

A simulation model for health insurance Fund: A Tunisian case study

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Abstract— Assessment of Service establishments has been the focus of a large number of published articles. Despite the diversity of the service establishment's problems, the management of medical insurance has been little explored by researchers. In this paper we try to analyze the performance in the insurance funds which have today great importance in our society because almost the totality of citizens are members of health insurance company. Our contribution consist in adapting, for the first time in Tunisia, clear and simple model in which we explain the flow of the insured patient through different complicated stages between the National Medical Insurance Fund (CNAM) and the National Social Security Fund (CNSS). Then, we evaluate the current insurance system of our case study based on some defined performance criteria.

Keywords--Modelling, Health insurance system, Discrete event simulation, Performance criteria

I. INTRODUCTION

Assessment of Service establishments has been the focus of a large number of published articles. Despite the diversity of the service establishment's problems, the management of medical insurance has been little explored by researchers. In this paper we try to analyze the performance in the insurance funds which have today great importance in our society because almost the totality of citizens are members of health insurance company. Our contribution consist in adapting, for the first time in Tunisia, clear and simple model in which we explain the flow of the insured patient through different complicated stages between the National Medical Insurance Fund (CNAM) and the National Social Security Fund (CNSS). Then, we evaluate the current insurance system of our case study based on some defined performance criteria.

Insurance business is part of the services that relate to the economy of huge financial profits. This is a hedging technique of financial losses could affect the property of a physical or moral person. The Health Insurance can be defined as a contract in which if the insured, during the warranty period, would reached in his own person by illness or even an accident. First the insured pay certain amounts, secondly repay all or part of the medical and pharmaceutical expenses necessitated by the realization of the risk. In Africa, several countries are working to establish and fund health insurance

programs. Ethiopia, Ghana, Kenya, Nigeria, Rwanda and Tanzania are examples.

The ministries of finance and of health must work together to assess what is the capacity and the government's commitment to fund health insurance. Economists, actuaries and accountants can provide information on this issue from the analysis of different scenarios relating to the financial capacity of the country and the design of insurance. Faced with rising health costs, several cost control policies are considered. In this context, Tunisia has recently adopted a reform of the health insurance system in order to ensure access to care for the entire population without distinction.

The National Health Insurance Fund (CNAM) is a reform of Tunisian health insurance. The CNAM is the product of a reform launched in 2004 and aims to improve the quality and access to care, to master health spending and to provide equitable health coverage system. This reform has a dual system: The mandatory: managed by social security funds CNSS, this system covers the non-agricultural private sector employees, agricultural sector employees, farmers, independent workers and fishermen and other optional: managed by insurance and mutual companies. These cover health expenses not supported by the basic plan. It is set up in 2006 as part of the reform to unify the health insurance plans and health benefits previously provided by the National Social Security Fund (CNSS) and the National Pension and Social Insurance (CNRPS), but also to expand health coverage to private providers of care.

This paper is outlined as follows: In the next section we will describe the problem treated in this paper. Section 3 describes the system of health insurance. Section 4 defines the distributions from data. Section 5 we will analyze the graphs of simulation results provided by the existing model.

II. SIMULATION OF THE HEALTH INSURANCE SYSTEM IN LITERATURE

Medical simulation reinforced in knowledge through experience in the field, but above all it will help to understand the barriers to their implementation. According to Morgan et al. the simulation is a related and complementary discipline in modeling a system. It assesses their dynamic behavior [1].

In Japan, Ihori et al. simulated the drastic reforms of the Japanese public health insurance began in 2006. The assessment shows that the reform does not significantly reduce future public health insurance benefits, but it can improve economic growth and welfare by promoting private savings [2]. In South Korea, Shin presented the historical and political context of the enlargement of the private health insurance in South Korea under the National health insurance system and he has performed simulations that show the social security contributions are relatively limited in South Korea, which implies direct payments can be reduced by improving the reform of health insurance [3]. In Australia, Cheng studied the effects of reducing subsidies for private health insurance on public sector expenditure for hospital care. An econometric framework using simultaneous equation models is developed to analyze the interrelated decisions on the intensity and type of health care use and private insurance. The framework is applied to the context of the mixed public-private system in Australia. The simulation projections show that reducing premium subsidies is expected to generate net cost savings. This arises because the cost savings achieved from reducing subsidies are larger than the potential increase in public expenditure on hospital care [4].

