

Process Engineering and Industrial Management

Process Engineering and Industrial Management

Edited by
Jean-Pierre Dal Pont

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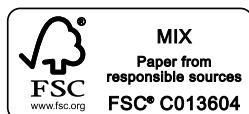


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Foreword

Process engineering, the science and art of effectively transforming feedstock materials into commercial products, was born in the 19th Century. Its origins can be found further back in the course of history: fermentations, distillations, macerations, and extractions enabled our remote ancestors to enjoy edible, potable, and pharmaceutically active substances, as mining, grinding, mixing, and smelting produced metals to be worked up into useful products – swords as well as ploughs. But it was only with the quantitative description of chemical science in the 19th Century that the engineering of processes could be put on a rigorous basis. The great chemist, Antoine Lavoisier had shown the way when he formulated the law of conservation of mass in 1789. The subsequent development of thermodynamics initiated by Lazare Carnot and continued by Clausius, Kelvin, Gibbs, and others, gave us the framework for designing efficient processes. As a result, by 1900 the world's production of basic chemicals like sulphuric acid was measured in millions of tonnes, and a vast range of new products, from dyestuffs to aspirin became available to the general public.

And so our profession has continued to develop, with the new science and technology enabling new processes to make new products, and new requirements stimulating new discoveries and more innovation. In parallel, *process engineering* itself has developed its own methods, theorems, terminology, and literature, organising and recording the advances made and applied.

The role of the industrial company in the history of process engineering is an honourable one, and we can be proud of the way in which the products we make have contributed to the health, welfare, and quality of life of the world's population. We have, it is true, suffered some terrible accidents, and we have been slow, in some cases very slow, to recognise the effects of our activities on the environment. But we can also be proud of the contribution of process engineers in introducing better approaches to industrial safety and environmental protection. "Systems thinking" with its imperative to look at the whole problem – the complete lifecycle, the entire

supply chain, the integrated plant – is a grand discipline for dealing with complex issues far beyond the limits of the chemical and process industries.

There are many texts dealing with the technologies of our profession, from reactor engineering to process control, but there are surprisingly few which deal with process engineering in the context of an industrial company, as this book does. That context is really important, as Industry has a vital role in solving the problems of excessive reliance on fossil fuels, meeting the challenge of sustainable development, exploiting the opportunities provided by the revolutions in biotechnology and information technology, and harnessing the power of change and innovation – the big issues of our time.

The authors have combined to write an authoritative account of process engineering and the business company, based on their extensive practical experience. It is a *tour de force*. I commend it to students, teachers, and practitioners alike. Read on!

Richard DARTON
President, European Federation of Chemical Engineering
OBE (Order of the British Empire)

Foreword

This book *Process Engineering and Industrial Management*, that Jean-Pierre Dal Pont has coordinated and to which he has widely contributed, is undoubtedly one of those books that an honest industrial man must read.

It is in fact the result of the experience of more than 30 years that Jean-Pierre Dal Pont has devoted to industry, in Europe, USA, and Asia Pacific.

For over a century, the industrial company has been the source of almost all the innovations that make our day-to-day life. It has been able to implement the process engineering technologies widely exhibited in this book, organize, and create new businesses beyond its original boundaries.

Currently, it is still the industrial company to which we must turn to face the challenges of the century: to fight hunger, to constantly improve people's health, to solve energy challenges, to protect the environment, and so on.

Now, the depletion of fossil resources (oil, gas, metals, etc.) compels us to imagine and implement radically new solutions.

The techniques of process engineering in this book by Jean-Pierre Dal Pont, as well as those relating to the project management, to the analysis of life cycle, or to TQM are those which are now used in industry and which enable our factories to remain competitive.

The book also questions the condition of the plant in the future, how it needs to be flexible, ever more environmentally friendly, and integrated into society to contribute to harmonious development.

This manufacturing plant will implement microtechnologies and intensified processes using more and more new techniques for modelization, simulation, and communication.

The book is a source of information and reflection for the students, engineering students, and professionals who have to study, develop the processes, build, and operate industrial tools. It will promote dialog among people in charge of marketing, human relations, finance, and technicians of process engineering whether they are from academia or industry.

The future of our society depends on the necessary *reorganization* of industry. It is a tribute to this book, that it contributes to the understanding of it.

Jean PELIN
Executive Director of Chemical Industries Association

Introduction

Process Engineering and Industrial Management: Industrial Projects and Management of Change

This book is a collection of the experiences of professionals from the academic and industrial worlds.

The book aims to explain what a company is, demonstrate its mechanisms and organization, and explain the processes that are at the root of its evolution. Its purpose is to depict the importance of process engineering in companies, whose mission is the transformation of matter and energy, and to define its contribution to the evolution of society.

