

USING SYSTEM DYNAMICS TO ADAPT BUSINESS MODELS TO CHANGING CONDITIONS

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ABSTRACT

This paper addresses the problem of determining organizational adaptations to ensure business continuity. We propose a methodology to assess the impact of disruptions on a business model and evaluate interventions using System Dynamics archetypes. The methodology aims to contribute to making decision-making more effective and efficient in an uncertain scenario.

1 INTRODUCTION

Uncertainty and crises have always existed, but the recent pandemic has had far-reaching effects on businesses, resulting in closures, supply chain breakdowns, changes in work practices, shifts in consumption patterns, and increased pressure for digital transformation among established companies. This heightened vulnerability defines a scenario where organizations must be prepared for periods of transformation and systemic change (Sánchez and De Batista 2023). Some disruptions show that the business model is inadequate for new conditions.

Although there are procedures, techniques, and standards developed for business continuity management, there are barriers and limitations that often compromise the development of continuity plans (Sánchez and De Batista 2023). Niemimaa et al. (2019) note that while Business Continuity techniques primarily focus on preserving value, they fail to consider contingencies that may challenge the underlying logic of the business model. Darkow (2019) argues that in the aftermath of a crisis, organizations should not simply aim to revert to the previous status quo. Instead, they should restructure their processes, and adapt their business models. However, redefining a business model is a complex task as interventions taken to address a problem can lead to unintended consequences in the medium or long term.

It is very important to find effective ways to manage business continuity during times of crisis. The objective of this study is to define a methodology that enables organizations to navigate crisis scenarios and determine the necessary adaptations to ensure continuity. Our proposal includes a participatory approach, encompassing activities ranging from problem identification to the evaluation of different interventions.

2 METHODOLOGY FOR BUSINESS MODEL ADAPTATION

The Business Model Canvas (BMC) (Osterwalder and Pigneur 2010) is a strategic management tool that provides a visual representation of business logic and hence it is good to communicate and aid in a participatory discussion with different stakeholders. To understand the impact of a disruption, it is helpful to begin by examining how it affects the different elements of the BMC.

We propose to understand the effect of a disruption by examining each of the BMC components. As a result of the analysis, preliminary adaptations or interventions arise. Each adaptation poses a decision problem, and we create a Causal Loop Diagram (CLD) (Sterman 2010) and identify key feedback loops. Once the key feedback loops are identified, an archetype (Wolstenholme 2003) can be matched or can help to complete the model with additional loops. These archetypes help us understand the dynamics of systems and how different variables interact with each other over time. Once the archetypes are matched to the

feedback loops, we consider how the feedback loops influence the performance, sustainability, and resilience of the business model. Simulating various scenarios using the identified archetypes can help us better understand how changes may affect the way the business operates. This iterative process allows to better align the business model with the dynamics of the environment in which it operates (see Figure 1). This can inform strategic decision-making and help identify leverage points for intervention.

	Uncertainty analysis	Disruption contextualization	Solution contextualization	Articulate the problem	Dynamic hypothesis formulation	Simulation model development
Procedure	Determine internal and external causes of uncertainty.	Determine adaptations in BMC. State required actions and intended consequences.	Examine how actions may impact BMC's components in search of unintended consequences. Match action and consequences with archetypes.	Define the problem, relevant variables, time horizon.	Model problem and solution based on selected archetype (s).	Translate CLD in simulation language. Define parameters and initial conditions.
Method	Participatory workshop.	Participatory workshop. BMC.	Participatory workshop. BMC.	Adapted BMC and selected archetype (s).	System dynamic modeling. Causal Loop Diagram.	Simulation.
Outputs	Definition of uncertainty causes. Preliminary course of actions.	Adapted BMC.	KPIs to monitor intended and unintended consequences. Adapted BMC.	Problem statement.	CLD of problem and solution.	Simulation model. Data regarding proposed solution.

Figure 1: Summary of the proposed methodology to guide a Business Model adaptation to disruptions.

The methodology has been applied to a manufacturing plant. Given an increase of demand, the initial strategy was increasing working hours but a decrease in productivity is observed during the first month. The underachievement archetype has shed light on the recognition that investing additional hours results in heightened employee exhaustion, consequently leading to a decline in productivity. Table 1 summarizes the simulation results of four policies (using software Stella™ 9.1.4). Policy 3 results in more sales.

Table 1: Simulation results of four policies combining additional employees and extra hours of work.

Policy	Employees	Extra employees	Hours of work	Extra hours	Backlog at day 180	Sales at day 180
1	20	0	4	0	234	8384
2	20	0	4	4	131	8616
3	20	10	4	0	162	8711
4	20	10	4	2	116	8701

3 FUTURE WORK

The results of this study contribute to the existing body of knowledge by expanding the range of available management tools and enhancing the understanding of crisis management. We plan to deepen the use of archetypes to different business problems and abstract common relationships within a business model.

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