CHAPTER 3

RATIONALE OF STUDY

3 Rationale of study

3.1 Inferences from the literature review

Gap spotting is the desired outcome of a literature review to develop research topics for future purposes. Knowledge gap (Miles, 2017).is when there are no suitable research findings. Theoretical gap (Müller-Bloch & Kranz, 2015) is when to get fresh insights into specific research problems, theory should be used. There is a gap because there is not enough theory. We find these gaps relevant for discussion in this context.

Understanding the concepts of "knowledge gap" and "theory gap" in research is crucial for advancing scholarly inquiry and addressing unresolved questions within a field. These gaps represent the areas where existing literature and theoretical frameworks fail to fully explain or address certain phenomena, thereby presenting opportunities for further exploration and discovery.

A knowledge gap occurs when there is not enough information, data, or comprehension of a certain subject in the body of study that has already been done. This gap shows that in order to improve our understanding of a subject, more empirical evidence or data collecting are required. For example, there is a knowledge gap if there is little research on how a new teaching strategy affects student learning. By reading through the literature and highlighting any places where the material is conflicting or lacking, researchers can find these gaps.

Conversely, a theory gap refers to a weakness in the models or theoretical frameworks used to explain particular events. This gap suggests that in order to more fully explain empirical findings, new theories must be developed or old ones must be modified. For instance, there is a theory gap if existing psychology theories are insufficient to explain why particular teaching tactics function differently in various cultural contexts. Finding theory gaps frequently necessitates a thorough examination of the empirical evidence as well as the underlying theories in a discipline.

Closing these gaps is essential to knowledge advancement. It entails determining regions in which there are unresolved issues or in which the theories currently in use conflict with empirical evidence. Scholars frequently identify these gaps through

critical evaluations of the coherence and applicability of theoretical frameworks, meta-analyses, and systematic reviews of the literature. (A. M. Grant & Pollock, 2011).

Both knowledge and theory gaps serve as catalysts for research, guiding scholars to the unexplored or inadequately understood territories in their fields. By bridging these gaps, researchers contribute to the comprehensive understanding of a subject, fostering theoretical advancements and practical applications that were previously unattainable.

3.2 Research Gap

Amongst all manufacturing sectors that have studied adoption and acceptance of IIoT in manufacturing, one of the least researched is Textiles . As is noticed from the most researched sectors in manufacturing such as agriculture, construction, healthcare etc, the models used to study IIoT adoption in these sectors focus mainly at an organization level with researchers modifying the variables to concur with the specific sector under study.

As mentioned earlier, there is no research paper in the current dataset focussing on technology adoption and its determinants in the textile sector at an organization level.

Therefore, it can be clearly inferred that there is a clear knowledge and theory application gap in the textile sector in comparison to the other manufacturing sectors and there is possible scope to study the technology adoption in textiles at an organization level.

There is no empirical study on technology adoption determinants in the textile sector indicating lack of descriptive research on technology adoption which means there is a scope to undertake empirical study on technological adoption of IIoT in the textile manufacturing sector at an organizational level.

3.3 The Textile industry

The global textile industry is worth 1005 Bn USD in 2020. Textile production accounts for 2 percent of the global GDP.

India ranks 6th as producer of textiles in the world. The Indian textile s is currently valued at approximately 200 billion USD. 20% of industrial production, 9% of excise taxes, 18% of industrial sector employment, approximately 20% of the nation's overall export revenue, and 4% of the GDP are all attributed to it. With around 35 million workers, the industry ranks second in the nation for employment. However, it is worth noting in India that only 3.34% of textile output is from the organized sector where technological adoption is at a very initial stage (as told by industry experts) and 96.6% is from the unorganized sector. The unorganized sector in textiles in India continues to operate in the traditional methods and adoption of technology is facing challenges.

This is causing the efficiency of the textile manufacturing to be at a lower level than other textile manufacturing countries For India to remain competitive in the global textile trade, it would thus be essential for both the organized and unorganized sector to adopt to the technological revolution and be world class. Therefore, despite being one of the major textile hubs of the world, technology adoption seems to be lagging and research on Technology adoption in this sector is very low.

Based on these gaps found in the literature review, scope for conducting research on these gaps was observed.

The following research questions and objectives were formulated for conducting the mentioned research.

