

**VALUATION OF FLEXIBILITY IN THE
CONTEXT OF PERFORMANCE OF INNOVATION
ECOSYSTEM IN INDIA**

**A STUDY OF MANUFACTURING (ESDM) AND SERVICES
(CSC-ITES) SECTORS**

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PERFORMANCE OF INNOVATION ECOSYSTEM IN INDIA**

A Study of manufacturing (ESDM) and Service (CSC-ITES) Sectors

by

Shishir Shrotriya

Submitted

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to the



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CERTIFICATE

“This is to certify that the thesis entitled “**Valuation of Flexibility in the context of Performance of Innovation Ecosystem in India – A Study of Manufacturing (ESDM) and Service (CSC-ITES) Sectors**”, being submitted by **Mr. Shishir Shrotriya** to the Indian Institute of Technology, Delhi for the award of the degree of **Doctor of Philosophy**, is a record of bona fide original research work carried out by him. He has worked under our guidance and supervision and has fulfilled the requirements for the submission of the thesis, which has attained the standard required for a Ph.D. degree of the Institute. The results presented in this thesis have not been submitted elsewhere for the award of any degree or diploma”.

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(Shishir Shrotriya)

Abstract

Researchers and practitioners have shown that why 'Strategic Flexibility' is an important measure in the dynamically changing and competitive environment. However, what measure of flexibility is required to be adapted at what stage has largely been left to the discretion of the managers. Implementing flexibility of any type has its own pros and cons, which are required to be thoroughly evaluated. Thus, a need arises for valuation of flexibility prior to implementation. The valuation for flexibility becomes a difficult measure as varied flexibility would be desirable in different contexts and at different stages of a product/project life cycle.

This research work is aimed at exploring the methodology for 'Valuation of Flexibility'. The sectorial context of the study has been selected as the Innovation Ecosystem for the Electronics System Design and Manufacturing (ESDM), which represents the manufacturing sector, and the Common Service Centre (CSC) of the Government of India, which represent the Information Technology Enabled Services (ITES) sector. Both the selected sectors are high growth and impact sectors and have been chosen to represent the Innovation Ecosystem, comprising of a mix of manufacturing and services sectors.

Based on the literature review, research gaps and research objective were drawn, one section of the research work was dedicated to exploring the antecedents of the 'Performance of the Innovation Ecosystem' (outcome) and the effect of 'Strategic Flexibility' on the causal relationship between these antecedents and the outcome in the context of ESDM and CSC(ITES) sectors in India. The application of strategic flexibility and related measures in the dynamically changing environment was hypothesized to influence the strength of relationship between the antecedents and the outcome.

This second part of the research work explored the methodology for 'Valuation of Flexibility'. To better understand the chosen sectors of study and the challenges faced by these sectors, TRIZ based approach was utilized to undertake functional modelling and cause and effect analysis, based on the secondary data analysis available for these sectors. Consequently, parameter mapping and development of contradiction matrix was undertaken using TRIZ toolkit. The secondary data analysis and TRIZ toolkit-based solutions for the key challenges faced by the ESDM and CSC-ITES sectors led to a set of questionnaires, which were served at firm level to the population databases taken from Industry bodies and Government of India databases. The responses received were analyzed for 'Valuation of Flexibility' through the TRIZ Ideality principle.

The research highlights the quantification, investigation of flexible initiatives and significance of solutions with respect to time, cost, risks, contradictions and failure mode implications. The research work provides a novel framework for the valuation of flexibility and structured problem-solving in the field of management through TRIZ toolkit.

Research work will also help practitioners, policy makers and researchers to holistically evaluate and prioritize inventive solutions and flexibility measures prior and during the various stages of implementation with respect to the related cost benefit analysis and harmful effects or risks involved.

The methodology explained in the research work for valuation of flexibility, can be applied in any chosen context after parameter mapping for the chosen context through TRIZ concepts. The practitioners, researchers, policy makers and managers can find this exercise useful, prior implementing flexibility measures which require capacity building and most times large investments, to take well-researched and qualified decisions.

