

# Categorization of Innovation concepts for Sustainable Improvement



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**Abstract:** Innovation is the key concept that drives creativity in to a reality. Irrespective of the field, striving for Innovation marks the survival as well as the success of any business. Innovation can be introduced for any stage of a supply chain in any organization, achieving the organizational strategies. It comes in different concepts according to its application across the supply chain. Perfect knowledge in innovation concepts and their categorization is crucial in applying them in the most effective way. Else would bring disastrous outcomes to the company which may even go bankrupt. This paper presents different innovation concepts, based on the literature, and attempt to establish their inter-relationship using the Graph Theory and the categorizing into main themes, with key innovation concepts related to each theme, using the Grounded Theory. Consistency of the categorization has been endorsed using the information collected through questionnaires. The data gathered following the Likert Scale have been illustrated in the graphs and furthermore tested according to Independent samples for Kruskal Wallis Test and a Hypothesis testing for all Innovation concepts. Sound knowledge on different innovation concepts, their interrelationships and categorization are imperative in constructive decision making, which enhances the ability of applying the most appropriate innovation concepts in the most effective way. Further categorizing of Innovation concepts will eliminate the confusions which may arise with the Innovations with similar concepts, but with different names. Precise application of the findings of this research across the Supply Chain would definitely support organizations for the survival and excel in the Business world, even bearing more opportunities in earning better ranks among World's most innovative Businesses.

**Keywords:** Innovation Concepts, Inter-relationships, Categorization, Sustainable Innovation

## I. INTRODUCTION

The concept of Innovation has been evolved over the years for different products and services and hence also the definitions.

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Core idea behind the most of the definitions of Innovation is turning an idea into a solution that adds value to the customer. American Society for Quality- ASQ [1] has defined Innovation as the new customer values for the market is enhanced by the conversion of novel concepts and knowledge into the process of creating new products, service and processes. Baregheh, Rowley and Sambrook [2] have defined Innovation as a process with multiple steps, where creative ideas can be reengineered into new or improved products, services or processes which enhances the competing powers in the market.

Innovation has been used by several manufacturers and service providers for survival under the rapid changes in customer needs and highly competitive market environment. Innovation strategies used on product and marketing segments while adopting proper risk assessment models developed by 'Apple' one of the world leaders in phone and computer business throughout decades [3]. Bullet Train, a Network of high speed railway lines in Japan, is one of the world class innovations introduced to the Transportation sector. The Mercedes S class car from Germany has become a rolling showcase where innovative ideas become reality. Learning of Hamid and Mohammad [4] express how Innovation has become the sole survival factor of organizations in achieving future growths. Global Innovation Index (GII) - 2018 has declared their theme as "Energizing the World with Innovation" and more countries are already in their indexing, being top innovators in the World. Bruno Lanvin, Executive Director for Global Indices has expressed the importance of Innovation in addressing Energy/Environment areas, with the new social, economic and business models [5]. These facts illustrate the existence of Innovation concepts all around the world, empowering in different fields. More concentration is being put on enhancing innovative capabilities as it defines the success of the innovations done by the organization [6]. Hence Innovative capability has become a crucial driver in any organization, which contributes to achieve the organizational goals. Meanwhile Daniel Zapfl [7] has emphasized having the knowledge on different concepts of innovations as this determines where an organization wants to innovate and how it would be disastrous, if wrong innovation type is being applied [7]. Block Bluster, one of the most iconic brands for movie and video games rental services had gone bankruptcy even after reaching the 'peak' due to incapable of transforming towards a digital model [8]. Being a pioneer in car manufacturing industry for more than 100 years, General Motors marked its demise going bankruptcy for failure to innovate and ignoring the Market competition [8].

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Further Innovation has become a guiding principle in every aspects of Social, Economic and environmental developments it is crucial to maintain a firm link between innovation and sustainability. This helps in applying innovative solutions for a sustainable existence of resources, organizations and Global environment [9]. In this perspective it is imperative to have a thorough knowledge on different innovation concepts and potential to identify the best matching innovation type for the organization matching with the innovative capability and core competencies of the organization.

Further more precise knowledge on different innovation concepts and the proper application are vital in achieving higher ranks among the innovative countries of the world. Moreover different innovation concepts have their own identities according to the area which they would be implemented in. There are instances where Innovations bear different names for the identical Innovation concepts according to the applicability. Having similar concepts with different names would make the research or decision more complicated. Further identifying different concepts of Innovations and there categorizations would be worthwhile for organizations as well as for new researchers which guide through the process of constructive decision making which would result in finding out the most appropriate direction on their move across the supply chain of any organization. This enhances the success of any innovation by minimizing the risk involved.

