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Utilize OperationalResearch and Modeling to Assess Innovation Impact on GDP: Morocco as Application

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Abstract—*The distribution of resources is a key to the success of a given production process and its maintenance. Indeed, companies can gain a decisive and immediate competitive advantage. We aim to model the allocation of resources in a power type production unit proposing improvements at a later stage. A model: workers, resources, tasks will be adopted as part of our model. Once developed, this model can be the starting point for further optimization efforts for the entire value chain component of any production process.CAPEX: Reduction of operating costs by dynamic elimination of losses. To our previous efforts, we add a problem resolution framework rendering it easier for the user to identify resource importance and resource leakage.*

Keywords*- allocation, ressources, production unit, optimization of resources, RocDel.*

I. INTRODUCTION

The allocation of resources is of paramount importance in the production process. Resources are intrinsically limited. Therefore, their distribution needs to be optimized in order to meet the following challenges :

1. Minimize capital expenditure gold Capital expense, CAPEX) [1,2].
2. Optimize permanent (non-depreciable) expenses in terms of variable cost of production (operating expense, Operating expenditure, Operational expense, Operational expenditure gold Opex) [3,4,5].
3. Improve performance in terms of HSE (Health, Safety and Environment) [6,7]

In this work, we focus on modeling the allocation of resources in a typical production unit. The objective of this paper is to maximize production by considering the following model : a given number of workers, use a given number of resources, in order to be able to perform a given number of tasks. Tasks can vary from production to maintenance or support functions. Our goal is to introduce the novice user to a problem of **optimizing limited resources** by using the standard tools of operations research in a**simple and comprehensive approach.** The experienced reader is endowed throughout this report with a manageable interactive tool that can be made even more sophisticated by increasing the number of variables and variabilities. It should be noted that a considerable effort has been made so that mathematicians and interested parties far from the field of the studied application can find in our work a scientific matter formulated in a simple way. Experts from production units may object to the validity of a number of assumptions. We invite them to contact the authors.

II. PRESENTATION OF THE MODELS

We perform the optimization on the interval of a work station (between 8hr and 12hr) and summarize the parameters used in our approach, as well as their notation in Table 1 :

Table 1: Les variables et leur signification.

Parameter	Notation or significance
A Resource Endowment Site	Varies with the different fields of application
D	The number of tasks
producitvite	The total productivity achieved on the production unit being studied
i, between 1 and D	A task *i*
Productivite_i	Productivity during the task *i*
M	The number of resources in the production unit being studied.
j, between 1 and M	A Resource Endowment Site *j*
N_ij	The number of workers assigned between the place of performance of the task *i* and the resource endowment *j*
l, between 1 and n_ij	Worker*l*Assigned between the task place *i* and the resource endowment location *j*.
C_l	Capacity in terms of worker *l*productivity
N_ijl	The productivity achieved by the worker *l*which is assigned the place of performance of the task *i*and the resource endowment *j*.
C_ijl	The cycle carried out by the worker*l*, Which is assigned the place of performance of the task *i* and the resource endowment *j* .
D_ijl	The distance traveled (it is possible to include the various difficulties to be overcome in order to be able to carry out a given task [8,9]) by the worker *l* The place where the task was carried out *i*and the resource endowment *j*.
T_p	Duration of the workstation (typically 8hr for three shifts per day, or 12hrs for two shifts per day)
v	Mean velocity (one can include the operative efficiency [10,11,12]) of the workers in the production unit studied

I. Objective of optimization

The optimization routine takes as input the places where the tasks are performed, the places where resources are endowed, and the workers with their characteristics, and aims to give as output the optimal assignment. It should be noted that our approach will allow an exchange between unknowns and parameters according to the need of the user: this is outside the perimeter of the report [13,14,15].

We illustrate the approach as follows :

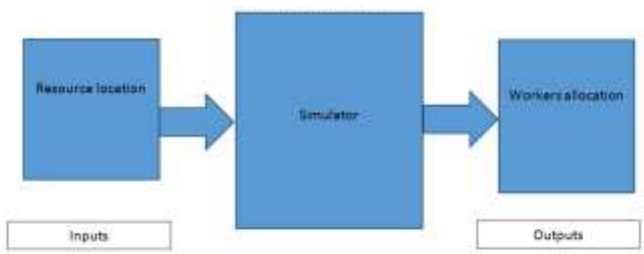

Figure 1: Optimization goal

We schematize the optimization problem in question as follows :

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Figure 2: Actors in the model

II. FORMULATION

In the discussion cited above, we explained that our objective is to maximize the function productivity which can be represented as following:

$$productivite = \sum_{i=1}^{D} productivite_i$$

Where*:*

n: Number of tasks.

