A System Dynamics Model for the Clinical Risk Management: A preliminary analysis

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Abstract
Clinical risk management has gained an increasing relevance because of the higher monetary and no monetary effects of clinical errors on healthcare companies' performance. For this reason, different risk management techniques from the industrial sector have been adopted by managers of healthcare companies in order to reduce the occurrences of errors and their relative impacts.
Although the reduction of clinical errors obtained by adopting clinical risk management techniques have been widely described, in most of developed countries such policies are not very widespread. Such circumstance can be explained by the costs healthcare companies have to bear to invest in clinical risk management in order to improve their risk profile. In fact, these techniques, based on a linear and static perspective, do not properly support the healthcare companies' management in the identification and assessment of policies aimed at improving the clinical risk profile without reducing financial performances. Therefore, it is necessary to adopt a systemic and multi-dimensional approach that supports cost-and-benefit analysis of the identified policies.
Based on preliminary results of a research project on system dynamics methodology applied to clinical risk management in Italian healthcare companies, some peculiar aspects are analyzed and discussed.

Key words: clinical risk management, patient safety, clinical error, system dynamics model, performance indicator, human resource management.

1. Introduction

In recent years, the higher sensibility about patient safety, the greater stress given by the media to news related to clinical errors, the relevant increase of insurance costs and the higher number of compensation claims have abruptly drawn the attention of healthcare companies' managers towards the topic of clinical risk management (CRM).
As a consequence, patient safety has gained increasing interest and healthcare companies have been forced to abandon those policies aiming at profit maximization at the expense of the quality of healthcare services.
Such a change in healthcare companies' vision has been fostered by the publication of the American Institute of Medicine's report entitled "*To err is human: building a safer*

health system" (Kohn et al., 1999), which stressed that also healthcare professionals may commit errors as it happens in other professions.
For this reason, clinical errors have to be examined not to find the "guilty", but to learn from them in order to prevent further occurrences. For this purpose, in the healthcare sector have been imported risk management methods that have been successfully applied in the industrial sector (Trucco and Cavallin, 2006), such as the Root Causes Analysis, the Failure Mode Effectiveness and Criticality Analysis, the Incident Reporting, etc..
However, these methods do not properly support the healthcare companies' management in the identification and assessment of policies aimed at improving the clinical risk profile, even though they are useful in the estimation of risk probability and in the evaluation of potential effects deriving from errors.
Moreover, CRM practices, such as the introduction of guidelines and protocols, patient involvement, etc., do not take into account monetary costs and their effects on personnel management. Indeed, often those practices determine a workload increase that, if not properly managed, may give rise to medics and paramedics' workload stress, which inevitably augment the probability of errors.
In other words, the improvement of the risk profile, although ethically incumbent, often requires relevant investments that may make such an objective appearing not cost-effective. Consequently, it may occur that a healthcare company does not invest in CRM because of the costs and the increasing complexity of the operating procedures that this investment may imply. Such a decision may be also caused by the difficulty that healthcare companies' managements experiment in assessing the benefits deriving from investments aimed at reducing the clinical risk.
Indeed, an improvement of the clinical risk profile often allows healthcare companies to obtain important savings on insurance costs. Furthermore, a reduction of clinical risk determines an improvement of company image and, hence, an increase of healthcare companies' competitiveness.
Therefore, it is necessary to adopt a systemic and multi-dimensional (Berg, 2010) approach that allows healthcare companies' managements to properly evaluate the effects of CRM policies on organizations' performance, both in the short and medium-long term.
With this regard, different examples of application of the System Dynamics (SD) methodology to the healthcare sector have been reported in literature (Dangerfield, 1999; Wolstenholme, 1999; Homer & Hirsch, 2006). These scientific contributions highlighted the numerous advantages of using SD models to manage the complexity characterizing the healthcare sector.
In a previous paper (Ceresia & Montemaggiore, 2010), the authors described their research project aimed at building a management flight simulator, based on the SD methodology, to support Italian healthcare companies' management in experimenting different CRM policies by monitoring their potential effect on both financial and non-financial performance indicators. The management flight simulator should allow them to design strategies that guarantee both a satisfying level of patient safety and a sustainable growth.
Based on preliminary results of this research project, in the following analysis, some peculiar aspects are discussed. In fact, a deeper exam of the cause-and-affect relationships between the key-variables of the company subsystems enabled the authors

to build a more detailed SD model. From the analysis of the simulation results interesting insights emerged.

2. The Italian healthcare companies approach to clinical risk management

The CRM is aimed at reducing the number of errors that may occur in the provision of healthcare services and in the containment of their potential adverse effects. With this purpose, on the one side healthcare companies adopt techniques to identify effective or potential causes of, respectively, active or latent errors, on the other side they implement organizational procedures aimed at eliminating (where possible) the causes of the identified errors.

In Italy, in those healthcare companies where the CRM has been taken into consideration often it has not found a real application. Precisely, these healthcare organizations limited their actions to a formal implementation of the prescribed procedures without any substantial improvement in the culture of patient safety.

In fact, many initiatives have been triggered by journalistic campaigns about serious adverse events stemming from clinical errors and have been concluded immediately after the initial euphoria.

National and regional institutions have managed the problem of medical malpractice by enacting rules that have obliged healthcare companies to participate to a data collection activity aimed at feeding a central error monitoring system and to create internal committees for the audit and the management of the clinical risk (Ghirardini et al., 2010).

However, on the one side the central error monitoring system does not allow to collect reliable information about the so called “near miss” and “no harm” events, on the other side in most of the Italian healthcare companies the internal clinical risk committees limited their activity at producing minutes of meetings and at suggesting procedures that have not been implemented.

