PRODUCTION AND OPERATIONS MANAGEMENT

Saoussen Krichen & Olfa Dridi

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Chapter 1

Introduction to POM : Basic concepts

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1.1 Introduction

1.2 Definition of POM

Productions and operations management is defined as the planification and of all project activities from the creation of goods, their progress and the transformation of the set of inputs into final products, generally termed as “outputs”.

1.2.1 Production

The production process is a sequencing of operations within a firm that encompasses numerous decisions as:

- Production of a new item
- Design of the new product
- Resource allocation of support the production
- Facilites allocation for the new product The production is a key step in the evaluation of a firm. It expresses, firslty, its efficiency in terms of quality of the products and time requirement.

1.2.2 Operations management

planning, coordination and controlling of an organization's resources to facilitate the production process. POM is an extremely important management area. Issues such as the location of production facilities, labor and transportation costs, and production forecasting are extremely important considerations.

1.3 Decision making process

The process of decision making can be viewed as a course of actions to be scheduled and well handled by the manager. Following are the main steps that well describe a decision making process:

1. Define and state the problem
2. Enumerate the objective(s) and the metrics adopted for the evaluation of the generated solution
3. Specify the solution approaches to be used
4. Dress a comparative study of the solution approaches
5. Rank the solution approaches in terms of their priority
6. Implement the appropriate solution approaches
7. Execute and control the implementation plan
8. Evaluate the implementation part

As described above, the decision making process is decomposed into elementary steps to be handled by appropriate experts and are to be validated to measure the real gap between the theoretical plan and its implementation. This system realization, impelmentation and validation makes its design (from a theoretical point of view) and building (from a practical standpoint) more coherent and much efficient once compared to the initial problem specification and system concept that can be pointed out from the following list:

1. **System:** A set of components inter-correlated by precedence and resource requirements in order to accomplish one or several objectives.

2. **Closed system:** A system that doesn't need any extrenal interaction to accomplish its aobjective(s).

3. **Open system:** A system that continuously need external interactions to accomplish its aobjective(s).

4. **Suboptimality:** The quality of the solution related to the accomplishment of the system objective(s) and be the best, in which case it is called "optimal" or close to the best, in which case it is called "suboptimal". The quality of such solution is closely dependent on the complexity of the process.

Once the decision making process is defined and clearly specified, the problem should be analyzed and quantitatively expressed in terms of its inputs and outputs.

1.4 Decision making problems

A decision problem generally involves one or several decision makers that are about a problem that requires preliminary studies in order to adopt profitable decisions. Substantial decisions arise in the managerial level that addresses the following activities:

1. Planning

2. Organization

3. staffing

4. Control of the production step

Each activity requires numerous managerial tools to make rational decisions and progress appropriately well in the whole project. We propose in the present chapter to define the basic concepts needed for planifying and managing a profitable strategy for Production and Operations Management (POM). To do so, one should well understand to define the terms Production, Operations manamegement, optimization techniques and supply chain management.
A decision making problem generally requires the so-called problem identification that helps the DM point out the class to which the problem lies. In fact, we enumerate two main classes of POM problems:

1. Unconstrained decision problems: It consists in minimizing or maximizing a function $f(x)$ that is generally nonlinear. The ain concern is the finding of the solution value that corresponds to the local optima of $f(x)$. In this case, there is no reconsideration of system constraints nor on the range of the solution x.

2. Constrained decision problems:

Needfulness of three main components in a decision problem:

- The decision maker(s)
- The objective(s) to be reached
- The set of structural constraints

1.4.1 Features of an optimization problem

Optimization problems can be classified in terms of the nature of the objective function and the nature of the constraints. Special forms of the objective function and the constraints give rise to specialized models that can efficiently model the problem under study. From this point of view, various types of optimization models can be highlighted: linear and nonlinear, single and multiobjective optimization problems and continuous and combinatorial programming models. Based on such features, one has to define the following points:

- *The number of decision makers:* if one DM is involved, the problem dealt with is an *optimization problem.* Otherwise we are concerned with a *game* that can be cooperative or non cooperative, depending on the DMs' standpoints.

- *The number of objectives:* it determines the nature of the solution to be generated. If only one objective is addressed in the decision problem, the best solution corresponds to the optimal solution. However, if more than one objective are considered, we are about generating a set of efficient solutions that correspond to some tradeoffs between the objectives under study.

