Factors affecting Standard Dominance in the battle between EDIFACT versus XBRL Data Exchange Standards in India.

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Companies and governments use information technology standards to conduct data exchange, the concept being called Business to Government (B2G) data exchange. Companies use these standards to report their financial and business data to the government and governments collect these data for regulatory purposes. This research analyses two such competing data standards EDIFACT and XBRL in the context of B2G data exchange in India. Both the standards have their own set of supporters (regulators and firms) due to which it is uncertain which standard will become the dominant standard in future. Therefore, it is important for standard supporters to identify and leverage factors that could increase the likelihood of dominance of these standards. This is because, implementation of such data standards firstly requires major changes to be made to the existing Information and Communication Technology (ICT) infrastructures. Secondly, such decisions are costly and difficult to reverse.

This research focuses on the factors that play a major role in the battle for dominance in the field of B2G data exchange between EDIFACT and XBRL in India. Five phases were described in this research that the standards go through in their lifecycle when battling for dominance. These phases were designed using the framework of Suarez 2004 as a foundation [1]. To analyze the battle and identify the factors in a structured manner, this research was conducted in 3 main steps. Firstly, factors that were relevant in each phase for the battle between XBRL and EDIFACT were identified via an extensive literature search. This has resulted in a comprehensive list of 21 factors. The second step was primary data collection to identify the most important factors that are crucial to XBRL and EDIFACT with the help of a questionnaire. 9 experts in the field of data exchange standards answered the questionnaire. Data collection and data analysis were done using a Multi Criteria Decision Making (MCDM) method called the Best Worst Method. The third step was to calculate weights and establish importance of these factors for EDIFACT and XBRL using BWM. In conclusion, 12 factors are identified to be very crucial in the battle for dominance between EDIFACT and XBRL in B2G data exchange in India. These are Availability of a more general standard and Collaborations in phase 1, technical Capabilities and diversity of network in phase 2, regulatory support, awareness of the standard, and, implementation costs and time in phase 3, infrastructure dependency, switching costs, trial-ability and observe-ability, intermediaries and Bandwagon effects in phase 4, and, the factor innovation capabilities in phase 5. Based on the progress that the standards have made till date, and the results of BWM, XBRL has better chances of becoming dominant in future.

The results of this research have significant contributions in research and practical applications of standard battles. This research bridges the gap that exists in the literature between two different aspects of standard dominance – Phases – which look at the evolutionary aspects of standards over time and, Factors – which
consider a single point of time at which factors affect dominance of a standard. By combining these two perspectives, this research provides a way to not only analyse standard dominance battles in a phase-wise approach, but also to identify factors that can play a crucial role in increasing the likelihood of standard dominance in each phase of lifecycle of the battle. By doing so, one could establish chances for dominance of a standard in future, by analyzing historical progress of the standard.

This research also has practical implications for standard supporters and managers of firms who are willing to implement these standards in India. Standard supporters can strengthen their efforts in the direction of the factors identified in this research to promote the adoption of the standard they support.

Managers of firms can also benefit from this research as it would help them make informed decisions about choosing the standard suitable for their organization. For example, they can see where their firms stand with regards to the factors identified in this research to improve their chances of successfully implementing their standard of interest by leveraging these factors. This is important because, with new innovations evolving rapidly in the field of ICT, implementation of ICT standards is no more seen as a tool for achieving business objectives, but has become a strategic choice and a part of the overall business strategy of the companies.

Future recommendations of this research include expanding the scope to analyze this battle in the field of B2B (business to business) data exchange. Another interesting area to study in future would be to explore the fragmentation of data exchange standards in the B2B and B2G sectors.
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1 INTRODUCTION

Electronic Data Interchange (EDI) is the exchange of information electronically via computers connected over a network. It is meant for business transactions using a standardized format [2]. The origin of Electronic Data Interchange (EDI) can be traced back to 1960s when computers were identified to have the ability to transfer and exchange information with one another [3]. The first instances of EDI messages were developed by Ed Guilbert who is also known as the ‘Father of EDI’ [4]. As an employee of Du Point Co., he developed standard electronic messages to exchange cargo information with its partner company. The partner company received these messages via telex, which was a popular international service for transferring messages with the help of connected teleprinters in a network at that time [4, 5]. From late 1960s till late 1970s, several industries were developing their own set of standard EDI messages [6].

Businesses and governments also started using EDI for commercial information exchange between them. Such Information exchange between public and private entities is called Business-to-government data exchange. EDI standards in B2G data exchange facilitate businesses with a single place to locate applications and tax forms for one or more levels of government (city, state or province or country), provide the ability to send in payments, update corporate information etc. [7]. Therefore, such standards simplify business reporting obligations through digital record-keeping of information that needs to be exchanged for regulatory purposes [8]. Other forms of data exchange between parties include Business to Business (B2B), Business to Customer (B2C) etc.

While using EDI standards has reduced the amount of money that clients or receiving parties spent on paperwork, sending EDI messages was costly. As different clients followed different EDI standards, senders of the EDI messages had to develop separate instances, making it very expensive. Therefore, there was a huge need for standardization of EDI messages nationally and internationally. According to a blog published in The Economist, [9] there was a need for symmetrical information sharing between businesses and governments to create policies based on tax filings, social security information, employee information, statistics etc. meant for economic welfare of the country [10]. Harmonization of data reporting standards would allow for interoperability and comparability of financial information nationally and globally.

Therefore, in 1987, the United Nations has developed a standard called UN/EDIFACT (United Nations Electronic Data Interchange for Administration, Commerce and Transport) in an attempt to join the Europe and North American versions of EDI to ensure harmonization of commercial information exchange. In
In 1991, about 12,000 businesses in the United States of America were using this standard with similar adoption levels in Europe [11].

The boom of internet has changed the way B2G information exchange was conducted [12]. Several new standards have emerged over the years for information exchange after EDIFACT like verticals, eGov, XML, X12, SGML, XBRL etc. [13]. While EDIFACT was mainly used for computer-computer transactions and was machine readable, Extensible Mark-up Language (XML), developed by World Wide Web Consortium (W3C), between 1996-1997, was both human and machine readable. Though XML was originally intended to handle issues of large-scale publishing on the internet, it has become popular for data exchange due to features like simplicity, well defined structure and human readability. Several data exchange standards sprung out from XML. One standard that has come to the limelight was XBRL, introduced in the early 2000s for business reporting. XBRL has become increasingly popular among the world nations, especially in Europe and Asia. The economic crisis in 2008 has further bolstered the need for a single standard that would enhance information symmetry and transparency [14]. This has marked the beginning of a battle for dominance between the incumbent standard EDIFACT [15] and the challenger XBRL (Extensible Business Reporting Language [14].

The battle between EDIFACT and XBRL is unique in the sense that it cannot be characterized as a typical black and white battle where a company (or group of companies) support one product (technology) while the competing company (or group of companies) support an alternative product (technology). In this research, XBRL and EDIFACT are considered as ‘standard formats’ that enable Electronic Data Interchange (EDI) on global business and financial reporting platforms. XBRL and EDIFACT can be called standard formats because, to put simply, “standard formats describe how and what each term specifies in the document that is exchanged [2]”. Moving forward, XBRL and EDIFACT will be referred to as ‘standards’ in this research.

The focus of this research is on the battle for standards dominance in the field of Business-to-Government Data Exchange between EDIFACT and XBRL in India, which is one of the fastest growing developing economies in the world [16]. India is a large country with 29 States and 7 Union Territories [17]. All the major decisions including the financial structures of States, defence, foreign relations, communications and information technology etc., are centrally controlled. Indian economy is mixed with several public and private sector companies. While public sector mostly controls oil, natural gas, defence etc., private sector has been blooming in recent times in fields of information technology, automobiles, retail etc. With respect to Information and Communication technologies and EDI, all the major policy decisions are also under the control of the central government [18]. It can be said that a digital revolution is happening in India. India has been taking steps in the form of implementing policies to digitize its public and private sectors. During
the 1990s, EDI has revolutionized the way people looked at commercial information exchange in India, which was previously done by paper. The process of tax filings and other transactions done between public and private entities was greatly improved using EDI and computers [18]. The need for international trade has further increased the importance of EDI in data transactions. An EDIFACT committee was set up in India by the EDI council to promote EDIFACT in India. Four major groups from different industries were involved in the development – Finance, Ports, Airports and Technical Support [19]. Since then, EDIFACT was implemented in India as a standard for B2B and B2G data exchange. On the other hand, some entities also started using XML for data exchange as it gained popularity in the late 1990s. Institute of Chartered Accountants of India (ICAI), the regulatory authority for accounting in India has recognized the importance of digital business reporting to regulatory agencies in late 2007. By then, XBRL implementation has already begun in developed nations worldwide for business reporting purposes. Therefore, ICAI, along with the Ministry of Corporate Affairs (MCA) of India has brought into India, the idea of using XBRL for B2G data exchange in India [20]. Since then, MCA, along with other regulatory bodies like Securities and Exchange Board of India (SEBI), Reserve Bank of India (RBI) etc., has been rolling out the implementation of XBRL in India in phases, following the footsteps of its western counter parts like Netherlands, which also followed a phase-wise implementation approach of XBRL [21, 22]. The Information Technology Act of 2008 provided legal recognition for EDI transactions using data standards for E-Commerce and business data reporting to government, which further bolstered companies to adopt these standards [23]. In July 2015, the current Prime Minister of India, Mr. Narendra Modi launched the ‘Digital India Campaign’ as a massive initiative to embed information technology at all levels of government and private sectors with a key notion called ‘E-Governance, which means, ‘Reforming Government through technology’ [24]. As a part of this initiative, the government also started heavily investing in ICT infrastructure. The Indian Income Tax Department also pledged to improve transparency in data exchange process by incorporating technology at all levels of data exchange between businesses and government [24].

The government of India also started a portal called ‘E-Governance data standards’ to facilitate the development and provide a room for discussion of data standards for various digital services [24, 25]. With India taking such huge initiatives as it prepares itself for an era of digital transformation, and with EDIFACT and XBRL, both having their own set of standard supporters in the country, it makes it interesting to study how the battle for dominance between EDIFACT and XBRL is shaping up in the Indian context. Moreover, analysing such a battle in the context of a developing country will give us insights into the nature of standards battles in developing nations.

The purpose of this research is to identify the most crucial factors that can influence standard dominance in the battle between B2G data standards EDIFACT vs XBRL in India. The battle is divided into 5 phases,
according to the ‘milestones’ proposed by Suarez in his framework [1]. Factors crucial for dominance are identified in a phase-wise approach because when the standards progress through their lifecycle battling for dominance, different factors could play a role in different phases of this life cycle.

Based on extensive literature review and primary data collected from experts in the field of data exchange standards in India, factors that play a crucial role in every phase of the battle between EDIFACT and XBRL are identified. Experts could be people working with B2G data exchange, professionals working with EDIFACT and XBRL, and researchers who have/are studying this battle closely in India.

Data collection and data analysis are conducted using an MCDM method called the Best Worst Method (BWM) developed by Dr. Rezaei [26, 27]. Weights of the factors and relative importance of these factors for EDIFACT and XBRL are calculated using BWM for each phase. This research has theoretical and practical implications. This research contributes to the body of literature of standards battles. It bridges the gap between two aspects of studies conducted in the standard dominance literature so far: Phases and Factors. By bridging this gap, this research provides a way to analyse how standards progress as they battle for dominance in phases while looking at factors that are crucial to this dominance in each phase. This research also contributes to the framework of Suarez [1]. By comparing the results of this research with the framework of Suarez, this research provides validation of the factors mentioned by Suarez, which is non-existent in literature.

This research also has practical implications for standard supporters and managers of firms who are willing to implement these standards in India. India is rolling out huge investments to digitally empower itself in the field of B2G data exchange. Therefore, factors identified in this research as crucial for dominance of EDIFACT or XBRL in India can be leveraged by these standard supporters. They can strengthen their efforts in the direction of these factors to promote the adoption of their standard of interest in India. Managers of firms in India will also benefit from this research as it would help them to make informed decisions about choosing the standard suitable for their organization. Managers can see where their firms stand with regards to these factors and improve their chances of successfully implementing their standard of interest, by leveraging and manipulating these factors.

1.1 DEFINITIONS.

1.1.1 EDIFACT.
UN/EDIFACT (Electronic Data Interchange for Administration, Commerce and Transport) is an ISO approved standard for conducting EDI. Developed by the UN/ECE (United Nations/Economic
Commission for Europe) in 1987 [28], EDIFACT provides rules for structuring EDI messages. Using EDIFACT, business entities can exchange information for B2B and B2G purposes electronically [15]. Currently, EDIFACT is used for B2G transactions by customs, central excise authorities etc. EDIFACT is also used for B2B in E-Commerce. A typical EDI transaction between two entities is described in the figure 1 below,

Before the rise of the internet, EDIFACT transactions were exchanged with the help of Value Added Network Providers (VANs). This was because when organizations had to send EDIFACT messages to other entities, they couldn’t develop separate data processing rules for each of these entities. Therefore, several big companies outsourced this work to VANs, who were responsible for translating an entity’s internal format to Standard EDIFACT format and vice versa, as represented in figure 1. As this was expensive, small and medium sized companies (SMEs) couldn’t afford VANs. This scenario hasn’t changed much even after the advent of internet. Instead of VANs, EDI gateways must be used to perform the function of VANs, and these gateways are also expensive. Thus, despite early entrance into the market, the pace of EDIFACT implementation is very slow in India even today. Currently, less than 10% of businesses have adopted EDIFACT in India [29].
A sample EDI document can be found here,

<table>
<thead>
<tr>
<th>EDIFACT form</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNH000002 + ORDERS: DD96A UN:EAN 008</td>
<td>Header</td>
</tr>
<tr>
<td>BGM + 220 - XY0342-9’</td>
<td>Order No. XY0342</td>
</tr>
<tr>
<td>DTM -137 - 20080415:102’</td>
<td>Message Date YYYMMDD</td>
</tr>
<tr>
<td>NAD + BY STANDARD BOOK COMPANY: 2+ A.B.C. 120 AD, BANGALORE++560022’</td>
<td>Purchaser's name and address</td>
</tr>
<tr>
<td>REF + API:SBC7432’</td>
<td>Purchaser's code</td>
</tr>
<tr>
<td>NAD+SU+++PHINC’</td>
<td>Vendor's name</td>
</tr>
<tr>
<td>CUX + 2: USD:9’</td>
<td>Order currency</td>
</tr>
</tbody>
</table>

*Figure 2 A Sample EDI document [29]*

As it can be seen, the document is very difficult to understand and not human readable. In addition, it is very expensive, therefore, SMEs couldn’t afford it.