Furthermore, in Italy are still not available relevant data about the occurrence of clinical errors, their main causes, the definition of performance indicators aimed at measuring the improvement in the management of the clinical risk (Trucco and Cavallin, 2006; Verbano and Turra, 2010).

From the above analysis of the environmental and normative context, it emerges a lack of strong stimulus for healthcare companies for an effective adoption of CRM policies. Therefore, it is necessary that such companies perceive that an improvement of the risk profile, on the one side, often allows to obtain considerable savings on insurance costs as well as on the costs of “non quality” and “non safety”, on the other side, determines an enhancement of company image and, hence, an increase of their competitiveness.

Nowadays, there is a lack of tools that support the management of healthcare companies in assessing alternative CRM policies on the basis of strategic and operating goals deriving from company mission and vision (Verbano and Turra, 2010). As a consequence, the management’s decision making process about CRM policies is particularly complex. Such a circumstance may foster wrong evaluations about the opportunity to postpone the introduction of procedures aimed at improving the healthcare companies’ risk profile at the expense of patient safety and company image.

In fact, at the present time very few Italian healthcare companies have applied for and obtained the accreditation from the Joint Commission International, the most famous

non-governmental and non profit organization that certifies healthcare organizations if they meet a set of standards requirements designed to improve quality of care.
From the analysis of the Italian context it is possible to sustain that, despite of the numerous attempts of the national and regional governments to spread CRM practices, a real change in the patient safety culture can be obtained only if the required investments to improve healthcare organizations' risk profile are economically convenient.
However, as previously said, in order to properly implement cost-benefit analyses, the healthcare companies' management should quantify short and medium-long term effects of CRM policies on financial (compensation costs, insurance premiums, revenues, cash flows, etc.) and non financial (company image, customer satisfaction, personnel motivation, etc.) variables.

3. Applying the System Dynamics methodology to clinical risk management

In order to detect errors and assess their potential effects, clinical risk managers currently adopt monitoring tools, such as incident reporting and clinical audit, and methods of process analysis, such as the root causes analysis and the hospital failure mode and effect criticality analysis.
However, these methods are based on a linear analysis of the causal relationships characterizing the business processes. In particular, they do not take into account the feedback structure underlying the net of causality connecting the variables of the different company sub-systems (Lee et al., 2009).
Furthermore, these analyses are static (Cavallin et al., 2006), namely they ignore delays normally existing between the triggering of the cause and the occurrence of the related error and, consequently, they are not suitable to simulate future trends (Trcek, 2008).
Current clinical risk assessment methods are also inadequate in helping healthcare organizations in setting safety targets and evaluating safety performance improvement on a quantitative basis (Trucco and Cavallin, 2006).
Moreover, the root causes analysis can also be misleading because it focuses only on identifying the rout cause, but an adverse event usually does not have a single root cause (Trucco and Cavallin, 2006). In particular, such method does not take into considerations the interrelationships and interactions between different risks (Nasirzadeh et al., 2008).
As for the incident reporting practice, some scholars demonstrated that it does not allow, if used alone, to improve the safety conditions of complex organizations such as heath care companies (Albolino et al., 2008).
Furthermore, an effective implementation of these methods is hindered by the health professionals' mistrust towards CRM topics due to a still diffuse blame culture (Catino e Albolino, 2007).
These limits of the examined methods may undermine the identification of the real company processes' criticalities.
Similarly, the organizational practices implemented to reduce the clinical risk, such as the "only therapy sheet", the introduction of guidelines and protocols, the patient involvement, etc., often increase workload that, if not properly managed, may give rise to medics and paramedics' burn-out, which inevitably augment the probability of errors from human factors.

Therefore, it is necessary to adopt a multidimensional (Howell and Obren, 1999) and systemic (Cook and Rasmussen, 2005) approach that allows healthcare companies' management to assess, according to a holistic perspective, the effects of CRM policies on the company performance.

The application of the SD methodology to CRM facilitates a deep analysis of business processes in order to identify the areas of criticality and the potential interventions to reduce the probability of adverse events.

Thanks to the systemic and multi-dimensional approach underlying the SD methodology, it is possible to assess, in a safe computer laboratory and before the actual implementation, the alternative CRM policies, taking into consideration both short and medium-long term effects on financial and non financial performance (Hirsch and Immediato, 1998). In particular, the SD model allows scenarios analyses, in order to test the identified policies under different environmental conditions. This would also support sensitivity analyses that help deal with uncertainty in available data (Homer et al., 2004).

The possibility for the healthcare companies' management to experiment the designed policies through the SD model, in order to identify the strategy that assures the best trade-off between patient safety and financial results, fosters organizational learning processes.

The SD model may represent a stimulus for healthcare companies to adopt CRM policies that could have beneficial effects both on patient safety and on company image and competitiveness. In fact, it allows ex-ante and ex-post analyses of the identified CRM policies' effects on monetary and non monetary variables in order to identify paths of sustainable growth.

4. The research project

4.1 The qualitative analysis

The following causal loop diagram presents a preliminary analysis of a generic CRM policy applied in a healthcare organization.

Compared to the qualitative analysis described in a previous paper (Ceresia & Montemaggiore, 2010), the initial discussions with the management of the healthcare companies participating to the research project, allowed the authors to identify more specific cause-and effect relationships that give rise to interesting dynamics, which will be analyzed in the next paragraph.