सार

शोधकर्ताओं ने दिखाया है कि गतिशील रूप से बदलते और प्रतिस्पर्धी माहौल में 'सामरिक सुनम्यता' क्यों एक महत्वपूर्ण उपाय है। हालांकि, सुनम्यता को किस स्तर पर अनुकूलित किया जाये, यह प्रबंधक विवेकानुसार तय करते हैं। किसी भी प्रकार की सुनम्यता को लागू करने के सकारात्मक और नकारात्मक पहलू हैं, जिन्हें पूरी तरह से मूल्यांकन किया जाना आवश्यक है। इस प्रकार, कार्यान्वयन से पहले सुनम्यता के मूल्यांकन के लिए एक आवश्यकता उत्पन्न होती है। सुनम्यता के लिए मूल्यांकन एक कठिन माप बन जाता है, क्योंकि विभिन्न सुनम्यता, विभिन्न संदर्भों में और उत्पाद / परियोजना जीवन चक्र के विभिन्न चरणों में वांछनीय है।

इस शोध कार्य का उद्देश्य 'सुनम्यता के मूल्यांकन' के लिए पद्धति की खोज करना है। अध्ययन के क्षेत्रीय संदर्भ को इलेक्ट्रॉनिक्स सिस्टम डिजाइन एंड मैनुफैक्चरिंग (ईएसडीएम) के लिए इनोवेशन पारिस्थितिक तंत्र के रूप में चुना गया है, जो विनिर्माण क्षेत्र का प्रतिनिधित्व करता है। सूचना प्रौद्योगिकी सेवाएं (आईटीईएस) क्षेत्र, भारत सरकार के आम सेवा केंद्र (सीएससी), चुना गया है। दोनों चयनित क्षेत्र उच्च विकास और प्रभाव वाले क्षेत्र हैं और इनोवेशन पारिस्थितिकी तंत्र का प्रतिनिधित्व करते हैं, जिसमें विनिर्माण और सेवाओं के क्षेत्रों का मिश्रण शामिल है।

साहित्य समीक्षा के आधार पर, शोध आभाव और शोध उद्देश्य तैयार किए गए, शोध कार्य के एक वर्ग को 'इनोवेशन पारिस्थितिक तंत्र के प्रदर्शन' (परिणाम) के प्रदर्शन और 'सामरिक सुनम्यता' के प्रभाव को तर्कसंगत संबंधों के प्रभाव के लिए समर्पित किया गया था। इन पूर्ववर्तियों और भारत में ईएसडीएम और सीएससी (आईटीईएस) क्षेत्रों के संदर्भ में परिणाम के बीच। गतिशील रूप से बदलते परिवेश में रणनीतिक सुनम्यता और संबंधित उपायों का उपयोग पूर्ववर्ती और परिणाम के बीच संबंधों की ताकत को प्रभावित करने के लिए परिकल्पना की गई थी।

अनुसंधान कार्य के इस दूसरे भाग ने 'सुनम्यता के मूल्यांकन' के लिए पद्धति की खोज की। अध्ययन के चुने हुए क्षेत्रों और इन क्षेत्रों द्वारा सामना की जाने वाली चुनौतियों को बेहतर ढंग से समझने के लिए, इन क्षेत्रों के लिए उपलब्ध सेकेंडरी डेटा विश्लेषण के आधार पर, TRIZ आधारित दृष्टिकोण का कार्यात्मक मॉडलिंग और 'कारण और प्रभाव' विश्लेषण करने के लिए उपयोग किया गया था। नतीजतन, पैरामीटर मैपिंग और विरोधाभास मैट्रिक्स का विकास TRIZ टूलकिट का उपयोग करके किया गया था। ईएसडीएम और सीएससी-आईटीईएस क्षेत्रों द्वारा सामना की जाने वाली प्रमुख चुनौतियों के लिए द्वितीयक डेटा विश्लेषण और टीआरआईजेड टूलकिट-आधारित समाधानों ने प्रश्नावली का एक सेट बनाया, जो उद्योग निकायों और भारत सरकार के डेटाबेस से ली गई आबादी डेटाबेस के लिए दृढ़ स्तर पर कार्यरत थे। प्राप्त प्रतिक्रियाओं का विश्लेषण TRIZ आदर्शता सिद्धांत के माध्यम से 'सुनम्यता का मूल्यांकन' के लिए किया गया था।

