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INFORMATION TECHNOLOGY FLEXIBILITY: A SYNTHESIZED MODEL FROM EXISTING LITERATURE

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ABSTRACT

Organizational leaders face an ever-growing set of challenges exemplified through customer demands and needs, increased global competition, and the pressure for higher returns. One way to accomplish these goals is through information technology. This literary review synthesizes an information technology flexibility model from eight different sources.

The works of Dr. Lawrence Ness, an instructor at Capella University forms the center of the synthesized model and works from Byrd and Turner, Gerbauer and Schober, Bond, Hayes and Barnes-Holmes, Bhatt and Grover, Byrd, Pitts, Adrian and Davidson, and Overby, Bharadwaj and Sambamurthy provide collaborative information technology flexibility material. These eight sources combine to show the relationship between information technology flexibility, information technology effectiveness, and organizational alignment.

After combining these sources, the information technology flexibility component is considered relative to the information technology infrastructure of the organization and the available skills found within the information technology group. While the organizational alignment corner of the triangle examines psychological aspects and executive leadership attitudes that lead to organizational alignment. The combination of these facets provides a comprehensive information technology flexibility model.

Keywords: information technology, flexibility, alignment, effectiveness

INTRODUCTION

Leaders within well run organizations are continually looking for ways to improve, satisfy ever-growing customer needs or demands, and beat or stay ahead of the competition. To further challenge organizations, the speeds to react and respond to these organizational tests are occurring at an increasing rate. Information technology (IT) is being applied within many industries as one of the avenues available to satisfy these organizational chal-

lenges [14]. From an IT perspective, a number of tasks require management, refining, and improvement to provide the maximum benefit back to the organization. Ness [13] suggested a framework that called out the relationship between “Information Technology Flexibility (ITF), IT Effectiveness (ITE), and Strategic Alignment (SA)” (p. 7).

In researching articles written on IT flexibility a pattern emerged. This pattern began to fit into the initial model suggested by Ness [13]. Components of this pattern began to fit into the three processes: ITF, ITE, SA,

and the relationships between the three variables. This composition and synthesis of these articles built a supporting structure for Ness's model.

This literary review focuses on this synthesized ITF model and dive deeper into the various facets of Ness's original model in an attempt to provide further explanation as well as to for its extension. New ITF methods are explored within this literary review. Note that ITF does not come without a cost [13]. Therefore, this literary review examines trade-offs that individuals and organizations need to make in determining the necessary amount of ITF required.

SIGNIFICANCE OF IT FLEXIBILITY

Before discussing ITF, an understanding of the flexibility component of IT is required. Merriam-Webster [8] defined *flexible* as "characterized by a ready capability to adapt to new, different, or changing requirements" (p. 1). Another commonly used term within the IT field is *agility* [14]. Merriam-Webster [1] described agile as "having a quick resourceful and adaptable character" (p. 1). Since flexibility and agility are defined similarly, the two words will be used interchangeably.

Luftman and Kempaiah [12] wrote about a maturity model for organizations. Many of the items discussed in the article will be included in this literary review. Luftman and Kempaiah identified six main areas that lead to business and information technology alignment the areas are "communications, value, governance, partnership, scope and architecture, and skills" (p. 167).

To this point, the flexibility discussion has been at a rather generic level and from a single perspective. Organizational flexibility is broader than simply IT flexibility. Organizational leadership, individuals, and business groups all contribute to a flexible organization. Groups beyond the IT group also have flexibility challenges. Supply chain organizations need flexible processes to enable product delivery to the right customers in a timely manner. Sales organizations need flexibility to stimulate sales and provide options that competition cannot offer. Group after group within an organization need flexibility to provide different services or products to fulfill customer needs or for sustained competitive advantage. In many ways, the IT group is at the heart of these capabilities, as depicted in Figure 1.