3.4 Research questions.

Keeping the literature review findings, gaps and the above macroeconomic scenario, we propose to undertake exploratory research to be supported with empirical studies with a view to answer the following.

1. *What are the determinants of IIoT adoption in the textile manufacturing sector in India at an organization level?*

2. *How do these determinants influence the adoption of IIoT in the textile manufacturing sector in India?*

3. *Are these determinants predictive of the IIoT adoption behaviour in the textile manufacturing sector in India?*

4. *To what extent do these determinants explain the adoption behaviour of IIoT in textile manufacturing sector in India?*

3.5 Research objectives.

In line with the research questions raised in the previous chapter, we formulate the research objectives as below.

1. *To identify the determinants of IIoT adoption in the textile manufacturing in India at an organization level*

2. *To identify the relationships between the determinants and adoption of IIoT in the textile manufacturing sector in India*

3. *To evaluate the predictive nature of these determinants on the adoption behaviour of IIoT in the textile manufacturing sector in India*

4. *To quantify the predictive power of these determinants on IIoT adoption in textile manufacturing in India*

Moreover, it is proposed to develop a logistic regression model based on empirical findings from this area of study. Such a model could serve as an instrumental resource for government bodies, including the Textile Export Promotion Council (Texprocil) and the Apparel Export Promotion Council (AEPC). These agencies are dedicated to encouraging technology adoption within the textile industry. The logistic regression model aims to identify textile firms that are likely adopters of new technologies. Preliminary discussions with experts from the International Textile Machinery Association (ITMA) have already indicated a strong interest in the development of this model. The interest shown from ITMA experts underscores the model's potential impact in aiding these agencies to target their efforts more effectively, thereby fostering technological advancement in the textile sector.

Given the scope of the RQs and the Ros, it thus becomes essential to build a framework to conduct the research.

3.6 Distinguishing theory, theoretical framework, and conceptual framework

Theory: A theory is a collection of ideas that are connected in a logical way, showing how different constructs and propositions are related to each other.(Varpio et al., 2020)

Theoretical framework: A theoretical framework is a logically structured and linked collection of concepts and principles, formed from one or more theories.

Conceptual framework: A conceptual framework is the rationale for conducting a particular study. It

(1) outlines the existing state of knowledge, usually by reading through the body of current literature.

(2) highlights areas where our comprehension of a phenomenon or issue is lacking; and

(3) details the methodological foundations of the research project.

Therefore, developing a conceptual framework to study adoption behaviour of IIoT in textile manufacturing based on the T-O-E framework would be the next step.

3.6.1 Conceptual Framework

We followed the following process (Creswell, 2014) in building the conceptual framework

1. **Review the Theoretical Framework**: Begin by thoroughly reviewing the existing theoretical framework. This step ensures a comprehensive understanding of the foundational theory.

2. **Analyze Empirical Research:** Examine relevant empirical research and studies that have utilized the theoretical framework. This helps in understanding how the theory has been applied in practice(Bryman, 2016).

3. **Identify Gaps and Adaptations**: Identify gaps or limitations in the theoretical framework concerning its application to our specific research questions. Additionally, consider any adaptations or modifications required to make it more suitable for our study(Maxwell, 2018).

4. **Develop Conceptual Definitions**: Create conceptual definitions for the key concepts in our research, drawing from the theoretical framework but also tailoring them to fit our research context. (Corbin & Strauss, 1990).

5. **Construct a Conceptual Framework**: Organize the adapted concepts into a coherent conceptual framework. This framework should illustrate the relationships between the variables and concepts that are central to our study. (Yin, 2023)

3.6.2 Reviewing models

As is observed in the literature review, (Oliveira & Martins, 2010) the most used framework for study of IoT adoption in manufacturing across sectors is the T-O-E framework.

The TOE framework, initially introduced and subsequently modified for IT adoption research, serves as an effective tool for examining the uptake and integration of various IT innovations. This framework is well-founded theoretically, enjoys robust empirical backing, and is versatile enough for application in IS innovation areas, though the specific elements within its three contexts might differ among studies.

Aligned with Rogers' Diffusion of Innovations (DOI) theory from 1995(Modica et al., 2021), which highlights the importance of individual and organizational characteristics (both internal and external) in fostering innovation, the TOE framework encompasses similar aspects in its technology and organization contexts (Iacovou et al., 1995b). However, it also introduces an additional critical element: the environment context. This aspect outlines the limitations and possibilities

that the external environment offers for technological innovation. By including this environment context, the TOE framework enhances Rogers' theory, making it more applicable to explaining innovation diffusion within firms (Hwang Y.-M. Rho J.-J., 2016).