1.1.2 XML and XBRL.

Extensible Markup Language (XML) is a self-descriptive, human and machine-readable language used for storing and transporting data via the internet (w3schools.com). XML provides a generic framework where unlimited number of user-defined tags (also called taxonomies) and relationships between those tags (also called schemas) can be developed [30]. Since its introduction in 1998, XML has become increasingly popular because of its readability and ease of use [31]. The government of India also has provided a portal called E-Filing, where Income Tax Returns can be filed using XML standards. The portal provides a software which the user can download. This software has a simple interface, where all the details can be entered. Once the details are entered, the file is converted into an XML document by the software, which can then be uploaded to the portal. Therefore, XML is being used as a standard in this area. Chartered Accountants in India also use such software to audit tax returns made to the government by companies [32]. A simple XML document can be seen in figure 3 below. It conveys the same message as what EDIFACT does in Figure 2. It is evident that XML is far more simple and easy to use than EDIFACT. XML also doesn’t need any kind of VANs or gateways like EDIFACT, thus making it an easily accessible standard.
XBRL (Extensible Business Reporting Language) is an off-spring of XML, and thus incorporates all the features of XML like human readability, ease of use etc. It is an open, international standard that facilitates exchange of business information digitally between public and private entities [33]. XBRL also has the functionality of storing and transporting data like XML. However, XBRL differs from XML. It is especially developed for financial and business reporting. The tags (taxonomies) in XBRL are specifically designed for financial data exchange and are taken from standards of financial reporting. XBRL consortium, an international non-profit consortium develops specifications and taxonomies that companies can use. The consortium also specifies how companies can define their own taxonomies and relationships [34]. Companies can look for tags and business rules they need from these standard taxonomies and specifications. As XBRL is an open standard and is extensible in nature, companies can define their own tags to suit their business needs. In India, usually, XBRL translation software are used by companies to submit XBRL filings to the government [35].

The difference between XBRL and EDIFACT can be found in Table 1 below.

Table 1 Generic Comparison of EDIFACT and XBRL

<table>
<thead>
<tr>
<th>EDIFACT</th>
<th>XBRL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO standard developed by the UN/ECE (United Nations/Economic Commission for Europe).</td>
<td>An open international standard developed in early 2000’s</td>
</tr>
<tr>
<td>Created for business transactions exchange</td>
<td>Created for business and financial reporting</td>
</tr>
<tr>
<td>Based on EDI syntax</td>
<td>Based on XML (eXtensible Mark-up Language)</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Acceptance in 1990s by large companies</td>
<td>Internet and the Financial crisis of 2008 led to the widespread adoption</td>
</tr>
<tr>
<td>Complex syntax, machine readable, Rigid format for data interchange</td>
<td>Human readable syntax, Flexible</td>
</tr>
</tbody>
</table>

1.1.3 The Competition

While EDIFACT is popular for data transactions (computer – computer data exchange which could be between B2B or B2G), XBRL is popular as a business reporting standard (using XBRL taxonomies to produce various financial and accounting filings to the government by businesses for example). However, there exists an overlap between these two standards which makes them competing standards. XBRL defines the data present in the transactions with help of its taxonomies which are specific to finance, business rules and accounting. On the other hand, EDIFACT has its own structure for defining and transporting data.

There are two scenarios where EDIFACT and XBRL overlap. XBRL overlaps with EDIFACT in transporting data through the concept of XBRL Global Ledger (XBRL GL) [36]. A general ledger, in terms of accounting, is a record which is made by companies to store all kinds of accounting information like balance sheets, transaction records etc. For example, it summarizes records of Accounts receivable and Payable, income accounts and their statements, deposits etc. [37]. XBRL GL overlaps with EDIFACT in the following way. XBRL GL is developed for data exchange at the transaction level. It builds on XBRL, and has its own taxonomies which are developed by taking accounting standards of several nations into account. It also shares many specifications in these taxonomies with those of EDIFACT’s [36, 38]. While from figure 1, an EDIFACT transaction is clear, EDIFACT’s focus was on ‘exchange’ of information between computers, irrespective of the nature of the data– business transactions for B2B or business reporting for B2G. EDIFACT’s focus was not on creating financial reporting specifications explicitly and sending accounting or reporting information to regulatory agencies, accountants or auditors. XBRL GL on the other hand, focuses on generating financial reporting information specifically. For example, XBRL GL stays in the system that generates a transaction. It then uses XBRL taxonomies to structure the financial data and sends it to the Ledger, where the data is
summarized. The ledger then generates a financial report, which can be transported to the regulatory authorities, auditors etc. [36, 38]. To be precise, both EDIFACT and XBRL GL compete at the transaction level in the way they send messages to the receiving party – EDIFACT is more generic, whereas XBRL GL is more specific to financial reporting. EDIFACT might or might not send the message unambiguously, whereas XBRL GL has more chances for being unambiguous. EDIFACT and XBRL in a way also compete at the data definition level. The way in which their messages are defined is different as can be seen from Figures 2 and 3 above.

It is due to the competition between EDIFACT and XBRL at these two levels that a ground for comparison exists. Moreover, it makes sense to analyse the competition in the field of B2G data exchange because B2G is concentrated around business and financial reporting and that is where these standards compete for dominance.

1.2 RESEARCH OBJECTIVE AND RESEARCH QUESTIONS.

Several factors can play a role in adoption of a standard. Investing and implementing data exchange standards is a decision that involves a lot of cost for companies [39]. Therefore, such decisions need a concrete analysis of standards and factors that play a major role in successful implementation of standards. By knowing which factors can be crucial and why, companies can make strategic and business decisions in the direction of those factors to gain competitive advantage over others. This is very important for companies who want to adopt XBRL or EDIFACT.

Therefore, the objective of this research is to identify factors crucial in the battle between EDIFACT and XBRL in a phase-wise approach. The framework of Suarez 2004 is taken as a foundation to define the current battle in phases [1]. Moreover, it also served as a starting point to identify the factors relevant for this battle. Factors are identified through extensive literature review and expert opinion, which is gathered via a questionnaire based on BWM. BWM is also used for calculating weights of factors and establishing their importance for EDIFACT and XBRL.

More specifically, the main research question is as follows,

“Which factors explain the dominance of XBRL or EDIFACT in Business to Government (B2G) data exchange in India in different phases of the life cycle of the dominance?”

A structured approach is followed in this research to answer the main research question. Firstly, factors that are relevant to the current battle must be found from the literature. Therefore, the first sub-question is,
1a. What are the factors identified from the literature as relevant to the battle between EDIFACT vs XBRL? How are the factors divided amongst the five phases that describe the battle?

1b. Are there any factors that are relevant to the battle of dominance between XBRL and EDIFACT from the framework of Suarez? If so, to what extent is the framework helpful in identifying the factors relevant to this battle?

Answering the first sub-question will yield a list of relevant factors for the battle. It also establishes the contribution of Suarez framework to current research. However, to identify the most crucial factors, the weights of factors and how relatively important a factor is for one standard over the other needs to be calculated. This will be done using the BWM which brings us to the second sub-question,

2a. What are the relative weights of the factors identified in the first sub-question for each standard?

Also, it is important to identify which standard dominates in each phase. This will give us insights about which standard has more chances of becoming dominant in future.

2b. How do the alternative standards EDIFACT and XBRL score in each of the 5 phases?

Answering the second sub-question will help in answering the main research question stated above. Clearly, the factors with higher weights will play a major role. An analysis of why these factors could be crucial will be explained with the help of primary and secondary data. This is explained in detail in the Methodology.

The research is structured as follows: Section 2 describes the Literature review conducted for this research. It has two components- Theoretical Background, to understand the theories behind standard battles for dominance, and Factor Search- to identify factors relevant for the current battle. This is followed by the Methodology which explains how this research is conducted and how the data is analysed using BWM. In the Results section, the results of BWM are discussed, along with establishing possible reasons for these results using primary and secondary sources. This section is followed by Conclusion and Discussion, where the results of this research are summarized. Also, contributions of this research, future recommendations, reflection of strengths and weaknesses of this research and relevance to Management of Technology (MOT) are established in this section.

2 LITERATURE REVIEW

Several researchers analysed battles between standards, technologies or platforms based on historical events to understand the dynamics of such battles in the history of technology dominance.
2.1 THEORETICAL BACKGROUND

According to the perspective of modern evolutionary economics, introduced by Nelson and Winter in 1982, firm’s competitiveness is a dynamic process that is largely depend on its strategic behaviour and it may include innovation as well [40] meaning, competitive advantage, business strategy and innovation are important in establishing success for companies. Geels, in his work on technological transitions, developed multiple perspectives based on both evolutionary economics and technology studies [41]. He mainly discusses how new technological breakthroughs occur and if there are any certain models or paths that they follow to describe technological evolution.

Some evolutionary economists have come up with notions like technological life cycles and dominance. Schumpeter and Marx were among the pioneers who studied the nature and dynamics of technological change as a technology goes through its lifecycle in the process of dominance [42]. In their work, Anderson & Tushman mentioned that in the context of dominance, the life cycle of a breakthrough technology goes through a process of variation followed by selection of a dominant design [42]. However, these evolutionary economists only looked at how the technology progresses over time. This is because for them, emphasis was on the evolutionary aspect of the technology but not on a specific point in time. On the other hand, some scholars emphasized on how certain factors influence technology dominance at one point in time rather than looking at how the technology has progressed over time. Scholars in network economics emphasizes the importance of network externalities along with other market mechanisms that play an important role in making a standard dominant [43]. For example, according to Katz and Shapiro, network externalities occur when the utility that a user derives from consumption of a product increases with the number of users consuming the product [44]. That is, for a standard to become widespread, networks of supporters(companies/groups of companies), the power of actors in the networks, and Bandwagon effects play a crucial role [45, 46].

Some scholars also focussed on the dynamics of battles that happen in converging industries rather than within a single industry. A combination of network theory and strategic management, factors like partnerships, diversity of network, installed base, complementary goods, commitment etc., were mentioned to play a crucial role in such battles [47]. According to Van de Kaa et al., firms apply strategies to increase their chances of achieving dominance [43].

Industrial economics which focuses on behavioural and strategic aspects of firms in industries is characterized by factors like mergers and acquisitions, bandwagon effects, reputation, switching costs, lobbying etc. Another interesting factor Uijl & Vries mentioned in this context is the time window between introduction of two competing technologies [48]. This can be related to the factor timing of entry, which
was mentioned in the previous research on format battles as a very important factor [49]. Schilling (2002) analyses the size of the installed base, learning orientation, the availability of complementary goods and timing of entry as part of a firm’s strategic decisions that can exert a significant degree of control over a technology selection process [49]. For instance, firms can use strategic relationships to gain an installed base advantage over competitors or sponsor the development of complementary goods.

Thus, researchers studying standard dominance have explored the two aspects of standard dominance separately which are ‘phases’ and ‘factors’. While evolutionary economists focused on the phases that a technology goes through in its lifecycle when battling for dominance, scholars of technology management, network economics and industrial economics have focused on factors that affect the dominance of a technology at a particular point in time. Very few researchers combined these two aspects of standard dominance in previous research.

For example, in 2004, Ortt & Schoormans have proposed a new dimension to the pattern of emerging breakthrough communication technologies. They emphasized that alternative patterns of such technologies are actually sub-phases within a single pattern, and to understand this pattern, they divided the course of the pattern into three phases: the Innovation phase which marks the period from the invention of a technology to its first market introduction, the Market Adaptation phase which comprises of the period from after the first market introduction of the technology/technology based product until when the diffusion of the technology takes off, and, the third phase, Market Stabilization which marks the period when diffusion takes off and continues until the technology is replaced/substituted by another breakthrough technology. These authors studied the time frames of these periods for some industries and technologies, for example, to know why some technologies can remain for a longer period in a phase than others. Also, they mentioned factors like Technological superiority and reliability, pricing, research funds (resources), products based on technology etc. to be crucial especially during the innovation and adaptation phases. However, the focus of the research was inclined more towards the time frames of these phases and not on factors. The authors merely mention few factors that are important in the phases based on examples from literature but do not emphasize the role of these factors in technology dominance [50]. Also, the factors were not validated by primary sources.

Similarly, Suarez 2004 [1] emphasized different phases that a technology goes through while competing for dominance. He proposed an integrative framework comprising of five key phases - R&D, Prototyping, Creation of Market, Decisive Battle and Post-dominance that a technology trying to achieve dominance goes through in its life cycle. For each phase, a set of firm-level and environmental-level factors were said to have had an influence on the outcome of the battle. For example, in the R&D phase, where a firm or groups of firms start researching on potential technological trajectories, technology factors like
technological superiority in terms of features etc., and collaborations to experiment with these trajectories were mentioned to be important by Suarez. Also, large budgets or financial resources of the parties will have a profound influence on the quality of the research and therefore, on the technology development [1]. In phase five Post-dominance, when a clear dominance of a standard can be observed, Suarez emphasizes that competition within standard is so intense that firms have to constantly innovate the processes and improve production capabilities to keep up with the competition [1]. Overall, Suarez identified four firm level factors technological superiority, credibility, installed base and strategic manoeuvring, and some environmental level factors Regulators, Network effects and switching costs, Appropriability which play an important role in one or more of the five phases. However, there exists no validation of the framework of Suarez in literature. Therefore, though Suarez has been the first researcher to suggest such a framework where phases and factors are brought together, the framework is not validated empirically and follow-up research in this case is non-existent.

In 2013, Uijl & Vries have applied the Suarez framework ex-post for analysing the case study of Blue-ray vs HD DvD formats [48]. They divided the battle between Blue-ray and HD DVD based on Suarez framework into five phases. For every phase, they identified some factors that played a crucial role in the battle. While Suarez framework was more general, Uijl & Vries applied it to a specific case, however, the case study research only considered the market and firm-level factors based on previous literature available on the battle. The conclusions were not empirically validated. Also, the main focus of their research was on the strategies that firms employ to push adoption of their standard, for example, by introducing a killer app feature or by forming alliances etc., and to verify if these strategies can help to achieve standard dominance [48]. Apart from this work, no follow-up research of Suarez framework exists.