III. SETTING PERFORMANCE CRITERIA

User satisfaction is regularly called a goal in every regard for public service. The health insurance fund is no exception to this rule. Satisfaction measurement uses multiple means, complaints, questionnaires and also specific or general inquiries on the initiative of the institutions. To extract the criteria for evaluating health insurance systems, we used insured patient satisfaction surveys. We found truly that the following criteria as the indicator of performance in the health insurance funds: the number of served insured patients and the waiting time. To properly assess the success of health insurance system, it is required to determine not only the indicators with regard to users who provide information on the quality of services but also with regard to the leaders of the health insurance systems. All processes internal to an establishment can be monitored by performance indicators in order to improve the profitability and efficiency of the service or the organization. According to the strategic objectives to be realized by the health insurance systems, it seems realistic to consider the total cost and the rate of resource utilization as the most important measures.

We will analyze in this work the actual performance of the studied health insurance establishment.

IV. DESCRIPTION OF THE HEALTH INSURANCE SYSTEM

The most common services present in the medical insurance institutions include:

- An entry reception office where the insured chooses the paper to fill according to his need.
- The management of medical costs: The patient may be supported by the CNAM care and hospitalization among

public and private institutions with which the CNAM established conventions.

- Long term diseases are determined by a commission of CNAM doctors.
- Reimbursement of care costs: The insured has the freedom of choice of doctors, pharmacist and physician assistants. Reimbursement by the CNAM expenses incurred by the victim is done within the limits of the official rate.
- The accident stop service work and occupational diseases: The National Health Insurance Fund supports the rugged travel expenses by the most economic means and in view of his health for all necessities care related accident or illness, as well as living expenses in non-hospital locations that require care at rates fixed by the Minister of Social Affairs.

There is a possibility that the insured patient has directed to the National Social Security CNSS fund for the regulation of his legal situation.

V. DEFINITION OF DISTRIBUTIONS AND MODELING OF THE MEDICAL INSURANCE FUND: CASE STUDY

We saw that there were several important factors to manage for the proper functioning of the CNAM. In particular, we are interested in the simulation cycle time of the course of the insured patient.

A. Definition of distributions rule from data

The application of Input Analyser on the collected data during 3 days in our case study insurance health medical fund of Gabes gives us the probability distribution of the patient arrival and time between arrivals which follows the exponential distribution. Also the time spent in front of the windows service and the service time follows the triangular distribution.

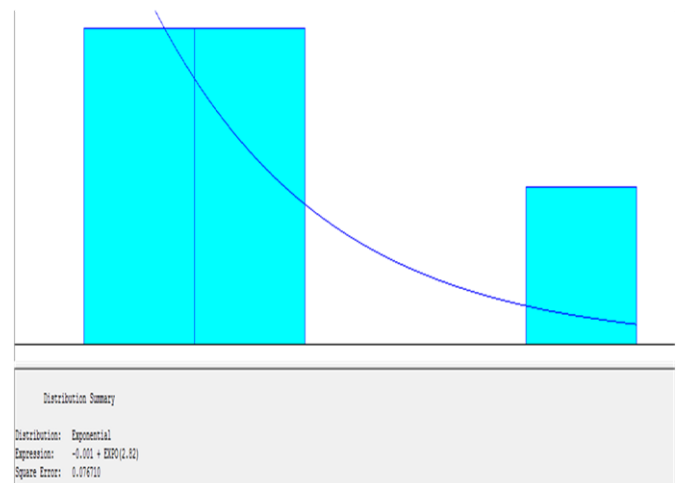


Fig. 1 The distribution of the insured patient's arrival

B. Modelling via Arena

The medical insurance fund of Gabes is a regional insurance institution. It contains in the entry reception office. Regardless of general infrastructure of the health insurance system institutions, the fund of our case study contains four

windows service: three versatile windows service which serve three different services provided by the medical insurance system: the management of medical costs, long diseases and reimbursement of care costs; and a fourth specialized window service for only accidents of job and professional diseases. This difference will create another vision of modeling the operating system. Each window service is served by a single agent and serves only one insured patient. The CNAM works 8 hours a day from 8 am in the morning until 16a.m in the afternoon. All the details of parameters describing the system functioning are integrated as data in the simulation software. ARENA offers a comprehensive response for the simulation and optimization of flows and industrial processes. This is a powerful decision support tool for modelling different systems.

