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A Business Continuity Robustness Assessment Approach Through Disruption's Sociological Indicators

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Abstract. During the last years, International Organizations for Standardization have been developing many quality management tools which are being implemented by several types of organizations. These tools are especially being implemented to manage disasters and reduce activity disruptions' consequences. However, monitoring the performance of the organizational norm requires developing metrics and assessment tools that can be used easily and on a daily basis to make organizations more resilient to crisis situations. The management tool that this research work considers is the "Business Continuity Plan" known as BCP. One way to assess this type of plan is to define, design then test quantifying and qualifying keys to measure its robustness.

Keywords: Business Continuity Management · Sociological factors · Robustness · Assessment tools · Risk Management

1 Introduction

The pandemic of COVID 19 along with the decisions that followed its arrival according to the World Economic Situation Report (WESR) 2021 [1, 2] is a such an important crisis during the last century. The aim of protecting employment and productivity emphasizes the role of the Sustainable Development Goals (SDGs) as a guarantee and impetus for the resilience of countries, businesses and communities. To develop their capacity for future crises, public authorities in many countries have sought to act in the face of the danger posed by the COVID crisis, taking measures to prevent them, to detect the threats, and then try to deal with them. In this research work, the robustness of the Business Continuity Management (BCM) is our main interest. In fact, a BCM is the "holistic management process that identifies potential threats to an organization and the impact those threats,

if realized, can cause on business operations, and provides a framework for building organizational resilience with the capability of an effective response that safeguards the interests of key interested parties, reputation, brand and value-creating activities”. While a BCP is the “document containing the critical information that an organization requires to continue value-creating operations during an unplanned event” [2, 3].

Whereas, **robustness**, explicitly links system dynamics with performance measurements. Therefore, **resilience** concepts about the nature of persistence and transformation in complex systems can be linked to performance measurements and used to make a decision-making framework for **sustainability** operational. Robustness is probably the clearest of these three concepts (robustness, resilience and sustainability), judging by the consistency or accuracy of its use in the literature [4].

Hence, this research work aims at the following:

- a. Define and explain: (i) **the pillars of a BCP** and (ii) **the dependencies of a BCP’s robustness** (Sect. 3).
- b. Propose a **BCP robustness assessment grid** based on (a), (Sect. 4).
- c. Introduce a **case study** then define, design and test **sociological indicators to assess the robustness of the BCP** (Sects. 4 and 5).

2 State of the Art: Setting the Scene and Literature Review

Business continuity (BC) is the organization’s ability to continue to deliver products or provide services with a predefined level of acceptable capability following a disruption. Business continuity management is the process of implementing and maintaining BC to prevent loss and prepare for, mitigate, and manage disruptions [5].

In general, business continuity is unique to an organization. However, its implementation can have implications that may extend to the wider community and other third parties. An organization may have external organizations that it depends on and conversely other organizations that depend on it. Therefore, effective business continuity contributes to a more resilient society [6]. A BCP must function in practice as well as in theory. The goal for an organization should be to be able to address all issues in a controlled and methodical manner without having to open the business continuity guidelines, which should be understood and memorized [7].

Organizations might become overly dependent on the checklists given in existing standards. A BCP is likely to be more helpful if it is utilized as a general support tool to solve any type of crisis rather than only as a guide for a set of predetermined eventualities (although some specific situations could have checklists prepared). These checklists for predetermined circumstances must be developed during the business continuity planning phase and kept up to date during the subsequent maintenance procedure. Managers should learn how to think strategically in risky contexts, which is arguably as essential as learning how to minimize risks or uncertainties [8].

To maintain these checklists for the BCP in particular, the pillars of such a plan should be identified so that the aspects to measure could be determined and thus through designed indicators their assessment could be possible. An example for this demonstration could be that in [9], instead of making use of safety audit type of techniques, which are typically rather time-consuming, more attention was rather be paid on safety

indicators, and in particular those that measure the remote organizational factors. The utilization of indicators will facilitate the demand for a ‘speedy’ evaluation and will also provide quantitative statements of the states of the organizational factors. The indicator values are based on registrations of observable variables carried out during a predefined time period. These values must then be transformed to a “state” for each of the organizational factors. Thus, we only rely on observations/registrations and not on interviews, questionnaires, etc., which are much more time-consuming. However, this puts high demands on the validity of the chosen indicators, both individually and in terms of the total coverage.

Using the same logic in the case of this research work, the term **“rating” or “qualifying” the business continuity factors refers to determining the quality or “goodness” of the factors.** It is a measure of a particular factor’s “state.” The weighting of organizational elements **indicates an evaluation of the robustness that these factors have on the BCP**, either directly or indirectly.

As stated in [6], a resilient society is tied up with robust business continuity. The following section will thus cite and explain the “factors” or “pillars” that this work considers for the BCP and its robustness. However, in the next sections the indicators and the use of the evaluation tool are demonstrated based on the proposed evaluation grid and the factors considered in its design, definition and calculation of the robustness qualifying indicators.

3 Robustness Assessment Grid for BCPs

Through this section, the proposal of our robustness assessment grid is explained. In fact, to design this grid two major factors were considered: (a) the pillars of a BCP; its most important parts and configurations, and (b) the dependencies of a BCP’s robustness; what does the robustness of these plans actually rely on.