As depicted in the above figure, the higher the number of people that necessitate a hospital treatment (*population to be cured*), all other things being equal, the greater is the number of people requiring hospitalization (*patient*) to a certain healthcare company. As a consequence, the number of *treatments* provided by a hospital increases as well as the number of *patients cured* reducing the *population to be cured* (loop B_1).

An increase of *treatments*, due to a higher number of *patients*, determines a rise in the number of *adverse events due to clinical errors*, if the percentage of clinical errors does not change. This would worsen *hospital reputation* and, hence, the number of potential *patients* (loop B_2).

However, if the number of *treatments* augments, the company would get more earnings (*treatments earnings*), which increase its *financial availability* that can be invested in CRM policies (*investments in CRM policies*). These investments, on the one side they reduce the *financial availability* (loop B_3), on the other side they should improve *CRM quality*, reduce the number of *adverse events due to clinical errors* and raise *hospital reputation,* with positive effects on the number of *patients* and, hence, *treatments* (loop R_1).

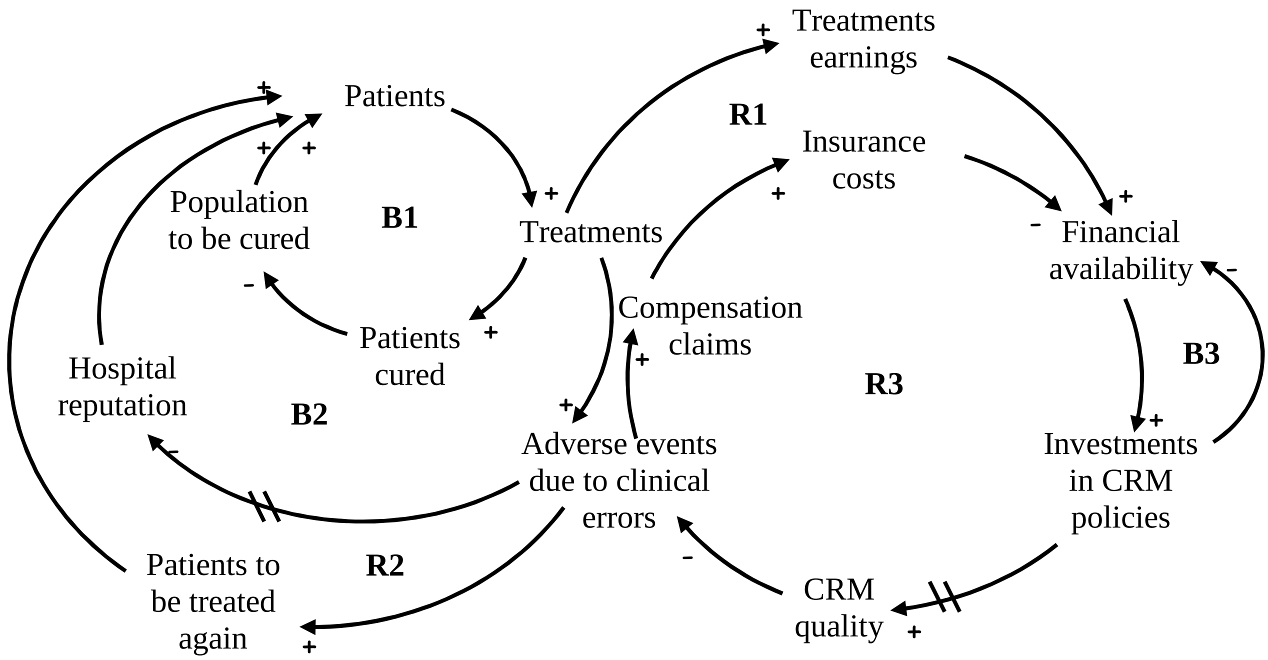


Fig. 1: *The preliminary causal loop diagram*

With regards to the loop R_1, it is important to point out that the effect of *investments in CRM policies* on *CRM quality* is delayed because it is necessary that the new operating procedures leave sediment in workers' behavioral patterns before real improvements in operational activities occur. Furthermore, it is not possible to gauge - in a deterministic way – the effect of *CRM quality* on the number of adverse events due to clinical errors, because even in a scenario where the healthcare company shows a low *CRM quality* clinical accidents may not occur. Therefore, a probabilistic function, expressing the likelihood of clinical errors occurrence with reference to different level of *CRM quality*, has been adopted to describe the causal relationship between these two variables. Consequently, the behavior shown by the SD model will be affected by this probabilistic function. In fact, if the decision maker assigns the same values to input variables and policy lever, the SD model will generate similar patterns, but not identical. Given these initial conditions, the less the standard deviation assigned to the probability function will be, the more the SD model behaviors will be similar.

As depicted in the loop R_3, a reduction of the number of *adverse events due to clinical errors*, stemming from an improvement of *CRM quality* obtained through *investments in CRM policies*, decreases the number of *compensation claims*. This should lower the premium required by insurance companies (*insurance costs*) with a positive impact on company *financial availability* that can be re-invested in CRM policies (*investments in CRM policies*).

In the loop R2 is described a potential pathological phenomenon that can be generated by the Italian healthcare system. Indeed, when *adverse events due to clinical errors* occur it is possible that the same patients have to be treated again for the same disease or different illness caused by the received treatment (*patients to be treated again*). It is likely that these patients return to the same hospital to obtain the new cure, because they may not be aware of the clinical error and they may continue trusting the same doctors. This determines an augment of the number of patients, increasing the number of treatments and, all other things being equal, the number of *adverse events due to clinical errors* (loop R_2). These re-treatments bring to the hospital new earnings (most of the time is the government paying for medical cures), triggering the previously described loop R_1. In other words, to a certain extent, for some healthcare companies may be economically advantageous committing clinical errors, if such errors do not bring any significant negative consequence. In order to prevent such phenomenon, the government should implement a control system to verify the reason why certain patients are treated by the same healthcare company in a brief period of time for the same or consequential pathologies.