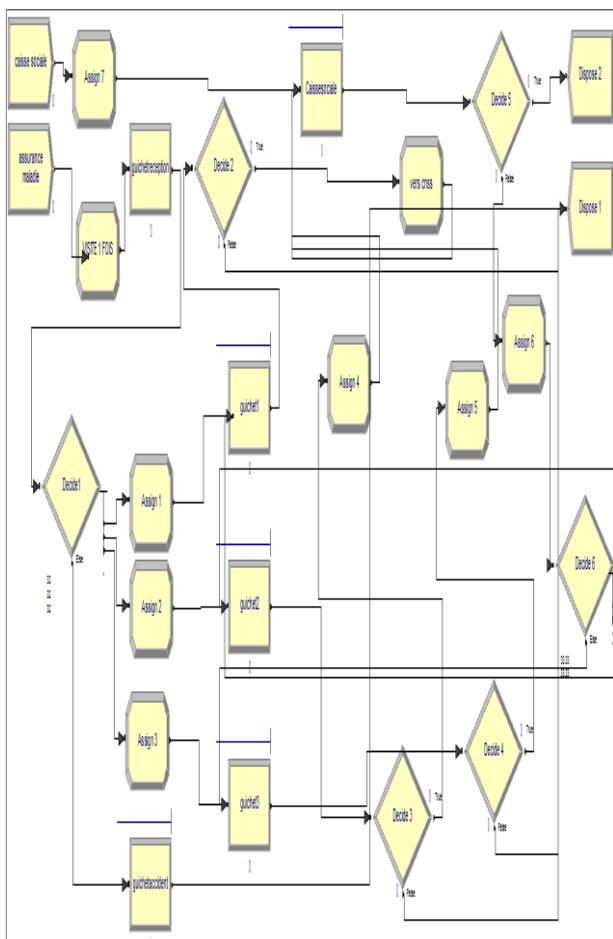


Fig.2 Model of the current medical insurance fund

C. ANALYSIS OF GRAPHS OF SIMULATION RESULTS PROVIDED BY THE MODEL OF THE CURRENT MEDICAL INSURANCE FUND

We simulated the model 100 replications on 16 hours of working time of the medical insurance fund.

System	Average
Total Cost	326
Number Out	285

Fig .3 Results of the released report

The number of insured patients who leave the system is equal to 285. There are on average 285 insured patients served during 980 minutes (16.33) hours of work for all 100 sessions.

Number In	Average	HalfWidth	Minimu Average	Maximu Average
accidents	11.4500	0.713	3.0000	22.0000
Caisse	123.82	0.890	115.00	135.00
guichet de reception	287.22	3.378	245.00	334.00
guichet1	95.0600	1.955	70.0000	118.00
guichet2	94.0000	1.935	71.0000	121.00
guichet3	93.5100	2.121	71.0000	133.00

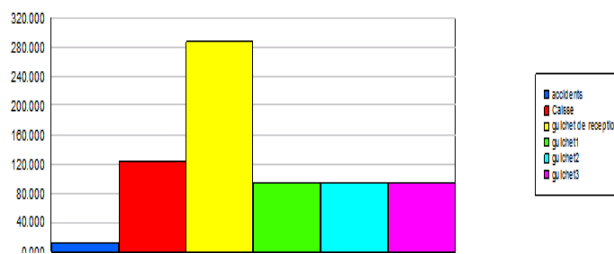


Fig. 4 Number of times of relative input of an insured patient for each window service

During 16 hours of the CNAM work, an insured is served on average 11 times by the accidents window service; 95 times by the window service 1; 94 times by the window service 2; 93 times by window service 3 and 123 times by the social fund.