This book is intended for students, to assist them in their research projects. By providing the basis for process development in the laboratory, and engineering techniques, it will serve professionals who design production tools, make them work, and improve them.

Lifecycle analysis, process assessment methods, progress techniques and the basics of risk management complement the range of essential tools for the engineer, who was considered to be the honorable man of the 19th Century, and is anxious to assert his role in society.

This book is not meant to be a project management guide or a book dedicated to business strategy for students in business schools.

Introduction written by Jean-Pierre DAL PONT.

It is above all a general book, a book of reflection in which the reader can benefit from the basic knowledge scattered across multiple works.

It rests on two essential pillars: process engineering and the company.

The concept of process engineering followed the concept of chemical engineering which originated in the United States during the early 20th Century when the oil industry was in the development stage. It accompanied the extraordinary growth of the chemical industry, in particular, during and after World War II. This concept, developed by the late Jacques Villermaux, Professor at the ENSIC (National School of Chemical Industries, Nancy, France), was based on the fact that chemical engineering techniques can be applied to all process industries, that is to say all industries that can transform matter and energy; pharmaceuticals, biotechnology, paper, cement, the environment, energy, metallurgy, cosmetics industries, and so on.

It received its consecration at the first congress held in Nancy, France in 1987. The GFGP (French Group of Process Engineering) was founded in 1988, and in 1997 became the SFGP (French Process Engineering Society), a learned society whose mission is to promote process engineering.

Manufacturing industry deals with the production of “discrete” goods with defined outlines (automobiles, electronic appliances, construction industry, etc.). Many chemical products of all kind are used in the processes of this industrial sector.

A European car uses 130–190 kg of plastics, silicones, paints (5 kg), oils (4 kg), and glass (90–140 kg).

Process and manufacturing industries have much in common whether it is management, strategic approach, how projects are led, concept of sustainable development, risk management, and so on.

The industrial company, as we presently know it, was shaped during the 18th Century. As early as 1712, blacksmith Thomas Newcomen’s atmospheric steam-engine enabled the use of mines by pumping out water that flooded them frequently. During the 19th Century, the Industrial Revolution expanded rapidly in Britain due to the industrial use of steam.

France, Germany, and the United States followed suit from the mid-19th Century.

Players in the Industrial Revolution raised their capital to move from inventions toward innovations, of which the railways are perhaps the best illustration. They invested by taking risks to create the most diverse machines which enabled them to create wealth. These enormous changes wreaked total havoc on predominantly rural

societies as well as on the environment. In Britain, the first industrialized country, it was not until the late 19th Century that the average individual started enjoying the benefits of industrialization.

Extraordinary characters who were active between the 19th and 20th Centuries, such as Edison, Ford, Fayol, Taylor, to name but a few, invented the basics of company management which are still in use today.

The company that we are focusing on is essentially the industrial company which can be distinguished from service companies by the fact they use an industrial tool. That distinguishes them from service companies.

To take an example: an industrial company will use its know-how in process engineering to transform fossil resources and biomass into all sorts of chemicals, pharmaceuticals, transportation means, power generators, and so on, to offer society an increasing number of goods and services that are essential for human well-being.

The company today is still a source of wealth and well-being but may also be a source of harm to both humans and the environment. The company must take itself to task.

It is faced with a situation that is unprecedented in the history of mankind, and subjected to considerable changes. The company, through its innovations, causes societal change at a rate never seen before.

Let us cite some of the most critical challenges faced by our societies:

- the depletion of raw fossil materials with increasing costs due to their location in inhospitable areas or politically unstable countries: oil, copper, lithium, rare earth minerals, and so on;

- developed countries had become accustomed to abundant energy at a low price, which in addition to comfort, which gave us a sense of unprecedented freedom where mobility is the most visible consequence. Those days are gone!

- water scarcity. Water is life! A billion people do not have a sufficient quantity and quality of water. This water imbalance has led to water borne diseases especially in young children, and this may become a source of conflict if planned efforts are not implemented worldwide! 500 million people live in the Brahmaputra basin. Tibet is the water tower of Asia! The White Nile and Blue Nile pass through 10 countries! The Turkish project, called Anatolia of the South-East, includes 22 dams; giving Turkey control of the Tigris and the Euphrates!

- global warming is subject to controversy, but its effects are already manifesting themselves! Examples of global warming include melting glaciers, melting ice packs, vegetation change, rising sea levels, and so on;

– population growth is putting an increasingly strong pressure on the environment and is accentuating a significant discrepancy in wealth between countries. The aging of the population in some of the developed countries such as Japan, Germany, and Italy is another source of imbalance whose effects are already being felt.