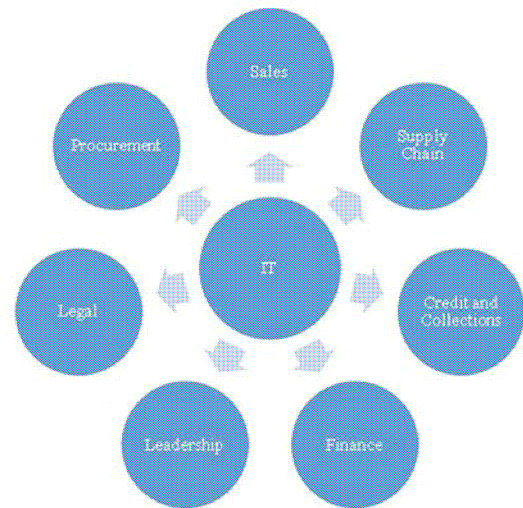


Figure 1: IT as the Hub of Organizational Flexibility

SYNTHESIS OF KEY IT FLEXIBILITY SOURCES

After researching numerous sources of scholarly writings dealing with keywords *information*, *technology*, and *flexibility* certain common and interlinking characteristics began to emerge. Figure 2 shows the synthesized ITF model. The center of the model comes from Ness's ITF model. The dotted lines map the shaded sources to Ness's model. The remainder of this section will dissect the synthesized IT model and integrate the synthesized model.

Ness [13] closely aligns to other sources that tie ITF's strong relationship to "IT effectiveness and strategic alignment" (p. 11). From a high level, ITF derives its characteristics from "connectivity, compatibility, and modularity" (p. 11). Byrd and Turner [6] characterized ITF slightly differently by referring to ITF as "technical it infrastructure and a human it infrastructure" (p. 168).