4.2 The Clinical Risk Management Framework

Vincent et al. (1998) have proposed a general framework of factors influencing clinical practice and contributing to medical adverse events (Tab. 1).

Table 1. Framework of Factors Influencing Clinical Practice and Contributing to Adverse (Vincent et al., 1998)

Framework	Contributory Factors	Examples of Problems That Contribute to Errors
Institutional	Regulatory context Medicolegal environment National Health Service Executive	Insufficient priority given by regulators to safety issues; Legal pressures against open discussion, preventing the opportunity to learn from adverse events
Organization and management	Financial resources and constraints Policy standards and goals Safety culture and priorities	Lack of awareness of safety issues on the part of senior management; Policies leading to inadequate staffing levels
Work environment	Staffing levels and mix of skills Patterns in workload and shift Design, availability, and maintenance of equipment Administrative and managerial support	Heavy workloads, leading to fatigue; Limited access to essential equipment; Inadequate administrative support, leading to reduced time with patients
Team	Verbal communication Written communication Supervision and willingness to seek help Team leadership	Poor supervision of junior staff; Poor communication among different professions; Unwillingness of junior staff to seek assistance
Individual staff member	Knowledge and skills Motivation and attitude Physical and mental health	Lack of knowledge or experience; Long-term fatigue and stress
Task	Availability and use of protocols Availability and accuracy of test results	Unavailability of test results or delay in obtaining them; Lack of clear protocols and guidelines
Patient	Complexity and seriousness of condition Language and communication Personality and social factors	Distress; Language barriers between patients and caregivers

Although this general framework depicts the main factors contributing to clinical errors, the underling approach proposed by Vincent et al. (1998) is really far from the root-cause analysis perspective and this for almost two reasons. First, the root-cause analysis hypothesizes that there is a single or at least a small number of root-causes, while the practical clinical evidences demonstrate that a clinical error is often the consequence of a wide number of factors. Second, despite the main aim of the root-cause analysis is to find the real cause of the error, the main goal of a deeper analysis should be the identification of the gaps and lacks in the health care system, where the approach is much more proactive and forward-looking (Vincent, 2003). For these two main reasons Vincent (2003) calls this approach “systems analysis”.

4.3. The quantitative model

Based on the causal loop diagram (CLD) described in the previous section, a stock and flow structure has been built, with the main aim to observe the behaviors of the System Dynamics Model.

The figure 1 shows the main stock and flow structure of the hospitalization processes. The first stock (on the figure’s left), represents the number of people of a specific population (for instance, a town) affected by some relevant clinical event, who need to go to the Hospital and, for this, they could potentially became Hospital inpatients, (hereafter called “Omega” Hospital).

From a realistic point of view, an individual affected by a clinical event could:

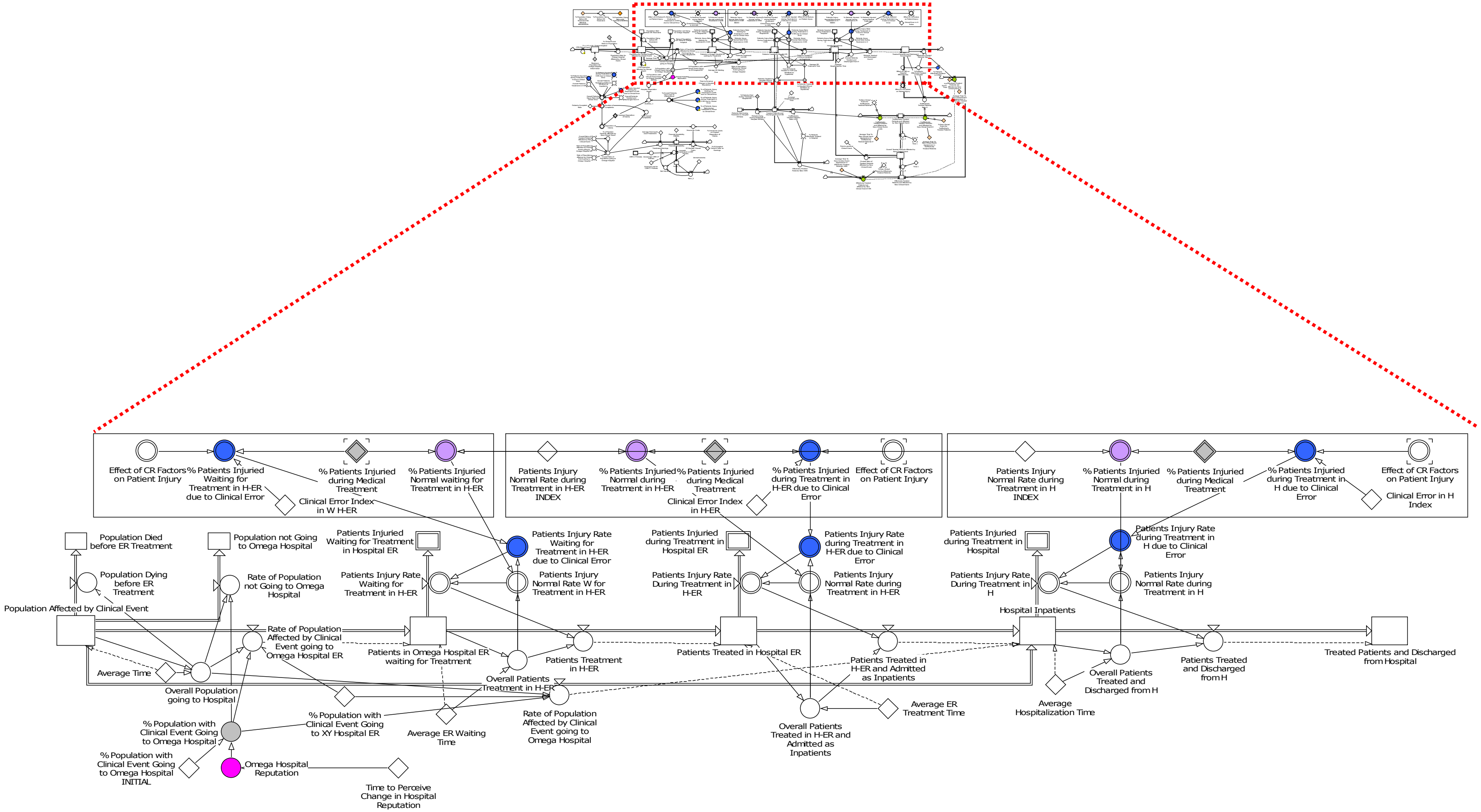
1. go directly to Omega Hospital and immediately became Omega Hospital’s inpatients;
2. go directly to another Hospital and immediately became Hospital’s inpatients
3. go directly to the Omega Hospital Emergency Room and immediately became Omega Hospital-ER’s inpatients
4. unfortunately die before any medical treatment