To be precise, while some scholars studied evolutionary aspects and others studied the importance of factors, there exists no empirical research which combines these two aspects in studying standard battles for dominance. The aim of this research is to bridge this gap by studying the battle between EDIFACT and XBRL via a combined perspective of phases and factors, that is, by looking at the current battle in a phase wise approach while simultaneously identifying factors crucial for each phase that play a role in this battle for dominance. This research also identifies the relative importance of these factors for both the standards in each phase, where, relative importance is the establishment of how much more a factor is important for one standard over the other between EDIFACT and XBRL in the battle for dominance.

2.2 Factors from literature survey

With respect to factors for standard dominance relevant for the current battle, an in-depth literature search has been conducted in the fields of technological dominance, technology diffusion, factors in technology
battles, technology life cycles etc. The research began with factors from the research work of Van de Kaa, 2011 [43] and Suarez, 2004 [1]. A backward and forward search was conducted using Web of Science (a scientific research platform produced by Institute for Scientific Information) and Google Scholar to find out whether these factors have been mentioned in the previous research available on the battle between EDIFACT and XBRL and to also find any other factors relevant for the battle.

Only few papers were available on EDIFACT (all dated in the 1990s) and most of them were confined to technical details, for example, Dosdale discussed the need for security of information as it is exchanged between diverse business entities [51]. Some papers analyzed the use of EDIFACT for various business purposes, for example, Martin discussed about implementation of EDIFACT for Book Trade [52]. Very few papers were found on adoption and diffusion of EDIFACT, for example, Storz studied the adoption of EDIFACT in Japan and mentioned that factors like switching costs, path dependency, stability, and infrastructure played a major role in EDIFACT (incumbent) not being replaced by a challenger [53]. He emphasized that EDIFACT has been so entrenched in the architecture of the IT that replacing it will be difficult for companies because of the costs involved to make changes at an architecture level [53].

Previous literature on XBRL has mostly been about the outcomes of using XBRL. For example, one paper provided an empirical comparison of XBRL effects on the audit fees in the US and Japan [54]. One paper described how several stakeholders could be engaged to improve the adoption of XBRL [55]. Country specific adoption of XBRL was studied by some researchers. For example, Rawashdeh et al. studied the critical success factors for adoption of XBRL in Saudi Arabia and identified that factors like perceived relative advantage, perceived ease of use, social influence to be very important [56]. Steenkamp & Nel analyzed the factors for adoption of XBRL in South Africa and identified factors like perceived benefits and costs, low level of awareness, not mandatory, lack of technical knowledge of XBRL etc. [57].

In the Indian context, literature on EDIFACT was confined to the technicalities of its implementation in E-Commerce [58]. A few papers exist about the reasons for XBRL non-adoption in India and the factors mentioned in those papers were similar. For example, all of them stated that XBRL was not implemented as it was ‘not mandatory’, ‘non-relevant’ to the organization, there was no awareness of XBRL and advantages of using it, no perceived benefits firms saw, and that the time needed to learn and implement XBRL was enormous [59-61]. It was interesting to see that factors like perceived ease of use, infrastructure dependency, non-relevance etc. were mentioned in all the cases [59, 61].

A few papers study the battle between XBRL and EDIFACT. Guilloux et al. analyzed the battle in the context of France from the perspective of Actor Network Theory and mentioned factors like authoritative support, collaborations, diversity of networks, network externalities, installed base, efficiency, learning and
development, safety and security to be important for EDIFACT. Flexibility, human readability, switching costs, regulatory support etc., was stated as important for XBRL adoption [14]. Perception-related factors like perceived ease of use, perceived benefits and costs, perceived relative advantage (of using the new standard when compared to its competitor) and perceived compatibility were mentioned in other papers like Pinsker and Li [62], Trauth and Thomas [63] etc. According to the authors, these attitudinal factors influence the adoption of XBRL and EDIFACT. Overall, there exist no empirical papers that compare EDIFACT and XBRL to identify and analyze the factors crucial for their dominance, especially in India.

2.3 RELEVANT FACTORS FOR CURRENT BATTLE

The following factors are identified as relevant for the battle between EDIFACT and XBRL based on previous literature. These factors are divided into five phases with the help of Suarez framework— R&D of a standard, Prototyping, Implementation of standard in the market, Large-scale diffusion/adoptions and, post-dominance. The Five phases are described in detail in Section 4 Case Description. Depending on the context and the timing in which a factor was mentioned in the literature, it is placed in a relevant phase. For example, Guilloux et al., mentioned that regulators play an important role in adoption of a standard [14]. Therefore, this factor is placed in phase 4 - Large-scale diffusion/adoption. It is to be noted that in phase 5, only one factor is considered as relevant for the current battle which is Innovation capabilities. This factor was mentioned by many literature sources as important for a standard after it achieved dominance to keep up with competition [1, 48, 64]. This factor also includes growth rate, as poor innovation capabilities lead to poor growth of the standard [64]. Other factors found in the literature like production capabilities, process innovation etc., are related to products, and are not relevant to the current battle [1, 65]. However, there could be more factors that are important in this phase. Therefore, experts are also asked an open question in the questionnaire about what other factors they think might be important in phase 5. Table 2 below also answers sub-question 1a- What are the factors identified from the literature relevant to the battle between EDIFACT vs XBRL? How are the factors divided amongst the five phases that describe the battle?

Factors identified for each of the five phases are described in Table 2 below.

<table>
<thead>
<tr>
<th>No.</th>
<th>Phase</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R&amp;D for a global standard</td>
<td>Financial Resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collaborations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Availability of a more general standard</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| 2 | Prototyping | Technical capabilities of the standard  
Diversity of network  
Big Fish  |
| 3 | Creation of Market/ Market Entry of the standard | Technical capabilities of the standard  
Knowledge/expertise/awareness of standard  
Company size  
Marketing Strategy  
training and support  
regulatory support  
implementation costs and time  
Perception  
Nature of the market  |
| 4 | Large Scale Diffusion | Intermediaries  
Bandwagon effects  
switching costs  
Infrastructure dependency  
Trialability & Observability  |
| 5 | Post-dominance | Innovation capabilities  |

For description of these factors, please refer to Appendix 8.1. Among the factors identified from the literature (as mentioned in table 2), Technical capabilities, Regulatory support, marketing strategy, nature of the market, switching costs, collaborations and innovation were also mentioned by Suarez, 2004 [1]. Switching costs and Nature of the market were mentioned in post-dominance (phase 4) and decisive battle (phase 4) respectively by Suarez, Nature of the market (how the market is in terms of accepting a
standard, if it is conservative and hesitant towards new standards or if it is modern and flexible) was also mentioned by Suarez. Also, trading partners who do not wish to accept the new standard could influence the adoption decision [56].

As an answer to sub-question 1b- ‘Are there any factors that are relevant to the battle of dominance between XBRL and EDIFACT from the framework of Suarez 2004? If so, to what extent are the frameworks helpful in identifying the factors relevant to this battle?’, it can be concluded that the framework of Suarez 2004 is helpful to a considerable extent because it covers about 8 of the 25 factors (32%) as relevant to the battle between EDIFACT and XBRL. However, which factors among these are validated will be found after the data analysis.

Whilst the factors mentioned by Suarez were mentioned in some papers in the literature, some uncovered aspects also exist. For example, company size was not mentioned by Suarez. However, company size was considered as an important factor in the battle between EDIFACT and XBRL, even though it is not a typical battle between companies (like mentioned before). The phases in which some factors were mentioned in Suarez 2004 differ from the current framework as well. For example, switching costs and Nature of the market were mentioned in post-dominance (phase 4) and decisive battle (phase 4) respectively by Suarez, but these factors are found to be relevant in the Large-scale diffusion (phase 4) and Creation of Market (phase 3) respectively in the current research. Nature of the market is identified as relevant in Creation of market (phase 3) in the current framework.

Another factor worth mentioning is the trial-ability and observe-ability of the standard. According to Doolin and Troshani, the ability for companies to see upfront if the standard works for them can be an important factor for adoption of a standard. The ability to observe and try out a new standard will give companies a chance to try out if the standard is suitable to their company [66]. The factor, relevance to the organization also is correlated to this factor[56]. Regulatory support was mentioned by almost all the literature sources including Suarez [1, 14, 43, 64, 67]. However, there exists a contrast in the phase in which the factor was mentioned in Suarez framework. For example, Suarez mentions it to be important in phase 2, however, the literature in the current research suggests that regulatory support is important in phase 3 when a market is created for the standard [64, 67, 68].

Perception or attitudinal factors were found to be crucial in the Market creation phase of new standards [56, 62, 64]. It cover four aspects – Perceived ease of use (how easy a user perceives using the standard to be), Perceived costs and benefits (whether the perceived costs of implementation are higher/lower than the perceived benefits), Perceived relative advantage (how advantageous people perceive the new standard to be in comparison to the existing standard) and, Perceived Compatibility (how compatible a
firm sees the new standard to be with the technologies/platforms it currently uses (infrastructure-systems, components etc.) There is a need to consider perception related factors because according to secondary data found for current battle, perceptional factors have a profound influence on standard adoption.

Availability of a more general standard, a factor not found anywhere in the literature at all, was mentioned by Dhata Praditya, a PhD researcher in B2G information sharing in the department of ICT, TU Delft. According to the Dhata, the factor is important in R&D phase, he quoted ‘there should exist a more general standard or platform for people to bring together a unifying standard[64]’, for example, EDIFACT had SITPRO, ANA etc., which were all unified. Whereas, XBRL had XML as a more general standard/format [64]. Whether this factor is crucial will be found based on the expert data collected using a questionnaire. Factors found in literature survey are used as inputs to develop the questionnaire based on BWM. Data collection is explained in detail in the Methodology section.

2.4 DECISION HIERARCHY

The following decision hierarchy will be applied in this research for data collection and analysis.

![Figure 4 Decision Hierarchy](image)

The decision hierarchy is represented in a tree-like hierarchical structure, with ‘dominance’ as the root node. Three layers can be seen in this structure. The first layer represents the five Phases of the battle. Considering
the approach of Suarez framework as a foundation, these five phases are defined for the battle between EDIFACT and XBRL which is explained in detail in the Case Description section.

The second layer represents factors pertaining to each phase. The third layer represents the alternatives (here EDIFACT and XBRL). Weights of factors in each phase will be calculated, called local weights. In each phase, weights of factors for EDIFACT and XBRL will also be calculated, called standard weights. These two weights will be multiplied to obtain global weights of factors for both the standards in each phase. These global weights will be used to identify factors crucial for standard dominance in the battle between EDIFACT and XBRL. This process is explained in detail in the next section Methodology.
3 Methodology

The strategy of this research is a combination of qualitative analysis of backward and forward literature search (secondary data) and quantitative analysis of data obtained from expert interviews (primary data) conducted with the help of a questionnaire in India. Using BWM with the help of Microsoft Excel Solver as a tool for solving the method, weights of the factors will be calculated. Results of BWM will be analyzed to identify the factors that play a crucial role for the battle between EDIFACT and XBRL. Figure 5 below defines the steps in this research.
The first step which was to identify the problem. This was transformed into research objective and research questions in the Introduction section which forms a part of Research design. The third step literature search resulted in a set of relevant factors pertaining to each of the five phases of the battle. An additional step, also included in the literature survey, was to contact a researcher in the field of B2G information exchange to narrow down factors obtained from the literature on EDIFACT and XBRL. Narrowing down the factors was important to avoid cumbersome data collection process and to keep only those factors that would make a difference to the battle. The factors obtained after this step are used in developing an online questionnaire through which data is collected from experts in India. A sample of the questionnaire can be found in Appendix 8.2. Data obtained from the questionnaire will be used to calculate weights for the factors using BWM.

### 3.1 Best Worst Method

In Multi-criteria decision-making (MCDM) process, one has to choose, among the available alternatives, the one that is most important by assigning preference to several criteria. Adopters of data exchange standards face the problem of MCDM because choosing such a standard can be influenced by a lot of criteria (factors). Many methods exist to solve MCDM problems like Analytic Hierarchy Process (AHP), Analytic Network Process (ANP), Choosing By Advantages (CBA), and Best Worst Method (BWM) [27]. In this research, Best Worst Method is chosen as the method for data collection and weight calculation. Best-Worst Method (BWM) is a new multi-criteria decision-making (MCDM) method developed by Dr. Jafar Rezaei (Delft University of Technology) in 2015 [26, 27]. This method is suitable for current research because current research is also an MCDM problem where multiple criteria correspond to the factors; and the best alternative corresponds to the dominating standard.

BWM has been successfully applied to many MCDM problems recently. For example, in assessment of multi-criteria sustainability assessment of technologies sustainability and transformation [69], for identifying enablers of technological innovation for Indian SMEs [70], for supplier development and segmentation [71], for supplier selection in integrating traditional and environmental criteria [72], to examine market segments and identify influences of consumer choice [73], to measure efficiency of university-industry Ph.D. projects [74], to develop a roadmap for energy efficiency in buildings [75], to evaluate strategies in medical tourism development [76], for assessing the quality of scientific output [77] etc. For more details about the methodology and projects that applied BWM, interested readers can refer to BWM bibliographic database (www.bestworstmethod.com). A step by step explanation of how weights are calculated using BWM is as follows.
3.1.1 Steps of BWM

To determine weights of criteria (here factors), BWM uses the model of optimization. Such mathematical optimization models help one make ‘better’ decisions by providing a quantitative way to evaluate and select them [78]. Linear programming with minmax model is used. This is suitable because, we can use linear programming to allocate resources (here weights), subject to the given constraints [26, 27, 79].

Step 1: Determining the Criteria

The criteria needed for the decision making are identified. Here the criteria are factors denoted by \((c_1, c_2, \ldots, c_n)\). Here, the criteria are nothing but the factors.

Step 2: Determining the best and the worst criteria

The Decision maker identifies the most important/ most preferred criterion, denoted by \(B\) (best), and the least important/least preferred criterion denoted by \(W\) (worst).

Step 3: Determining the preference of best criterion over all the remaining criteria.

Decision maker gives preference between 1-9 for of the most important criterion in step 2 over the remaining criteria, where 1 indicates both the criteria are equally important/preferred, 2 means the most important criterion is slightly preferred, \(\ldots\), and 9 means the most important criterion is extremely preferred over the criterion to which it is compared. This results in a Best-over-Others Vector denoted by \(B_O\)

\[
B_O = (a_{B1}, a_{B2}, a_{B3}, \ldots, a_{Bn})
\]

Step 4: Determining the preference of best criterion over the worst criterion.