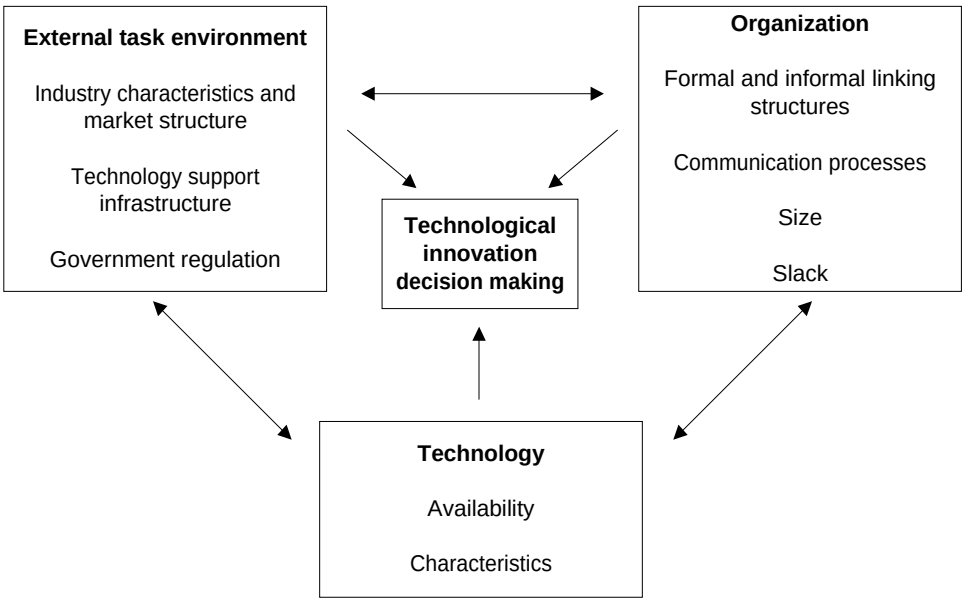

Figure 12 The T-O-E framework.

Source:(Oliveira & Martins, 2011),(Tornatzky et al., 1990)

T-O-E framework

The TOE (Technology-Organization-Environment) framework, formulated by (Tornatzky et al., 1990), delineates three critical dimensions that shape how a business adopts and implements new technology shown in Fig 12. These dimensions are:

(1) Technological context, which encompasses both the technologies a firm currently uses and those available in the broader market. This concept includes internal tools and procedures (Hedberg et al., 1976), along with externally accessible (Hage, 1999).

(2) Organizational context, which encompasses characteristics such as the company's size, scope, and management hierarchy.

(3) Environmental context, which pertains to the external ecosystem of the firm, including its sector, rivals, and interactions related to governmental entities.

Tornatzky and Fleischer introduced the TOE framework as a method to examine how technological innovations are adopted. They suggest that the adoption decision is influenced by elements within the technology, the organization, and the external environment. This approach presents a tripartite model for understanding the acceptance and application of breakthroughs in technology, focusing on the organizational, technical, and environmental contexts.

The technological context is centred around the technologies that are pertinent to a company, encompassing both the technologies already in use and those emerging technologies that are relevant(Tornatzky et al., 1990). Various attributes of these technologies can affect their adoption. In terms of the organizational context, it relates to the specific traits characteristics of an organization, including its size, degree of centralization, the degree of formalization, the organizational structure, the potential of its work force, and the availability of workforce(Kuan & Chau, 2001). These organizational traits can challenge or help the adoption of new technology. The environmental domain pertains to a setting where a company operates, including its sector and interactions with business associates, rivals, also governmental entities (Tornatzky et al., 1990). These are external elements that can create both challenges and opportunities for technological innovations.

Innovation diffusion framework by Rogers (Rogers et al., 1983) is extensively utilized in forecasting technology adoption at the organizational level. Rogers pinpointed five key attributes of technology that precede an adoption decision: the benefits it offers over existing options, its compatibility, its complexity, its trialability, and how observable its benefits are. He also highlighted three main categories influencing adoption: characteristics of leaders, internal attributes of the firm, and non-internal factors surrounding the firm. Leader characteristics are seen as a distinct aspect within the organization itself (Zhu & Kraemer, 2005). The external factors related to the organization align with the environmental context described in the TOE framework. Therefore, Rogers' diffusion theory aligns well with the TOE framework (Zhu et al., 2006).