This is the reason why from the Stock called “Population Affected by Clinical Event” depart four different out-flows, where each of them represents one of the above mentioned alternatives.
Once the inpatients have been hospitalized, they are discharged from the Hospital and can go back home.

As the figure 1 shows, from each of the three patients’ stock (patients waiting for Hospital ER, patients treated by Hospital ER, Hospital Inpatients) depart two main different flows: the first one represents the progression of the hospitalization process, while the second one depicts the negative consequence of every medical activity, that is, the patient injury rate. Conceptually, the patient injury rate can be viewed as the sum of two different rates:

- a patient injury normal rate, which expresses the consciousness that every medical intervention, even if well prepared and managed, can produce a patient injury, as an unavoidable consequence of the patients’ illness and seriousness;
- a patient injury rate due to clinical error, which express the negative consequence for the patient of a medical intervention, where the injuries produced could have been avoided by the medical staff, if it were been better watched the patient safety, respecting more strictly medical procedures and protocols.

Figure 1. Stock and Flow Structure related to the Hospitalization Processes and the Effects of Clinical Risk Management on patients' safety.



The "patient injury rate" variable is affected by the clinical risk factors as defined by Vincent et al. (1998). More in details, Vincent et al. (1998) identify seven different general frameworks of factors influencing clinical practice and contributing to medical adverse events, as they are describe in the Table 1.
Nevertheless, a deep analysis show us that just five of them can be directly affect the clinical practice as managed by the medical staff of an Hospital. In fact, both the institutional and patient frameworks seem to refer at a respectively, macro and micro scenario, while the other five frameworks (Organization and management, Work environment, Team, Individual staff member, Task) refer to factors directly related to medical practice, which can be improved trough clinical risk management policies.

In table 2 the clinical risk Contributory Factors considered in the System Dynamics Model and their initial Values are depicted:

Table 2. Clinical Risk Contributory Factors considered in the System Dynamics Model and their initial Values:

CR Contributory Factors	Initial Values
Financial resources and constraints	0,45
Policy standards and goals	0,39
Safety culture and priorities	0,56
Staffing levels and mix of skills	0,61
Patterns in workload and shift	0,44
Design, availability, and maintenance of equipment	0,53
Administrative and managerial support	0,73
Communication	0,42
Supervision and willingness to seek help	0,64
Team leadership	0,58
Knowledge and skills	0,34
Motivation and attitude	0,29
Physical and mental health	0,31
Availability and use of protocols	0,42
Availability and accuracy of test results	0,37

In table 3 the clinical risk Macro Scenario Factors (Institutional) considered in the System Dynamics Model and their initial Values are depicted:

Table 3. Clinical Risk Macro Scenario Factors (Institutional) considered in the System Dynamics Model and their initial Values:

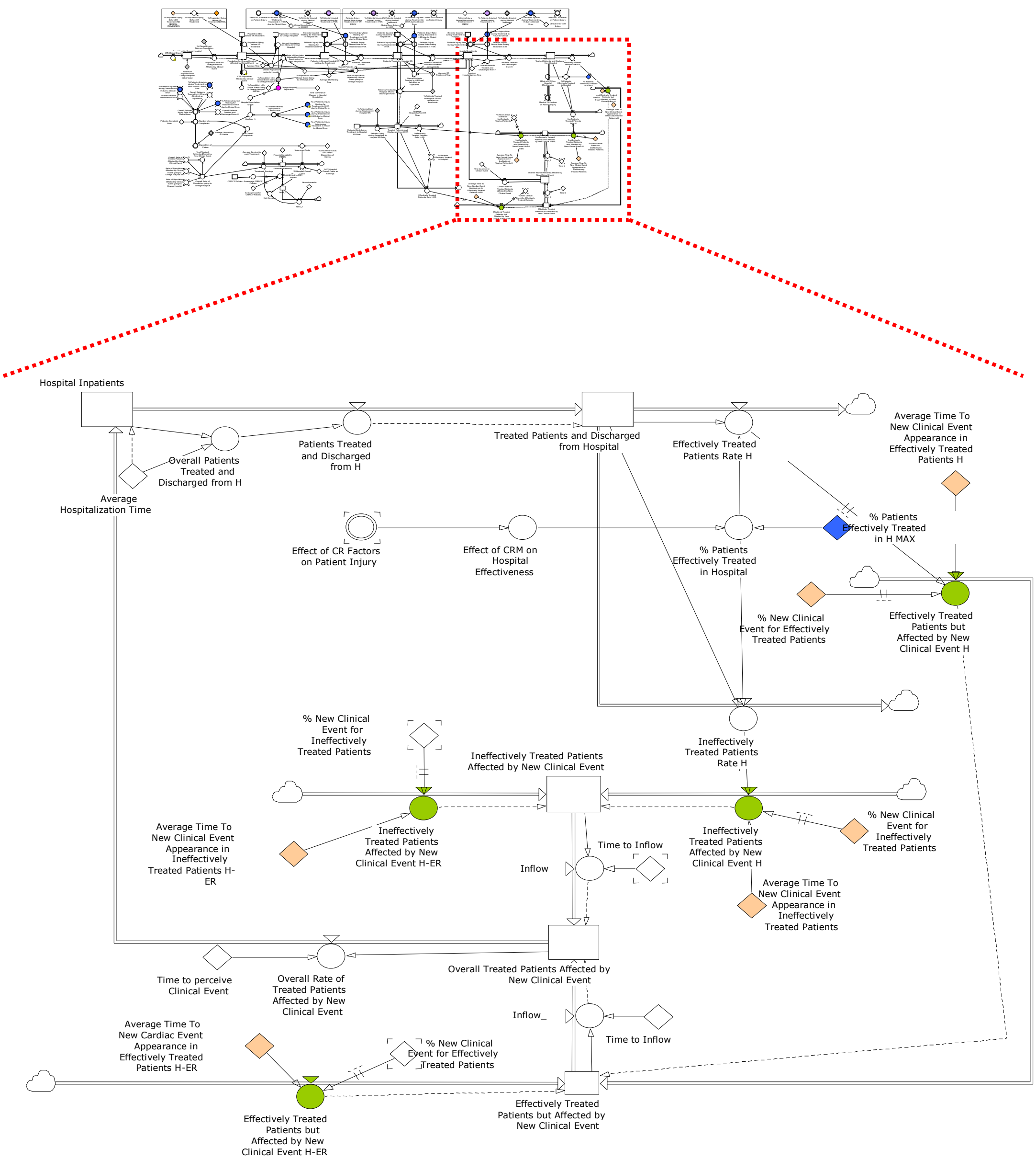
CR Macro Scenario	Initial Values
Regulatory context	0,65
Medicolegal environment	0,75
National Health Service Executive	0,55

In table 4 the clinical risk Micro Scenario Factors (Patient) considered in the System Dynamics Model and their initial Values are depicted:

Table 4. Clinical Risk Micro Scenario Factors (Patient) considered in the System Dynamics Model and their initial Values:

CR Micro Scenario	Initial Values
Complexity and seriousness of condition	0,50
Language and communication	0,40
Personality and social factors	0,70

Figure 2. Stock and Flow Structure of the reinforcing feedback loop of the re-treatments processes.



The figure 2 shows that the augment of the hospital inpatient causes the increase of the medical treatments, which produces the rise of the patients (effectively or ineffectively) treated by medical staff. Some of these patients will need for new medical treatments, due to a new clinical event appearance after a defined average time.

4.4 Test for model validation

The following tests have been applied to the proposed system dynamics model, to verify its validity:

4.4.1 Boundary Adequacy
To define the boundary of the observed system, some interviews with doctors, manager and personnel staff of Healthcare companies have been conducted, in Italy and in China.

4.4.2 Structure Assessment.
Three workshops with Healthcare company's managers have been conducted to assess the stock and flow structure of the SD model.

4.4.3 Dimensional Consistency and Parameter Assessment
Several tests have been conducted to verify if the model equations was dimensionally consistent and if the parameter values assigned to the main SD model variables was coherent with the clinical risk management literature.

4.4.4 Extreme conditions
The SD model has been stressed by several tests to verify its behavior under extreme conditions.

All the runs described in the scenario analysis has been launched after having put the SD model in equilibrium.

5. Scenario Analysis

Based on the qualitative and quantitative analysis of the system structure outlined above, three alternative policies have been compared in order to evaluate their potential effects on the company performance.

As depicted in the table 5, these policies differ by the degree of improvement of the quality of clinical risk contributory factors, which ranges from 0 (very low CRM quality) to 1 (very high CRM quality):
- in the base run, the quality improvement of these factors is equal to zero;
- in scenario 1, there is a small improvement of clinical risk contributory factors;
- in scenario 2, the improvement of these factors is more relevant.

The higher is the degree of CRM quality improvement, the higher is the amount of money the healthcare company has to invest in CRM policies.

According to the first policy, indicated as "base run", the healthcare company decides to not invest in CRM practices and equipments. As shown in figure 3, such a decisions determines a progressive deterioration of CRM quality (indicated as "average value CR contributory factors"), due to obsolescence of medical tools and practices, which leads to an augment of clinical errors, a worsening of hospital reputation and, hence, a reduction of the number of people going to the Omega hospital (indicated as "overall rate of population going to the Omega hospital").

Table 5. The Clinical Risk Management Policies adopted by the Omega Hospital in the three different scenarios.