- *The linearity:* When both the objective(s) and the constraints are linear, the optimization problem is said linear. In that case specific solution approaches can be adapted as the simplex method. Otherwise, the problem is nonlinear in which case the resolution becomes more complex and the decision space is not convex.
  A mathematical expression $f(x)$ is said:

  - *linear* if $f(x) = a_1x_1 + a_2x_2 + a_3x_3 + \ldots + a_nx_n$
  - *nonlinear* elsewhere

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  where $x = (x_1, \ldots, x_n)$.

- *The nature of the decision variables:* If the decision variables are integer, we deal with a combinatorial optimization problem.

1.4.2 A didactic example

Let's consider the following optimization problem involving the two decision variables x_1 and x_2. We show in this illustrative example, inspired from [?], how the solution changes in terms of the nature of the decision variables that can be either continuous or binary and the number of objectives $k = 1,\ 2$. Hence, four optimization problems follow:

	SINGLE OBJECTIVE	MULTI-OBJECTIVE
CONTINUOUS DECISION VARIABLES	Max $2x_1 + x_2$ $S.t.$ $5x_1 + 7x_2 \leq 100$ $x_1 - 3x_2 \leq 80$ $x \geq 0$ $\Rightarrow$ $x = (x_1, x_2) = (20, 0)$ $z(x) = 40$	Max $2x_1 + x_2$ $x_1 + 5x_2$ $S.t.$ $5x_1 + 7x_2 \leq 100$ $x_1 - 3x_2 \leq 80$ $x \geq 0$ $\Downarrow$ $E_D = \{(20, 0), (0, 14.285)\}$ $E_O = \{\begin{pmatrix} 40 \\ 20 \end{pmatrix} \begin{pmatrix} 14.285 \\ 71.428 \end{pmatrix}\}$
BINARY DECISION VARIABLES	Max $2x_1 + x_2$ $S.t.$ $5x_1 + 7x_2 \leq 100$ $x_1 - 3x_2 \leq 80$ $x \in \{0, 1\}$ $\Rightarrow$ $(x_1, x_2) = (1, 1)$ $z(x) = 3$	Max $2x_1 + x_2$ $x_1 + 5x_2$ $S.t.$ $5x_1 + 7x_2 \leq 100$ $x_1 - 3x_2 \leq 80$ $x \in \{0, 1\}$ $\Downarrow$ $E_D = \{(1, 1)\}$ $E_O = \{\begin{pmatrix} 3 \\ 6 \end{pmatrix}\}$

1.4.3 Problem definition

The goal in studying a problem is the to define a problem

1.4.4 Problem statement and formulation

1.4.5 solution quality

Depending on the adopted approach

1.5 Optimization of a decision problem

Linear requirements for the simplest case
Optimality

$Maximize$ $\quad Z(x) = 2x_1 + 3x_2$

Subject to

$$x_1 + 3x_2 \leq 20$$
$$2x_1 - x_2 \leq 15$$
$$x_1,\ x_2 \geq 0$$

1.6 Exercises

1.6.1 Exercise 1

A five-question POM questionnaire

1- What kind of project are you interested in?
Give only one example.

2- What do you prefer:

- to manage a project with a DSS.
- to manage a project without using a DSS.

3- Do you like the POM course?

Please provide a level of satisfaction $(0, \ldots, 100\%)$.

4- For project analysis do you prefer the use of histograms or numbers?

5- Do you prefer the use of slides or writing in the blackboard?

1.6.2 Exercise 2

General background
1- Production is . . .
2- The fundamental functions of the busniness' organization : . . .

1. How would you define a project?

2. Describe the life cycle of a project.
3. Name and briefly describe the three primary goals
4. How do projects, programs, tasks, and work packages differ?
5. Would you like to be a project manager? Why, or why not?

1.6.3 Exercise 3

1. In what kind of situations are expert systems being used?
2. What is the difference between a management information system (MlS) and a decision support system (DSS)?
3. What are the different phases of decision making process?
4. Explain how decision making is related to the planning process?
5. What is the difference between problem analysis and decision-making

1.6.4 Exercise 3

Strategic management and project selection

1. What are some of the limitations of project selection models?
2. What is the distinction between a qualitative and quantitative measure?
3. What are some advantages and disadvantages of the profit numeric models?
4. Contrast validity with reliability.
5. Can a measure be reliable, yet invalid? Explain.

Plan :

Week	1	2	3	4	5	6	7	8
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