Hence minimizing the innovations with similar concepts and categorizing the innovation concepts is a prerequisite, which lacks in literature related to Innovations. Through this paper, authors attempted to categorize the Innovation concepts in a logical way, based on the ideas shared in the literature, since this covers an untouched area in research.

### II. METHODOLOGY

The review of literature has shown the necessity of recapitulate the different Innovation concepts, since they have been given different explanations by researchers.

1. Integration of all the ideas shared by researchers in literature on different innovation concepts – For deriving comprehensive meaning of each and every Innovation concept, which provides the base for the categorization.
2. Generating the Inter relationships of different innovation concepts through analysis of the summarized explanations and their underlying meanings across all Innovation concepts.
3. Illustrating the Inter relationships using the Graph Theory, based on the derived Inter-relationships
4. Categorization of Innovation concepts using the Grounded Theory, a methodology use for qualitative data analysis and categorization.
5. Analysing and grouping of data into main themes incorporating Coding, Sorting, Synthesizing and Theorizing
6. Generating "Key Innovation concept" which represents the other innovation types listed under a particular theme with the concepts of Grounded theory, applying in explanations derived.
6. Distribution of a questionnaire to find out the consistency of the categorizing.
7. Illustrates the questionnaire data with graphs and Kruskal-Wallis test for Independent samples with Hypothesis testing.

### III. RESULTS

Innovation concepts described in 50 research papers have been summarized into 21 different innovation concepts. This included 31 Manufacturing sectors and 19 Service sectors worldwide.

Table 1 illustrates the summary of innovation concepts described in the literature common to product and services. Inter-relationships were derived through comprehensive analysis of the explanations of innovation concepts and the underlying meanings extracted through literature.

**Table -1: Summarized Explanations of different Innovation concepts**

C A T E G O R Y	I N N O V A T I O N C O N C E P T	S U M M A R I Z E D E X P L A N A T I O N S	I N T E R - R E L A T I O N S W I T H O T H E R I N N O V A T I O N T Y P E S (Followed by the "Category" column)
A	Product Innovation	Product innovation is the function innovation of a product which improves the original function or introduces new functions to meet the needs of the customer. This directly links with Technology, Marketing and culture innovations concepts and Research and development activities which provides cost benefits [10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,50].	C,J,K,L,M,P,S,T,U
B	Process Innovation	Process innovation uses different concepts to improve the firm's performance and increase the return on investment by incorporating the concepts such as BPR, JIT, TQM and Lean manufacturing [26, 30, 41, 42, 44, 45, 51].	C,J,L,M,P,R,S,T