The *producitivite _ i* associated with the place of performance of tasks*i*, comes from all resource endowment sites *j*. Moreover, between the place where tasks are carried out *i* and a place for performing tasks *j* performed by the affected workers. Each worker between a given place of performance of tasks and a place of realization of tasks carried a total number of tasks and has a given capacity. Therefore,*producitivite_i*can be written as follows:

$$productivite_i = \sum_{j=1}^{M} \sum_{l=1}^{n_{ij}} N_{ijl} C_j$$

The number of tasks carried out by the worker*l*, which is assigned between the place where tasks are carried out and the place where tasks are carried out, can be written according to the cycle as follows :

$$N_{ijl} = \frac{T_p}{C_{ijl}}$$

In addition, the cycle of the said worker, can also be written as follows :

$$C_{ijl} = \frac{d_{ijl}}{v}$$

Thus, the "*producitivite*" in question can be written as follows :

$$productivite_i = vT_p \sum_{j=1}^{M} \sum_{l=1}^{n_{ij}} \frac{C_j}{d_{ijl}}$$

In the end, our objective ***producivity*** can be written as follows :

$$\boldsymbol{productivite = vT_p \sum_{i=1}^{D} \sum_{j=1}^{M} \sum_{l=1}^{n_{ij}} \frac{C_j}{d_{ijl}}}$$

III. IMPLEMENTATION (ROCDEL) :PHENOMENOLOGIC PROCEDURE

In a second part of this work, we will present another approach based on a broad analysis of a typical production unit. We will focus on "micro" data streams, and main actors. Subsequent work will be intended to combine modeling and stream analysis. To this end, we have developed an interactive framework called *RocDel*(Reducing operating costs by Dynamic elimination of losses). We have set up the RocDel framework on the two following pillars:

A. The industry strategy is divided into two components: Strategic, and Tactical.

a. The Strategic side is based on top management decisions. In the field, people “do not have the hand on” top managers’ thoughts. They have to “UnderGO”. Another aspect of RocDel I am currently developing focuses on how to make of the framework atool to assist top managers: how senior and top managers can avoid being disconnected from what is happening in the field (I think this is a challenge most managers face)?How they can trigger profitable initiatives based on actually happening facts?How the hierarchy can play innovative roles other than tell superiors what subordinates are doing (this traditional process accuracy is subjective and subject to several uncertainties)? This is a cultural dilemma which I call: *Manager Field Awareness* versus*OperatorHierarchy Rule Recognition*. How can we marry operators’ skills and managers’ vision?

b. The Tactical side is mostly controlled by field people (RocDel Field people = Production + Maintenance teams. The current version of RocDel neglectssupport functions: this is another area of improvement for future work). Here we are talking about daily operations’ management. For instance, we try to bring grounded answers to the following questions: how can we adapt maintenance schedule to match production objectives? How to ensure the neuralgic machines availability during production peaks? How to plan long-term maintenance operations during low-production seasons? In a word, how to get the maintenance involved in production to ensure equipment quality, and how production teams can get the best performance of an available equipment [16,17,18].

In this component, several issues are discussed: spare parts supply, equipment stoppageschedule, performance forecast and monitoring, and technical expertise evaluation.

B. RocDel models the activity as follows: Result = Availability x Performance. The availability is computed in terms of the working hours (typically 6500 hours per year per equipment), and the performance is measured in terms of Result per hour (tones per hour, meters per hour, liters per hour, and times per hour). Availability is utilized to monitor maintenance and Performance to monitor production. I assertthe following points are the heart of success of any industrial activity:

i. For how long are you performing?

ii. When you perform, how is your performance?

iii. How can your operators suggest ways to improve their performance?

We present a simplified version of RocDel as follows:

Figure 3: RocDel Model

A question one can ask here: how can operators evaluate their performance (auto-evaluation)? Here comes the rule of field managers to set goals and interactively challenge what has been done. To answer this question, it is recommended to use modeling to estimate the objectives that have to be targeted. For instance, the RocDel framework has been utilized in a minning context, and field people have used Matlab to calculate objectives. We are not allowed to show data, however, we present some success results after employing the RocDel framework:

i. In a frame of two months, Opex has been reduced by 12% (a few dozens of thousands USD).

ii. The cost reduction is made a continuous process since the framework, besides being user-friendly, is interactive and dynamic: a field operator can improve it.

iii. There was no additional investiment on OPEX.

iv. The investment in CAPEX was maintained to 7% of the previous year OPEX.