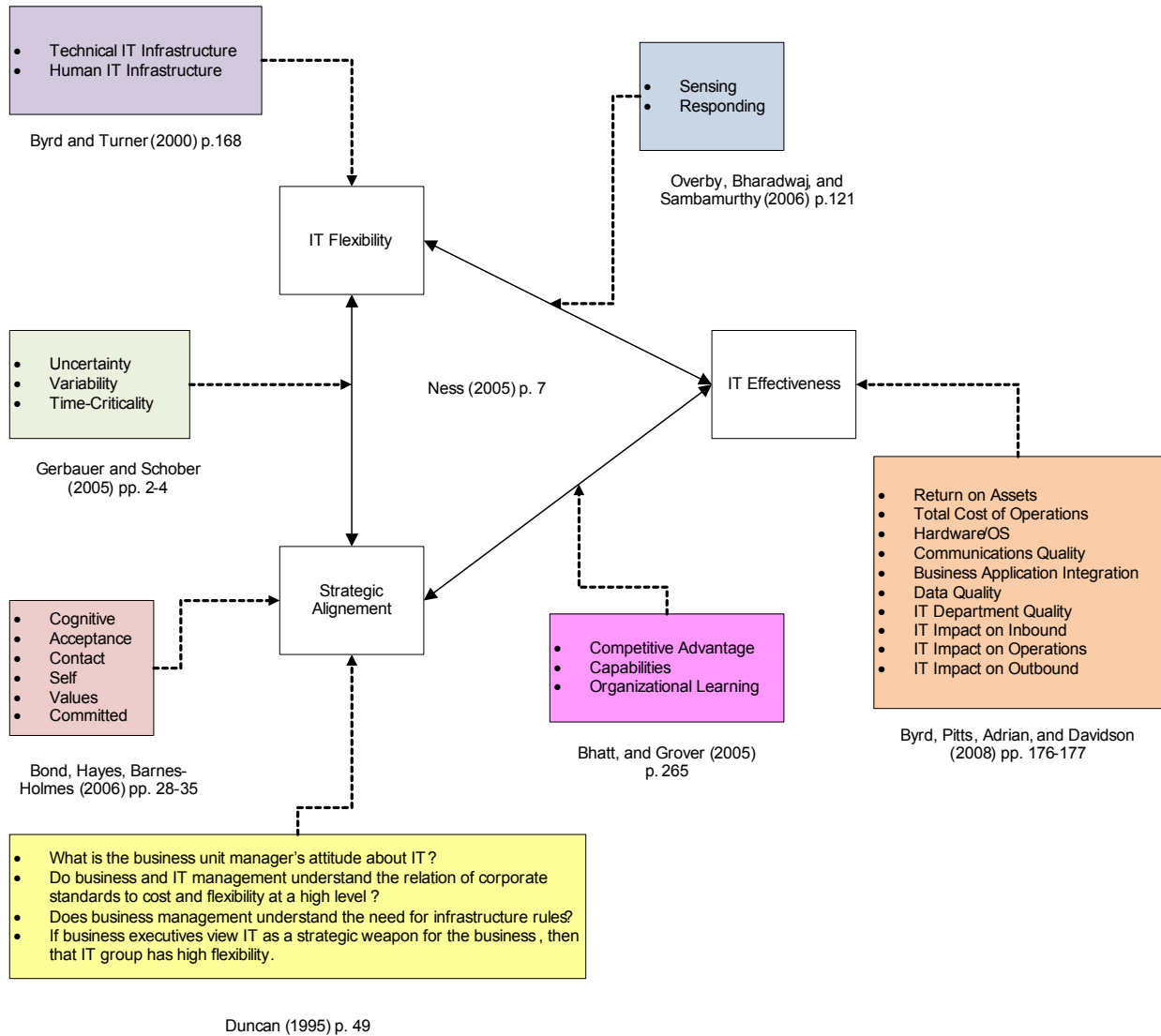


Figure 2: Synthesized ITF model

Infrastructure, as a component of ITF, implies the use of switches, routers, firewalls, system hardware, laptop, desktops, printers, application software, telecommunications components, wide area network, and local area network, plus all of the people that enable and keep those components running [5]. The people component of ITF consists of the technical capabilities of the IT team, the breadth of the team’s knowledge and ability to support multiple products, their dedication to the organization, and psychological characteristics as subsequently described in this literary review by Georgsdottir and Getz. Byrd and Turner [6] specifically call out “commitments, values, and norms” (p. 168) that directly tie to Georgsdot-

tir and Getz [10]. Byrd and Turner’s research statistically identifies “technology management, application functionality, IT compatibility, and data transparency” (p. 190) alignment to ITF. Another component of Byrd and Turner’s research combines the technical skill side of IT with the alignment between IT and the business, and a relationship to ITF [6].

Additionally, the similarity between the Ness [13], and Byrd and Turner’s [6] ITF models are clearly identified via the use of common terms connectivity, and compatibility. Digging deeper into the question asked in Byrd and Turner’s survey, references to reusability and

modularity directly correlate to Ness's third ITF characteristic, modularity.

Relative to alignment, Duncan wrote an article dealing with ITF. Although written in 1995, Duncan's article is still relevant. Duncan [7] looked at six components "Configuration rules, Compatibility rules, Integration rules, Access standards, Connectivity of systems, and Excess Capacity" (p. 45). A strong tie to Ness's [13] components of "connectivity, compatibility, and modularity" (p. 11) exists.

Duncan [7] sought to answer four questions when describing alignment:

1. *What is the business unit manager's attitude about IT?*
2. *Do business and IT management understand the relation of corporate standards to cost and flexibility at a high level?*
3. *Does business management understand the need for infrastructure rules?*
4. *If business executives view IT as a strategic weapon for the business, then that IT group has high flexibility* (p. 49).

Bond, Hayes, and Barnes-Holmes [4] supplied a different component to the ITF model from the psychology and organizational behavior disciplines. Georgsdottir and Getz [10] described how some individuals deal with "change and adaption" (p. 166) better than other individuals. Given this ability to adjust to the conditions, these individuals can lead organizations to become more inventive and when used properly can lead organizations to be more flexible. From a personality perspective, observed traits that lead to individual flexibility include a "cognitive aspect" (p. 167), "adaptive flexibility" (p. 167), and "spontaneous flexibility" (p. 167). Bond et al. [4] developed a similar theory shown that explains the theory behind psychological drivers of flexibility.