The decision maker gives preference between 1-9 for every criterion over the least important criterion identified in Step 2, where 1-9 scale has the same meaning as used in Step 3. This results in an Others-over-Worst vector denoted by \(O_W\)

\[
O_W = (a_{1W}, a_{2W}, a_{3W}, \ldots, a_{nW})
\]

Step 5: Finding Optimal weights

Optimal weights are calculated for all the criteria denoted by \((w_1^*, w_2^*, \ldots, w_n^*)\) and \(\xi^{13}\) which denotes optimal consistency. For this purpose, the linear version of BWM is used as a unique optimal solution is desired [26]. For any given criterion \(j\), the absolute differences between the pairwise comparisons and their corresponding weight ratios are given as follows.

\[
|w_B - a_{Bj}w_j|, |w_j - a_{jW}w_W|
\]
To obtain an optimized solution with unique weights, the maximum among the absolute difference values above has to be minimized,

$$\min_j \max \{ |w_B - a_{ Bj} w_j|, |w_j - a_{ jW} w_W| \}$$

subject to the constraint,

$$\sum_j w_j = 1$$

$$w_j \geq 0, \text{ for all } j.$$ 

This means, the sum of the unique weights obtained must be equal to 1. This can be solved by transforming it into the following linear programming problem:

Minimize $\xi^L$

such that,

$$|w_B - a_{ Bj} w_j| \leq \xi^L, \text{ for all } j$$

$$|w_j - a_{ jW} w_W| \leq \xi^L, \text{ for all } j$$

$$\sum_j w_j = 1$$

$$w_j \geq 0, \text{ for all } j$$

Solving this linear programming problem will result in a unique solution. It will result in obtaining optimal weights $(w_1^*, w_2^*, \ldots, w_n^*)$ and optimal consistency $\xi^{L*}$. Let these weights be called ‘local weights’ of factors, denoted by $w_j$.

The decision maker is also asked to choose the best (most important) standard, among the given alternatives (here XBRL and EDIFACT), for each factor and then give their preference between 1-9. For example, for a factor X, if the decision maker chooses EDIFACT as the best standard, and gives a preference of ‘9’, it means, EDIFACT is highly desirable/important over XBRL for factor X. For each factor, the above steps are repeated to calculate their weights for both the standards. Let the weights of standards be denoted by $(w_{EDIFACT}$ and $w_{XBRL})$ for each factor.

For a given standard, the global weight for each factor, can be then calculated by the product,

$$w_j * w_{EDIFACT} \text{ for EDIFACT and } w_j * w_{XBRL} \text{ for XBRL.}$$
A comparison is fully consistent if the preference of the best criterion over a criterion \( j \) (given by \( a_{Bj} \)) multiplied by the preference of a criterion \( j \) over the worst criterion (given by \( a_{jW} \)) is equal to the preference given for the best criterion over the worst criterion (given by \( a_{BW} \)) \cite{27}. In that case, \( \xi^{*} \) is 0. However, as there is a possibility that this might not be the case, the closer \( \xi^{*} \) is to zero, the higher the consistency and the more reliable, the results.

This process is repeated for obtaining weights for factors in all the five phases. Therefore, the weights for both the standards for each factor are also calculated.

Finally, the results (weights) obtained from BWM are analyzed to obtain the most important factors for the current battle in each phase of the life cycle of the battle. Reasons for why some factors scored better than others will be identified based on the relevant information gathered via primary and secondary data.

4 CASE DESCRIPTION

Based on the Suarez framework\cite{1}, the battle between EDIFACT and XBRL is divided into five phases as follows,

**Phase 1: R&D for a global standard**

EDIFACT (from 1980-1986): Several organizations were looking for a standard to globalize commercial data exchange around this time. Between 1983-1985, the Commission for European Communities (CEC) started a project called SITPRO to coordinate EDI transactions. Another organization called Article Numbering Association (ANA) was also exploring to coordinate EDI. ANSI X12 was used in the US for EDI transactions. The need for harmonization of EDI for commercial transactions made CEC realize that national standards might become a barrier for international trade. Therefore, it has established a Joint Electronic Data Interchange (JEDI) committee combining Europe and North America. JEDI has proposed the idea of EDIFACT in 1986 \cite{80}.

XBRL (Creation of XBRL) from XML (1998): In 1998, Charles Hoffman, a member of the American Institute of Certified Public Accountants (AICPA) has brought about the idea of developing XBRL using XML for electronic reporting. Having experienced the cumbersome process of creating and validating financial reports, Hoffman has established the initial idea that XBRL will make the process simpler and efficient \cite{81}. This phase is initiated by a person unlike for EDIFACT, which was initiated by a representative group.

**Phase 2: First Specification Development /Prototyping**
EDIFACT (1986 to 1990): The EDIFACT group chose UN/ECE as its parent organization to support and promote its development. UN/ECE has appointed representatives from various nations to coordinate their EDIFACT development activities globally called rapporteurs. The rapporteurs were responsible for development of the syntax of EDIFACT required for their nation. International Organization for Standardization (ISO) approved EDIFACT in 1988. About 12 Message Development Groups (MDGs) were responsible to develop EDIFACT message syntaxes for various sectors like trade, transport, retail etc. [68, 80].

XBRL (1998-2008): Several taxonomies were developed by accounting firms, software vendors and financial organizations in different nations to use XBRL. XBRL international consortium was established to manage these XBRL taxonomy development activities [82]. For example, the Netherlands recognized the potential of XBRL and started working on taxonomies in 2002. Between 2004-2007, it recognized the need for reducing costs of financial reporting to government and to harmonize data exchange between businesses and the government [8] and started development and design of the required tools [83]. In 2008, XBRL Europe, the non-profit consortium for development and promotion of XBRL was formed [84, 85].

Phase 1 and Phase 2 for EDIFACT and XBRL are the same for the Indian scenario. This is because, the developments of standards until phase 3 was a combined effort of multiple nations. Therefore, phases 1 and 2 are not specific to any single country, rather, they are the same for any nation globally. It is only from phase 3, when countries wish to implement these standards that they customize the standards to suit their needs. India has adopted EDIFACT and XBRL standards after have been implemented by its western counterparts.

Phase 3: Implementation of the standard/Creation of market
EDIFACT (1994-present): In 1994, Ministry of Commerce of India established an ‘EDIFACT committee’ to adopt EDIFACT in all EDI international trade transactions. This adoption decision was supported by main actors like Reserve Bank of India, Customs and Airport authority, Port authority, Railways. This means India adopted EDIFACT early [19, 86]. GS1 (Global language of Business) is a globally industry led body with about 110 member countries. In India, it was set up by Ministry of Commerce and Industry. It has created two complementary standards based on EDIFACT to enable faster and better international transactions [87]. Apart from this, many organizations and groups have provided services (VANs) to companies to understand and adopt EDIFACT standard. Also, Singapore Network Services (SNS) formed a joint venture in India with Mahindra group called ‘Mahindra Network Services’ which will help provide EDI services in India [88] via VANs. Despite these efforts, till date, the standard is still in market creation phase, because, the number of companies using EDIFACT is less than 10%.
XBRL (2007-present): The first occurrence of XBRL in India was in 2007 when the Ministry of Corporate Affairs (MCA) and the Institute of Chartered Accountants of India (ICAI) initiated the idea of using XBRL as a part of the E-governance project. The project’s main aim was to keep up with the growing information technology standards, using XBRL to improve efficiency of transactions across the globe [60]. This initiative was backed by three main regulators apart from the two regulators mentioned above, which are, the Reserve Bank of India (RBI) which is the topmost authority centrally for banks in India, Securities and Exchange Board of India (SEBI) which holds a list of all registered companies, Insurance Regulatory and Development Authority (IRDA) which is the regulating body for Insurance in India. In their words, the regulator’s opinion was that ‘XBRL is the way to improve efficiency, accuracy, timeliness and reliability of the financial data [60]’.

Starting in 2010 [89], regulators made the use of XBRL mandatory for large firms first, followed by small firms and also unlisted firms [61]. In 2010, the Ministry of Corporate Affairs (MCA) mandated XBRL filings for large firms (turnover above 100 crores) that were listed under Indian MCA. About 30,000 companies fall under this category. However, banks, SMEs and other private businesses were exempted [90]. Future plans for making the use of XBRL for B2G mandatory is on its way [60].

Phase 4: Large-scale Diffusion (future)

EDIFACT: According to the Information Technology Act 2008, India, transactions based on EDI will be recognized legally thus providing a legal assurance for companies conducting paper-based transactions to shift to electronic transactions [91, 92]. This could be a potential event that can probably trigger the large-scale diffusion of EDIFACT. However, the standard is still in phase 3, despite being an incumbent standard because, according to a news article in The Hindu, even after 22 years from the introduction of the EDIFACT standard in India, more than half of India’s trading points still use paper-based transactions [93].

XBRL: After the MCA made it mandatory for 30,000 companies to submit their filings in XBRL [61, 89], the implementation of XBRL stalled. The second phase of XBRL implementation was supposed to happen in 2011 where more companies were to be asked to submit XBRL filings. The current situation in India is that, regulators have not implemented the standard full-fledged for larger transactions, many regulators (for example, banks) have not made it mandatory to submit filings in XBRL. Also, there is a road-map for commercial banks, financial firms and non-banking institutions to submit their returns to Reserve Bank of India (RBI) for which 100 different templates are made available. RBI has mandated 45 of these returns to be filed through XBRL [20, 94].

Dominance can be established in this phase when either XBRL or EDIFACT take over the majority of the B2G transactions.
Phase 5: Post Dominance:

For XBRL or EDIFACT, post-dominance would be the phase when one of the standards which has already become dominant in the market faces a threat to its dominance because of competing alternatives or new alternative and disruptive standards. During this time, continuous improvement of the standard to keep up with the growing information and communication technology needs is important.

Overall, factors which could have contributed to dominance of EDIFACT or XBRL in each phase until phase 3 so far will be identified (ex-post). Also, factors that can be crucial for dominance and sustainability of EDIFACT or XBRL in future (ex-ante) will be found with the help of the questionnaire and BWM as mentioned in the previous section.

![Figure 6 EDIFACT vs XBRL Indian Scenario](image)

Figure 6 distinguishes the phases of EDIFACT and XBRL according to their timelines (x-axis). It also establishes likelihood of dominance for EDIFACT and XBRL represented by blue and yellow vertical lines respectively (y-axis). For both the standards, their likelihood of dominance is given in each phase. For example, EDIFACT had more chances of being dominant in phase 1 as compared to XBRL. However, in phase 2, XBRL seems to be dominating. Currently, both the standards are in phase 3 market creation, where both have similar likelihood for dominance according to the information collected from secondary sources. This is because, both the standards are struggling to create a market for themselves. However, in the next
section, primary data findings will help to establish chances of dominance for the standards in all the phases, and therefore, to identify the standard that has better chances of becoming dominant in future. Phases 4 and 5 are not represented in the figure, as it is uncertain, when the standards will pass through these phases.

5 RESULTS

5.1 QUESTIONNAIRE

A questionnaire was developed based on the factors identified from Table 2 via secondary data sources. The respondents were explained with examples on how to answer the questionnaire. The questionnaire was completely objective and dynamic. For example, if an expert has chosen a factor ‘B’ as most important, then the next question would be how important was ‘B over the other factors ‘A’ & ‘C’. 9 experts who have knowledge and/or experience in both EDIFACT and XBRL standards answered the questionnaire. Of the 9 respondents, 2 were researchers in data standards and ICT, 2 were professors of e-learning, 2 were consultants of which 1 was a Business Intelligence consultant and 1 was an IT consultant. 1 expert was an Information Architect from the Government -Ministry of Electronics and IT and 2 were software developers. The country of the respondents was India. BWM was used to calculate the weights. Questions were asked from Phases 1 to 5 in an order, where for each phase, factors along with their descriptions were described. Two sets of questions were asked in each phase. First set was regarding the factors important in each phase for the battle between EDIFACT and XBRL in general. This resulted in local weights of factors. In the second set, the respondents were asked to choose which standard (XBRL or EDIFACT) scores high on these factors. This resulted in weights of factors for EDIFACT and XBRL. Global weights for each factor can be calculated by multiplying the local weights of factors with their respective standard weights for EDIFACT and XBRL respectively.

5.2 WEIGHTS

Table 3 below gives an overview of the weights calculated for 9 responses in Phase 1.
### Table 3 Local Weights

<table>
<thead>
<tr>
<th></th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
<th>R6</th>
<th>R7</th>
<th>R8</th>
<th>R9</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>0.07</td>
<td>0.07</td>
<td>0.08</td>
<td>0.07</td>
<td>0.22</td>
<td>0.08</td>
<td>0.19</td>
<td>0.23</td>
<td>0.22</td>
</tr>
<tr>
<td>F2</td>
<td>0.71</td>
<td>0.79</td>
<td>0.71</td>
<td>0.64</td>
<td>0.68</td>
<td>0.73</td>
<td>0.69</td>
<td>0.07</td>
<td>0.10</td>
</tr>
<tr>
<td>F3</td>
<td>0.22</td>
<td>0.15</td>
<td>0.22</td>
<td>0.29</td>
<td>0.10</td>
<td>0.19</td>
<td>0.13</td>
<td>0.7</td>
<td>0.68</td>
</tr>
</tbody>
</table>

### Table 4 Standard weights for EDIFACT

<table>
<thead>
<tr>
<th></th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
<th>R6</th>
<th>R7</th>
<th>R8</th>
<th>R9</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>0.14</td>
<td>0.13</td>
<td>0.86</td>
<td>0.10</td>
<td>0.83</td>
<td>0.14</td>
<td>0.14</td>
<td>0.9</td>
<td>0.80</td>
</tr>
<tr>
<td>F2</td>
<td>0.90</td>
<td>0.86</td>
<td>0.88</td>
<td>0.86</td>
<td>0.83</td>
<td>0.13</td>
<td>0.14</td>
<td>0.9</td>
<td>0.14</td>
</tr>
<tr>
<td>F3</td>
<td>0.89</td>
<td>0.83</td>
<td>0.14</td>
<td>0.90</td>
<td>0.83</td>
<td>0.17</td>
<td>0.83</td>
<td>0.9</td>
<td>0.10</td>
</tr>
</tbody>
</table>