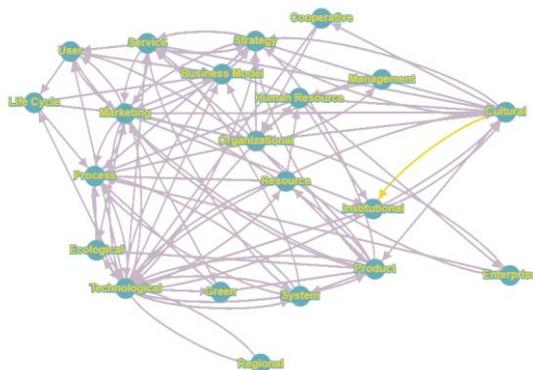


C	Technology Innovation	Technology Innovation helps survival and continuous growth of the organization by creating IP rights, economic and social benefits. This directly links with Research & Development, product, Process, Management, culture, Structure innovations and optimizing the resource utilization[10,11,12,13,14,15,16,17,18,20,21,24,29,30,31,32,33,34,35,36,37,38,39,40,41,47].	A,B,D,F,G,J,L,M,O ,P,Q,S
<b>CA TE GO RY</b>	<b>INNOVATION CONCEPT</b>	<b>SUMMARIZED EXPLANATIONS</b>	<b>INTER-RELATIONS HIPS WITH OTHER INNOVATION TYPES</b> (Followed by the “Category” column)
D	Service Innovation	Service innovation focuses on whole economic activity of the company in attaining sustainable competitive advantages [10, 11, 12, 16, 26, 42].	F,J,S
E	Service Innovation	Service innovation focuses on whole economic activity of the company in attaining sustainable competitive advantages [10, 11, 12, 16, 26, 42].	F,J,S
F	System innovation	System Innovation provides certain systems to be adopted in setting up environment for enterprise innovation system including Technology Innovation [33].	C
G	Regional Indigenous Innovation	Regional Indigenous Innovation independently solves major key technical issues of regions to enhance regional competitiveness, market share and sustainable development in the economy [29, 32].	C,L,M,P
H	Green Innovation	Green innovation relates to technologies involve in energy saving, waste recycling, pollution prevention and designing of Green products and processes with significant effect on a company's environmental performance and competitive advantage [54].	A,B,C,J,L,M
I	Ecological Innovation	Ecological Innovation focuses on developing products and processes that contribute to sustainable development which mainly focuses on environmental friendly technological advances [51].	A,B,C,J,L,M,O
J	Marketing Innovation	Marketing innovation ensures survival, constant growth and economic success. Close relationship with customer in understanding the needs and wants has become the key concept of Marketing innovation. This helps to know current trends and demands, Management concepts and techniques for product and process innovation[10,11,13,17,18,19,23,24,36,40,43,44].	A,B,C,E,K,L,M,T, U
K	User Innovation	User innovation mainly focuses on customer satisfaction, which is a part of Marketing innovation [48,49]	J
L	Strategy Innovation	Strategy innovation is the direction of guiding through all the innovation concepts, Technological, Marketing, Organizational, Management and cultural innovation. This develops new business areas and has become an important determinant of improved quality and firm's performances [11, 13, 17, 18, 19].	C,J,M,N,O,P,Q,R,S
M	Management Innovation	Management innovation directly links with the Vision for innovation of the organization with significant impact on Research and Development. This Includes strategic business model innovation, organizational structure innovation and Human Resource management innovation as well [11, 13, 17, 52].	A,B,C,E,J,N,O,P,S
N	Institution Innovation	Institutional Innovation consists of concepts related to the Human Resource of an organization which promotes innovational performance, incentive mechanism and reward system to encourage innovative consciousness and innovative actions of the employees of an organization [11, 13, 17, 23]	C,J,O,P,S

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O	Organizational Innovation	Organizational innovation supports in optimizing organizational structure to ensure survival and development of the organization. This links with Technology, Human Resource innovations and Management Vision of the organization[11,13,17,19,24,31,33,43,45].	C,J,L,M,N,P,S,T,U
C A T E G O R Y	INNOVATION CONCEPT	SUMMARIZED EXPLANATIONS	INTER-RELATIONS HIPS WITH OTHER INNOVATION TYPES (Followed by the “Category” column)
P	Culture Innovation	Culture innovation combines with Strategy, management, Institutional, Market, technology and HR management innovation to give sustain growth to solve bottleneck problems in Technological Innovation. This ensures a learning culture, stimulating innovative consciousness related to firm's performances, personal attribute of employees, educational qualifications, motivational level, intelligence level, Team spirit, Recognition and remuneration which are the important determinants of Firm's performance. [11,12,13,17,21,28,31,32,37,41,43,46].	C,J,L,M,N,R,S
Q	Cooperative Innovation	Cooperative innovation adjusts resources to finish innovation activity together based on sharing equal profits. This improves high innovation efficiency and innovational motive with reduced risk, which result in strengthening of the organization [13, 21].	C,D,L,M,R,S
S	Human Resource Management Innovation	Human Resource Management Innovation has a strong relationship with Innovation performance and innovation capability which ensures the success of the company through recruiting capable staff and improving the required talents in achieving organizational goals. [17,19,1,33,43].	A,B,C,E,N,O,P,Q
T	Business Model Innovation	Business Model Innovation mainly focuses on continuous relationship with customer, customer processes, support life cycle, learning, knowledge catching and continuous innovation by solving complex market problems [9, 16, 18, 26, 33, 42, 45].	A,B,J,L,M
U	Life Cycle Innovation	Life Cycle Innovation focuses on working closely with customers and their processes to get a deep understanding of customer s values, which will be the key element in producing innovation, which satisfies customer requirements. This helps re-engineering of the business [18, 19, 42].	A,B,J

Inter-relationships were further illustrated in Diagram 1 using Graph Theory with the numbering sequence followed in Table 1.