3.1 The Pillars of BCP

Figure 1, below shows the main four pillars of a BCP that we are considering in this research work and that are inspired from the ISO 22301:2019 [6]. These four pillars are explained in details in the following paragraphs.

1. Commitment

The commitment, defined as the involvement of the resources, within one organization regardless of its nature and role can be demonstrated by:

- Staff training: Guiding and supporting individuals to contribute to the effectiveness of the BCMS (Business Continuity Management System), promoting continuous improvement and assisting other relevant managers to demonstrate leadership and commitment as it applies to their areas of responsibility.
- Informative meetings: ensuring that BCMS requirements are integrated into the organization’s business processes, ensuring that the necessary resources for the BCMS are available and communicating the importance of effective business continuity and compliance with the BCMS requirements.



Fig. 1. BCP main pillars

- Staff awareness: guide the staff and raise their awareness of the subject of business continuity.

2. Policy

A policy is an organization's method of conduct or a principle of action and could be basically established by:

- Certifications: including and certifying a commitment and know-how to meet applicable requirements.
- Control of standards: Maintaining the certifications level and frequency and providing a framework for setting business continuity objectives.
- Hierarchy and assigned responsibilities (department/team and manager): Defining the responsibilities and authorities, and designing who has the responsibility and authority to: (i) ensure that the BCMS complies with the requirements of this document and (ii) report to the executive desk on the BCMS performance.
- Control of recurring or non-recurring disruptions: including a commitment to continuous improvement of the SMCA and thus better managing the upcoming disruptions. This also implies an estimation of the frequency of the danger (e.g. absenteeism from work) and its potential damage.

3. Support

The business continuity support is the proactive business process that allows identifying potential threats, vulnerabilities, and weaknesses within one organization, and it can be verified and enhanced by the following measures:

- Documentation of a BCP: the organization's BCMS shall include: (i) documented information required by the BCP and (ii) documented information that the organization determines is necessary for the effectiveness of the BCMS.
- Integration of a BCP into the organization's IS (Information System): the documented information required by the BCMS must be controlled to ensure that: (i) it is integrated in the IS and available and fit for use, where and when needed, (ii) it is adequately protected against loss of confidentiality, inappropriate use or loss of integrity, and (iii) it is well-stored and preserved; including readability preservation, version change control, and information retention and disposal.

4. Operation

The operation within an organization is the business's day-to-day value-creating organizational activities and it can be enhanced by:

- Fallback site: a default site can which is defined for the scenario of a major risk that could cause an important disruption of the organization's main activities.
- Use of telecommuting, subcontracting or mutual aid agreements: to have other alternatives to work in the case of difficulties in the workplace under the existing conditions.
- Acquisition of specific equipment on the day of the disaster: equipment needed for fires, attacks, floods and other major risks.

3.2 Factors of the Robustness of BCPs

To start with defining the robustness dependencies and afterward indicators for a BCP, a definition for the robustness itself should be adapted in this concept. Resilience should be as well distinguished from the robustness to avoid any possible misconceptions. Overall, the definitions of robustness and resilience are different in all domains, but we note that they have strong similarities. For robustness, most research works speak of an 'initial state' and of the fact that robustness is qualified in relation to the disturbance that should not modify it or its main functionalities. For resilience, the research works establish a consensus on the capacity of the system to adapt to a disturbance until it returns to the initial state of the system. This adaptation is often described in two phases: the reaction to the disturbance and the response to a return to the initial state [10].

Vulnerability should be as well defined since it belongs to same context and can impact the robustness and resilience of an organization. Vulnerability is typically described as an underlying condition that is distinct from the risky events that may cause the outcome [11]. Sometimes the literature is vague about what constitutes loss or damage, and whether it matters to whom the losses or damages accrue. The literature on disaster management divides vulnerability into two categories: (a) disaster prevention, and (b) disaster response [12].

Thus, the definition that would be adapted in our case is the following: "Robustness corresponds to the ability of the organization to survive and stay under control by the emergence of new organizational patterns, keeping its most important or "vital" activities in continuity when a disruption of any given type occurs." [13].

Therefore, three types of robustness are distinguished:

- a. "Absolute" robustness: total invariance to disturbances.
- b. "Tolerated" robustness: variance within a robustness zone.
- c. "Mastered" or "controlled" robustness: "Mastered" secondary functions are derived from the main invariant function [14].

The second type of robustness is where this research work is situated as the indicators designed within this paper measure the organization's capacity to deal with a "tolerated" disturbance and maintain its most important activities accordingly.

Through the interpretation of the ISO 22313:2020 [5], and as shown by Fig. 2. Below, the robustness of a BCP could be impacted by:

- a. Physical layout of the organization: the organization's premises; its various offices, production units, administrative offices, storage facilities, etc.
- b. Customers and staff satisfaction: the impact of the organization's services on satisfying the customers' and/or staff's needs and meeting their expectations.
- c. Internal management of the staff and skilled workers: the management strategy deployed, the communication to the staff, their evaluation, dispatching, conflict resolution, etc.