### Table 5 Standard weights for XBRL

<table>
<thead>
<tr>
<th></th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
<th>R6</th>
<th>R7</th>
<th>R8</th>
<th>R9</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>0.86</td>
<td>0.87</td>
<td>0.14</td>
<td>0.90</td>
<td>0.17</td>
<td>0.86</td>
<td>0.86</td>
<td>0.1</td>
<td>0.20</td>
</tr>
<tr>
<td>F2</td>
<td>0.10</td>
<td>0.14</td>
<td>0.12</td>
<td>0.14</td>
<td>0.17</td>
<td>0.87</td>
<td>0.86</td>
<td>0.1</td>
<td>0.86</td>
</tr>
<tr>
<td>F3</td>
<td>0.11</td>
<td>0.17</td>
<td>0.86</td>
<td>0.10</td>
<td>0.17</td>
<td>0.83</td>
<td>0.17</td>
<td>0.1</td>
<td>0.90</td>
</tr>
</tbody>
</table>

### Table 6 Global weights of factors EDIFACT

<table>
<thead>
<tr>
<th></th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
<th>R6</th>
<th>R7</th>
<th>R8</th>
<th>R9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>0.01</td>
<td>0.01</td>
<td>0.07</td>
<td>0.01</td>
<td>0.18</td>
<td>0.01</td>
<td>0.03</td>
<td>0.21</td>
<td>0.18</td>
</tr>
<tr>
<td>F2</td>
<td>0.64</td>
<td>0.68</td>
<td>0.62</td>
<td>0.55</td>
<td>0.56</td>
<td>0.09</td>
<td>0.10</td>
<td>0.06</td>
<td>0.01</td>
</tr>
<tr>
<td>F3</td>
<td>0.20</td>
<td>0.12</td>
<td>0.03</td>
<td>0.26</td>
<td>0.08</td>
<td>0.03</td>
<td>0.11</td>
<td>0.63</td>
<td>0.07</td>
</tr>
</tbody>
</table>
Table 7 Global weights of factors XBRL

<table>
<thead>
<tr>
<th>XBRL-GLOBAL WEIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 1</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>F1</td>
</tr>
<tr>
<td>F2</td>
</tr>
<tr>
<td>F3</td>
</tr>
</tbody>
</table>

Description of Abbreviations

F1: Financial Resources

F2: Availability of a more general standard

F3: Collaborations

R: Respondent

Weight Calculations:

Let $W_{m,n} = \begin{bmatrix} w_{1,1} & w_{1,2} & \ldots & w_{1,9} \\
 w_{2,1} & w_{2,2} & \ldots & w_{2,9} \\
 \vdots & \vdots & \ddots & \vdots \\
 w_{21,1} & w_{21,2} & \ldots & w_{21,9} \end{bmatrix}$

Local weights of factors for each of the ‘n’ respondents (along the rows). These weights correspond to Table 3 (only weights of factors from phase 1 are shown in table 3 above for easy understanding. For weights of the remaining factors, refer to Appendix 8.3).

Let $E_{m,n} = \begin{bmatrix} e_{1,1} & e_{1,2} & \ldots & e_{1,9} \\
 e_{2,1} & e_{2,2} & \ldots & e_{2,9} \\
 \vdots & \vdots & \ddots & \vdots \\
 e_{21,1} & e_{21,2} & \ldots & e_{21,9} \end{bmatrix}$

Weights of factors for EDIFACT for each of the ‘n’ respondents (along the rows).
Where \( E_{m,n} \) indicates a matrix containing weight of ‘m’ factors \((along\ the\ columns)\) given by ‘n’ respondents \((along\ the\ rows)\) for EDIFACT. ‘\( e_{m,n} \)’ are the elements of the matrix. These weights are represented in Table 4.

And,

\[
\begin{align*}
\text{No. of Respondents, } n &= 9 \\
\text{Weights of factors for XBRL} \\
\text{No. of factors, } m &= 21 \text{ factors}
\end{align*}
\]

\[
\begin{bmatrix}
x_{1,1} & x_{1,2} & \ldots & x_{1,9} \\
x_{2,1} & x_{2,2} & \ldots & x_{2,9} \\
\vdots & \vdots & \ddots & \vdots \\
x_{21,1} & x_{21,2} & \ldots & x_{21,9}
\end{bmatrix}
\]

Where \( X_{m,n} \) indicates a matrix containing weight of ‘m’ factors \((along\ the\ columns)\) for each of the ‘n’ respondents \((along\ the\ rows)\) for XBRL. ‘\( x_{m,n} \)’ are elements of the matrix. These weights are represented in Table 5.

The global weights for EDIFACT and XBRL is calculated in Tables 6 and 7 by using a simple multiplication formula given below.

\[
\text{Global weight EDIFACT}_{m,n} = W_{m,n} \times E_{m,n} \quad \forall \ m = 1 \text{ to } 21, \forall \ n = 1 \text{ to } 9
\]

\[
\text{Global weight XBRL}_{m,n} = W_{m,n} \times X_{m,n} \quad \forall \ m = 1 \text{ to } 21, \forall \ n = 1 \text{ to } 9
\]

Example: To calculate global weight of factor 1 for EDIFACT corresponding to respondent 2 the following procedure is used. From the matrix \( W_{m,n} \) & \( E_{m,n} \) we select the elements corresponding to \( m=1 \) & \( n=2 \), i.e.,

\[
\text{Global weights}_{1,2} = W_{1,2} \times E_{1,2} = 0.07 \times 0.13 = 0.01
\]

Calculation of Average weight is as follows

Sum of global weights of EDIFACT is a column vector given by \( SE_m \).

\[
SE_m = \sum_{n=1}^{9} W_{m,n}E_{m,n} \quad , \forall \ m = 1 \text{ to } 21
\]

Sum of global weights of XBRL is a column vector given by \( SX_m \).

\[
SX_m = \sum_{n=1}^{9} W_{m,n}X_{m,n} \quad , \forall \ m = 1 \text{ to } 21
\]
Example: if we want to calculate the sum of global weights for the factor F1 of EDIFACT then from the above equations we have m=1,

\[ SE_1 = \sum_{n=1}^{9} W_{1,n} E_{1,n} \]

\[ SE_1 = W_{1,1} E_{1,1} + W_{1,2} E_{1,2} + \cdots + W_{1,9} E_{1,9} \]

\[ SE_1 = 0.07 \times 0.14 + 0.07 \times 0.13 + 0.08 \times 0.86 + 0.07 \times 0.1 + 0.22 \times 0.83 + 0.08 \times 0.14 + 0.19 \times 0.1 + 0.23 \times 0.9 + 0.22 \times 0.8 \]

Therefore, \[ SE_1 = 0.6973 \]

The global weights of EDIFACT and XBRL for the remaining factors given in Tables 6 and 7 follow the same procedure.

Averages of factors for EDIFACT and XBRL in Table 8 is calculated as follows. Let ‘NoR’ be the number of respondents i.e., NoR=9 in the current case, Then the averages of EDIFACT and XBRL are calculated as follows.

Average of EDIFACT is given by \( AE_m \), which is a column vector defined as,

\[ AE_m = \frac{SE_m}{NoR}, \forall m = 1 \text{ to } 21, NOR = 9 \]

And,

Average of XBRL is given by \( AX_m \), which is a column vector defined as,

\[ AX_m = \frac{SX_m}{NoR}, \forall m = 1 \text{ to } 21, NOR = 9 \]

For example, to calculate Average weight of EDIFACT for factor 1, we already have \( SE_m \) value from equation 1. Substituting value of \( SE_m \) in equation 2,

\[ AE_1 = 0.6973/9 \]

\[ AE_1 = 0.07 \]

This is the Average weight of EDIFACT for factor 1 in Table 8 shown below. The same procedure is repeated to calculate Average weights of EDIFACT and XBRL for all the factors in every phase.
### Table 8 Factor weights for EDIFACT and XBRL

<table>
<thead>
<tr>
<th></th>
<th>EDIFACT Average</th>
<th>XBRL Average</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial Resources</td>
<td>0.08</td>
<td>0.06</td>
</tr>
<tr>
<td>Availability of a more general standard</td>
<td>0.37</td>
<td>0.20</td>
</tr>
<tr>
<td>Collaborations</td>
<td>0.17</td>
<td>0.13</td>
</tr>
<tr>
<td><strong>Phase 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Big Fish</td>
<td>0.08</td>
<td>0.06</td>
</tr>
<tr>
<td>Diversity of Network</td>
<td>0.13</td>
<td>0.22</td>
</tr>
<tr>
<td>Technical Capabilities</td>
<td>0.22</td>
<td>0.29</td>
</tr>
<tr>
<td><strong>Phase 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Company size</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>awareness of the standard</td>
<td>0.09</td>
<td>0.06</td>
</tr>
<tr>
<td>regulatory support</td>
<td>0.04</td>
<td>0.14</td>
</tr>
<tr>
<td>nature of the market</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>Technical Capabilities</td>
<td>0.09</td>
<td>0.07</td>
</tr>
<tr>
<td>implementation costs and time</td>
<td>0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>Perception</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>marketing strategy</td>
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<td>0.04</td>
</tr>
<tr>
<td>training and support</td>
<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
<td><strong>Phase 4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>relevance to the organization</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Intermediaries</td>
<td>0.06</td>
<td>0.11</td>
</tr>
<tr>
<td>switching costs</td>
<td>0.14</td>
<td>0.06</td>
</tr>
<tr>
<td>infrastructure dependency</td>
<td>0.15</td>
<td>0.17</td>
</tr>
<tr>
<td>trial-ability &amp; observe-ability</td>
<td>0.03</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Phase 5</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innovation</td>
<td>0.34</td>
<td>0.66</td>
</tr>
</tbody>
</table>

### 5.3 Data Analysis

#### 5.3.1 Phase 1

In phase 1, more than half of the respondents (about 57%) have chosen ‘Availability of a more general standard’ to be the most important factor, followed by ‘Collaborations’ (30%) while ‘Financial resources’ was considered least important by all the respondents (14%). As mentioned before, this factor was never
mentioned in the previous literature of standards battles. Dhata Praditya, a PhD researcher in field of B2G data exchange who was contacted to narrow down the factors has quoted this factor as important in the R&D phase [64]. This was indeed validated because the factor was attached the highest importance in R&D phase. Availability of a more general standard means that if there is a more general standard to look up to, developing a more specified standard would be made easy and attractive as it provides the new development with a solid foundation [64]. On an average, EDIFACT scored high on Availability of a more general standard. The more general standards here being various national EDI standards that existed before the invention of EDIFACT. Before EDIFACT, several nations developed their own standards for EDI exchange. For example, EDI data exchange was facilitated by Value Added Network Providers in British Telecommunication sector, retailers and suppliers have used TRADNET service for the same. US had its own ANSI X12 standard etc. [19]. Hence, availability of more general standards provided nations a strong base to develop a unifying standard EDIFACT to harmonize global data exchange.

XBRL also had a more general standard available which is XML. However, this factor didn’t prove to be of much help to XBRL according to our primary sources. One primary source, who is an information exchange consultant, who worked on XBRL projects with SEBI (Security and Exchange Board of India), has quoted, “XML is also happening. For example, tax returns are done using XML by many firms in India from the last 7-8 years. Chartered Accountants (CA) buy XML template based software which is cheap and easy to use. All CAs have to do is to upload data on the interface and hit send. No quality problems also arise as data in tax forms is limited and simple”. Therefore, XML is doing well in terms of B2G data exchange which could have reduced the value of XBRL as a standard for data exchange. It was surprising to see that ‘financial resources’ was considered important in inter-firm battles in standard history and even by some researchers on EDIFACT vs XBRL, but, it secured the least important position in reality. One of the respondents has stated the following when asked why this was the case, “Financial Resources is not a deciding factor. In fact, if there are no collaborations, financial resources cannot achieve anything alone in a battle where standards are not developed independently but in a collaborative manner.”. Collaborations on the other hand occupied a considerable role in this phase. One primary source said, “for developing such standards, if interested parties collaborate, what comes out will be a consensus, which will harmonize the whole exchange process’. This could be the reason that Collaborations scored considerably well for both EDIFACT and XBRL, because, this reasoning applies in general for standard development. This could also be validated from the findings of scholars of institutional theory who study the behavior of firms. For example, Schilling 2002 identifies that firms collaborate with each other for technological success and competitive advantage [49]. Guilloux et al., who analyzed the battle between EDIFACT and XBRL in the context of France also identified collaborations as an important factor for implementation of EDIFACT [14].
5.3.2 Phase 2

In phase 2, about 51% of the experts chose ‘Technical capabilities’ as the most important factor, followed by ‘diversity of network’ (35%). Big Fish was chosen as least important by 6 of the 9 experts. XBRL scored high on both Technical capabilities (29%) and Diversity of Network (22%) over EDIFACT (22% and 13% respectively). Technical Capabilities includes flexibility, reliability, accuracy and compatibility of the standards. Though XBRL scored higher for technical capabilities than EDIFACT, with many secondary sources backing this result [14, 31, 95], according to an expert, this is only the case for small reports like tax filings. When it comes to large reports, XBRL has a lot of quality issues, which is also the reason why the SEBI project to develop prototypes of XBRL were shelved. EDIFACT on the other hand, scored considerably well (22%) on technical capabilities because it is mentioned to have superior quality and accuracy [14, 31, 51, 96]. Overall, it can be said that both the standards have their own advantages with respect to technical capabilities, however, the factor itself is very important in phase 2. This is also backed by scholars like Suarez and Van de Kaa et al., who emphasized the importance of technological superiority in standard dominance. Scholars who studied technology battles in networks of industries also supported that diversity of networks has a profound effect on the outcome of the battle [1, 43].

5.3.3 Phase 3

Regulatory support was chosen as the most important factor in phase 3 (18%). This is very consistent with the secondary sources because, most of the previous research spoke about the role of regulatory support in standard adoption and dominance [31, 56, 61, 95]. Regulatory support was followed closely by ‘technical capabilities’ (16%), ‘awareness of the standard’ (15%) and ‘implementation costs and time’ (12%). ‘Perception’, ‘company size’ and ‘nature of the market’ were chosen as the least important factors. Though perception was mentioned in almost all the previous papers in literature of XBRL adoption, especially in developing countries, it was not so important as compared to other factors in this phase according to the experts.