The current economic crisis which originated with the bankruptcy of Lehman Brothers in September 2008 took the world by surprise. It highlighted the complexity and opacity of the banking systems.

Presently, trust has not been restored. The industrialized world hopes that only growth can create wealth and jobs. This requires consumption leading to a loss of raw materials, and increased adverse human impact on the environment. Has not the world returned to a paradoxical, even inconsistent, economic and industrial process?

Globalization has jostled the balance arising from the Europeanization of the world following the conquests of the Portuguese in the 15th and 16th Centuries which was then followed by Spanish, British, French, and German imperialism. Currently, China has emerged as the banker of the United States and the workshop of the world. What a change!

The company, faced with increasingly demanding customers in a world under media scrutiny, where everything goes faster and where competition, especially under the impact of emerging countries, is intensifying, should review its strategy in a timely manner. This strategy can be simply defined by answering the following questions:

- in which markets should we remain, which should we expand, or abandon?
- which technologies should be used, which means of production and distribution should be implemented?

Answers to these questions result in a strategic plan for the company. This plan underpins a portfolio of research projects, investments, and disinvestments of structural changes.

Its implementation requires knowledge of company operations, project management, and the industrialization process. These areas implement process engineering and the engineering of which it is a component.

The company must ensure the smooth running of operations that frees up the profit essential to its survival, and also manage the change resulting from its strategic vision.

Change management is implementing processes that rely on hard techniques and the most advanced social and human sciences; part of the book is devoted to this.

The societies of industrialized countries are based on science and technology.

The IT revolution is not over; the petaflops computer has arrived! Along with a society based on IT, a new forward-looking concept can now be added: a society based on knowledge.

The employee, to face this changing world, will be forced to undergo training throughout his lifetime.

Knowledge management has been made necessary because of the abundance and fragmentation of knowledge generated by the increasing complexity, the proliferation of technology, and by the mobility of required or subjected individuals.

The concept of sustainable development is not the latest media concept in fashion. The company is aware that our present behavior will affect the lives of future generations.

The development of new products and services must be considered. There arises a question about the future, it is the question of what we want to produce: where and how we want to produce it? These questions require the company to reconsider its research, industrialization, production, and distribution processes in a spirit of continuous improvement and innovation.

The reconciliation of the company, customer, and its suppliers will continue. It will also be closer to society and the communities where it operates. In a transparent company, “citizen” is not an empty word. The company will always be judged based on its profit, but this will not be the only criteria.

Man is more than ever at the center of the mechanism! A position he should have never left!

We increasingly ask the question about “circular” economies based on the rational use of raw materials, where their recycling is made easier by launching “green” eco-designed products on to the market.

Will it be otherwise?

A new industry needs to be invented with new processes and new “sustainable” equipment.

This would be a new industrial revolution! Chemistry and process engineering are essential for its deployment! “Chemistry is our future”, said Thomas Alva Edison ... That was a century ago!

The future today is tomorrow!

Note to reader

The chapters can be read separately and are grouped into three parts:

– *the company today*: brief history, description of its structure, and mode of operation;

– *process development and industrialization*: methods to incorporate the laboratory research into an industrial tool to meet current expectations;

– *the need to adapt the company for the future*: this last part aims to explore the methods necessary for organizations to define, develop, and improve competitive industrial tools.

Acknowledgments

This book is the result of a long process that started 40 years ago, when my late master, Pierre Le Goff, Professor ENSIC, asked me to return to school for a conference on distillation; he thought that I could bring out the views of a person from the industry!

This liking for contact with the academic research and teaching, and students and much more, process engineering, has never left me.

I am grateful to Jean-Claude Charpentier, whose successful career and dynamism is well known for supporting me from the beginning in this “parallel career” only interrupted by 6 years of expatriation to the United States and 5 years to Asia Pacific and which extends within the SFGP (French Process Engineering Society).

Jacques Villermaux, who vanished too soon and was the founder of GFPG (French Process Engineering Society), which later became SFGP, internationally recognized visionary, encouraged me, on my return from the United States in 1989 to do an industrial, managerial conferences, rather than technical ones.

The aim of this book is to juxtapose the academic point of view, cautiously left to teachers–researchers, and the industrial point of view that I acquired after 7 years of technical research, 10 years in manufacturing, and then working as an industrial manager in the United States, France, and Asia.

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¹ These items are only available at the Bibliothèque Nationale de France.

As I have already pointed out, this book is not the work of a specialist but is intended as a book of introduction, thought and, if I may, of passion, striving to provide sources of solutions to the problems that raise questions and concerns in current society.

I owe this passion to all those with whom I have spent my professional life: I thank and dedicate this work to them.

Jean-Pierre DAL PONT