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Editorial

Celebrating a century of the economic order quantity model in honor of Ford Whitman Harris

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ABSTRACT

This writing presents a brief introduction to the papers included in the special issue "Celebrating a century of the economic order quantity model in honor of Ford Whitman Harris" published by the International Journal of Production Economics. Forty-one papers covering an extensive scope of inventory management have been incorporated in this volume from contributing authors from 20 countries located in America, Asia, Europe and Africa. This special issue also provides a basis for new directions in inventory management research

1. Introduction

Inventory management is one of the most relevant and challenging activities for any manufacturing organization and must be executed as efficiently as possible to achieve success in today's fierce competitive business world. Organizations take very seriously any activities related to managing their inventories of raw materials, work in process, finished products, spares, and equipment. Thus, it is very important that inventory managers build flexible and robust models that allow them to react quickly and with the highest service level to consumer demands. The economic order quantity (EOQ) is arguably the simplest and most robust inventory model, and it is now celebrating its 100th anniversary, after Ford Whitman Harris introduced the first EOQ inventory model in February 1913. Since then, there has been an impressive growth in the number of published papers related to it. The EOQ model appears in essentially all books covering the topic of inventory control and is one of the most basic pieces of theory in Production Economics tying together a physical production model with its economic consequences.

The main motive for compiling this Special Issue is to make a tribute to Ford Whitman Harris as the creator of the very first inventory model, but it also is intended to provide a basis for new directions in inventory management research. The impact of his original short paper ($2\frac{1}{4}$ pages) on inventory management has been huge, because it has motivated thousands of other inventory models. It is important to remark that Harris's inventory model is a fundamental part of the history of both the management science and operations research fields, due in part to the fact that it is very simple to implement and very robust to errors in the input data of the parameters. Basically, the main focus of Harris's inventory model is to show the trade-off between inventory holding costs and ordering costs. Additionally, Harris's inventory model is taught as the most basic topic in inventory courses around the world. Ford Whitman Harris has undoubtedly been the most influential person in inventory theory. Without hesitation, we may consider him as the *Founding Father of the Inventory Theory.*

To obtain the broadest potential participation for this Special Issue in honor of F.W. Harris, the call for articles was widely distributed around the world. We are happy for the overwhelming response and significant attention given by researchers to this Special Issue. The manuscripts received from 20 countries in America, Asia, Europe and Africa were placed into a thorough evaluation process with 2–4 rounds of rigorous double-blind peer-review, after which 41 papers were accepted. Several of these contributions were co-authored from different countries.

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Ford Whitman Harris was born on August 8, 1877, in Deering, Maine, USA. He passed away in Los Angeles, California, USA, on October 27, 1962, at the age of 85. Harris married Eugenia Mellon on November 4, 1905, in Baden, Pennsylvania, USA. They had two children: Ford Whitman Harris Jr. and Jean Knox Harris.

Although Ford Whitman Harris only received a high school education, he worked as an Engineer and Patent Attorney thanks to the gift of being a self-educated person. Throughout his remarkable career, he displayed an outstanding ability to develop new innovative ideas and eventually becoming a prolific inventor with more than 100 patents to his credit. He received his first joint patent in 1904 at the age of 27 and the last one in 1958 at the age of 80.

FORD WHITMAN HARRIS
August 8, 1877–October 27, 1962
Founding Father of Inventory Theory
(Photo provided by courtesy of Sheryl (Smith) King, granddaughter of F.W. Harris)

Harris was also a productive author leaving behind a legacy in books, papers, communications and reviews. His major achievements in terms of publications are his contributions to Management and Patent Law. He was the sole author in the majority of his publications, with a few having a single co-author. One of his most valuable contributions to Management is the development of the first inventory model well-known worldwide as the Economic Order Quantity (EOQ) model. The theory behind the EOQ model was published in 1913 in *Factory, The Magazine of Management* under the title "How many parts to make at once" (Harris, 1913). In his historical and outstanding writing, he made a huge contribution to inventory control. From our perspective, this particular contribution has become a cornerstone in the development and growth of modern inventory management because essentially all inventory models rely heavily upon in his seminal work.

Undoubtedly, during his long career as an engineer, management scientist and patent attorney Harris left an incredible and indelible big footprint in this world. He will be forever remembered by those involved in inventory theory. Without his original lot size model and its innovative development, inventory theory would not be what it is today.

We cannot complete a tribute to Ford Whitman Harris within the space allowed by this introduction. But among our contributors is Donald Erlenkotter, who in his contribution Erlenkotter (2014) has added new perspectives to the life and scientific achievements of F.W. Harris. We also refer to Professor Erlenkotter's earlier biographical writings, Erlenkotter (1989, 1990), in which his 1990 article incorporates a full bibliography of F.W. Harris's authorship.

We have classified the papers appearing in this Special Issue into seven categories: Introduction and historical overviews (7 papers), Basic EOQ models (14 papers), Inventory models in the supply chain (6 papers), Inventory models with trade credits (6 papers), Periodic and continuous review models (3 papers), Dynamic lotsizing (2 papers), and Miscellaneous (4 papers).

The first paper included is a reprint of the original contribution of Harris as it was originally published in 1913. It is worth mentioning that Harris's paper was reproduced twice before, first as a book chapter "What Quantity to Make at Once" in 1915, and then in Operations Research in 1990. However, neither of these replicas shows the original layout. In this Special Issue, the re-print of Harris's (1913) paper is exactly as it was published originally.

2. Introduction and historical overviews

Following Harris's original paper, the second article (Erlenkotter, 2014) discusses the conditions under which the EOQ inventory model was developed. The author exposes some causes that explain why the EOQ inventory model developed by Harris had been forgotten for many years. Furthermore, some aspects of the rich life of Ford Whitman Harris are introduced along with pictures of Harris with his family.

The third paper, by Andriolo et al. (2014), presents a comprehensive literature survey of 219 selected articles discussing the evolution of EOQ inventory models over the past 100 years. Additionally, the authors provide new research directions that can be explored in this field in the near future.

Glock et al. (2014) present an interesting tertiary study that first proposes a methodology for the review. Using the proposed methodology, the authors perform an extensive review of the most important literature reviews in the field of lot sizing that arose from Harris (1913). The results of this effort should prove useful to researchers interested in conducting similar work in the future either as main research (primary), review (secondary) and review of reviews (tertiary).

Sarker (2014) conducts a comprehensive survey on consignment stock policy models in the supply chain finding that the operational mechanics of consignment policies vary from system to system and from product to product.

Beullens (2014) establishes the connections among the inventory models developed by Harris (1913), Clark (1958), Crowther (1964) and Monahan (1984).

Holmbom and Segerstedt (2014) describe the derivation of the economic lot scheduling problem from the EOQ formula proposed by Harris (1913) to the recent advanced solution methods.

3. Basic EOQ models

The papers in this category describe closed extensions of the EOQ inventory model. These inventory models are separated into three sub-themes related to EOQ inventory models, i.e., EOQ inventory models without backordering, EOQ inventory models with full backordering, and EOQ inventory models with partial backordering.

3.1. Without backordering

The development of supply chain models with supply disruptions has attracted the attention of the researchers in recent years.