XBRL scored very high (14%) on ‘Regulatory support’ as compared to EDIFACT (4%). According to an expert who is an Information Architect at Ministry of Electronics and IT, India, ‘If there is no regulatory support, especially in a country like India, there is no assurance, and therefore, no matter what other factors you have, it would be of waste for implementation’. Regulatory support was mentioned in all the secondary sources as important in the battle of EDIFACT vs XBRL was clearly validated by experts [14, 60, 95, 97]. Assurance from regulators is indeed highly influential in creation of market for XBRL for example. India has planned to roll out XBRL implementation in a phase-wise approach like its western counterparts. For example, MCA has mandated 30,000 companies to use XBRL to submit their filings to governments in 2010. The plan was to include more companies in 2011 and 2012. However, the plan was not put into
action. This could have happened due to several reasons. For example, one expert mentioned that SEBI invited bids for the SUPER D Project in 2012 to develop prototype specification for Electronic dissemination of all Mutual Funds in India using XBRL. However, due to the immense number of complaints about the quality and accuracy issues of XBRL, the project was shelved and SEBI lost interest. Also, the Reserve Bank of India (RBI) has not mandated the use of XBRL, so banks do not use XBRL. Other regulators have invited companies to experiment with XBRL filings to the government. However, these efforts were limited to small-scale experiments. The second phase of implementation of XBRL didn’t work out as planned because regulators may not be ready for this yet. In his own words, an expert has said, “Different regulators have different purposes in India. So, there is no agreement till today to implement XBRL based filings in India and regulators are not keen enough to implement XBRL for large projects”.

EDIFACT scored high on ‘Awareness of the standard’ in phase 3. This could mean that many of the Indian companies are not yet fully aware of XBRL and its benefits. Lack of awareness was also mentioned in other secondary sources of XBRL implementation in India [60, 97]. This situation is similar to that of XBRL implementation in other developing and semi-developed countries like China, Saudi Arabia etc. [56, 98]. According to a primary source, “Those who tried implementing XBRL haven’t got the value they expected” and therefore, were not willing to go further with the implementation. This means that benefits of XBRL are not fully communicated and demonstrated yet. Lack of awareness and regulatory support were also mentioned by scholars who studied factors for standard hindrance and success in literature. For example, Madureira [99] mentions that role of regulators is very important in adoption of a standard. If regulators are too inflexible, or too slow in catching up with new innovations to improve the standard, this could slow down the adoption of standard [99]. Standard awareness was quoted by almost all the researchers who studied the adoption of XBRL in various countries. Lack of awareness of the uses and benefits of the standard was mentioned as an important factor for XBRL non-adoption [14, 56, 59, 61, 97].

‘Technical capabilities’ was considerably important in this phase as well. However, XBRL scored low on this factor compared to EDIFACT. The quality aspect of XBRL for large filings, as mentioned by one of the experts, could be the reason for this. One primary source quoted, “XBRL has lot of problems about quality. People don’t trust XBRL and so some of them still use pdf. The role of XBRL is to convert financial statements into computer readable format and whoever does this needs to know what financial reporting is. He/she needs to know accounting. But, Indian government involved company secretaries who have no clue about XBRL and have insufficient expertise in validating XBRL filings that companies make to the government. This could also be one reason why quality of XBRL filings in India is poor. In the US, quality checks are held to ensure the quality of XBRL filings”.
XBRL scored high on ‘Implementation costs and time’ as well. In secondary resources, costs and time taken to implement EDIFACT were mentioned to be higher than XBRL [14, 31]. In fact, one of the primary sources said, “In our India, markets are not going to invest much on EDIFACT rather they will prefer XBRL which implementation is not costly. As a software engineer, I can tell you that EDIFACT is better than XBRL but its implementation is costly. Also, the time taken to understand the technology is more”. However, there is another angle to be explored with regards to this factor. One primary source quoted, “One should use an XBRL conversion software to convert traditional files to XBRL format. Some software for simple filings like taxes are cheaper however, software for larger reports are very expensive. Costs is a major problem even for the 30,000 companies for whom MCA made XBRL filings mandatory. One XBRL software costs approximately 5000 US dollars, which is a huge amount for people in a developing country like India.”. He also added, “and this is not the only cost. Other costs include – development of a platform for XBRL, and, for the format of a company’s financial statement, XBRL taxonomy has to be developed. After XBRL is implemented, there is also a need for analytical tools to analyze XBRL data to create value from it”. Therefore, in reality, costs of implementing XBRL may not be as cheap as they were portrayed to be.

All the respondents have mentioned that ‘nature of the market’, ‘company size’ and ‘marketing strategy’ were similar for XBRL and EDIFACT. This could be because both the standards were not part of the strategy of a single company, but rather, are supported and promoted by groups of format supporters [14]. Several scholars emphasized the role of marketing strategy in dominance of a technology in technology battles [100-102]. For example, Cusumano et al. analyzed marketing strategies of rival firms, and concluded that marketing approach including timing of entry, pricing strategy etc., play an important role in the dominance of a standard over its competitor [103].

‘Training and support’ though chosen as least important factor for the battle in general, scored high on XBRL. One primary source mentioned, “In India accounting professional is regulated by ICAI. ICAI implemented auditing of XBRL without training accountants. Without knowledge of XBRL, CAs could only ensure that XBRL filings were passed to the MCA. They only validate XBRL files against some basic rules. For example, rules like ‘a private company should have at least 2 members’, or, ‘financial year cannot be older than 2010’ etc. Only the basic business rules are checked. This is due to lack of proper training”. The source went ahead and said, “India was the first country which mandated the auditing of XBRL. However, deficiencies exist in ICAI point of view. They incorporated a validation certificate in which the accountant will either give a ‘go’ or ‘no-go’ for the XBRL filing, but there is no room for change or comments. There is no room for error identification, mitigation, no checks of where and what is wrong”. This explains why experts have given high importance to the factor for XBRL.
With regards to the factor ‘Perception’, one primary source quoted, “Ask any investment analyst in India—no one will trust XBRL because of quality issues”. Also, apart from MCA, no other regulator has mandated the use of XBRL, so people might not perceive it to be useful for their companies. Overall, the factor was given the least importance in the phase, as opposed to some of the secondary sources [56, 104].

Despite the hype created initially about the implementation of XBRL in India after its implementation in Europe and US, and, despite the early entrance of EDIFACT in India, currently, both the standards are in phase 3. When building the case history for this Thesis, it seemed like both the standards were in phase 4 in India. However, this was not the ‘reality’. Both the standards are still in phase 3, and from the information gathered from primary sources, the factors especially in phase 3 and phase 4 will play a considerable role in standard dominance.

5.3.4 Phase 4

In phase 4, ‘Infrastructure Dependency’ could be the most important factor for dominance of EDIFACT or XBRL (32%) followed by Switching costs (20%), Intermediaries (17%), Trialability & Observeability (17%), Relevance to the organization (15%). Apart from Infrastructure dependency, the remaining four factors had minute difference in their weights. Therefore, it can be said that, all the factors are considerably important in this phase. However, the factor ‘switching costs’ scored extremely high (almost double) for EDIFACT (14%) as compared to XBRL (6%). XBRL had higher infrastructure dependency score (17%) than EDIFACT (15%), however, this difference is minute. Intermediaries, relevance to the organization and Trialability and observability, have scored higher for XBRL as compared to EDIFACT. Therefore, supporters of XBRL in India should focus on these factors if they want XBRL to become the dominant standard in India in future. On the other hand, EDIFACT supporters should find a way to reduce switching costs and infrastructure dependency for dominance of EDIFACT in future.

In phase 5, only 1 factor was found to be relevant for the current battle, ‘Innovation Capabilities’ because, developing improvements/innovating is important for companies to have a competitive advantage over any new/discontinues standard that could substitute the standard post dominance (phase 4). Innovation capabilities also facilitate growth rate. Therefore, respondents were asked to rate Innovation Capabilities of XBRL and EDIFACT. EDIFACT scored the least on Innovation capabilities. This is consistent with the fact that EDIFACT is a proprietary standard, where only the UN participates in developing the standard. This restricts the inflow of knowledge from diverse sources in standard improvements, and thus limits the innovation capabilities to only a group of developers. On the other hand, XBRL is more open, and therefore has the advantage of gathering expertise from various sources. This will allow the standard to innovate in a better way. Supporting his choice of XBRL, one expert stated, ‘relevance with respect to the evolving
technologies and machine learning capabilities would surely challenge the standard if not innovated in a faster pace.

One of the experts, who is a software developer, also mentioned that ‘project allocation’, ‘project timelines’, Project teams who work on B2G data exchange in companies play major factors. However, these factors are more ‘internal’ and are inclined towards successful implementation of the standard within the company, rather than on standard dominance in general. Therefore, individual firms can emphasize on these factors when implementing either of the two standards.

Averages scores of EDIFACT and XBRL for each phase can be found in Table 5 below. This average is nothing but the sum of averages of EDIFACT and XBRL for all the factors in the phase. Phase 3 is highlighted in blue, as both the standards are currently in this phase.

<table>
<thead>
<tr>
<th>Phases</th>
<th>Average EDIFACT</th>
<th>Average XBRL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.62</td>
<td>0.38</td>
</tr>
<tr>
<td>2</td>
<td>0.44</td>
<td>0.56</td>
</tr>
<tr>
<td>3</td>
<td>0.45</td>
<td>0.55</td>
</tr>
<tr>
<td>4</td>
<td>0.42</td>
<td>0.58</td>
</tr>
<tr>
<td>5</td>
<td>0.34</td>
<td>0.66</td>
</tr>
</tbody>
</table>

From table 5, it is evident that, on an average, apart from phase 1, XBRL scored high in all the remaining phases. EDIFACT scored very high in phase 1, because majority of the factors in phase 1 were in favor of EDIFACT. However, the situation was completely opposite for the other phases, where many of the factors were in favor of XBRL on an average. This answers the sub-question 2b, ‘How do the alternative standards EDIFACT and XBRL score in each of the 5 phases?’.
5.3.5 Standard Progress

Overall, XBRL has more chances of becoming dominant than EDIFACT given its progress so far and its likelihood of dominance in phase 3 and phase 4.

From the line chart in figure 7 above, it can be seen how EDIFACT and XBRL have progressed from phase 1 to phase 5. While EDIFACT seems to have more likelihood of dominance in phase 1, this situation has changed from phase 2, from which, the likelihood of dominance of XBRL kept steadily increasing along the phases. This can be related to figure 6 in Section 4, where EDIFACT had better chances of dominance in phase 1, however, XBRL took over from phase 2. It is important to explore why this is the case. A major distinction between XBRL and EDIFACT is that when EDIFACT was introduced as a standard, XML didn’t exist. The rise of internet and introduction of XML between 1995-1998 could be one of the major reasons why XBRL took off from phase 2, which started in 1998. As the implementation of EDIFACT started before the advent of XML, and the structure of EDIFACT and XML completely differ, EDIFACT couldn’t incorporate XML in its structure. This is also a problem that incumbent standards face in terms of innovation and growth [14]. Incumbent standards face the problem of path dependency, where, even if a new technology is available, it is difficult for them to incorporate this ‘change’ as it might affect their whole infrastructure. Instead, they stick to their previously defined structure and only go for limited or incremental innovations [46]. On the other hand, XBRL had the opportunity to start from scratch, by building itself on top of XML [38].

Association with XML was important because it has become a popular technology from the time it has been introduced and it has changed the way data exchange is conducted via the internet [14, 31]. Other reasons
could be the flexibility and extensibility of XBRL as compared to EDIFACT. As mentioned in the Introduction, EDIFACT is costlier to implement due to which only few large organizations in India adopted it. However, SMEs couldn’t afford the standard and were looking for cheaper alternative standards. This could also be the reason why XBRL seems to be having more chances of dominance from the trend in the figure above. As the number of SMEs is large in number compared to large corporations, if more and more SMEs adopt XBRL, it would be possible that XBRL has better chances for dominance in future. Also, XBRL has shown gradual improvement over time in comparison to EDIFACT, whose growth has almost stalled and is at a point of decline. This could also be another reason why XBRL has more chances of being dominant. From this analysis, a new factor that is important for a standard to become dominant in all the phases could be ‘rate of improvement of the standard’.

Supporters of XBRL and EDIFACT could leverage factors in phases 3 and 4 to improve chances of their standard in becoming the dominant one. For example, EDIFACT supporters could find a way to reduce its implementation costs & time and increase regulatory support. XBRL supporters could work on improving the technical capabilities of the standard. If these factors are leveraged, XBRL has better chances of becoming dominant, whereas for EDIFACT the chances would be slightly lower.

Overall, the factors that could play a major role in this dominance battle, and therefore, the factors that standard supporters could emphasize are, regulatory support, awareness of the standard, implementation costs and time, technical capabilities and training and support, rate of improvement. Once a standard has achieved dominance, innovation capabilities and rate of improvement are very important factors to keep new/discontinuous standards from threatening its dominance.
5.3.6 Factors and Standard Deviation

The average of weight of each factor obtained using BWM can be seen in figure 8, along with its standard deviation. Availability of a more general standard, collaborations, technical capabilities, regulatory support, infrastructure dependency, trialability & observability etc. have the highest averages in their respective phases. However, averages are particularly susceptible to outliers, which is why, standard deviation is also taken into consideration. Standard deviation gives us an insight into how concentrated or different our responses are from the average [105]. The smaller the deviation, the closer the data is to the average. This means, responses in the dataset on an average agree with each other. However, a large standard deviation is not necessarily a bad thing when we are observing a dataset, as we do not restrict ourselves to a fixed value [105]. It merely indicates a large variation in the opinion of the group. For example, collaborations, technical capabilities and Big Fish have noticeably large standard deviations, meaning, there is a high variation among the responses in the group. However, If the number of responses increases, there could be a smaller standard deviation as larger samples represent the data better [106]. Another notable difference is that financial resources, and not collaborations is the second most important factor in phase 1. This change proves that not only averages, but also other statistical measures should be considered when trying to establish how representative the data is.
5.3.7 Consistency

For all the responses, a consistency index (ksi*) was also calculated using BWM to establish how consistent the comparisons are. Table 6 below gives the mean and standard deviation of Ksi* values calculated from all the 9 responses for each phase.