Research in innovation adoption aligns with the principles of the TOE framework, as evidenced by studies (Cooper & Zmud, 1990). Iacovou and colleagues identified three key elements which impact acceptance of Electronic Data Interchange in key businesses (Iacovou et al., 1995b). These elements include the enthusiasm of the organization, the pressure from external sources, and the perceived advantages of the adoption. In the TOE framework, organizational readiness is categorized under organizational context, while external pressure falls under the environmental context. The notion of perceived benefits relates to recognizing the relative advantage that EDI technology offers an organization. Hence, this concept of perceived benefits fits within the technological context of the TOE framework.

The TOE framework has received robust empirical support and is recognized as effective in exploring the adoption of technological innovations (S. Xu et al., 2004) .An illustration of this is the work of Kuan and Chau, who utilized the TOE framework to investigate how small businesses adopt EDI (Kuan & Chau, 2001). Similarly, Hong and Zhu's research differentiated between Adopters as well as non-Adopters of e-commerce by examining six variables within the TOE framework [29]. Zhu and colleagues also explored the TOE factors' effects on the assimilation of various industries at the firm. A summary of these pertinent studies is presented. The TOE framework has been applied not only to study the adoption of general IT innovations but also to specific IT innovations like EDI.

3.6.3 Model Analysis

Table 6 shows all papers pertaining to the T-O-E model to study IoT adoption in different manufacturing and e-commerce were put through thorough reading

Table 6 A summary of relevant T-O-E papers

Serial Number	Author	Country	Industry
1	(Ming-Ju & Woan-Yuh, 2008)	Taiwan	Telecommunications
2	(Awa & Ojiabo, 2016)	Nigeria	MSMEs
3	(Zhu et al., 2003)	USA	E-business
4	(Chau et al., 2014)	Hong Kong	General manufacturing
5	(Kuan & Chau, 2001)	USA	MSME

Serial Number	Author	Country	Industry
6	(Grover, 1993)	USA	General Manufacturing
7	(Lin & Lin, 2008)	Taiwan	E-commerce
8	(Oliveira & Martins, 2010)	Portugal	E business
9	(T. S. H. Teo et al., 2006)	USA	General manufacturing
10	(Thi Ha Uyen Tran, 2020)	Vietnam	Handicraft production
11	(Zhu & Kraemer, 2005)	USA	Retail Industry
12	(Ebrahimi et al., 2019)	Malaysia	Smart production
13	(Chong et al., 2013)	Hong Kong	Collaborative commerce
14	(Thong, 1999)	Hong Kong	MSME
15	(C. Sharma et al., 2023)	USA	Manufacturing

3.6.4 Tabulating findings

A rigorous reading of all empirical studies using T-O-E was conducted and the most frequently used determinants in each of the constructs were identified shown in Table 7.