CRM Policies	Base Run	Scenario 1	Scenario 2
Financial resources and constraints	0	0,12	0,29
Policy standards and goals	0	0,21	0,50
Safety culture and priorities	0	0,08	0,19
Staffing levels and mix of skills	0	0,11	0,26
Patterns in workload and shift	0	0,21	0,50
Design, availability, and maintenance of equipment	0	0,17	0,41
Administrative and managerial support	0	0,07	0,17
Communication	0	0,01	0,02
Supervision and willingness to seek help	0	0,23	0,35
Team leadership	0	0,05	0,12
Knowledge and skills	0	0,14	0,34
Motivation and attitude	0	0,10	0,24
Physical and mental health	0	0,15	0,36
Availability and use of protocols	0	0,12	0,29
Availability and accuracy of test results	0	0,04	0,10

Because of the higher number of clinical errors, the Omega hospital would experiment an increase of the "% of treated patients affected by new clinical events" and of the "% of overall complaints". The reduction of treatments earnings, due to the lesser number of patients, and the increase of insurance costs, due to the higher number of complaints, determine a reduction of company "net earnings".

In the scenario 1, the Omega hospital decides to invest in CRM policies. As shown in figure ----, this decision produces an improvement of CRM quality with a positive effect on all the previously examined performance indicators. The comparison between the base run and scenario 1 shows that an investment in CRM policies brings, in the medium term, higher net earnings. In fact, after an initial reduction of the net earnings due to the investment costs, the economic results improve because of a higher number of patients and a lower number of compensation claims.

As depicted in figure 4, the higher investment in CRM policies represented in scenario 2 determines a better performance with respect to scenario 1. However, the relevant investment costs required by this policy produce, in the short term, a sensible worsening of the net earnings. This could undermine the financial solidity of the Omega hospital. As a consequence, the management could prefer the scenario 1, even though this would imply a lower level of CRM quality.
The adoption of the policy described in scenario 2 could be incentivized by the government, offering to healthcare companies' tax exemptions or other financial aids.

Figure 3. Base Run (Reference) & Scenario 1 (Current)