Time per Entity			
	Total Time	VA Time	Wait Time
accidents	9.338	7.802	1.536
Caisse	151.468	7.225	144.243
guichet de	1.998	1.998	0.000
guichet1	45.620	5.946	39.674
guichet2	38.023	5.988	32.034
guichet3	59.640	5.865	53.775

Fig. 5 Ratio of average waiting results of an insured patient by window service

Figure 5 shows that the insured patient passes 1.99 minutes in the reception office with 0.00 waiting time. If he is directed to the accidents window service he spends 9.33

minutes to be served: 7.80 in the window service and 1.53 in the queue. The insured patient who is directed to the window service 1 spends 45.62 minutes to be served: only in the window service 5.94 and 39.67 in the queue. The insured patient directed to the window service 2 spends 38.02 minutes to be served: only 5.98 in the window and 32.03 in the queue. The insured patient directed to the window service 3 spends 59.64 minutes to be served: only 5.86 in the window service and 53.77 in the queue. The insured patient directed to CNSS spends 151.46 minutes to be served: only 7.22 in the window service and 144.24 minutes in the queue.

Resource						
Usage						
Number Busy	Average	HalfWidth	Minimu Average	Maximu Average	Minimu Value	Maximu Value
Resource 1	0.4895	0.004	0.4178	0.5091	0.00	1.00
Resource 2	0.4894	0.003	0.4252	0.5088	0.00	1.00
Resource 3	0.4879	0.004	0.3850	0.5087	0.00	1.00
Resource 4	0.0925	0.006	0.02418972	0.1783	0.00	1.00
Resource 5	0.5098	0.000	0.5011	0.5102	0.00	1.00

Fig .6 Resource utilization in current system

Figure 6 shows that the system uses only 48% of the three versatile windows service, 9.25% of the accidents window service and 50.98% of the social fund.

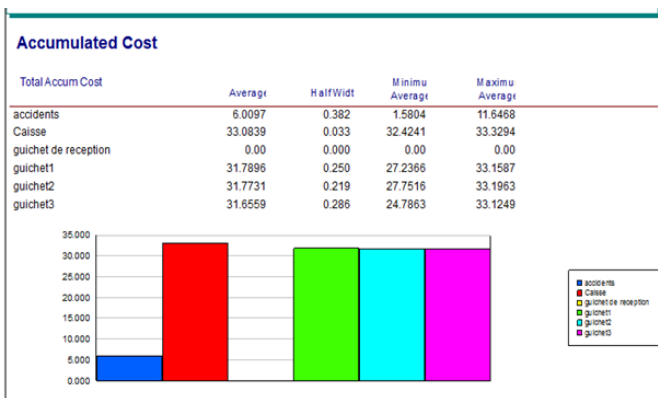


Fig .7 Total accumulated cost of resources

During 16 hours, services provided by the window service accidents cost 6 DT, services provided by the window service 1 cost 31.78 DT, services provided by the window service 2 costs 31.77 DT, services provided by the window service 3 cost 31.65 DT, services provided by the CNSS cost 33.08 DT.

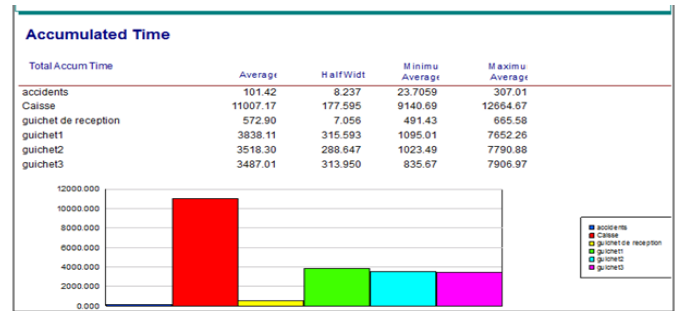


Fig .8 Total accumulated time spend by the insured patient in the window service

Insured patient oriented to accident window service spends on average 101.42 minutes. Insured patient oriented to window service 1 spends on average 3838.11 minutes. Insured patient oriented to window service 2 spends on average 3518.30 minutes. Insured patient oriented to window service 3 spends an average 3487.01 minutes. The insured patient directed to CNSS spends 11007.17 minutes on average.

VI. CONCLUSIONS AND FUTURE SEARCH

Our contributions, in the first place, concern the modeling of the current system of health insurance. Secondly, we have evaluated of the current system of health insurance according to well-defined criteria. This work opens the way to various research opportunities such as the improvement of the performance of the current system.

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