Table 10: Phase-wise Consistency Index Ksi*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Resp. 1</th>
<th>Resp. 2</th>
<th>Resp. 3</th>
<th>Resp. 4</th>
<th>Resp. 5</th>
<th>Resp. 6</th>
<th>Resp. 7</th>
<th>Resp. 8</th>
<th>Resp. 9</th>
<th>Average Ksi*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>0.18</td>
<td>0.25</td>
<td>0.17</td>
<td>0.24</td>
<td>0.18</td>
<td>0.23</td>
<td>0.06</td>
<td>0.2</td>
<td>0.02</td>
<td>0.17</td>
</tr>
<tr>
<td>Phase 2</td>
<td>0.2</td>
<td>0.08</td>
<td>0.29</td>
<td>0.26</td>
<td>0.18</td>
<td>0.1</td>
<td>0.08</td>
<td>0.21</td>
<td>0.12</td>
<td>0.17</td>
</tr>
<tr>
<td>Phase 3</td>
<td>0.1</td>
<td>0.13</td>
<td>0.14</td>
<td>0.07</td>
<td>0.11</td>
<td>0.06</td>
<td>0.05</td>
<td>0.04</td>
<td>0.1</td>
<td>0.09</td>
</tr>
<tr>
<td>Phase 4</td>
<td>0.08</td>
<td>0.15</td>
<td>0.25</td>
<td>0.23</td>
<td>0.16</td>
<td>0.08</td>
<td>0.06</td>
<td>0.19</td>
<td>0.19</td>
<td>0.15</td>
</tr>
<tr>
<td>Phase 5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

As phase 5 has only one factor (innovation capabilities), the preference 1-9 is only given for EDIFACT over XBRL or XBRL over EDIFACT. Therefore, solving the constraint equations as shown in the section Methodology would give a ksi* value 0. This makes sense as there exist only two criteria here, and if one of them is chosen as the best, the remaining would be the worst and best over worst or worst over best would be the same. Phase 3, has the lowest ksi* index value 0.09 which is very close to 0, representing the highest consistency. Since the average consistency in all the phases is closer to zero, the comparisons are consistent and the results are reliable.
6  CONCLUSION AND DISCUSSION

The main objective of this research was to identify the factors for standard dominance in the battle between EDIFACT and XBRL for B2G data exchange in India, which is translated into the main research question, “Which factors explain the dominance of XBRL or EDIFACT in Business to Government (B2G) data exchange in India in different phases of the life cycle of the dominance?”

To arrive at the answer to this main research question in a structured approach it is broken down into sub-questions. Firstly, it was important to find the factors that are relevant to the battle between EDIFACT vs XBRL from standard battles literature, which was the sub-question,

1a. What are the factors identified from the literature relevant to the battle between EDIFACT vs XBRL? How are the factors divided amongst the five phases that describe the battle?

An in-depth literature review has resulted in a comprehensive list of 21 factors, which were placed in 5 phases. The phases in the battle between EDIFACT and XBRL were described with the help of the framework of Suarez 2004 [1]. The framework of Suarez [1] was an important source of factors for this research, therefore, it was necessary to find the extent to which it was helpful in identifying the 21 factors found above. The sub-question was,

1b. Are there any factors that are relevant to the battle of dominance between XBRL and EDIFACT from the framework of Suarez 2004? If so, to what extent was the framework helpful in identifying the factors relevant for this battle?

Suarez framework was helpful to a considerable extent. 8 of the 21 factors (32%) identified as relevant for the current research were contributed by this framework. These factors include, Technical capabilities, Regulatory support, marketing strategy, nature of the market, switching costs, collaborations and innovation. However, of the 12 factors validated in this research as the most important by experts, only 4 factors were suggested in Suarez framework. A comparison of the results of current research with those of framework of Suarez 2004 can be found in the Contributions section.

The next step was to find the most important factors among the factors identified from literature and establish their relative importance for EDIFACT and XBRL. The second set of sub-questions were,

2a. What are the relative weights of the factors identified above for each standard?

2b. How do the alternative standards EDIFACT and XBRL score on each of the 5 phases?
9 expert responses were collected via a questionnaire using BWM for this purpose. With the help of this data, weights of the factors were calculated using BWM for both the standards. This resulted in a list of weights for all the factors for both EDIFACT and XBRL. The final step was to establish likelihood of dominance via identifying how EDIFACT and XBRL scored for each phase in the life cycle of the battle for dominance between EDIFACT and XBRL.

It can be concluded that while EDIFACT was dominant in phase 1, XBRL took over from phase 2, and currently, XBRL has better chances of becoming the dominant standard for B2G data exchange in future. This also helps us to answer our main research question,

“Which factors explain the dominance of XBRL or EDIFACT in Business to Government (B2G) data exchange in India in different phases of the life cycle of the dominance?”

12 most important factors are identified in this research as crucial for standard dominance in the battle between EDIFACT and XBRL as consolidated in the Table 7 below.

Table 11 Summary of Factors in Current Research

<table>
<thead>
<tr>
<th>Factor</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Phase 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of a more general standard</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaborations</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Capabilities</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diversity of Network</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulatory support</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Awareness of the standard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Implementation costs and time</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Infrastructure Dependency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Switching costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Trial-ability and Observe-ability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Intermediaries and Bandwagon effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Innovation capabilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
It is evident that most of the phases have a combination of factors at the firm and the environmental-levels. For example, phase 3 has regulatory support, which is an environment-level factor, and technical capabilities which is a firm-level factor. In conclusion, XBRL has more chances of becoming a dominant standard in future, provided, the supporters of the standard work towards strengthening the factors identified in this research.

6.1 Recommendations

The results of this study and the insights gained from analyzing this battle have significance for future research. Suggestions include areas that could be explored as an extension of current research, as well as about new topics that haven’t been touched in this research.

On extension to the current research is to establish the importance of each of the five phases in the standard dominance life cycle, by collecting data about how important each phase is in the standard lifecycle for dominance. Current research results can be then combined with those results to establish a more concrete understanding of such battles. Another direction of research would be in the field of B2B information exchange standards. Current research establishes importance of factors; however, it doesn’t take into consideration, the interrelationships between some factors. Therefore, establishing these interrelationships between factors could be a future trajectory of this research. Some new areas that could be explored include the field of B2B data exchange. The scope of current research is limited to the field of B2G, where XBRL has more chances of becoming dominant in future. However, in the case of B2B, one primary source quoted that EDIFACT is used by many Indian companies for B2B data exchange. This could lead to a fragmented market where XBRL could dominate in the field of B2G and EDIFACT could be the major standard used for B2B transactions. If such is the case, an interesting topic for future research would be, ‘A study on the fragmentation of data exchange standards in the B2B and B2G markets’. Another new and completely unexplored area so far is the within standard competition for data exchange between XML and XML based standards like XBRL. In fact, a new development of XBRL, called IXBRL (Inline XBRL) has only come into light towards the end of this research. However, the standard has a great potential for data exchange in near future. Also built on top of XML, IXBRL not only enables data exchange, but also renders the data visually. Using this feature, IXBRL makes it possible to view XBRL documents in standard web browsers. However, XML itself can also perform data exchange and render it visually with the help of XSL (Extensible Stylesheet Language) and CSS (Cascading Style sheets). Therefore, analyzing a within standard competition between XML and IXBRL would be an interesting topic for future research.
6.2 Contributions

This research contributes to the literature of standards battles and their dominance in several ways [1, 48]. Firstly, it provides a framework that bridges the gap between two research perspectives that exist in literature to analyse standard battles for dominance [1, 40, 50, 100]. Scholars of evolutionary theory analyse standard battles by considering how the standards progress over time [1, 40, 50]. On the other hand, technology management scholars studying technology dominance and standard success analyse a standard battle with the help of factors that contribute to this dominance [12, 43, 63, 99, 107-109]. However, such battles are so dynamic and competitive, and could have irreversible implications for standard supporters participating in them, due to which, analysing them from multiple perspectives is very important. This research provides a way to do so by combining the two perspectives such that scholars can analyse how standards progress during their battle for dominance over time and can also simultaneously look at what factors can cause such dominance at each point in time. Secondly, by determining factors for standard dominance, this research contributes to the existing body of literature on factors for standard success and dominance in the field of ICT. This research also contributes to the work of Uijl and Vries [48]. They applied the framework of Suarez ex-post to analyze the battle of Blue-ray vs HD DVD and present factors that played a role in the dominance of Blue-ray. However, they haven’t validated the framework with primary data. Current research goes a step further and combines ex-post and ex-ante analysis. It looks at historical progress of the standards and predicts the likelihood of dominance in future. It also validates this framework with expert opinion.

This research also provides a structured validation to the framework of Suarez. A comparison of the current research with the framework of Suarez can be found in the table 8 below,

<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Phase 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of a more</td>
<td>✓</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>general standard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaborations</td>
<td>✓</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Capabilities</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Diversity of Network</td>
<td>✓</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulatory support</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Awareness of the standard</td>
<td>✓</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 12: A comparison of Surez Framework with Current Research
Suarez suggests 8 key factors of success in each phase of dominance [1] of which only 4 factors are validated through the current framework. – Technical capabilities, regulatory support, switching costs and innovation. Also, some factors, though present, were mentioned in a different phase. For example, ‘collaborations’ was mentioned in phase 2 in Suarez framework, however, the factor is important even earlier than that in R&D phase according to the findings of the current research. Regulatory support was an important factor in phase 2 according to Suarez, but it is found to be crucial in phase 3 in current research. One reason why regulatory support is important in phase 3, could be that when markets adopt a new technology, it is important that regulators adopt it too. If regulators are not embracing the new technology, then this will slow down the process of adoption. Therefore, it is important that regulatory support is in line with technological developments and vice versa. Current research doesn’t contradict the framework of Suarez, it adds the possibility that some factors can be more important in phases different than those mentioned in Suarez framework. 8 additional factors that were not mentioned by Suarez were found and validated in the current research as the most important factors for standard dominance as can be seen in the table above.

Thus, this research contributes to re-contextualizing the existing technology dominance framework of Suarez by applying the current framework which is a combination of two aspects of dominance-phases and factors to the context of standard dominance. Suarez framework is a more generic framework, which can
be used to analyze dominance of technologies, standards or even technological products. However, current framework is exclusive to the dominance of standard battles. This could also be a reason why, of the 12 factors found in current research as important for standard battles, only 4 factors were suggested by Suarez. It goes without saying that current research also provides a validation of the Suarez framework, which is non-existent in the literature so far. Moreover, by adding new factors to the existing phases of Suarez framework, current research also provides an expansion to the framework of Suarez.

This research also contributes to the standard dominance literature by establishing the viability of BWM for determining factors for standard success. So far, BWM has not been used in the analysis of standard battles for dominance in literature. Because of the reliability and consistency of results obtained using BWM, and because of less data required for comparison, BWM can be used for analyzing standard dominance, standard competition, standard selection etc.

The findings of this research also have significance in the industrial economics and strategic management literature. Studying this battle in context of Business to Government data exchange gives us insights into the viewpoints and strategies behind decision-making of private and public-sector organizations in adoption and promotion of data standards. For example, MCA mandated XBRL for large companies to submit their filings to the government. This was a strategy they followed to enforce the use of XBRL by these companies. Another example could be that companies that used EDIFACT as their data standard outsourced translation of EDIFACT to third party Value Added Network providers, as it is time-taking to do in-house.

Practical implications of this research have significance for standard supporters of XBRL and EDIFACT, firms and regulators that are interested in adoption and subsequent implementation of the standards. The results of this research provide factors crucial for dominance of EDIFACT and XBRL. Standard supporters could leverage factors that enhance standard dominance, in efforts to improve the likelihood of dominance of the standard they support.

While developed nations are progressing quickly in implementing XBRL using a step-wise approach (for example the SBR project in the Netherlands) [8, 21, 110, 111], India is struggling to move beyond its initial efforts of XBRL implementation. In fact, India failed in rolling out the second phase of implementation of XBRL, also due to lack of some factors as discussed in the Results section. Despite being an incumbent standard, EDIFACT too is still trying to create a market for itself due to various reasons stated in the previous sections of this research. Therefore, regulators can benefit from this research by looking at what factors have the potential to make standard adoption and implementation successful in the country and work to leverage those factors. This would improve the chances of successful adoption of their standard of interest. For example, trialability and observe-ability of the standard was chosen as a very important factor
by the respondents. One primary source quoted, ‘firms do not know if XBRL would be useful for them, and if it would bring in any results’. Therefore, if regulators could provide a way in which firms can try the standard for a limited amount of time, it would give them a chance to better understand the implications of the standard. This is also attractive to firms because implementing an ICT standard requires major changes in the existing infrastructure of the firms, and so is a costly and irreversible decision for them. Additionally, firms can also check how competent they are in terms of the factors identified in this research, when making a choice of the standard they wish to implement. Managers would benefit from this as it would help them to make informed decisions about standard selection and implementation.

6.3 REFLECTION

This chapter reflects on the strengths, limitations and unusual findings of this research. It then establishes relevance of this research to Management of Technology (MOT).

6.3.1 Strengths and Limitations

The strength of this research lies in its relevance and applications in the field of B2G data exchange. Companies are looking for cheaper alternatives to conduct B2G data exchange, and would like to make informed decisions about implementation of data standards. For regulators struggling to implement new standards like XBRL, this research highlights why this could be the case and identifies factors that they could leverage to increase the likelihood of standard success. The methodology used in this research provides reliable and consistent results with less amount of data needed for comparison, which is a plus. This research also sheds light on the lack of transparency from the regulators in communicating issues related to the standards to general public and the lack of awareness about data exchange standards among standard experts. In addition, it shows how reality could be completely different from the hype created by standard supporters to promote their standard of interest.

This research also has its limitations. The results of this research are obtained from the inputs of 9 experts. This was disappointing as more responses would improve the reliability of results even more. This was not possible in the current research due to various reasons like time constraints, availability of experts with suitable respondent profile and, geographical constraints. This research requires the experts to have knowledge of both the standards so that they can compare them when answering the questionnaire. Also,
the respondents must be from India. This has made the target group of respondents quite narrow. So, gathering experts purely through online sources in the available time-frame was very challenging. Another limitation is that the current research establishes the importance of factors in phases, however, it doesn’t establish how important a phase is in the life cycle of standard dominance. It should be noted that this research doesn’t ensure success of the standard. It only establishes the likelihood of a standard becoming dominant via providing insights into the factors that play a crucial role in this dominance.

Another limitation was the complexity of the questionnaire. Though BWM provides results with good consistency, the questionnaire was lengthy (about 25-30 minutes) due to the presence of high number of criteria (21) that the respondents had to choose. They took a considerable amount of time to understand the scale used in the questionnaire, as it was new to them. This could also have been the reason why some respondents didn’t complete the questionnaire.

### 6.3.2 Unexpected Findings

One finding of this research, which was not anticipated at all, was the shelving of second phase of implementation of XBRL in India. It was revealed from the primary sources, who developed specifications for XBRL implementation with MCA when it was implemented for the first time in India. However, this information was not available anywhere on the internet. This also shows the lack of transparency and openness on the government’s side in sharing this information with the public. It goes without saying that XBRL was given a lot of hype by regulators in India, however, in reality, they are struggling to implement the standard.