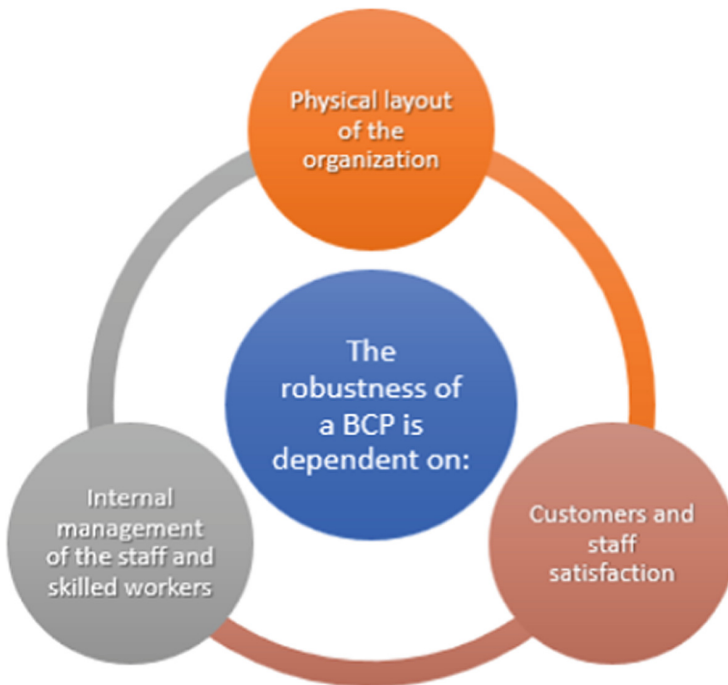


Fig. 2. BCP's robustness dependencies

3.3 The Proposed Evaluation Grid

Based on 2.1 and 2.2, a robustness assessment grid for business continuity plans has been developed. This grid allows a freedom of twelve degrees in order to place sociological indicators of robustness. It includes: (a) 3 repartition layers which represent the dependencies of the robustness of a BCP and (b) 4 improvement axes which consist of BCP main pillars: operation, policy, support and commitment. The Fig. 3. Below represents namely the evaluation grid and its composition.

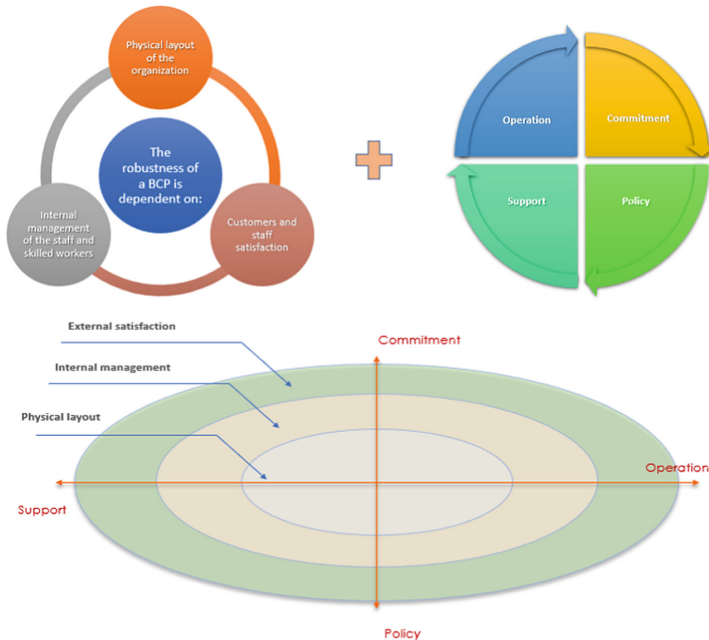


Fig. 3. The BCP robustness evaluation grid

4 Robustness Indicators Proposed from the Sociological Study of the Case Study

To test this research work’s empirical proposal, a case study was considered. In the following paragraphs, we will start by introducing the case study and how the used data was collected. Afterwards, the calculation of the sociological robustness indicators will be explained which we will lead us to their definition and representation. In the following section, the classification of these indicators is detailed in order to justify the evaluation’s grid usability and its interpretation in a real-life situation and a practical field.

4.1 Introduction to the Case Study

In fact, this implementation took place in a pediatric ward of a public middle-sized health-care organization in a city with a population of around 50,000 people in the southwest of France. During the first wave of the COVID-19 pandemic, non-Covid-19 patients had limited access to health care [15]. This was the situation in France, particularly in our case study. As a result, a sociological survey was constructed and addressed to the patients. In the event of a pandemic (such as the COVID-19 pandemic), the hospital is compelled to manage a “crisis inside a crisis.” It must understand the reasons for hospital worker and patient absences (renunciation of treatment). Individual and group human elements must be included in the business continuity plan, including the reasons for absence as well as collective mental representations of threat and risk (fear of being exposed to a

viral threat, panic, and panic caused by rumors). Sociological studies (surveys of patients and workers) enable the profile of people who are most concerned to be recorded (age, education level, distance to the hospital, kind of occupation, and so on). To get further information about the pediatric ward's situation, the patients' survey was completed by some investigations and observations conducted in the health services as an ethnologist in the hospital as in [16] and some additional requested data from the HR department of the staff to survey the development of absenteeism in the pediatric ward before, during, and after the first lockdown in France due to the COVID-19 pandemic.

