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ABSTRACT

Numerous claims have been made regarding the use of information technology (IT) infrastructure for strategic benefit. However, examination of these claims has been hindered by a lack of clarity regarding the nature of the infrastructure construct. This paper develops a framework to provide a more clear conceptualization of infrastructure. The focal point of this framework is that IT standards play a crucial role in the development of effective IT infrastructure.

INTRODUCTION

Recent trends to decentralize IT decision making, coupled with a proliferation of IT options, has placed increased pressure on organizations to avoid fragmented systems, lack of integration, or as Lindquist (1992) warns, "islands of automation." Consequently, the development of corporate IT infrastructure has become an extremely important activity to insure some degree of cohesiveness among the firm's diverse computers, operating systems, networks, core databases, and mission critical applications (Keen, 1991; Niederman, Brancheau, & Wetherbe, 1991; Sambamurthy & Zmud, 1992).

This growing importance of IT infrastructure is also evident from compelling evidence of companies who have benefited from the development of comprehensive IT infrastructure (Rockart, 1988). However, these claims of benefits remain unsubstantiated, due to a poor conceptual understanding of the nature of the IT infrastructure and its impacts (Weill, 1993).

This paper develops a conceptual framework of IT infrastructure through identification and discussion of its elemental components and the inter-relationships among them. Attention is given to the central role that standards play in the development of comprehensive IT infrastructure. This conceptualization is essential to provide a basis for empirical work to investigate the multiple claims of infrastructure impacts.

CONCEPTUAL FRAMEWORK OF IT INFRASTRUCTURE

One theme found in the various definitions of IT infrastructure is that it is a shared organizational resource or capability, typically coordinated by some form of central IS organization (Rockart, 1988; McKay & Brockway, 1989; Weill, 1993). For example, a telecommunications network coordinated by the corporate IS and shared by multiple business units would constitute a shared IT capability.

Differences exist as to whether the infrastructure consists purely of physical IT assets (Gunton, 1989) intellectual IT assets (Weiss & Birnbaum, 1989), or both (Weill, 1993; McKay & Brockway, 1989; Sambamurthy & Zmud, 1992). Table 1 illustrates these multiple views.

Table 1. Views of Information Technology Infrastructure

Conceptualization of Infrastructure	Definition	References
Physical Assets	Computer processors, operating systems, databases, telecommunications devices, and development languages.	Gunton, 1989
Intellectual Assets	The human infrastructure that includes a specific body of IT related knowledge, skill sets, and experience.	Weiss & Birnbaum, 1989
Physical & Intellectual Assets	Physical and intellectual IT assets which are "linked together" to form shared IT services.	Weill, 1993; McKay & Brockway, 1989; Sambamurthy & Zmud, 1992

The first view, describes infrastructure as consisting solely of physical IT artifacts. These artifacts are readily available on the open market, however, they provide little competitive advantage to the firms that purchase these assets since the mere existence of physical assets add little differentiated value to a firm's infrastructure, unless the human expertise necessary to utilize these assets exists.

A second view focuses on infrastructure in terms of intellectual assets which include IT knowledge, skill sets, and experience. These assets act as the "mortar" that binds the physical IT components into robust and functional IT services (McKay & Brockway, 1989). Like the physical view of infrastructure, the intellectual view by itself forms an incomplete picture of infrastructure. A firm may have the necessary knowledge, skill sets, and experience with IT, however, the IT infrastructure is incomplete in the absence of the physical IT assets to which this expertise can be applied.

A third view conceptualizes infrastructure as a shared corporate resource that consists of both physical and intellectual IT assets. Definitions by Weill (1993), McKay & Brockway (1989), as well as Sambamurthy & Zmud (1992) reflect this mode of thought.

This paper argues that an appropriate view of IT infrastructure must include both physical and intellectual IT assets as distinct yet essential components of IT infrastructure.

Figure 1 presents a framework that builds upon the previous work and views of IT infrastructure as extending beyond the concept of a purely physical infrastructure to one that contains physical assets, intellectual assets and IT standards. The following paragraphs conceptualize IT standards as governance mechanisms that act as the "glue" that bind together the use of both physical and intellectual components of the IT infrastructure. Shared IT services are the realization of the infrastructure and their delivery into business applications.

