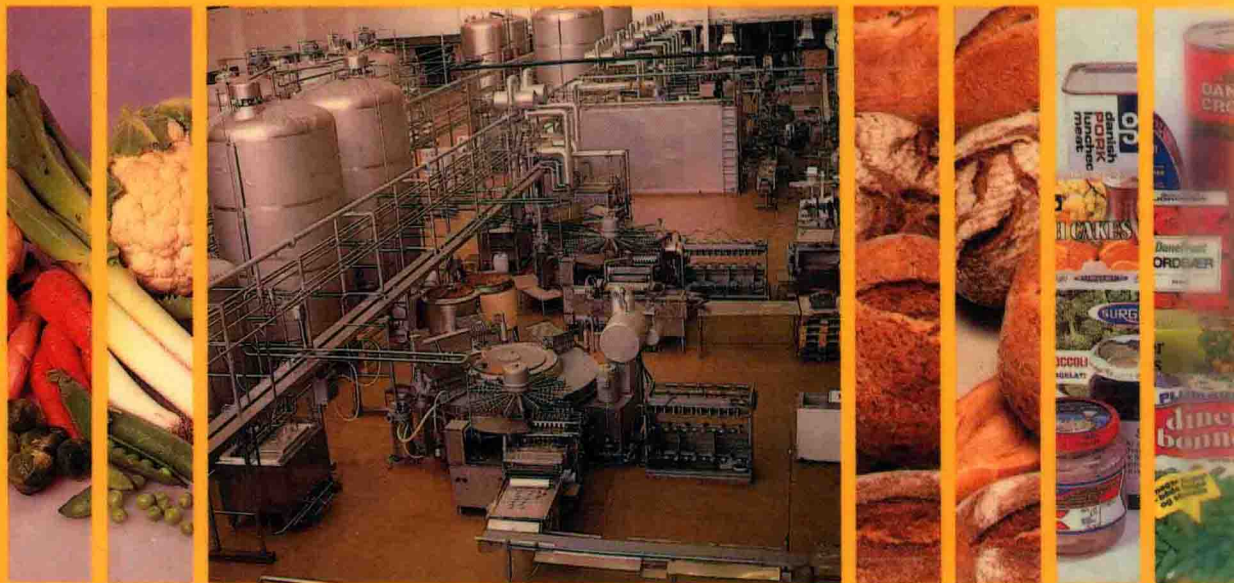


# Food Factories

Processes, Equipment, Costs

Edited by  
Alfred Bartholomai



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**Food Factories**



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To the entrepreneurs of the Developing Countries.

May they create successful food production businesses, and may these ventures help subsistence farmers change their lives and prosper.

To Fred and Alex, the future.

To Maria, the present.

# Preface

The technical role of a food factory is to convert the farmers' perishable raw material into a stable food product, an unappetizing raw material (flour) into a palatable one (bread or pasta), to extract and refine a usable product (oil) from an unsavory raw material (soybeans).

The economic role of a food factory is to add value to raw products; to benefit investors; to create jobs for managers, workers and farmers; to provide business for suppliers and manufacturers of ingredients, packaging materials and equipment.

The role of this manual is to assist in investment decision, to help you in your economic evaluation of an investment in a food processing business.

The material for each chapter was prepared by specialists with extensive experience in the engineering and operation of the plant described.

Throughout my years in food plant engineering I always have had to search for design and cost data, and for a long time I thought that there ought to be a book compiling all that information.

I hope it will be useful to you.

Sparta, New Jersey  
October 1986

Alfred Bartholomai

# Thanks

I am indebted to my publisher, VCH Verlagsgesellschaft, and to my contributors, who believed in me and my project. They have invested time and effort, some of them a lot of it.

My family has provided me with encouragement and warm support throughout this project. My son Alex made many useful style suggestions to my text.