4.2 The Data Collection Approach

A bottom-up strategy was used to collect the used societal data which are the only type of data considered in the design of the indicators mentioned by this paper. The strategy to collect these data consists primarily of the following steps: (a) definition of the sociological survey, (b) first confirmation with the concerned organization, survey development (c), (d) discussion and modifications, (e) survey update, (f) CNIL (Commission Nationale de l'Informatique et des Libertés) declaration, (g) final organization acceptance, and (h) investigation start.

The key issue explored by this study is the reasons why parents do not bring their children to the hospital on time. As result, a telephone poll was conducted to interview the children's parents about the pediatric ward. This survey consists of around 44 items and was completed by 673 parents of children being treated by this department.

As a result, the parents' responses were recorded using LimeSurvey (a statistical survey and polling program) and then analyzed. In fact, the current study intends to extract certain essential data from the responses of the parents to the survey such as information reflecting their professional stability, life balance, age, distance to hospital, impression regarding the pediatric ward and so on. These essential figures are utilized in the calculation of the sociological indicators of the robustness of the BCP.

4.3 The Crisis Type

In our case, the study of the pediatric ward during the COVID-19 pandemic, the crisis the hospital is facing is actually an event-driven crisis and of a hyper-crisis form (see Fig. 4 for definition). In fact, the hyper-crises can be mostly external as a pandemic or a significant natural disaster such as the Icelandic volcano "Eyjafjallajökull" eruption in 2010 that lead to a cancellation of 95,000 flights and a US\$1.7 billion loss for the airline industry [17]. Major crises can be mostly external as well but with less "worldwide" damage. As per the internal crises, they do basically happen within the firm and affect only its activity and stakeholders. From another perspective based on the occurrence of a crisis, crises can be either frequently occurrent on a daily-basis or related to a certain event such as a storm or a flood [18]. Given this explanation, the crisis that we are dealing with "the COVID-19" and that our case study "the pediatric ward" is facing is basically of an (event-driven; hyper-crisis) nature.

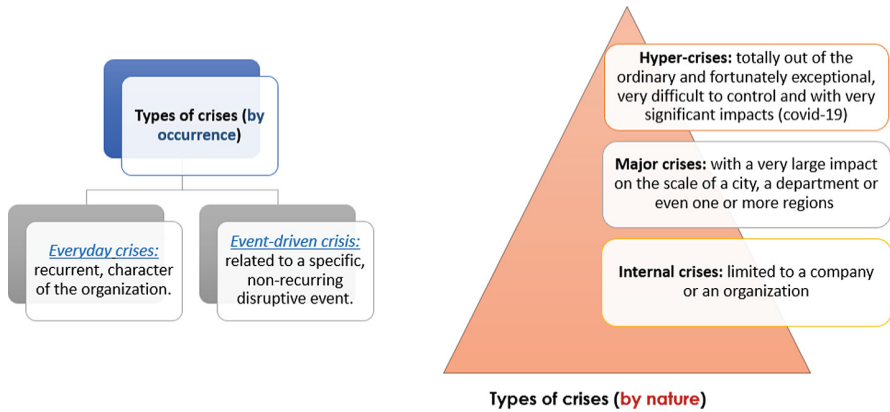


Fig. 4. Types of crises [18]

4.4 Explanation of the Basis for Calculating the Indicators

To obtain a final designed and tested version of the sociological robustness indicators regarding of the case study, several steps were followed:

- a. **Data clustering:** It mainly consist of dividing the data into several categories, such as during the first lockdown and the same period in 2019, absence due to pandemic reasons and causes, socio-professional situation (level of education and nature of work: manager, employee, etc.), economic situation (monthly income, work situation: suspended, unemployed, etc.), professional situation during the first lockdown, and the parental residence.
- b. **Relevant plots representation:** After the sociological data was separated, the necessary digitized responses were utilized to create certain essential graphs, such as displaying the dispatching of appointments during the first lockdown and the parents' refusal based on their employability status.
- c. **Key figures extractions:** Some essential statistics were taken from multiple graphs and processing and put in a "Societal Performance Indicators (SPI) dashboard" so that these key figures may serve as the foundation of the β -version indicators calculation.
- d. **β -version indicators calculation:** Some indicators were determined based on the retrieved important figures as mentioned above. The planned ratios essentially measure the cancellation of appointments during the first lockout, the parents' dropout rates for their children's appointments, the parents' satisfaction with the pediatric ward, and the rate of not attending appointments owing to COVID-19 dread. The ratios are all between 0 and 1, These metrics measure basically: (i) patient satisfaction, (ii) the frequency of interruptions (dropout rates, health effects, not attending appointments, etc.), and (iii) their influence.
- e. **Final γ -version indicators calculation:** Based on the previous steps and the β -version indicators, the γ -version of the indicators was then designed and calculated. The difference consists basically of: (i) the final version indicators qualify and quantify accurately the pillars and factors explained in 3.1 and 3.2, (ii) the indicators assess the robustness of the BCP regarding the societal facet including both patients and the

staff and are easily interpretable for the decision-making of preventive actions, and (iii) these final indicators are perfectly matched with the proposed evaluation grid given by 3.3 and are thus easily placeable and interpretable on the given grid.

