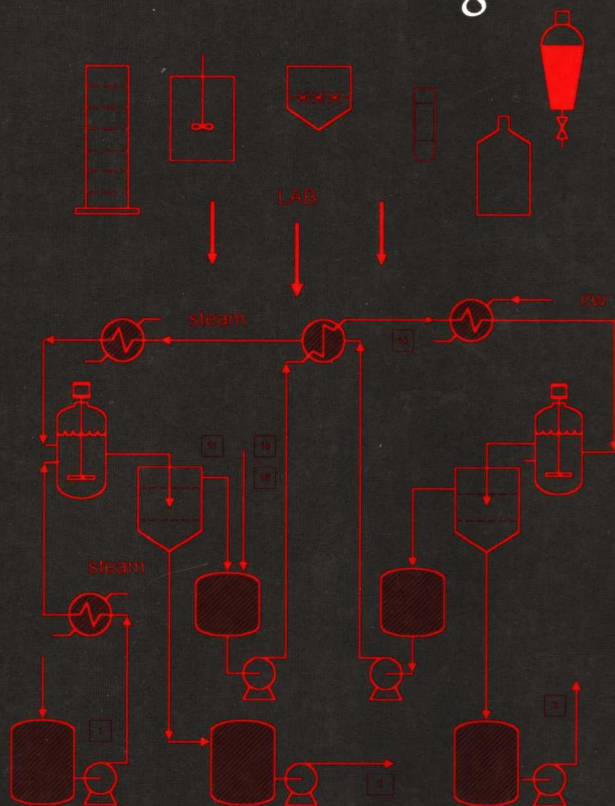


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DEVELOPING *an* INDUSTRIAL CHEMICAL PROCESS

An Integrated Approach



Joseph Mizrahi



CRC PRESS

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Preface

This book presents a detailed discussion of the issues that have to be addressed, in most cases, in the development and the first implementation of a novel industrial chemical process.

These issues start with the "whys" and "wheres," then address the working organization and all the different steps, activities, and reviews in the process development program, and finally in the implementation, design, construction, and start-up of a new plant.

Why is such book needed at all?

This specific field of activity is constantly occupying many thousands of managers, scientists, engineers, chemists, specialists, economists, and technicians. These professionals work in industrial corporations, research organizations, universities, engineering companies, equipment suppliers, statutory public functions, to name a few, in many countries around the world. The result of their activity has been hundreds of new processes and new plants in the chemical industry every year.

Nevertheless, at present, there seem to be no recognized professional standards, no generally accepted written procedures, or even a book covering this professional field. Quite different working practices are implemented in different corporations and in different countries. Thus, any professional who encounters some of these issues for the first time in his job can only rely on the direct teaching of his boss and colleagues. And in that lottery some have more luck than others. Strangely enough, up until now, the know-how in this important professional sector has been transmitted only by "apprenticeship."

Somehow, novel processes have been finally developed and used in new plants that have been built and operated, most of them successful. But, on the other hand, many case stories are widely spread in the profession about all the associated problems, serious waste of time and resources, start-up troubles, and occasionally complete failures.

These problems have been generally attributed to personal errors in specific situations, possibly to the individualistic characters of the inventors and promoters, and to the opportunistic demand for quick results in new processes. Such explanations could only be true for the initiation stage

(possibly 5% of the efforts invested), but cannot hold for all the development and implementation work. So, a systematic study of the common aspects to most projects can be instructive.

This book is intended primarily for those professionals who are already on the job in real life, to help them, hopefully, to do a better and more efficient job, to be happier by understanding more about what is going on around them, and to reduce the frustrations associated with this line of work. It is assumed that the readers will be graduates with some professional experience, who have access to all the textbooks, handbooks, and publications available, to Chemical Abstracts and to the Internet, and who know how to use these. So, this book will not be competing with these sources and will not copy what is readily available. At most, it will refer the readers to the more useful sources, in this author's opinion. The suppliers of commercial services have essential contributions to such projects, and the general issues connected with the selection of such suppliers are discussed, but no particular reference is given as far as possible. The other references direct the readers, who may be interested in any of the example cases mentioned, to more detailed sources.

Also, in this book, with due apologies to the chemists, a chemical process does include any physical or mechanical transformation or separation which is necessary to obtain the final products.

On the face of it, the development and implementation of a new chemical process may appear to be a matter of chemistry, materials, equipment, control, etc., but it should be recognized that this is a very complex endeavor, and its success depends, in fact, mostly on the interactions and organization of many different people in various positions.