Dr. Christina Dyllick-Brenzinger did an outstanding job of editing, querying and improving on my English. I must say that she had a tough job, because *mi Englisch es prefect!*

Producing this book has been a long and lonely struggle, far greater than I expected when I got started 2 years ago. Therefore I am grateful for the help and support received from the following special people:

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Dr. Paolo Orlandi, GPA Orlandi SpA, Verona  
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Dr. Hans F. Ebel was my link with VCH Verlagsgesellschaft and provided me with excellent guidance and advice.

If this edition sells as expected, I would produce Volume II. For this I will need contributors to provide material for a chapter. If you are interested, write a brief summary of the plant you intend to cover and send it to me: Alfred Bartholomai, 570 Stanhope Road, Sparta, New Jersey 07871 USA, with a copy to: Dr. Hans F. Ebel, VCH Verlagsgesellschaft, Pappelallee 3, D-6940 Weinheim, W. Germany.



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# Introduction

Each chapter follows a uniform format, so that the information sought is easy to find.

Chapters are organized into the following sections: introduction, market size, economic considerations, social impact, process description and tables with data on cost of the plant, cost of equipment, utilities and operating costs. Some of the chapters include nutritional information about the product.

The *Introduction* defines the product, package and distribution channels. Sometimes it describes particular features of the product, the process or the design of the plant.

The next section, *Market Size*, gives consumption per capita for two or more countries; this information may give an indication of the size of the market in the country or region where the product is intended to be distributed.

The *Economic Considerations* section will provide an order of magnitude of the unit cost of the plant described. What about the cost of larger or smaller plants? As a rule of thumb, a plant of twice the capacity will cost 50% more ( $\times 1.5$ ), and a plant of half the capacity, 33% less ( $\div 1.5$ ). This is a very rough formula which sometimes works and sometimes does not, therefore it is always safer to do a complete cost estimate for each plant size.

This section also includes key profitability factors. Only those factors specific to this plant are mentioned. Of course, the economic success of any food manufacturing business hinges on common denominators such as size of the market, selling price of the product, utilization of plant capacity, cost of money, labor productiv-

ity and management skills. There is no point in repeating them in each chapter.

The *Social Impact* section explains how many people will be necessary to operate the plant, and the skills required.

The *Plant Design Basis* defines the hourly raw materials consumption rate and the production capacity on which the design of the plant is based.

The next section describes the process.

Each chapter includes several tables with information on costs and utilities.

The *Cost of the Plant* table includes approximate construction and engineering costs. These figures will vary widely depending on the location.

The cost of site preparation, which includes removal of the organic layer of soil and other low bearing capacity soils, fill and compaction, will depend on the quality of soil (which determines how deep to excavate) and how level the site is (which determines the volume of fill). With low bearing capacity soils in steep sloping sites, site preparations may cost as much or more than the building.

In most cases we have used an arbitrary cost of \$ 300/m<sup>2</sup> for civil works. The local architect/engineer/constructor should be consulted for actual local costs.

Engineering and project control cost data are rough approximations. Careful consideration must be given to these services; trying to scrimp on project management expenses may show as a 5% reduction in the budget, but may result in 25% cost overruns at the end of the project.



Good project management will ensure that the plant is completed on time and on budget and that the plant is built in accordance with specifications and good sanitary practices.

The *Cost of Equipment* table includes figures that are accurate and valid until the end of 1986. Afterwards, they will change with inflation and manufacturers cost of materials and labor; therefore, the equipment manufacturer must be consulted to get updated figures.

The *Utilities* table summarizes plant consumption of water, fuels, compressed air, steam and electric power.

The data in the *Operating Costs* table is meant to give an indication, in \$/unit weight or volume of product, of all direct manufacturing

costs. The unit cost for raw materials, packaging materials, other ingredients, chemicals and utilities are those shown in *Appendix I*: some of them are arbitrary and many may not apply to the location of your choice; they must then be replaced with those that apply to the project in question.

All cost figures are in US dollars.

Some chapters include nutritional information on the product.

Each chapter ends with information about its author.

Certain design data are given in *Appendix II*. Conversion factors used throughout the book are shown in *Appendix III*.