4.5 Definition and Representation of the Indicators

Following the approach explained in 4.4, a final version was designed for the sociological indicators of BCP robustness. This version measures both societal aspects that are crucial for the robustness of these plans resulting from the behaviors and impressions of patients as well as the staff. To this, different underlying assumptions could be made. The crisis affects more strongly the less fortunate and less educated populations. All epidemiological surveys point to the existence of structural social inequalities in health: working-class people are always more affected by epidemics, as was the case with COVID19, particularly in serious and fatal forms. These inequalities are reinforced by the decrease in hospital credits. The fewer staff there are, the more important the social capital of the patients is. As a matter of fact, the more the patient belongs to a working-class environment, the less resources he or she has to get out of it on his or her own if the hospital is failing. The hospital therefore plays an essential role in protecting the most working-class environments [19]. Besides, in normal times the hospital staff is insufficient and is often absent because the working conditions are difficult. During the COVID-19 Crisis, the staff gets sick like everybody else, is exhausted because of the high demand on them and is afraid for themselves and their families because they are very exposed to illness and disease. While they are essential, they are potentially missing from the organization.

Therefore, the designed indicators ultimately measure: (a) the relative attendance of the staff (the attendance during the first lockdown period in France: 17/03/2020 to 11/05/2020, compared with the absence during the same period in 2019): the collective absence of the pediatric ward personnel was amplified by 6.25 between the first lockdown period in France and the same time the previous year, (b) the capacity of the pediatric ward, (c) the overall satisfaction rate of the patients' parents, (d) the patient's fear regarding the sanitary situation, (e) the service occupancy and (f) the attendance of the staff during the first lockdown period in France.

The Fig. 5, below illustrates these γ -version indicators, their definitions and formulas. It should be noted that T_{sppC} , $TipC$, $TrpcpC$ and $TrppC$ are sociological robustness indicators resulting from the beta-version of this dashboard and which measure accordingly the **pediatric service parents' satisfaction rate** during the first lockdown, the **health impact rate of children in the pediatric ward** during the same period, the **rate of not attending appointments by fear of becoming infected with COVID-19** and **parent dropout rates for their children's appointments** during the first lockdown.

Once these indicators were calculated, we proceeded to calculate their values and to visualize them in a dashboard. The representation of these ratios is given by the Fig. 6. Below. To interpret these values and evaluate their influence on the robustness of the BCP, we conducted a placement of these indicators in the robustness evaluation grid explained in Sect. 1. In the following section, the classification of the indicators and their signification is treated.

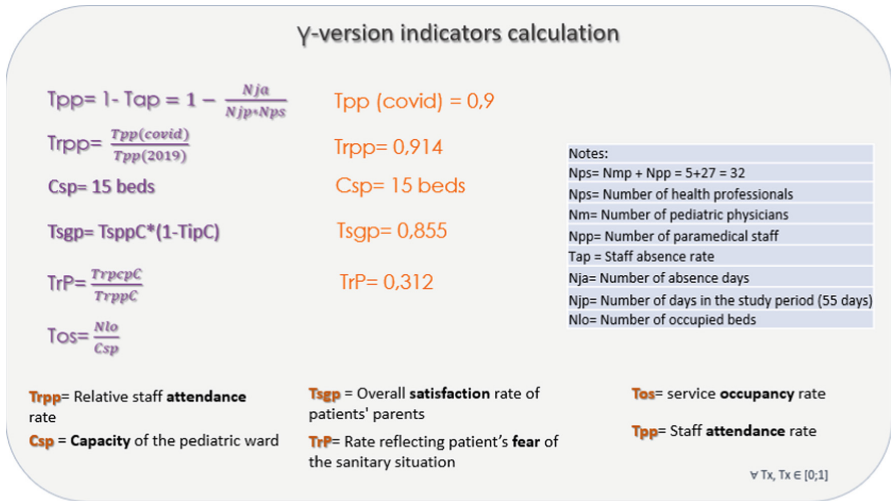


Fig. 5. The γ-version indicators calculation

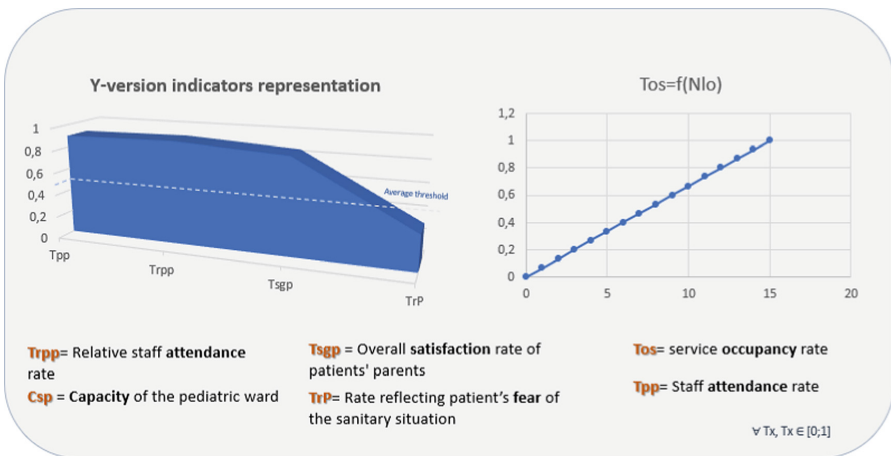


Fig. 6. The γ-version indicators representation

The Task Slippage Coefficient One more exceptional ratio was designed according to a key phenomenon in the sociology of organizations known as “Task Slippage”.