The flexibility model identifies six characteristics pairs. One side of the pair promotes flexibility and one side of the pair does not promote flexibility. Georgsdottir and Getz [10] described the first pair as "cognitive fusion" (p. 28), and "cognitive defusion" (p. 28), which deal with individuals awareness of thoughts and feelings. The second driver pair is "avoidance" (p. 30), and "acceptance" (p. 31). This second pair is applied to seek to explain an individual's lack of willingness, or willingness to explore new challenges. The third pair of flexibility variables refers to "contact with the present moment" (p. 31) and how an individual allows past events to influence current events. For example, if an individual allows a bad information technology upgrade experience to influence their judgment against doing future upgrades this would adversely affect ones flexibility. However, if that same per-

son looks at the same past negative experience as a learning opportunity this would be a positive influence on flexibility. The next pair deals with how one reflects upon one's self or sees themselves. This concept looks at how a person visualizes themselves in the "here and now" (p. 33). If a person carries a victim mentality, that personality characteristic adversely affects their flexibility. Conversely, if a person looks at the current environment with openness and candor, they will be more flexible. The fifth pair involves a person's "values." (p. 33). People with a more team-based philosophy tend to be more flexible. If an individual lacks "values" (p. 34) "psychological rigidity and inflexibility" (p. 34) ensues. The final pair entails "committed action" (p. 34), which relates to self-discipline. People that are "goal" (p. 35) oriented tend to be more flexible and open to flexibility than individuals less driven by goals.

Bond et al.'s [4] model represents the interlinked nature of these paired characteristics via connecting lines. Inclusion of these topics in this literary review occurs because organizational flexibility does not happen naturally. Individuals, leader need to drive flexibility within an organization. Thus far, the requirement to sense the need for flexibility, to act upon those senses, as well as flexibility from a psychological perspective has been reviewed within this paper.

Focusing in IT Effectiveness (ITE), which Ness [13] showed to be correlated to ITF, Byrd, et al., [5] collaborated in writing an article evaluating how IT within over 200 organizations supported supply chain teams at those organizations. Byrd et al. evaluated two metrics in determining the performance for an organization's ITE. Besides the traditional monetary based effectiveness measures such as "return on asset (ROA) and total cost of operations (TCO)", (p. 162) the measures consisted of "Hardware/OS", "Communication Quality", "Business Applications Integration", "Data Quality", "IT Department Quality", "IT Impact on Inbound", "IT Impact on Operations", "IT Impact on Outbound" (p. 175).

The results of the study showed that "IT Department Skill", "Comm Quality", "Business Application Integration", "Data Quality", and "Hardware/OS Quality" [5] (p. 176) affected "IT Infrastructure" (p. 176). "IT Impact Internal Operations", "IT Impact Outbound", "IT Impact Outbound" (p. 177) influence the "Supply Chain" (p. 177). The measures related to the IT group are common to IT professionals. However, the measures associated with the supply chain are not so familiar to IT professionals and require defining. The inbound measures deal with procurement activities and "supplier" (p. 170) activities related to the supply chain. Outbound measures deal with "customer", (p. 171) "marketing", (p. 171) "distribu-

tion" (p. 171), and how the IT groups support "product" (p. 171) distribution. Finally, operational measures include "R & D" (p. 170), groups like "accounting, finance, legal" (p. 170), and completion of the "final product" (p. 170).