Table 7 Most frequently used determinants of T-O-E

Author	**Ming-Ju pan**	**Hart et al.**	**Kevin et al.**	**Chau et al.**	**Kevin.Kuan et al**	**Grover et al**	**Hsiu et.al**	**Tiago et al**	**Thompson et al.**	**Thi et al**	**Yu-min et al.**	**Kevin Zhu et al.**	**Kevin Zhu et.al**	**Ebrahim et.al**	**Aatish et al**	**James et. al**
Country	**Taiwan**	**Nigeria**	**USA**	**Hong Kong**	**USA**	**USA**	**Taiwan**	**Portugal**		**Vietnam**	**Taiwan**	**USA**	**USA**	**Malaysia**	**Mauritius**	**HongKong**
Industry	**telecommunications**	**MSMEs**	**E-business**	**General manufacturing**	**EDI in MSME**	**Organization systems**	**E-commerce**	**E business**	**general production**	**Handicraft production**	**General manufacturing**	**Retail Industry**	**Small businesses**	**healthcare**	**Cloud computing**	**MSME**
Technology	IT infrastructure	ICT infrastructure	Technology Integration		Perceived direct benefits	Compatibility	IS infrastructure		Unresolved technical issues		Relative advantage	Technology competence	Technology readiness	Complexity	Compatibility	
	Technology readiness	Technical know-how			Perceived indirect benefits	Complexity	IS expertise		Lack of IT expertise		Complexity		Technology integration	compatibility	Complexity	
		perceived compatibility				Relative advantage			Lack of interoperability		Compatibility			optimism		
		perceived value														
Organization	Size	Size of firm	Firm size	Complexity of IT infrastructure	Perceived financial cost	Structure	Organization compatibility		difficulties in organizational change	Organization awareness	Top management support	Size	Firm size	Top management support	Organizational competency	Business size
	Perceived barriers	Demographic composition	Firm scope	Satisfaction of existing systems	Perceived technical competence	Formalization	Expected benefits		problems in project management	Organization attitude	Firm size	International scope	Global scope	Financial support	training and education	Employees IS knowledge
-		Scope of business		Formalization of systems development and management		Centralization			lack of top management support	Organization commitment	Technology competence	Financial comittment	Managerial obstacles	Training	Top management support	Information intensity
		Subjective norms				Integration			Lack of strategy							
						size			Difficulties in cost benefit analysis							
						Strategic planning										
						Implementation planning										
						Infrastructure										
Environment	Productions and operations improvement	External support	competitive intensity	Market uncertainty	Perceived industry pressure	Maturity	Competitive pressure	Competitive pressure	Unresolved legal issues		Competitor pressure	Competitive pressure	Competition intensity	Government IT policy	Competitive pressure	
	Enhancement of products and services	Competitive pressure	Regulatory policy		Perceived government pressure	Competition	Trading partner pressure	Trading partner collaboration	Fear and uncertainty		Trading partner pressure	Regulatory support	Regulatory environment	Government laws and legislations	Trading partner support	Competition
	Competitive pressure	Trading partner readiness				Information Intensity					Information intensity					
	Regulatory policy					Adaptable innovations										
						Power										
						Vertical co-ordination										

The determinants were studied across various sectors. It was therefore imperative to ascertain importance of these variables in purview of the textile manufacturing sector in India.

To ascertain the importance of these variables to the textile industry, expert opinion was sought.

In doing this a Delphi technique was used.

An expert can be described as a person who has unique skills or knowledge. This is shown by their roles as leaders in professional groups, holding positions in these organizations, speaking at big national meetings, and having their work published in well-known journals (Cabaniss, 2002).

In this process, 12 experts were chosen in accordance with the advice from the industry professionals who were a part of the earlier in-depth interviews carried out in India (Adnan et al., 2018). The 12 expert panels were Chief Executive Officers, Executive Directors, and Senior General Managers with vast experience. The experts were given the complete definitions of each of the constructs and explanations through semi structured interviews and asked to rank the constructs based on the criticality The gathered replies were combined and examined utilizing the process and equation denoted as below. The constructs were analysed by providing numerical scores on each of the scale of criticality with 100 points on Extremely Critical (4), 50 points on Critical (3), 10 points on (Less Critical) and 0 points on (Not Critical). These scores were then converted into importance indices to establish relative importance. A Relative Importance Index (RIX) was then developed to convert the E- Scores into a decimal figure using the following formula(Kometa et al., 1994)

$\sum W / AxN$

Where

W = weighting given to each factor in the evidence scale, A = the highest weight applied,

N = total number in sample. A consensus was reached on the following constructs

Table 8 Final constructs of the conceptual framework

Context	Constructs
Technological context	Perceived direct benefits
	Perceived indirect benefits
	Compatibility
Organization context	Firm size
	Perceived financial cost
	International readiness
Environmental context	Trading partner pressure
	Information intensity
	Regulatory support

Consensus means when a group agrees or shares the same opinion and feelings.(Mitchell, 1991)

3.6.5 Expert view and consensus

Based on the consensus from experts, conceptual definitions for each of the constructs were finalized and recorded (discussed in the next chapter)

3.6.6 Variables finalization

In the literature, numerous factors have been identified. Rather than reviewing all, this study concentrates on select key factors crucial for understanding and explaining IoT adoption. For this, we sought the expert opinion as explained above. As depicted in Fig. 13, our proposed research model positions adoption as the central variable. Adopting IoT is a primary measure for determining if companies have embraced the technology, and we consider this as a binary outcome: companies have either adopted or not adopted the IoT technology in question.