The overall outcome of RocDel can be represented as follows:

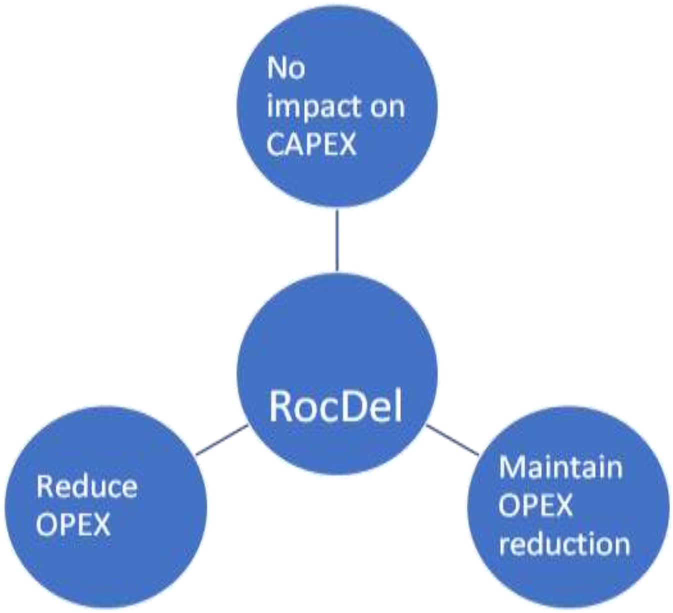

Figure 4: RocDel roles.

IV. PROBLEM RESOLUTION FRAMEWORK

In this section, we aim to guide the user to identify the possible issues within its organization in terms of leakage and sub-optimal resource allocation. This step can be viewed in one of the following ways:

i. A preliminary step to identify problems before applying the above-explained framework

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ii. A final step to validate the findings of the modeling and deal with any not-considered problems.

The framework can be detailed as followed:

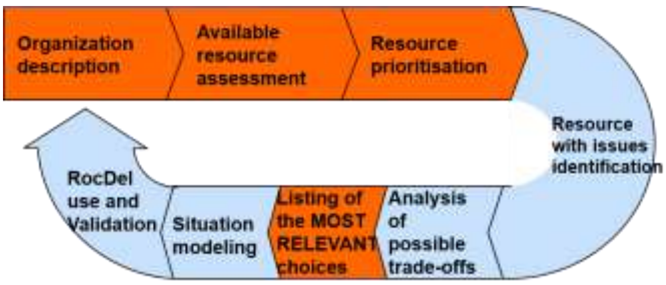

Figure 5: RocDel preparation/validation

V. GDP CONTRIBUTION

Lets assume the case of a country: for example Morocco, and the following approximative figures:

- 100 billion dollars as GDP, from which:
  - 50 billion dollars as government expenditure
  - 10 billion dollars as government investment
  - 15 billion dollars loans, payment, out of 100 billion dollars
  - 55 billion dollars Imports
  - 20 billion dollars exports

Our model aims to improve the efficiency using high-outcome investment. Indeed, the 10 billion dollars will be able to generate more outcome via:

- Less government expenditure
- Higher value exports
- Less imports

$$GDP = EX - I - IM + EX - L$$

Thanks to efficiency improvement, the model will change to the following:

$$GDP = \alpha.EX - \beta.I - \gamma\, IM + \delta\, EX - \zeta.L$$

We cal that in our work: "Apparent GDP", and "Apparent effect of Efficiency on GDP". We model the effect as follows:

$$\alpha = A.e^{a}$$

$$\beta = B.e^{a}$$

$$\gamma = C.e^{a}$$

$$\delta = D.e^{a}$$

$$\zeta = E.e^{a}$$

Then:

$$GDP = \alpha.EX - \beta.I - \gamma\, IM + \delta\, EX - \zeta.L$$

or:

$$GDP = \alpha.A.EX.e^{a} - \beta.B.I.e^{a} - \gamma\, C.IM.e^{a} + \delta.D.EX.e^{a} - \zeta.E.L.$$

Thus:

$$\frac{GDP}{e^{a}} = \alpha.A.EX. - \beta.B.I - \gamma\, C.IM + \delta.D.EX - \zeta.E.L$$

Where:

is the apparent

And

is

We call the other parameters as follows:

- : government expenditure multiplier
- : investment multiplier
- : imports' multiplier
- : exports' multiplier
- : Loans' multiplier

Our model highlights the following consideration: **by investing in a linear way in innovation and cutting-**

edge technologies, the impact on GDP is exponential. Please note is a negative number.