Gerbauer and Schober [9] provided the link between ITF and SA from the perspective of "IS flexibility-to-use" (Abstract) and "IS flexibility-to-change" (p. 2). To further define the challenges facing information technology groups are three variables "(i) uncertainty, (ii) variability, (iii) time-criticality" (p. 4). These three variables affect an IT group's ability to provide easy to use solutions and easy to change solutions. *Uncertainty* relates to the effectiveness of the solution requirements definition. The higher the confidence levels in the requirements definition, the higher the level of certainty, conversely, the lower the confidence in the requirements definitions, the lower the level of certainty. *Variability* follows a similar pattern. The more unpredictable the requirements, the greater the opportunity afforded the IT group. For example, if the sales force has a clearly defined set of parameters limiting their creativity in structuring a sale, the IT group has a better opportunity to create a solution to account for the various types of sales. However, facilitating creativity in the sales forces' ability to structure a sale, and provide more options to customers, which leads to potential advantages over the competition. This delicate balance identifies one of the challenges organizations face when making ITF decisions. Finally, *time-criticality* if the IT group requires months of lead-time to implement system enhancements and a change is needed in thirty days a significant gap exists between the IT group's ability to deliver changes compared to the business needs.

The *use* component of the equation contains four items "(i) system functionality, (ii) scope of the underlying database, (iii) user interface, and (iv) processing capacity" [9] (p. 8). The *change* component comes from Byrd and Turner (2000) the "human IT infrastructure" (p. 168) and the *redundant theme* from Ness's [13] "connectivity, compatibility, and modularity" (p. 11).

Overby et al., [14] described the organization's ability to "sense environmental changes and respond readily" (p. 121) as keys to the relationship between ITF and ITE. If the organizational leaders fail to recognize a necessary change or cannot implement the change in a timely manner the efficiency of the information technology group is less than optimal. Overby et al., suggested a matrix to explain how organizations identify the need for change and the ability to react to changes as they relate to ITF. The worst situation involves organizations that lack the awareness to recognize that a change has occurred and

once recognized the organization is slow to react. Two suboptimal situations also exist. The first type occurs when an organization detects the need for a change but lacks the ability to react to the change due to inflexibility. The other suboptimal situation occurs when an organization reacts slowly to changes but upon determining that a change has occurred flexibility exists to implement the corrective actions. The optimal situation occurs when an organization recognizes the change and is able to react to the change in a timely manner [14].

Addressing the central question regarding what an organization needs to sense, Van Oosterhout, Waarts, and van Hillegersberg [15] identified six areas that require the sensing ability "social/legal changes, business network changes, competitive environment changes, customer needs changes, technology changes, and internal changes" (p. 135) that organizational leaders need to monitor. Through monitoring these six areas, organizations will be able to identify triggers that lead to potential change agents [15].

The final piece in the synthesized ITF model comes from Bhatt and Grover [2]. This component covers the relationship between SA and ITE. The key measure used to determine that SA and ITE enhances organizational prosperity over the competition, or as Ness [13] described "sustained competitive advantage" (p. 1).

Bhatt and Grover [2] focused on measuring an organization's "competitive advantage" (p. 255) and "capabilities" (p. 256) in the form of "value capabilities" (p. 258), "competitive capabilities" (p. 260), and "dynamic capabilities" (p. 261) over competition. Competitive advantage" (p. 255) involves the adding of "resources" (p. 256) and "capabilities" (p. 256) to the organizations portfolio of services and offerings. However, Bhatt and Grover's research did not show that "competitive advantages" (p. 255) lead to an organizational benefit over competition. The primary capabilities required for IT infrastructure systems are "compatible", "modular", "scalable", "transparent" (easy to use), "can handle multiple applications" (connectivity), and follow "IT standards" (p. 265). Again, the three key ITF components from Ness's [13] "connectivity, compatibility, and modularity" (p. 11) can be observed. Bhatt and Grover's research showed that increasing organizational abilities did increase the organization's position over the competition. The third component closely aligns to Overby et al.'s [14] theories dealing with the organizations ability to identify opportunities to gain an advantage over the competition and having the ability to act upon perceptions [2].

This synthesized ITF model was rather unexpected. While conducting research into ITF, the pieces fell into place. The different pieces were written on a

white board and the synthesized model quickly emerged. This was an interesting learning experience into the nature of scholarly research surrounding ITF that showed how the existing research supported the individual models, and synthesized model.