In fact, task “slippage” or “shifting” is the performance of acts that are not related to the duties or rank of the performer [20, 21]. Task shifting therefore raises the issue of accountability, which does not seem to be addressed in the day-to-day work. There are several reasons for this: (a) cyclical reasons such as lack of personnel or an overload of work that results mostly into “occasional” task slippage, (b) structural reasons since the nursing profession is characteristically in the face of a staff shortage [20, 22] or (c) reasons linked to the strategies of the actors; the caregivers do not have a positive feeling

about the tasks they perform and do not find recognition from their care partners by doing “the dirty work” [22].

In our study, these are activities that fall under the purview of the nurse and are carried out by the nursing assistant. Because nursing is a regulated profession, doing nursing actions by a caretaker is considered unlawful nursing practice.

Accordingly, we proceeded to design the task slippage coefficient “Cgt” by analogy to the slippage in the case of an asynchronous motor [23]. The formula given by Fig. 7 below explains the analogy made and the designed ratio to calculate the slippage in one’s tasks during their daily job time. Our proposal consists then of dividing the number of tasks performed per milestone by the number of the planned tasks for the same milestone by a given employee to calculate the task slippage rate.

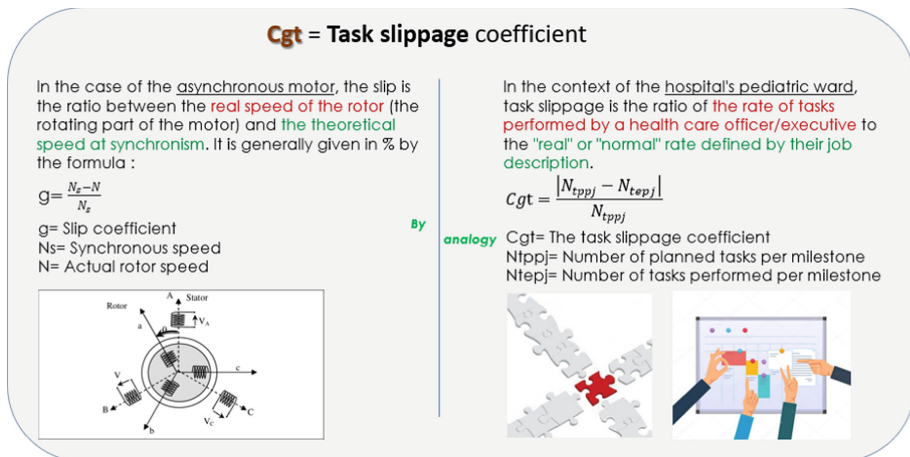


Fig. 7. The task slippage coefficient

5 Discussion and Classification of Indicators in the Proposed Model

5.1 The Classification of the Indicators in the Model

Once the sociological indicators were designed and formulated for measuring the robustness of a BCP, the process of their classification within the BCP robustness assessment grid explained in Sect. 2 was started.

The grid counts 3 layers namely physical layout, internal management and external satisfaction, and 4 axes namely operation, commitment, support and policy. As a result of this topology the evaluation grid counts 12 intersection points known as “classification patches”.

These classification patches are the spots on which the sociological indicators are placed as shown by Fig. 8. Below. For example, the axis “Operation” holds the indicator representing the capacity of the pediatric ward “Csp” in between the physical layout

and the internal management layers. Whereas the relative staff attendance rate “Trpp” is held by the commitment axis and located in between the internal management and the external satisfaction layers. To this, the following representation is written:

- $Csp = OPL-IM = (\text{Physical layout, Internal management}) \text{ Operation}$
- $Trpp = OIM-ES = (\text{Internal management, External satisfaction}) \text{ Commitment}$

Following the same approach, all of the indicators and the classification patches could be assigned and represented.

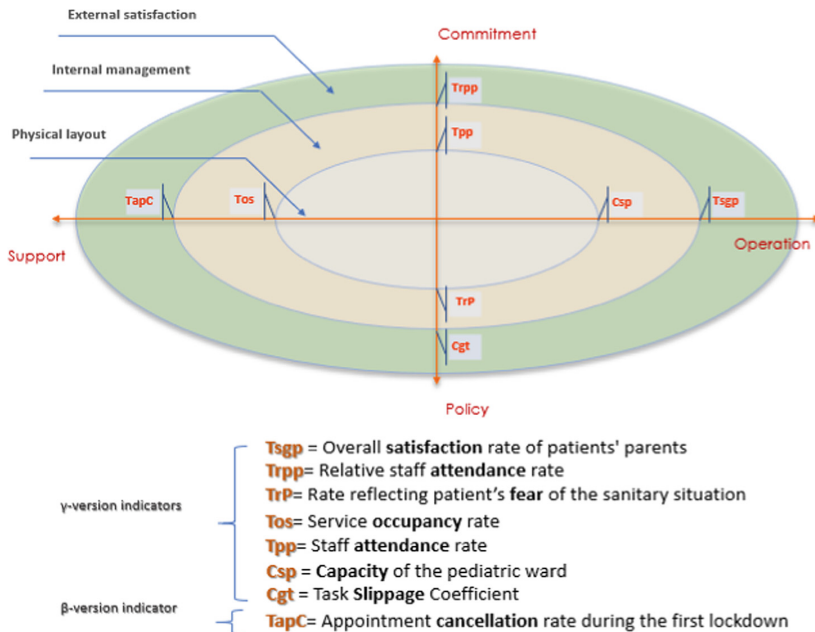


Fig. 8. The classification of the sociological robustness indicators in the assessment grid