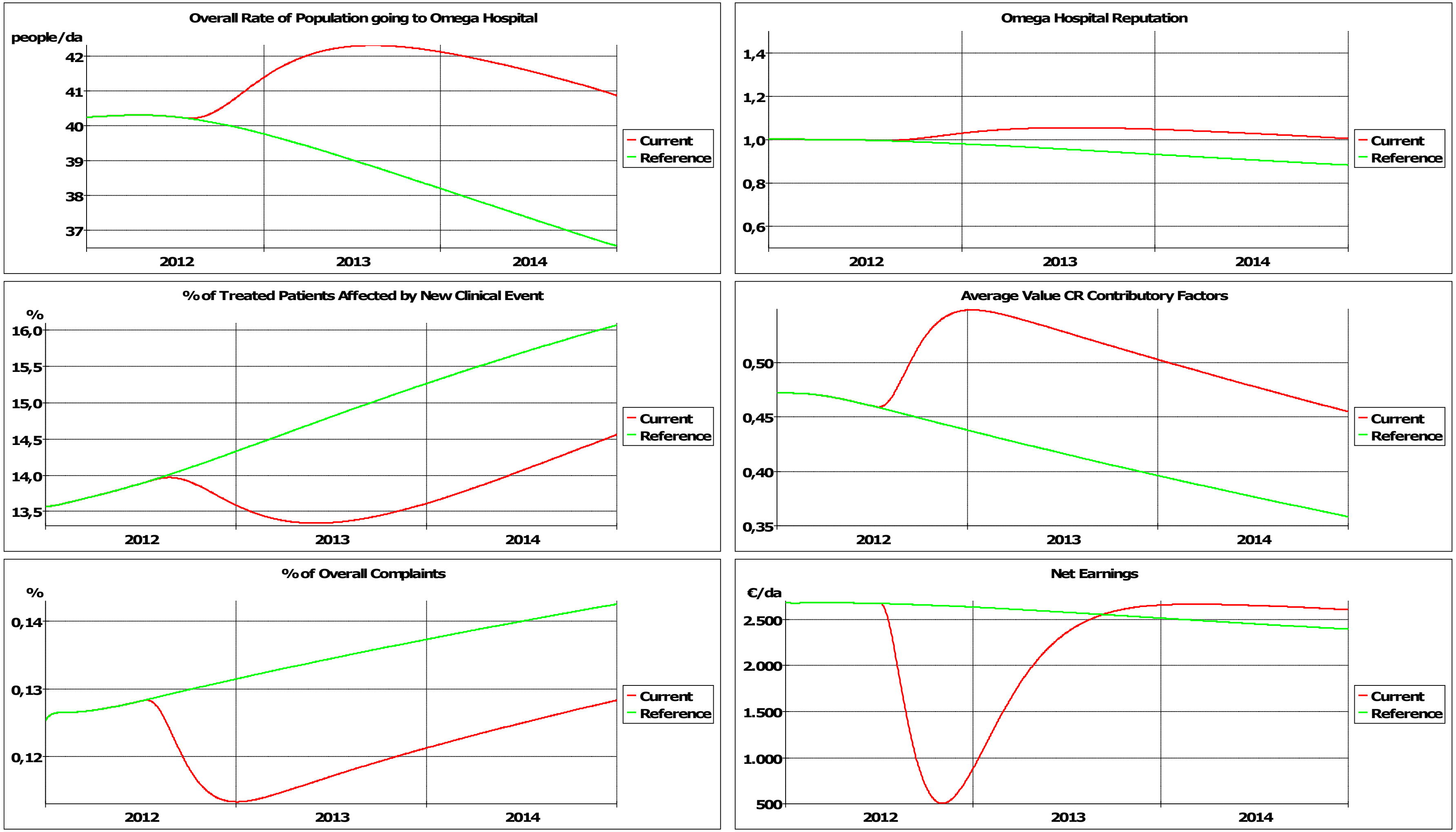
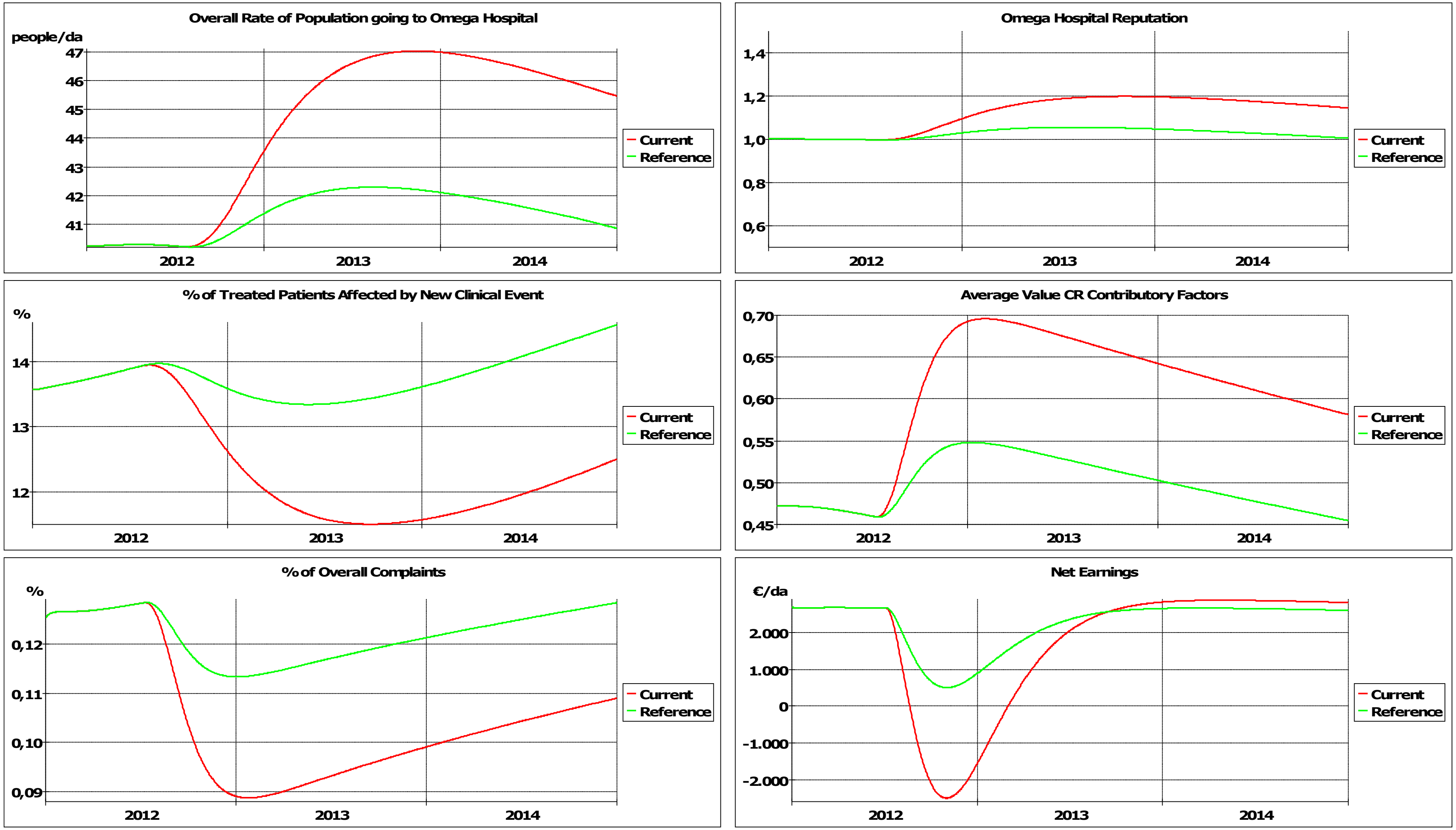


Figure 4. Scenario 1 (Reference) & Scenario 2 (Current)



6. Conclusions

CRM practices do not take into account costs and their effects on personnel management. Furthermore, healthcare companies' managements experiment serious difficulty in quantifying the benefits deriving from investments aimed at reducing the clinical risk.

Such a circumstance may foster wrong evaluations about the opportunity to postpone the introduction of procedures aimed at improving the healthcare companies' risk profile at the expense of patient safety and company image.

Therefore, it is necessary to provide healthcare companies' managements with a systemic and multi-dimensional approach that supports cost-and-benefit analysis of CRM policies.

Based on preliminary results of a research project on SD methodology applied to clinical risk management in Italian healthcare companies, it has been pointed out that for these companies may be convenient to invest financial resources to obtain a certain level of CRM quality. Indeed, according to the simulation results previously described, further investments still improve CRM quality but at the expense of financial results, because the marginal costs related to these further investments are higher than the marginal benefits the companies can obtain. As a consequence, if the national healthcare system aims to obtain a higher level of CRM quality than the healthcare companies' "breakeven" threshold, it should make these investments more convenient through tax exemption policies or other financial aid measures.

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