Another unusual finding was the lack of awareness among experts in data standards about a potential competing standard like XBRL. When some respondents were contacted for the questionnaire, despite being in the field of B2G data exchange, they had no clue how XBRL works, and some didn’t even hear the name. This clearly highlights the lack of awareness of the standard among the experts in the field.

A third, and very surprising finding was about the costs of XBRL. Many sources in the literature stated that XBRL was cheap [14, 20, 21, 35, 60, 62, 112]. However, there is more to this than what XBRL supporters mention. XBRL is cheap for filing very small documents for example, for filing tax, which is only a few pages. However, XBRL conversion software for large files of data that needs to be exchanged is very expensive (about 5000 US dollars) for companies in a country like India. Additionally, one primary source quoted a new development of XBRL called IXBRL (Inline XBRL), and surprisingly, it wasn’t associated with XBRL in any of the secondary sources.

Another realization when analyzing EDIFACT standard was its lack of Business model for SMEs. Despite not being adopted on a large scale for many years, and knowing that SMEs couldn’t afford the standard,
the developers of EDIFACT haven’t developed a business model for SMEs. Restricting the development of standard to themselves, thus making the standard complex to understand for outsiders, and, setting up the costs of implementation of the standard without taking SMEs into consideration could have weakened the demand for EDIFACT over time and attracted cheaper alternatives.

In retrospect, instead of choosing respondents from India, who were only accessible via the internet, and the lack of willingness to respond, choosing a different country, for example, the Netherlands, where respondents could be approached physically could have been a better choice. Also, the domain chosen for the current research is B2G at a country level. However, if the choice of domain was B2B, and if the research was conducted industry or sector wise, the research could have got more responses, as the standards were used widely in B2B data exchange.

6.3.3 Relevance to Management of Technology (MOT).

The growing trends in information and communication technologies have organizations (public and private) to constantly look for simpler, better and more efficient ways of exchanging information. Therefore, it is necessary for managers and leaders of these organizations to make informed decisions about choosing the standard suitable for their organization. Moreover, it is also important for them to know how to leverage the chosen standard so as to create benefit to their organization. The process that stretches from R&D introduction of a new innovation (here, standard) to post – dominance finds its relevance in MOT curriculum.

Research Methods (MOT 2312): This course has helped in conducting primary and secondary data research and also in developing the questionnaire needed for quantitative data collection.

Technology Strategy and Entrepreneurship (MOT 1435): The objective of this study is to establish dominance of standards, to compare incumbent standards with new/emerging standards. For firms and standard supporters, it is to strategically work in direction of certain factors (for example establish collaborations, increase innovation capabilities, reduce infrastructure dependency etc.) for successful adoption of standards. This course was helpful to a great extent in understanding the above aspects. It was also helpful in understanding the nature of the firm and market dynamics for the current research.

Inter and Intra-Organizational Decision Making (MOT 1451): This course helped in establishing the current research as a multi-criteria decision-making problem with criteria as factors and the standards XBRL and EDIFACT as alternatives. This research can help managers of firms to make both intra-organizational decisions (for example, reducing the infrastructure dependency of the standard) and for inter-organizational decisions (establishing collaborations) for successful adoption of the standards.
Emerging and Breakthrough Technologies (MOT 2421): This course helped the current research in understanding the evolutionary aspects of emerging standards, and thereby to establish the progress of standards over time in phases.

Technology Battles (MOT 9591): This course helped greatly in analyzing the current battle for dominance from theoretical perspectives of many scholars in the standard dominance literature. It has also provided great insights into identifying factors relevant for the standard dominance. It has helped me with the know-hows of conducting interviews, preparing questionnaires and using the Best Worst Method for data collection.

I&C Architecture: This has helped me in understanding the basic operations and workflows of the two Information and Communication Technology standards EDIFACT and XBRL analyzed in this research and also the complexities (for example, the time and costs involved) involved in implementation of such standards. It has also helped to understand the importance of efficient data sharing in the digital era for effective communications and reporting.
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# Appendix

## 8.1 Factor Descriptions

### Phase 1

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Resources</td>
<td>How financially sound the standard supporter(s) and/or providers are today and how financially capable they are in the future (the funds required for development of the standard).</td>
</tr>
<tr>
<td>Collaborations</td>
<td>When interesting parties come together to achieve a goal (to support/promote the standard)</td>
</tr>
<tr>
<td>Availability of a more general standard</td>
<td>For EDIFACT, there was SITPRO, X12, ANA etc. For XBRL there was XML.</td>
</tr>
</tbody>
</table>

### Phase 2

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Capabilities</td>
<td>This includes how 'flexible', 'reliable', 'accurate', &amp; 'compatible' the standard is in terms of</td>
</tr>
</tbody>
</table>
the adapting to the changing needs of users (Customization), and to the new developments in the market, and with the current and the previous similar standards or complementary products. Also, the design features of the standard that can make the standard better compared to its competitor (here, superior design features of XBRL and EDIFACT)

<table>
<thead>
<tr>
<th>Diversity of network</th>
<th>For a particular standard, how effective is its network of supporters, and the extent of the diverse nature of these networks. For example, International consortium where a diverse group of supporters (internationally) support and promote the standard.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Fish</td>
<td>A key player that can influence the course of the battle in terms of not only financial resources but also in terms of other resources (like their relations in the network).</td>
</tr>
</tbody>
</table>

**Phase 3**

<table>
<thead>
<tr>
<th>Technical Capabilities</th>
<th>This includes 'flexibility in terms of the ability to adapt to the changing (Customization). How 'reliable', 'accurate' the standard is, how 'compatible' the standard is with current and previous standards or complementary products.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness of the standard</td>
<td>The ability to understand and implement the standard, to have knowledge and expertise of the standard.</td>
</tr>
<tr>
<td>Company Size</td>
<td>If the firm is a large corporation or an SME and if this size influences the choice of the standard.</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Marketing strategy</td>
<td>This includes, Communications: All the tactics like promotions, advertisements, displays in trade-shows, conferences etc., Pricing strategy: premium pricing, penetration pricing, competitive pricing strategy etc., Timing of entry: The first point of entry of the standard into the market in this case, entities that have implemented the standard in their information exchange activities, Distribution channels: Channels chosen to distribute the standard to the users</td>
</tr>
<tr>
<td>Training and support</td>
<td>Provision of learning material, information sessions and support for users.</td>
</tr>
<tr>
<td>Regulatory support</td>
<td>The authorities that have the power to influence dominance of a standard, even change the course of the battle by enforcing rules to use the standard.</td>
</tr>
<tr>
<td>Implementation costs and time</td>
<td>The costs of implementing the standard( including infrastructure), the time needed to learn and implement the standard</td>
</tr>
</tbody>
</table>
| Perception                   | The attitudinal factors which include, Perceived ease of use: How easy a user perceives using the standard to be,
<table>
<thead>
<tr>
<th>Nature of the Market</th>
<th>Perceived costs and benefits: Whether the perceived benefits and costs of implementation are higher/lower, Perceived relative advantage: How advantageous people perceive the new standard to be in comparison to another (existing) standard Perceived Compatibility: How compatible a firm sees the new standard to be with the technologies it currently uses (infrastructure-systems, components etc.) Is it conservative/ traditional and takes time to adopt a new standard? Or is it modern/ flexible and thus quick in adoption?</th>
</tr>
</thead>
</table>

**Phase 4**

<table>
<thead>
<tr>
<th>Intermediaries and Bandwagon effects</th>
<th>Pressure from the market to innovate, Financial intermediaries (cost and chartered accountants) trading partners that influence a firm to adopt a standard because they are using the same etc. This leads to Bandwagon effects- the more people use a standard for a solution, the more its demand grows and other people tend to use the same.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching Costs</td>
<td>The costs required to switch from or to a competing standard. The higher these costs, the difficult and longer it gets for users to switch to a competing standard</td>
</tr>
<tr>
<td>Infrastructure dependency</td>
<td>When there is a need to make changes to the existing infrastructure to implement a new standard, the firms may be willing to do so because of the great time and money involved in this change</td>
</tr>
<tr>
<td>Trial-ability &amp; Observe-ability</td>
<td>The ability to have a proof of performance of the standard before adopting, the chance to observe, test-trial before implementation</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Relevance to organization</td>
<td>If the standard is really required and suitable for the organization when they already have an existing standard</td>
</tr>
</tbody>
</table>

**Phase 5**

<table>
<thead>
<tr>
<th>Innovation</th>
<th>Developing improvements/innovating is important for companies to have a competitive advantage over a new/discontinues standard. Innovation capabilities also facilitate growth rate.</th>
</tr>
</thead>
</table>
8.2 QUESTIONNAIRE EDIFACT vs XBRL – SAMPLE SCREENSHOTS.

Phase 1: R&D for a global standard

This phase includes the R&D activities of standard development. Companies and groups have come together to develop a unifying standard EDIFACT during 1980-1986.

A similar R&D phase can be observed for XBRL in 1998 when Charles Hoffman (AICPA) has brought the idea of developing XBRL using XML for electronic reporting.

The factors identified for this phase are listed below.

For reference, definitions of the factors can be found after the question.

1. What factor do you consider to be “most important” in the battle between EDIFACT and XBRL for B2G data exchange in phase 1? *

   ○ Availability of a more general standard
   ○ Collaborations
   ○ Financial Resources

Financial Resources: How financially sound the standard supporter(s) and/or providers are today and how financially capable they are in the future (the funds required for development of the standard).

Collaborations: When interesting parties come together to achieve a goal (to support/promote the standard)

Availability of a more general standard: For EDIFACT, there was SITPRO, X12, ANA etc. For XBRL there was XML.
Best Factor: Phase 1: Availability of a more general standard

7. Please select a number from 1-9 to show your preference of your most important factor "Availability of a more general standard" over,

<table>
<thead>
<tr>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Resources</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Collaborations</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
EDIFACT versus XBRL

Phase 1: R&D for a global standard- (Most important factor already chosen: Availability of a more general standard)

You have chosen “Availability of a more general standard” as the most important factor in phase 1. Kindly choose the least important factor for phase 1 among the remaining factors listed below.

For reference, definitions of the factors can be found after the question.

4. What factor do you consider to be “least important” in the battle between EDIFACT and XBRL for B2G data exchange in phase 1?

- [ ] Collaborations
- [ ] Financial Resources

Financial Resources: How financially sound the standard supporter(s) and/or providers are today and how financially capable they are in the future (the funds required for development of the standard).

Collaborations: When interesting parties come together to achieve a goal (to support/promote the standard)
Least Important Factor: Financial Resources

8. Please select a number from 1-9 to show your preference of the following factors 'over' your least important factor "Financial Resources"

<table>
<thead>
<tr>
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<th>1</th>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborations</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Availability of a more general standard</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
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<td>[ ]</td>
</tr>
</tbody>
</table>
EDIFACT vs XBRL Phase 1

For each factor listed below, first pick which standard scores better for that factor (therefore choose either XBRL or EDIFACT), then, give your preference between 1-9 to show how much better this standard scores for this factor is over the other standard.

For example, for a factor "Financial Resources", if you checked "EDIFACT" and wrote "5", this means, EDIFACT scores better on Financial Resources with a value "5" (meaning considerably important) over the other standard XBRL.

11. Financial Resources *

☐ XBRL  ☐ EDIFACT

☐ Give your preference between 1-9

12. Collaborations *

☐ XBRL  ☐ EDIFACT

☐ Give your preference between 1-9

13. Availability of a more general standard *

☐ XBRL  ☐ EDIFACT

☐ Give your preference between 1-9
### 8.3 Weights of Factors – Phase-wise

#### Table 1: Weights of factors in Phase 2

<table>
<thead>
<tr>
<th></th>
<th>O/p 1</th>
<th>O/P 2</th>
<th>O/P 3</th>
<th>O/P 4</th>
<th>O/P 5</th>
<th>O/P 6</th>
<th>O/P 7</th>
<th>O/P 8</th>
<th>O/P 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>0.07</td>
<td>0.08</td>
<td>0.18</td>
<td>0.06</td>
<td>0.1</td>
<td>0.1</td>
<td>0.33</td>
<td>0.06</td>
<td>0.26</td>
</tr>
<tr>
<td>F2</td>
<td>0.16</td>
<td>0.67</td>
<td>0.76</td>
<td>0.15</td>
<td>0.22</td>
<td>0.7</td>
<td>0.25</td>
<td>0.16</td>
<td>0.08</td>
</tr>
<tr>
<td>F3</td>
<td>0.77</td>
<td>0.25</td>
<td>0.07</td>
<td>0.79</td>
<td>0.68</td>
<td>0.2</td>
<td>0.42</td>
<td>0.77</td>
<td>0.66</td>
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</table>

<table>
<thead>
<tr>
<th></th>
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<th>XBRL</th>
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<td>0.25</td>
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<td>0.12</td>
<td>0.9</td>
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<td>0.25</td>
<td>0.75</td>
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<td>0.2</td>
</tr>
<tr>
<td>F2</td>
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<td>0.83</td>
<td>0.17</td>
<td>0.11</td>
<td>0.89</td>
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<td>0.14</td>
<td>0.86</td>
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<td>0.9</td>
<td>0.88</td>
<td>0.12</td>
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<td>0.83</td>
<td>0.86</td>
<td>0.14</td>
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</table>

<table>
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<tr>
<th></th>
<th>Total</th>
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<th>O/p 1</th>
<th>EDIFACT*</th>
<th>O/P 2</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.06</td>
<td>0.02</td>
<td>0.06</td>
<td>0.16</td>
</tr>
<tr>
<td>F2</td>
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<td>0.56</td>
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<td>0.08</td>
</tr>
<tr>
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<td>0.67</td>
<td>0.02</td>
<td>0.23</td>
<td>0.07</td>
</tr>
</tbody>
</table>

F1: Big Fish  
F2: Diversity of Network  
F3: Technical Capabilities
Table 2: Weights of factors in Phase 3

<table>
<thead>
<tr>
<th></th>
<th>O/P 1</th>
<th>O/P 2</th>
<th>O/P 3</th>
<th>O/P 4</th>
<th>O/P 5</th>
<th>O/P 6</th>
<th>O/P 7</th>
<th>O/P 8</th>
<th>O/P 9</th>
</tr>
</thead>
<tbody>
<tr>
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Table 3. Weights of Factors in Phase 4

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F1 Relevance to the organization
F2 Intermediaries and Bandwagon Effects
F3 Switching Costs
F4 Infrastructure Dependency
F5 Trialability and Observe-ability
Respondent Group Composition.

Of the 9 respondents, 7 were male and 2 females. The country of respondents was India.

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