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Application of Multi Criteria Decision Making (MCDM) to Analyse the Impact of External Environment on Innovation Ecosystem

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Introduction

The Innovation ecosystem has become an emerging area of academic research within the last 15 years Grandstrand and Holgersson, 2020) and this has been recognized as a key element to achieve value proposition in particular for innovative firms (Talmar et al. 2020). However, no comprehensive approach has been developed in order to understand the extent to which this ecosystem is affected by external environment and if any remedial action needs to be taken by the firms in order to bring the ecosystem back to its normal status following a major external event/shock with a severe impact or potential disruption.

Purpose

The purpose of this research project is to understand and investigate the impact of the external event/shock on an innovation ecosystem as a whole. In the context of exogenous shocks there are various impacts on ecosystems which needs to be investigated and these can be evaluated by applying various theories such as multi criteria decision making and the context of variety within the big data context. This research will investigate the ecosystem as a whole and how it is affected by the environment given the theoretical lens of Multi Criteria Decision Making (MCDM) and in particular Analytic Hierarchy Process (AHP), in the context of how big data can be analyzed via using decision making theories.

Design / methodology

This research project uses a mixed methods approach for data collection and data analysis. The input data relevant to the decision-making model will be qualitative and these will be collected from the industry/business experts via online/email surveys. These data will be then transformed into quantitative values using the AHP standard process and these quantitative values will be then used by AHP for making decisions about the severity of impact. The research strategy will be case study and we consider an external event/shock as a case for investigation.

Findings

This study is part of a larger research which focuses on understanding the resilience of an innovation ecosystem. The provisional results of this study show that a decision- making model can be developed in order to identify the severity degree of impact relevant to external environment events on an innovation ecosystem, as a whole. This model use PESTEL (Political, Economic, Social, Technological, Environmental and Legal) as the key external factors to analyse the external events/shock, influencing an innovation ecosystem. This model will also provide invaluable insights about identification of a critical factor (out of above 5 external factors) which contributes the most to the selected/desirable severity degree of impact.

Practical implications

This research explains how an innovation ecosystem can be explained when considering the impact of the environment. Decision making can be explained in this context for practitioners by showing which elements are critical when considering the impact of the environment on the innovation ecosystem.

Originality / value

The concept of the *ecosystem* has its roots in the science of ecology, and is conceptualized based on the movements of material and energy. Shaw and Allen (2018, p. 90) defined it to be the "recycling flows of nutrients along pathways made up of living subsystems which are organized into process-orientated roles; connects living and non-living subsystems; energy gradients power recycling of scarce nutrients, e.g. a rainforest". Business ecosystems and more specifically innovative ecosystems are considered to be '[t]he collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution' (Adner, 2006 p.2). Other definitions have been offered such as an innovation ecosystem approximating an interconnected network of companies and other entities that develop capabilities around a shared set of technologies, knowledge, or skills, and work together and competitively to create new products and services (Moore, 1993). Three defining attributes of an innovation ecosystem are the dependencies which exist among the constituents (the constituents' performance and survival are tightly linked to that of the ecosystem), a common set of goals and objectives (shaped by the ecosystem-level focus on a unique customer value proposition), and a shared set of knowledge and skills (complementary set of technologies and capabilities) (Adner and Kapoor, 2010; Iansiti and Roy, 2004; Teece, 2009).

The review on the definition of innovation ecosystems by Granstrad and Holgerson (2020 p.8) shows that actors, artefacts, and activities are all elements in an innovation ecosystem, linked together through relations, including complement and substitute relations. The review also points to the importance of institutions and the developing nature of innovation ecosystems, and that these components are key to the definition of innovation ecosystems.

An organization and its internal systems are in frequent communications with external/macro environments (such as markets etc.) which are volatile, and they are being influenced by this environment on a regular basis with the potential increasing risk of this influence turning to disruptions. Resilience is regarded as the ability of a system and elements of that system to return to its stable status after being disrupted by an external environment event/incident (Burnard and Bhamra, 2011). This disruption may or may not happen depending on the severity of the impact of external event/incident and considering political, economic, social, technological, environmental and legal implications of that event/incident as the key elements/factors of the relevant impact (Yüksel, 2012).

Having defined a business ecosystem earlier, this research project looks specifically at the level of impact imposed by an external environment incident/event on this ecosystem. Considering that the identification of level of impact can be viewed as a decision-making problem, this research is using Multi Criteria Decision Making (MCDM) and in particular Analytic Hierarchy Process (AHP) theories to investigate this phenomenon. AHP was first developed by Thomas Saaty in 1971 (Wind and Saaty, 1980) and it uses a very structured process in order to make decisions based on a set of qualitative and/or quantitative factors/criteria (Taherdoost, 2017)

In this research, AHP uses the relevant external impact factors as the criteria to make decision about the level of impact imposed on a business ecosystem by an external environment event/incident. The decision alternatives here are classified as low-level impact (i.e. likelihood of the ecosystem to be disrupted is low), medium-level impact (i.e. likelihood of the ecosystem to be disrupted or not is equal), and high-level impact (likelihood of the ecosystem to be disrupted is high). The following figure also demonstrates a schematic view of the AHP conceptual decision-making model for this specific context.

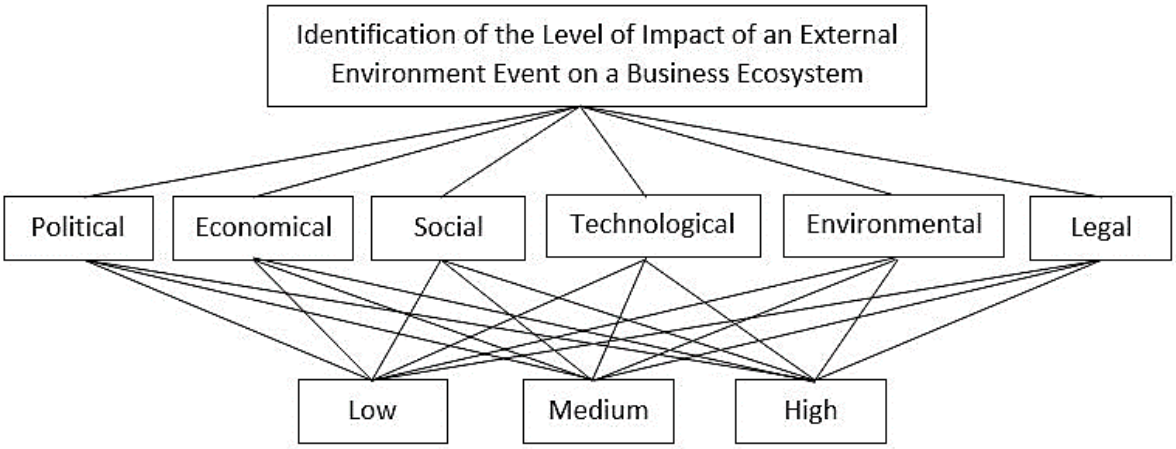

Figure 1: a schematic view of the conceptual decision-making model for analysis of the impact of an external environment event on a business ecosystem

A digital/computerized model of above conceptual model is to be developed in the next step and the model is going to be run multiple times using data from real-life external events. This research uses primary and/or secondary sources of data as the inputs for this AHP model. These data will be collected for all relevant external impact factors, which reflect the variety and volume elements of big data concept. The AHP model itself can also be regarded as an innovative way of handling specifically the "variety" element of big data since it addresses different analytical aspects of a phenomenon.

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