In each such project, hundreds of professionals are concerned, full-time or part-time, with the research organization, the various functions in the corporation, the engineering company, the equipment suppliers, patent attorneys, specialist consultants, and civil servants with statutory functions. These professionals are mostly chemical engineers, but all the related professions are also involved: managers (in particular in finance, production, and marketing), different fields of engineers, research and analytical chemists, various specialists, patent attorneys, lawyers, economists, and supporting technicians.

The first need in a new project organization is to establish a common communication and reference system in which every participant in the project will understand the point of view, the priorities, and the "jargon" of the others. This aim can require both patience and goodwill from everyone concerned and should be motivated by the example of the management.

It is hoped that this book can be used for such purposes. The author has been occupied in this field of activity all of his professional life in many different positions. He strongly believes that a project involving the development and implementation of a new chemical process can be done better and more efficiently if:

- All the issues and all the interactions were discussed and understood from the beginning by all the participants
- The limits of responsibility were clearly defined
- A proper organizational structure and adequate programs were used

The detailed recommendations in this book can be readily integrated, without any contradiction or competition, with the latest trends in corporate research and development (R&D) management procedure, such as the "Stage Gate" system and similar tools, which recently have been introduced in many large corporations. These detailed recommendations can assist the "Gate Keepers" in defining the "deliverables" and "criteria" to be achieved in the next "Stage."

All the engineers, scientists, and managers concerned with the development of a novel industrial chemical process, and/or with the implementation, design, construction, and start-up of a plant based on this process, can use this book to assist them in their work. The book will give them a general overview of all the issues ahead, and also provide them with checklists to draw up their own working programs, or at least understand the logic of the instructions given to them by their boss.

Friends with experience have remarked that the scope of this book may appear to be very complex and its "message" may be confusing for rapid readers sampling here and there. Therefore, it was decided to add at the end of each chapter a short recapitulation of the issues that can be worth an additional thought and possibly further reading or discussion.

At least, the core team of a project would benefit from a systematic study. Evidently, not everyone would be interested in all issues at one specific time, but it is nice to know that they can come back and consider more intensively any pertinent issue whenever they might face the need. Professionals with a few years of experience in this field, who may recognize some of the issues discussed from personal exposure, should benefit more.

Part of the material in this book can also be used as a basis for an overall course for graduate students who are intending to start their work in industrial R&D, equipment development, process engineering, plant design, and managing functions in industrial corporations. It also can be used for workshops of continuing education for these working professionals.

Obviously, one could have filled the book with examples from actual projects, but it is debatable whether more such particular examples would have helped illustrate the points or distract attention from the complex issues. Furthermore, most of the examples are covered by commercial secrecy and cannot be published. So, the compromise chosen here by the author may not satisfy every reader.

The author will be pleased to receive any comment or suggestion that can help expand the usefulness of this book.

The author

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From 1979 to 2001, he provided independent professional consulting services to corporations worldwide in the fields of organization and streamlining of R&D programs; consolidation, evaluation, and transfer of know-how; initiation, organization, and evaluation of projects; process design of new plants; troubleshooting and expansion of existing plants; and analysis of corporate development strategy.

Acknowledgments

This book is dedicated to my wife, Sara, for a lifetime of motivation and support.

I would like also to acknowledge:

- The influence of Professor Avram Baniel from whom I learned very much in various forms of collaboration in many projects over more than 4 decades, since he founded and managed the pioneer team at the IMI Institute for R&D where I spent the first 16 years of my professional career.
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- The long and productive interaction over all my professional life with a large number of my friends and colleagues in many countries, the names of whom I cannot list in this limited space.

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chapter 1

Why a new industrial chemical process could be needed?

1.1 Changing world

The development of a new chemical process is a major technical, economical effort that can be justified only if it fills a definite need of an industrial corporation. The present chapter discusses the various situations in which such a need could be defined. This review allows one connected to the chemical industry to evaluate the probabilities that his/her corporation would need a new chemical process in the foreseeable future. There are basic reference books that can be used as sources for this initial information.¹⁻⁵

The chemical industry has always been operated in a *changing world* with expanding markets, a need for better products at lower prices, change in raw materials, addition and removal of political barriers, great jumps in the technology available for industrial application, higher ecology demands, etc. As time goes on, the dynamic rate of such changes seems to be *increasing exponentially*. In the past 3 decades, in particular, it requires an open attitude from any corporate management towards possible process revision.

In such a changing world, an operating chemical corporation could require a novel process for a certain product, if and when one (or more) of the *objective* situations discussed below becomes dominant and is recognized, at least inside the organization. Let us consider first the situation in which a corporation is already producing and selling the product, but now needs *process changes* for:

- Obtaining a better quality product
- Reaching a lower cost of production
- Using different raw materials
- Responding to ecological pressures