5.2 Discussion of the Previous Findings

These indicators once calculated make the qualification of the robustness of the BCP feasible on the four different axes. Since these indicators are basically ratios between 0 and 1, an estimation of “how robust the pillar is” on a certain axis in a given zone can be easily made and thus this helps to adapt the business continuity strategy. So that it would be possible to “evaluate” or “qualify” the main factors of the BCP, the indicators assess these elements’ quality. It is a measure of the “state” of a certain element, basically the four axes in the evaluation grid. The grading of organizational aspects represents an assessment of the impact that these factors have, either directly or indirectly, on the BCP, which are given by the three layers on the grid. This would also lead to think of an assessment tool for this evaluation grid itself in order to maintain its efficiency and guarantee a continuous self-improvement modality such as in [24].

Not to forget that the assessment tool suggested by this paper is completely extensible. For instance, it consists simply of 4 axes, 3 layers and thus 12 classification patches as explained previously but if other sub-factors to its design basis could be considered, these axes and layers would be increased and thus multiply the number of the classification patches and accordingly the indicators to design and to place. For example, the risk assessment and mapping framework suggested in [25], offers an extensible substance database that includes information on the structural and physicochemical properties of chemicals in order to define hazardous substances found in plant units. To identify chemicals, data such as name, chemical number are employed. The property definition framework is used to specify the physicochemical properties of substances. However, a property estimating framework is used to estimate ‘missing property’ data. By doing such; implementing an “estimating” framework for the missing data, other ‘missing subfactors’ to the BCPs and its robustness could be identified and thus an extension could be made to this paper’s proposal which is a fully extensible assessment grid based on the qualifying factors within the business continuity literature.

Additionally, the case study presented in this paper demonstrates only one usage of the grid with the instantiation of calculated indicators in a real-life situation such as the COVID-19 pandemic. One way to refine the explained methodology and generalize it could be: (i) build an ontological framework for the BC, (ii) use it to generate some survey-based generic robustness indicators that could be used for different types of organizations and disaster scenarios, (iii) extract a part of the generated indicators following the organization’s type and the considered crisis, and (iv) calculate the indicators based on the use case’s data. Indeed, using a reasoner and an ontology could semantically generalize item features, improving the effectiveness of the decision tree constructed in [26]. The same could be done to generalize a set of indicators and, as a result, the potential threats they represent [27].

In the next section, the conclusion, other limitations to this work are discussed. The future works are consequently proposed and explained. Finally, an auto-evaluation of the paper’s contribution is provided to conclude this work.

6 Conclusion

This research work proposes an assessment grid for the robustness of BCP and tests this proposal using sociological indicators designed following a societal data collection and interpretation approach. Whereas the proposal was tested considering one case study and its societal data, several other types of data can be used as well which will lead to other robustness indicators. In fact, not only societal data can be used and sociological indicators to assess the robustness of a BCP but rather other types of data (financial, technical, etc.) that we don’t discuss in this paper.

Another limitation of this work and thus an improvement future work possibility is that the evaluation consists simply of 4 axes (operation, policy, commitment and support), 3 layers (physical layout, internal management and external satisfaction) and thus 12 classification patches but by considering the sub-factors of the robustness factors themselves and/or the sub-pillars of the BCP pillars these axes and layers could massively increase and thus the classification patches would be multiplied. This would make

it possible to assess the BCP robustness more precisely using more designed robustness indicators of different types (technical, financial, social networks, etc.) and following many subfactors.

At this point, this research work allows to evaluate the robustness of the BCPs based only on sociological indicators but proposes on the other hand, from the literature, an evaluation model valid for all types of indicators and which is particularly extensible by following the same tracks of its design. This gives the possibility to three future works: (a) the extension of the robustness evaluation grid of BCPs, (b) its verification using different types of data and therefore indicators such as technical, social networks, financial and so forth and (c) its application on a second use-case of a different nature.