Our model includes nine predictors believed to directly influence a company's decision to adopt IoT technology. This research is aimed at pinpointing elements that can forecast whether a firm is an adopter or non-adopter of IoT technology, thus the interconnections between these nine factors were not explored in our study.

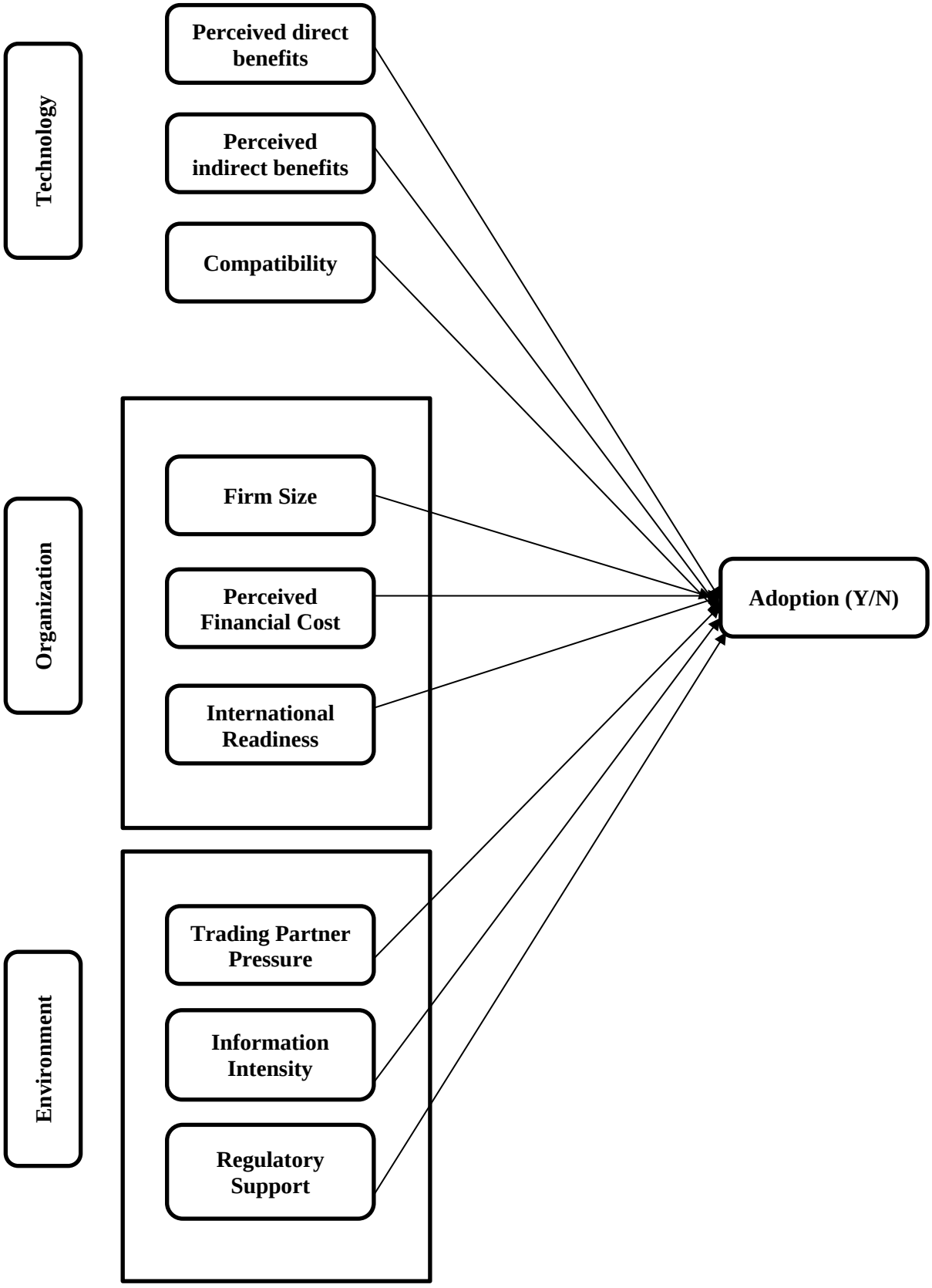

Figure 13 Conceptual Framework for empirical study.