**Fig.1. Inter-relationships of Innovation Concepts: Using Graph Theory** Deep analysis of relationships between innovation concepts and the underlying meanings across them have shown a different linking pattern, which represents main phases of Innovation process. This also expresses the initial phases of the Technological Hype Cycle which reduces the risk of the Technological Investment. Based on these concepts, Innovations were categorized in to three main

themes as illustrated in Figure 2. Method of Axial Coding has been used to further analysis of the innovation concepts within each group to ensure concepts of the innovations in the same group Contributes more to the concepts represented by the Main theme which they have been listed under.

Intra – Organizational Innovation – Structuring the Organization for a sustainable Innovation

Structuring the organization comprises of organization’s Vision, strategic planning, shaping the organizational culture, well trained and qualified Human Resource fitting to the job roles, rewarding systems, defining the investment capabilities, Organizational efficiency improvements, and Future growth. These are significant factors laying the foundation for a sustainable innovation in order to maintaining a competitive edge in the Global market. Hence structuring the organization for a sustainable innovation can be achieved through Organizational, Management, Structure, culture, Cooperative, Human resource, Institutional and Enterprise Innovations[11,12,13,17,18,19,21,23,24,28,31, 32,33,36,37,41,43,45,46,52].

Peripheral Innovation - Information outside the organization for a sustainable Innovation

The ultimate goal of any innovation is to produce goods or services, which cure the pain points of the customers and introduce them to the market, in a way that they would make profits while maintaining the market share. In reaching this goal, it is crucial to get to know the customer requirements precisely and the market trend since the customer behavioral patterns are changing rapidly. Competitor information is also a prime factor directly affecting the innovations. Innovations get failed due to inadequate diagnostics of the factors mentioned above. Summary of the literature reviews define it as the key to stay competitive in ensuring constant growth to achieve economic success of the organization. Hence Marketing, Business model, Life cycle and user innovations are mastering the Concepts and Expectations of Theme 2, which leads for a sustainable innovation [18, 19, 26, 33, 42, 45].

Sustainable Innovation – Implementing a sustainable Innovation Firm’s dynamic capabilities are rooted in the ability to produce products or services which dominate in the market ensuring the success of the organization. Innovation process will be completed only after it has been introduced to the market. Perfect Implementation of any innovation always carries the concepts of Technological, Product, Process, Service, System, Regional Indigenous, Resource, Green and Ecological Innovations backed by the Innovation concepts mentioned under Theme 1 and Theme 2, which moves the organization towards a sustainable Innovation [5,6,10,11,12,13,14,15,16,17,18,19,21,22,23,24,27,29,30,32,33,34,35,36,37,38,39,48]. Figure 2 illustrates the Categorizing of Innovation concepts in to 3 main themes. 1. Intra-organizational innovation, 2. Peripheral innovation 3. Sustainable innovation