शोध मात्रा, लागत, जोखिम, विरोधाभास और विफलता मोड के प्रभाव के संबंध में मात्रा, लचीली पहलों की जांच और समाधान के महत्व पर प्रकाश डाला गया है। अनुसंधान कार्य ट्रिज टूलकिट के माध्यम से प्रबंधन के क्षेत्र में सुनम्यता और संरचित समस्या-समाधान के मूल्यांकन के लिए एक अभिनव ढांचा प्रदान करता है।

शोध कार्य से संबंधित लागत-लाभ विश्लेषण और हानिकारक प्रभाव या जोखिमों के संबंध में कार्यान्वयन के विभिन्न चरणों के दौरान और बाद में आविष्कारक समाधान और सुनम्यता उपायों को समग्र रूप से मूल्यांकन और प्राथमिकता देने के लिए चिकित्सकों, नीति निर्माताओं और शोधकर्ताओं को समग्र रूप से मूल्यांकन और प्राथमिकता देने में मदद मिलेगी।

सुनम्यता के मूल्यांकन के लिए शोध कार्य में समझाया गया कार्यप्रणाली, TRIZ अवधारणाओं के माध्यम से चुने गए संदर्भ के लिए पैरामीटर मैपिंग के बाद किसी भी चुने हुए संदर्भ में लागू की जा सकती है। चिकित्सकों, शोधकर्ताओं, नीति निर्माताओं और प्रबंधकों को यह अभ्यास उपयोगी, पहले लचीलापन उपायों को कार्यान्वित करने के लिए मिल सकता है, जिसके लिए क्षमता निर्माण और अधिकतर बड़े निवेश की आवश्यकता होती है, ताकि वे अच्छी तरह से शोध किया और योग्य निर्णय ले सकें।

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NOMENCLATURE

AIM	Atal Innovation Mission
AIMED	Association of Indian Manufacturers of Medical Devices
ARIZ	Алгоритм Решения Изобретательских Задач (Russian acronym routinely translated as ‘Algorithm for Inventive Problem-Solving’)
BPO	Business Process Outsourcing
CEAMA	Consumer Electronics and Appliances Manufacturers Association
CSC	Common Service Centre
EBIT	Earnings before Interest and Taxes
EBITDA	EBIT plus Depreciation and Amortization
ELCINA	Electronics Industries Association of India
ESDM	Electronic System Design & Manufacturing
GDP	Gross Domestic Product
GOI	Government of India
ICT	Information and Communication Technology
IEEMA	Indian Electrical & Electronics Manufacturers' Association
IESA	Indian Electronics & Semiconductor Association
IFR	Ideal Final Result
IP	Intellectual Property
IT	Information Technology
ITES	Information Technology Enabled Services
KITVEN	Karnataka Information Technology Venture
KPO	Knowledge Process Outsourcing
LEDMA	LED Products Manufacturer’s Association
MAIT	Manufactures Association of Information Technology

MeitY	Department of Electronics & Information Technology
NLSA	National Level Service Agency
PMA	Program Management Agency
R&D	Research and Development
RIM	Residual Income Model
SCA	Service Centre Agencies
SIDBI	Small Industries Development Bank of India
SDA	State Designated Agencies
SPV	Special Purpose Vehicle
TRIZ	Theoria Resheneyva Isobretatedshehuh Zadach (Russian Acronym for TRIZ, routine translation as ‘Theory of Inventive Problem Solving’)
VLE	Village Level Entrepreneurs