NEW DEVELOPMENTS IN INFORMATION TECHNOLOGY FLEXIBILITY

The synthesized ITF model presents a rather comprehensive list of components that apply to the organizations, business groups, and information technology teams. One of the challenges surrounding the identification of new developments in an area relates to limited sources supporting the emerging development. Given this, two new areas of ITF appear to be present. The areas are disaster recovery and outsourcing.

Disaster recovery has been receiving increased focus especially in the United States since 9/11. Information technology flexibility research is beginning to include disaster recovery components within the study. Boh and Yellin [3] wrote an article dealing with IT enterprise architecture standards, including consideration for concepts such as “human IT infrastructure” (p. 166). Through decentralized IT practices that lead to IT personnel being located close to business units thus addressing a number of disaster recovery concerns. With a decentralized information technology group, personnel are not all in one place and a local disaster does not affect an organization to the same magnitude as a local disaster under a centralized structure. In addition, under a decentralized structure “telecommunications, network services, and security services” [3] (p. 174) are protected via geographic dispersion. Disaster recovery practices are also driving organizations to standardize IT practices. Through these standardizations local groups argue that they are losing flexibility but the organization as a whole are finding that the overall organization gains flexibility through better use of resources and common processes that lead to increased overall flexibility [3].

Dr. Chow, Capella University Departmental Chair, referred to how outsourcing of IT services can lead to filling gaps in the in-house information technology team’s service offerings (Personal Communications, March, 2009). Two main areas mentioned by Dr. Chow included the use of outsourcing to improve an IT group’s *value chain* and *IT capabilities*, which directly applies to ITE and ITF within the synthesized information technology model discussed in this literary review (Personal Communications, March, 2009).

From a corporate perspective, outsourcing enhances organizational flexibility in several other ways. Organizational leaders face exorbitant costs to hire a full-time employee. A temporary spike in demand due to increased workload or specialized skill set is especially costly for organizations. Filling these specialized needs with outsourced personnel drives efficiency and competitive advantages over organizations that lack this option and are beginning to appear as a new development in ITF.

INFORMATION TECHNOLOGY FLEXIBILITY IMPLICATIONS FOR INDIVIDUAL AND ORGANIZATIONS

To this point in the literary review covering information technology flexibility, a number of organizational benefits have been discussed as part of the synthesized information technology flexibility model. Organizational benefits include a stronger alignment between the business and information technology group, an information technology group that is more effective, and organizations are able to exploit advantages over the competition. Through these characteristics associated with information technology flexibility, organizations become more profitable and see a better return from their information technology group when compared to the competition. Organizations can also identify and react to changes in the market places quicker than the competition or identify opportunities more quickly than the competition. From an individual perspective, organizations utilize the skills and talents of the information technology team better and identify areas requiring added skills. Bond, Hayes, and Barnes-Holmes identify psychological characteristics that organizations need to understand, identify, and utilize. Without a comprehensive understanding of information technology flexibility, these individual skills might be overlooked from an organizational perspective. Likewise, individuals that identify market place changes or act upon those changes drive organizational benefits.

However, information technology does not come without some costs. From an individual perspective, outsourcing continues to increase. The problem with this from an on-shore standpoint relates to the number of jobs going overseas due to cost control measures. This is causing concern among information technology professionals.

Turning to an organizational viewpoint, Bhatt, and Grover’s [2] first hypothesis showed that increased “IT infrastructure would not have a positive effect on the competitive advantage of the firm” (p. 269). Glasser [11]

stated that more frequent “planning” (p. 39) needed to occur so that organization could stay flexible. In addition, organizations need to maintain extra capacity in the form of people, and resources to support the agility needs of the organization [11]. This should not be a new finding for organizations. Duncan [7] wrote about the need for “excess capacity” (p. 45) requirements over a decade ago. Similarly, Gerbauer and Schober [9] found that not only is extra capacity required but information technology flexibility “can also limit the success of an IS by limiting usability [Silver, 1991] and by increasing complexity” (p. 2).