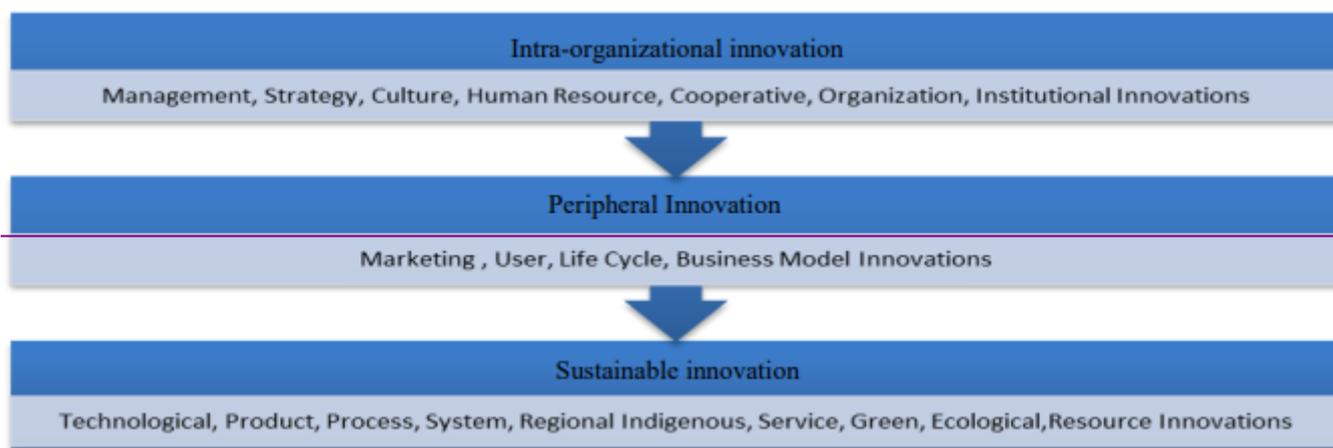


Fig.2. Categorizing of Innovation Concepts

In order to validate the consistency of the grouping, questionnaires were distributed among 350 expertises in different manufacturing and service organizations. 321 complete questionnaires were received. Analysis of the data has been illustrated in Figure 3, Figure 4 and Figure 5 which clearly depict the consistency of the grouping with 89% for the “Agree” and “Strongly Agree” options.

Summary of the responses to the questionnaires –

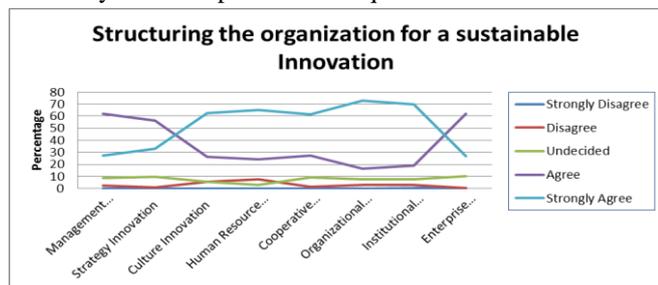


Fig.3. Summary of responses for Structuring the Organization for a Sustainable Innovation

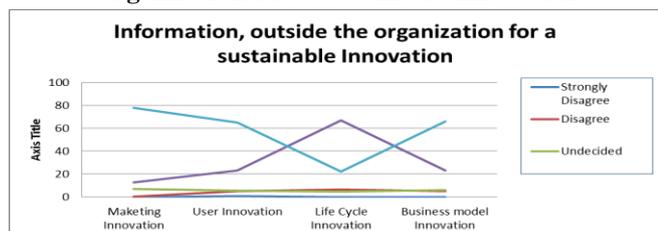


Fig.4. Summary of Responses for Information needed from outside the organization for a sustainable Innovation

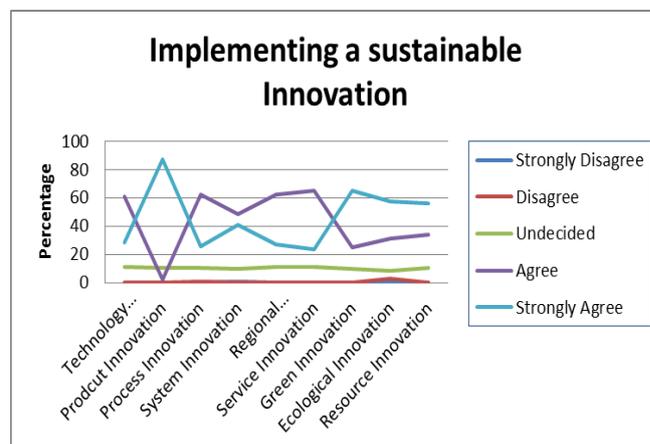


Fig.5. Summary of responses for implementing a Sustainable Innovation.

Furthermore consistency of the categorization has been statistically proved with the Kruskal- Wallis Test. Rational for Applying Kruskal-Wallis Test was taken as consisting of 3 Independent variables – C1- Intra organizational Innovation, C2- Peripheral Innovation and C3- Sustainable Innovation, Dependent Variable has been measured at ordinal level using Likert Scale and the Independence of Observations.

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Independent samples – Median test and Independent samples-Kruskal-Wallis tests were performed for the responses obtained through questionnaires and results showed that Medians of responses are not same across all the categories and having a significant difference in one category with the other 2 remained same, rejecting the Hypotheses. Results were same across all 21 innovation concepts and again same with the Kruskal- Wallis test together with the Hypothesis Summary illustrated in Table 3, which were common to all 21 Innovation concepts proving the categorization illustrated in Figure 2.