VI. APPLICATION

Let's assume the Moroccan government has invested in a technology whose parameters are as follows:

- A linear Investment $A = 2$ in cost reduction, in governement expenditure
- And efficiency scale $\alpha = -0.3$
- That spans over 5 years

The results are as follows:

- An increase in government expenditures from 10 billion dollars to 20 billion dollars, to be deducted from the overall GDP
- The apparent GDP is: $100 \times e^{0.3} = 135$ billion dollars

Overall, Morocco has gain $135 - 100 - 2($ billion dollars. **Morrocco has gained 25 billion dollars in GDP over 5 years.** That gives a CAGR of: $\left(\frac{1}{1}\right.$, which is above what the country has been achieving in many years.

VII. CONCLUSION

In this work, we successfully modeled the ressources allocation in a typical production unit. This acheivement can have the following uses:

- Reduce costs by eliminating leaks and losses.
- Easily evaluate workers on quantifiable basis.
- Develop software to solve the optimization problem.
- Automatically allocate resources in a ressource-short environment.

In future work, we aim to implement our method in user-friendly software and apply it to real data. Preliminary results have shown a significant reduction of OPEX without a need to heavy investment in CAPEX.

RocDel has been used in a minning context, and to chemical plants. The results are encouraging and adaptable to any industrial context.

REFERENCES

1. "capital expenditure (CAPEX)". BusinessDictionary. Retrieved 11 July 2017.
2. "What is a Capital Expenditure (CAPEX)?". My Accounting Course. Retrieved 11 July 2017.
3. Harry I. Wolk, James L. Dodd, Michael G. Tearney. Accounting Theory: Conceptual Issues in a Political and Economic Environment (2004). ISBN 0-324-18623-1.
4. Angelico A. Groppelli, Ehsan Nikbakht. Finance (2000). ISBN 0-7641-1275-9.
5. Barry J. Epstein, Eva K. Jermakowicz. Interpretation and Application of International Financial Reporting Standards (2007). ISBN 978-0-471-79823-1.
6. Stephan, Constantin (2012), Industrial Health, Safety and Environmental Management, epubli, Berlin, 3rd edition 2012, ISBN 978-3-7418-7478-9
7. "Environmental Leader Is Your Source For Energy, Environmental & Sustainability News". Environmental Leader.
8. Fehlauer, R., Die Sicherheitsanalyse, einMerkbuchzuihrerDurchführung {L'analyse de la sécurité du travail, manuel pratique). Édit. :Hüttenwerk Salzgitter AG.
9. lndustriegewerkschaftMetallfür die BundesrepublikDeutschland {Syndicat industriel des

métallurgistes de la République fédérale allemande) : Sicherheitsanalyse {L'analyse de la sécurité du travail), numéro 6, SchriftenreiheArbeitssicherheit, Francfort-sur-le-Main. Pas d'indicationd'année.

10. Nutzhorn, H., RKW Leitfaden der Arbeitsanalyse {Principes de l'analyse du travail), Édit. : Rationalisierungskuratorium der deutschenWirtschaft, Bad Harzburg, Francfort-sur-le-Main, 1964.
11. Rijksarbeidsbureau, Handleidingvoor de Functieanalyse {Manuel de l'analyse des fonctions), Handboek van het Rijksarbeidsbureau, La Haye, 1954.
12. Trilling, L. (2006). Aide `a la d´ecision pour le dimensionnement et le pilotage de ressources humaines mutualis´ees en milieu hospitalier. PhD thesis, INSA de Lyon.
13. Val´erio de Carvalho, J. (1999). Exact solution of bin-packing problems using column generation and branch-and-bound. Annals of Operations Research, 86 :629–659.
14. Krichen, S. and Dahmani, N. (2010). A particle swarm optimization approach for the biobjective load balancing problem. Electronic Notes in Discrete Mathematics, 36 :751– 758.
15. Labed, S., Gherboudj, A., and Chikhi, S. (2012). A modified hybrid particle swarm optimization algorithm for solving the travelling salesmen problem. Journal of Theoretical and Applied Information Technology, 39(2) :132–138.
16. Mallo y Merlo, "Control de gestión y control presupuestario" Mc Graw Hill, Madrid 1995.
17. Mallo, C, Kaplan, R, Melgem,S y Gimenez, C, "Contabilidad de costos y estratégica de gestión", Prentice Hall, Madrid, 2000.
18. Saez Torrecilla, Fernandez Fernandez, Gutierrez Díaz, "Contabilidad de Costes y Contabilidad de Gestión" Mc Graw Hill, Madrid 1996.
19. Shank, J y Govindarajan, V, "Gerenciaestratégica de costos" Editorial Norma, Barcelona, 1995 - Smolje, A. y otro, "Outsourcing:Herramienta para el análisiseconómico y estratégico" RevistaCostos y Gestión, Año VII, nº 25.
20. Tanaka, Yoshikawa y otros. "GestiónModerna de Costos". Editorial Diaz de Santos;Edición 1997.