research Design: Choosing Among Five Traditions. Thousand Oaks: Sage Publications.

Evans, J., Evans, J., & Collier, D. (2007). Operations Management: An Integrated Goods and Services Approach. Singapore: Thomson/South-Western.

Griffin, R. (2014). Fundamentals of Management. Singapore: South-Western-Cenagage Learning.

Heizer, J., & Render, B. (2008). Principles of Operations Management. Singapore: Pearson Education.

Heizer, J., & Render, B. (2011). Operations Management. Singapore: Pearson.

Patton, M. (2002). Qualitative Research and Evaluation Methods. Thousand Oaks: Sage Publishing Company.

Romer, J. (2013). A History of Ancient Egypt: From the First Farmers to the Great Pyramids. UK: Thomas Dunne Books.

Schermerhorn, J. (2010). Introduction to Management. Aisa: Wiley.

Slack, N., Chambers, S., & Johnston, R. (2010). Operations Management with MyOMLab. UK: Prentice Hall/Pearson Education.

Volberda, H., Morgan, R., Reinmoeller, P., Hitt, M., Ireland, D., & Hoskisson, R. (2011). Strategic Management: Competitiveness and Globalization. South-Western/Cengage Learning.