**Table - 2: Summary of Kruskal-Wallis Test**

Innovation Concept	Independent Samples - Kruskal-Wallis Test (Significance Level 0.5) – Box Plot range of the Majority of Responses		
	C1	C2	C3
Management Innovation	4-5	1-3	1-3
Strategy Innovation	4-5	1-2	1-3
Organizational Innovation	4-5	1-2	1-2
Institutional Innovation	4-5	1-2	1-2
Human Resource Innovation	4-5	1-2	1-2
Culture Innovation	4-5	1-2	1-2
Enterprise Innovation	4-5	1-3	1-2
Cooperative Innovation	4-5	1-3	1-3
Marketing Innovation	1-2	2-4	1-2
User Innovation	1-2	4-5	1-2
Life Cycle Innovation	1-3	2-5	1-3
Business Model Innovation	1-2	4-5	1-2
Technological Innovation	1-3	1-2	4-5
Product Innovation	1-2	1-2	3-4
Process Innovation	1-3	1-2	4-5
Service Innovation	1-3	1-3	3-5
Green Innovation	1-2	1-2	4-5
Resource Innovation	1-2	1-2	4-5
System Innovation	1-2	1-2	4-5
Regional Indigenous Innovation	1-2	1-3	4-5
Ecological Innovation	1-2	1-2	4-5

**Table - 3: Hypothesis Test Summary with significance level 0.05**

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig .	Decision
1	The medians of responses are the same across categories of Category	Independent Samples-Median test	0	Reject the Null Hypothesis
2	The distribution of Response is the same across categories of Category	Independent Samples Kruskal- Wallis test	0	Reject the Null Hypothesis

### Discussion

Innovation has become one of the Main Research Interests of many researchers and Industry expertise, since Innovation has been identified as one of the key players in deciding the success and survival of any organization. Literature describes 21 innovation concepts which some carry the same meaning though they have been given different names. Area related to Categorization of Innovation types still holds gaps which carry the need of further exploration. Explanations summarized based on literature provides a better understanding of different innovation concepts which will definitely provide an immense support in adopting the most appropriate Innovation type which gives the best match with the core competencies of the organization. Precise understanding of innovation concepts contribute more on researches and organizational strategic planning by guiding through the entire process of supply chain. Bankruptcy of Kodak is one of the major examples which caused due to not taking precise innovative initiations [55].

Categorization of Innovation types with similar meanings deducted the number of Innovation concepts, which enhance the ability of innovative decision making by eliminating the repetitive task of information analyzing. Hence this will improve the accuracy and effectiveness of the innovation process.

Due to the fact that the innovation types have a complex relationship with each other, Innovation concepts cannot be separated entirely from the rest of the innovations during the categorization. This can be identified as one of the limitations of this study. The other limitation can be taken as the difficulty in assigning heuristic values to the relationships of innovation concepts in identifying the closeness of the relationships.

### IV. CONCLUSION AND FUTURE SCOPE

Literature reviews describes on 21 different innovation concepts and data gathered from literature have been reduced capturing the significant ideas of researchers, without losing their actual meaning, which provided the base for summarizing the explanations of different innovation concepts. Further analysis of these explanations and the underlying meanings of the same were used to derive the inter-relationships among different innovation concepts which were illustrated using the Graph Theory. This clearly depicts the fact that Innovation concepts have been linked in such a way that none of the Innovation concepts could be completely separated from the other Innovation concepts. Three main themes were generated based on the relationships between innovation concepts which represent different phases of the innovation process, i.e. Intra Organizational Innovation which represents Structuring the Organization for a sustainable Innovation, Peripheral Innovation which represents the External Information needed for a sustainable innovation and Sustainable Innovation represents all the concepts related to implementing a sustainable Innovation. Grounded theory was used to find key innovations, which represents the concepts of the other innovations listed under the same Theme.



Management Innovation bears all the concepts related to the innovations listed under “Intra Organizational Innovation” while Marketing Innovation is the key Innovation concept related to “Peripheral Innovation” and Technological Innovation represents all the innovations belonging to “Sustainable Innovation”. This provides a more precise understanding on innovation concepts which is crucial during the application. Hence this categorization would close the current gap in the literature on categorizing the innovation concepts and amalgamating similar concepts, which would ease the work of researchers and other professionals. While innovation has become the sole survival factor of any business in this highly volatile global market, most of the innovations do not see the light of success due to high risks involve in innovation. There are many evidences that suggest the current high level of volatilities in the business world going to worse in the years to come. This trend of increasing uncertainties and the resulting risks for the business demands a strategic level attention to risk management. Therefore, future scope of this research is to introduce risks involved in different innovation concepts and their impact on the business organizations, which holds a great importance for a successful innovation.

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