Technological Forecasting & Social Change xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

Strategic flexibility analysis of agrifood nanotechnology skill needs identification

Robert M. Yawson [a,*], Bradley C. Greiman [b]

[a] Department of Healthcare Management & Organizational Leadership, School of Business, Quinnipiac University, 275 Mount Carmel Ave., Hamden, CT 06518, United States
[b] Division of Applied Economics and Agricultural Education, University of Minnesota, 146J Ruttan Hall, St. Paul, CT 55108, United States

ARTICLE INFO

Article history:
Received 23 March 2016
Received in revised form 1 September 2016
Accepted 12 February 2017
Available online xxxx

Keywords:
Human resource development
Nanotechnology
Systems approach
Skills needs forecasting
Scenario analysis
Strategic flexibility framework
Workforce development

ABSTRACT

The world is experiencing significant, largely economic and sociotechnical, induced change. These induced changes are meaningful with a function of people taking collective actions around common beliefs. These changes are more than jargon, cliché, and hyperbole, and they are effecting major transformations. These transformations will impact on how human resources are developed, and we need to be able to forecast its effects. In order to produce such forecasts, Human Resource Development needs to become more predictive - to develop the ability to understand how human capital systems and organizations will behave in future. As part of a multi-phase, mixed methods study design based on systems and complexity theories to identify skill needs for the emerging agrifood nanotechnology sector, a strategic flexibility analysis (SFA) was conducted. Strategic Flexibility Framework (SFF) is a scenario analysis tool and its use in this study is based on the idea that Business Leaders, Managers, Educators and Human Resource Development professionals require flexibility to adjust decisions within given constraints. This paper describes the use of strategic flexibility analysis and the qualitative systems approaches as tools for systems research and it implications for human resources development and management.

1. Background of study

The world is experiencing significant, largely economic and sociotechnical, induced change. These induced changes are meaningful with a function of people taking collective actions around common beliefs. These changes are more than jargon, cliché and hyperbole, and they are effecting major transformations. These transformations however, should consistently meet the growth expectations of various constituents in an increasingly competitive global marketplace through a kind of leadership that solves complex social, economic, and political problems by leveraging the opportunities of an interconnected world (Holliday, 2013; Scheinfeldt, 2012).

These game changing developments have the dimensions of space and time. An action of a group of people or individual can have a game changing impact in just a particular locality or region; or can have global impact (Yawson, 2015). These transformations will impact on how human resources are developed and we need to be able to forecast its effects. In order to produce such forecasts, Human Resource Development (HRD) needs to become more predictive - to develop the ability to understand how human capital systems and organizations will behave in future.

Further development of systems models is required to allow such predictions to be made. Critical to the development of such models will be to understand that linear epistemology cannot be the dominant epistemology of practice and that dynamic complexity of challenges confronted by HRD professionals in their daily research and practice requires a nonlinear epistemology of practice, rather than reductive or linear thinking or processes of normal science (Yawson, 2013). Central to this will be the use of systems approach in HRD research. A systems approach in which physiognomies of one level in a hierarchy are reconnoitered as emergent properties of processes lower down in the hierarchy (Norris, 2012), will be important for making HRD predictions in novel conditions. The reason for this is that systems approaches do not assume that the validity of a systems description is interminable (as do phenomenological models by definition), "they rely on the fact that the internal processes will continue to operate into the future and that their operation will be in some way altered by the changed conditions" (Evans et al., 2012, p. 164). The higher order emergent properties change as a consequence of the shifts in the internal processes not because the higher order effects themselves have been projected into the future (Evans et al., 2012).

Although the adoption of a systems approach to research in HRD is not novel, methodologies and concepts underlying the approach are not very well developed. In a mixed methods study to identify skill needs for agrifood nanotechnology, a comprehensive methodology was developed for a systems approach research in agricultural education, public policy and HRD. In this paper, scenario planning analysis methodology that was developed as part of a novel method in conducting systems approach research in human resource development is described.

This study was part of a multi-phase, mixed methods study design (Creswell & Plano-Clark, 2011) based on systems theory and complexity

* Corresponding author.
E-mail addresses: robert.yawson@quinnipiac.edu (R.M. Yawson), bgreiman@umn.edu (B.C. Greiman).

http://dx.doi.org/10.1016/j.techfore.2017.02.019
0040-1625/

theory. The main study was an interdisciplinary study involving disparate fields of systems theory; nanoscience and nanotechnology; science policy; agricultural education; human resource development and workforce education. The research was based on theory that accounted for the dynamic aspects of systems modeling, complexity theory, skill identification and workforce development. This interdisciplinary approach was predicated on the conception that "disciplinarity is no longer the dominant system for creating and organizing knowledge, and that knowledge creation is now trans-disciplinary, more reflexive, non-linear, complex and hybridized" (Yawson, 2009, p. 9). Lubet (2009) in discussing his pioneering role in the field of Disability Studies in Music described this scholarly approach as the tenets of "epistemology of interdisciplinarity" (p. 120).

The main multiphase study followed a four-step process involving different methods and approaches. The first phase marked (1) in the schematic diagram in Fig. 1 involved a comprehensive systematic evidence review (SER) and analysis of the literature. This phase of the study was also used to identify key experts, conduct stakeholder analysis, and formulate questions for in-depth and semi-structured interviews. The second phase of the study, marked [2] in the schematic diagram used multi-criteria approaches for value elicitation including surveys and semi-structured interviews with key stakeholders and experts to identify current and future skill needs in agrifood nanotechnology sector. The third phase of the study (marked [3] in the schematic diagram) included Qualitative Systems Analysis (QSA); Quantitative Data Analysis (QDA); and Strategic Flexibility Analysis (SFA) (a scenario analysis method) of evidence from the literature and results from the multi-criteria value elicitation of experts and stakeholders. The final phase of the study (marked [4] in the schematic diagram) created a systems model from the QDA, QSA and SFA to describe holistically the current and future skill needs and the important links, interrelationships and apparent themes and patterns identified in the prior phases. This paper describes the use of Strategic Flexibility Analysis as a Tool for Systems Research and it implications for management practice.