FURTHER INFORMATION TECHNOLOGY FLEXIBILITY RESEARCH OPPORTUNITIES

Based upon the impact of information technology flexibility on organizations and individuals, more research is needed in the area of information technology flexibility. Research should include determining the proper mix of flexibility for an organization. The proper mix must account for the people side of information technology, business, and information technology governance.

Other worthwhile research would include how organizations identify opportunities and act upon those opportunities in a timely manner. Information technology flexibility research could also focus on specific IT groups such as development, project management, support, and telecommunications. Additionally, information technology groups are looking to standardize processes and procedures. Information Technology Infrastructure Library (ITIL) provides a good example, in that, the ITIL process calls for formalizing processes and procedures. While these standardization efforts propose to lead to great delivery of services, the added processes and procedures adversely affect information technology flexibility. A study could incorporate research around how to implement a framework like ITIL while maintaining information technology flexibility.

Other research should include the emerging findings around information technology flexibility around disaster recovery and outsourcing. With information technology groups and business units attempting to become more closely aligned, numerous opportunities for further information technology flexibility research exist.

CONCLUSION

This literary review began by examining the interrelationship between information technology flexibility,

information technology effectiveness, and strategic alignment as proposed by Dr. Ness. Combining Dr. Ness’s work with seven other researchers’ publications led to a synthesized view of information technology flexibility.

The IT flexibility (ITF) theories from Byrd and Turner [7] examined information technology flexibility from a technical and information technology worker perspective. Byrd, Pitts, Adrian, and Davidson provided a set of metrics and measures designed to evaluate an information technology group’s effectiveness. Again the theories provided by Byrd et al., [5] closely aligned with Ness’s [13] IT effectiveness model. Bond et al., [4] examined strategic alignment from a psychological and organizational behavior perspective while Duncan [7] sought to ask a series of questions designed to focus an organization’s strategic alignment initiatives.

Overby et al., [14] added to the synthesized model by explaining the relationship between IT Flexibility and IT effectiveness based upon an organization’s ability to sense the need for change and actually react to change drivers. Bhatt and Grover [2] showed how an organization’s ability to learn, and utilize competitive advantages develops and organization’s information technology effectiveness and strategic alignment capabilities. Finally, Gerbauer and Schober [9] examined the relationship between IT flexibility and strategic alignment based upon ambiguity, unpredictability, and time pressures.

Armed with this synthesized model a number of different research directions could be undertaken. Since Ness’s original research sought to understand the relationship between an information technology group and the business from an information technology flexibility, information technology effectiveness, and strategic alignment perspective the synthesized model opens up new avenues of research. One research opportunity could include help organizations build an organization that maintains the optimal balance between information technology flexibility, information technology effectiveness, and strategic alignment. Through this research, organization could develop methodologies to capitalize on unique advantages held within the organization. The advantages might include the ability to sense and implement change better than the competition or utilize technical and human infrastructure better than the competition. Additional research in surrounding the key metrics of an organization might teach information technology groups how to become more effective than the competition.

While Ness [13] and other researched within this synthesized model looked at the relationship between the information technology group and the business the model across different organizational cross-sections. Additional research opportunities might exist relative to an examina-

tion of how sub groups within an information technology interact when this synthesized model as applied to the sub groups. Since information technology has become more integrated into organizational competitive advantage how do different information technology sub groups interact and ultimately benefit the overall organization.

For example, further examination from an information technology flexibility, information effectiveness, and strategic alignment as the synthesized model relates to an information technology development and information support organization could lead to interesting results. Take Duncan's [7] first question "What is the business unit manager's attitude about IT?" (p. 49). What if the question was changed to what is the information support manager's attitude about the information technology development team? What if the support team lacks trust in the development team's ability to deliver reliable code? Additional research might show how such a lack of trust would affect the overall information technology team's ability to be flexible, effective, or aligned. Likewise, this same synthesized model could be applied to non-information technology relationship such as the relationship between a sales team and the supply chain team. Ultimately, this synthesized model can be applied across any number of groups across an organization.

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