References

1. Zhenmin, M.L.: World Economic Situation and Prospects (2021)
2. Corrales-Estrada, A.M., Gómez-Santos, L.L., Bernal-Torres, C.A., Rodriguez-López, J.E.: sustainability and resilience organizational capabilities to enhance business continuity management: a literature review. *Sustainability* **13**, 8196 (2021). <https://doi.org/10.3390/su13158196>
3. ISO 22300:2021(en), security and resilience — vocabulary. <https://www.iso.org/obp/ui/#iso:std:iso:22300:ed-3:v1:en>
4. Anderies, J.M., Folke, C., Walker, B., Ostrom, E.: Aligning key concepts for global change policy: robustness, resilience, and sustainability. *Ecol. Soc.* **18**(2) (2013)
5. ISO 22313:2020(en), security and resilience—business continuity management systems—guidance on the use of ISO 22301. <https://www.iso.org/obp/ui/#iso:std:iso:22313:ed-2:v1:en>
6. ISO 22301:2019(en), security and resilience—business continuity management systems—requirements. <https://www.iso.org/obp/ui/#iso:std:iso:22301:ed-2:v1:en>
7. Lindström, J., Samuelsson, S., Hägerfors, A.: Business continuity planning methodology. *Disaster Prev. Manage. Int. J.* **19**(2), 243–255 (2010). <https://doi.org/10.1108/09653561011038039>
8. Bazerman, M.H., Moore, D.A.: Judgment in Managerial Decision Making, 7th edn. John Wiley & Sons, Hoboken (2009)
9. Øien, K.: A framework for the establishment of organizational risk indicators. *Reliab. Eng. Syst. Saf.* **74**(2), 147–167 (2001). [https://doi.org/10.1016/s0951-8320\(01\)00068-0](https://doi.org/10.1016/s0951-8320(01)00068-0)
10. Clément, A., et al.: Robustesse, résilience : une brève synthèse des définitions au travers d'une analyse structurée de la littérature. Presented at the mosim'18 - 12ème conférence internationale de modélisation, optimisation et simulation, p. 8, June 2018
11. Webb, P.: Coping with drought and food insecurity in Ethiopia. *Disasters* **17**(1), 33–47 (1993). <https://doi.org/10.1111/j.1467-7717.1993.tb00486.x>
12. Siegel, B., Jorgensen, L.: Vulnerability: a view from different disciplines. In: Social Protection Discussion Paper Series, vol. 115 (2001)
13. Wybo, J.-I.: The role of simulation exercises in the assessment of robustness and resilience of private or public organizations. In: Pisman, H.J., Kirillov, I.A., (eds.) Resilience of Cities to Terrorist and Other Threats, pp. 491–507. Springer, Dordrecht (2008). https://doi.org/10.1007/978-1-4020-8489-8_23
14. Clément, A.: Proposition d'indicateurs de robustesse basés sur la prise en compte des risques afin d'évaluer les tournées de transport routier de marchandises. These de doctorat, école nationale des mines d'albi-carmaux (2019)

15. Negrini, S., et al.: Up to 2.2 million people experiencing disability suffer collateral damage each day of Covid-19 lockdown in Europe. *Eur. J. Phys. Rehabil. Med.* **56**(3), 361–365 (2020). <https://doi.org/10.23736/s1973-9087.20.06361-3>
16. Breton, D.: Anne vega, une ethnologue à l'hôpital. L'ambiguïté du quotidien infirmier. Paris, éditions des archives contemporaines, 2000, 213 p., réf., **25**(2), 179–180, (2001). <https://doi.org/10.7202/000246ar>
17. Lund, K.A., Benediktsson, K.: Inhabiting a risky earth: the eyjafjallajökull eruption in 2010 and its impacts (respond to this article at <http://www.therai.org.uk/at/debate>). *Anthropol. Today* **27**(1), 6–9 (2011). <https://doi.org/10.1111/j.1467-8322.2011.00781.x>
18. Pearson, C.M., Mitroff, I.I.: From crisis prone to crisis prepared: a framework for crisis management. *7*(1), 48–59 (1993). <https://doi.org/10.5465/ame.1993.9409142058>
19. Buchet-Molfessis, C.: glissements de tâches de l'infirmier vers l'aide-soignant: le lien entre la formation initiale et le positionnement des nouveaux diplômés. *recherche en soins infirmiers* **92**(1), 68–94 (2008). <https://doi.org/10.3917/rsi.092.0068>
20. Michaud, S.: les glissements de tâches des infirmiers vers les aides-soignants: quelle stratégie le directeur des soins peut-il adopter? (2004)
21. Sainsaulieu, I.: le malaise des soignants: le travail sous pression à l'hôpital. le malaise des soignants, pp. 1–238 (2004)
22. De Barros, F.: Anne-marie arborio, un personnel invisible. Les aides-soignantes à l'hôpital, paris, anthropos-economica, coll. Sociologiques, 2001, rééd. 2012, 334 p. *Corps* **14**(1), 177–180 (2016). <https://doi.org/10.3917/corp1.014.0177>
23. Fayyad, S., Al-Rawashdeh, M.O.: Factors affect slipping of automobiles. *WSEAS Trans. Syst. Control* **15**, June 2020. <https://doi.org/10.37394/23203.2020.15.26>
24. Caffyn, S.: Development of a continuous improvement self-assessment tool. *Int. J. Oper. Prod. Manage.* **19**(11), 1138–1153 (1999). <https://doi.org/10.1108/01443579910291050>
25. Girgin, S., Krausmann, E.: RAPID-N: Rapid natech risk assessment and mapping framework. *J. Loss Prev. Process Ind.* **26**(6), 949–960 (2013). <https://doi.org/10.1016/j.jlp.2013.10.004>
26. Bouza, A., Reif, G., Bernstein, A., Gall, H.: SemTree: ontology-based decision tree algorithm for recommender systems (2008). <https://doi.org/10.5167/uzh-5392>
27. Daniel L. Costa, M.L.C., Samuel J. Perl, M.J.A., George J. Silowash, D.L.S.: An ontology for insider threat indicators--development and applications. Carnegie-Mellon Univ Pittsburgh Pa Software Engineering Inst (2014)