2. Strategic flexibility framework: a scenario analysis tool

The Strategic Flexibility Framework (SFF) is a scenario analysis tool and its use in this study is based on the idea that Business Leaders, Managers, Educators and Human Resource Development professionals require flexibility to adjust decisions within given constraints. Various definitions of 'scenarios' can be found in the literature. Bradfield et al. (2005:796) have contended that "there appears to be virtually no area in scenarios on which there is wide-spread consensus; the literature reveals a large number of different and at times conflicting definitions, characteristics, principles and methodological ideas about scenarios"

There is however, a broad agreement that all the definitions converge, in that, scenarios are not forecasts or predictions of future developments, but rather descriptions of how the future might unfold, mapping out the 'possibility space' of future developments (Bradfield et al., 2005; Giaoutzi et al., 2011; Zanoli et al., 2012). Zanoli et al. (2012) defined scenario analysis as a tool for strategic policy analysis that allows researchers and policymakers to support decision making, and a systemic analysis of the main determinants of an organization, sector or policy issue. Scenario analyses are powerful tools in modern policy analysis, in both the private and the public domains (Giaoutzi et al., 2011).

Scenario analyses are very different from other forecasting methods in that they usually provide a more qualitative and contextual description of how the present will evolve into the future, rather than a description that seeks numerical precision (Bradfield, 2008; Zanoli et al., 2012). Another important difference is that, they are generally used to identify a set of possible futures, where there is the possibility of occurrence, but without any certainty (Zanoli et al., 2012). Therefore, one will have to understand that "scenario analysis is a process of understanding, analyzing and describing the behaviors of complex systems in a consistent and, as far as possible, complete way" (Zanoli et al., 2012:42). Wack (1985:150) defined scenario analysis as: "a discipline for rediscovering the original entrepreneurial power of creative foresight in context of accelerated change, greater complexity and genuine uncertainty".

Although scenario techniques have a long history dating back in time immemorial, the modern day scenario techniques, only emerged in the post-war period and was originally developed for strategic military purposes (Bradfield, 2008; Bradfield et al., 2005; Zanoli et al., 2012). From the work of Herman Kahn and others at RAND and the Hudson Institute in the 1960s, scenarios reached a new dimension with the work of Pierre Wack in Royal Dutch/Shell (Saritas and Nugroho, 2012). Since then numerous models have been published, with the first journal article on comprehensive model for the development of scenarios published by Zentner in 1975 (Bradfield, 2008). The literature is now replete with descriptions of prototypical patterns or models for generating scenarios ranging from the simple to the elaborate and highly structured recipe-type techniques (Bradfield, 2008).

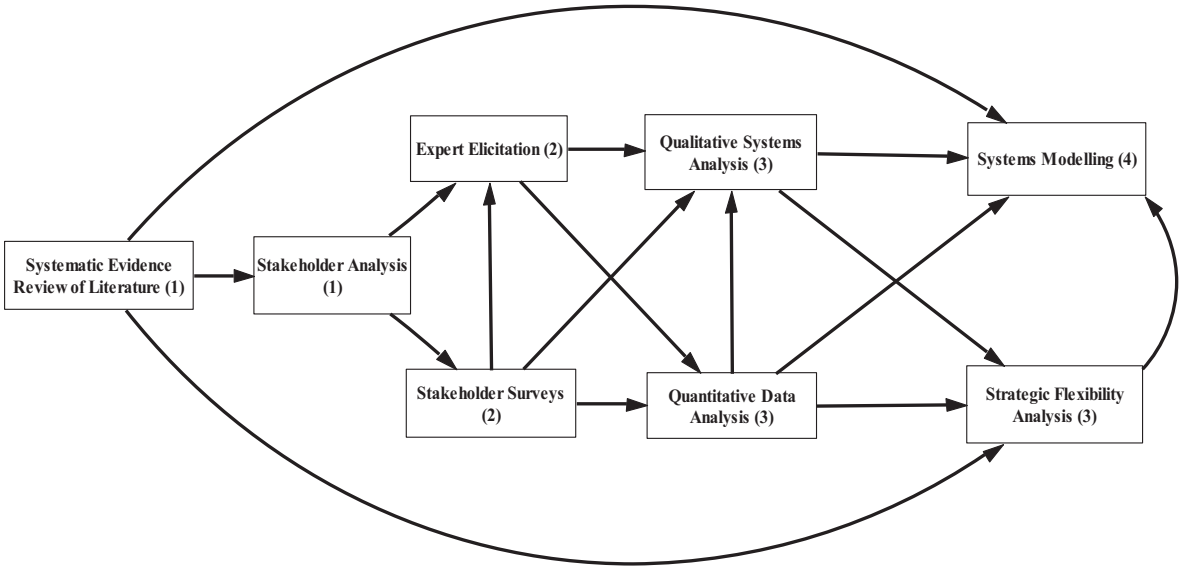

Fig. 1. Schematic representation of research framework.

Please cite this article as: Yawson, R.M., Greiman, B.C., Strategic flexibility analysis of agrifood nanotechnology skill needs identification, Technol. Forecast. Soc. Change (2017), http://dx.doi.org/10.1016/j.techfore.2017.02.019