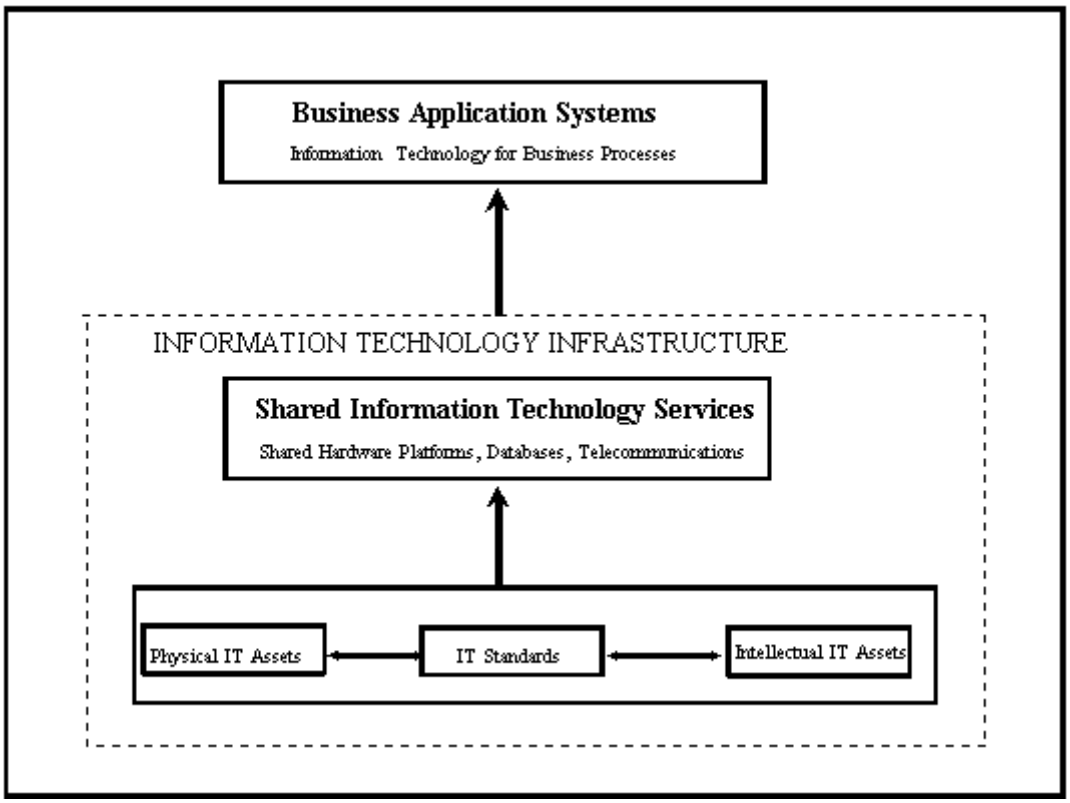

Figure 2. Conceptual Framework of IT Infrastructure

IT Infrastructure Standards. Infrastructure standards represent the third elemental component of IT infrastructure. A standard is a definitive rule, principle, or guideline established by some given authority for the purpose of (1) instituting uniformity in organizational behaviors and practices (Simon, 1976), (2) establishing organizational routines (Nelson & Winter, 1982), or (3) constraining the options of decentralized business units in line with larger organizational objectives (Gurbaxani, King, Kraemer, McFarlan, Raman, Yap, 1990).

In the context of IT, infrastructure standards can be defined as uniform or definitive guidelines that dictate how IT assets are to be acquired, managed, and utilized within the organization. Thus, standards can be conceived of as a management mechanism that links

the use of physical and intellectual IT assets. IT standards not only define the use of individual assets, but they also define how the physical and intellectual assets should interrelate. In essence, standards determine what, when, and how certain asset configurations should be used. They act as a type of "glue," or a coordinating mechanism, that links both physical and intellectual IT assets to facilitate the delivery of shared IT services to support the development of business applications.

To illustrate, the software development methodology embraced by an organization's systems development personnel represents a standard that is used to blend the human (intellectual) skill sets used in software development. The choice of prototyping over the traditional SDLC method influences how systems developers conduct their work. This same systems development group may also have certain software development standards that dictate the use of physical assets such as development languages (i.e., C++, Pascal, Cobol). In this example, IT standards provide the guidelines that determine both the use of intellectual assets in development methodologies as well as the use of specific physical assets (programming languages) in the software development process.

While firms may possess the requisite IT assets (physical and intellectual) needed for a reliable infrastructure, corporate standards governing the use of these assets may enhance the firm's ability to capitalize on these assets' deployment. Therefore, it is conceivable that a given firm may have a well developed and sophisticated IT asset base (in terms of physical and intellectual IT assets); however, a lack of standards on how to utilize these assets may result in an inability to integrate the systems across the organization. A simple example of this is the use of data definition standards. A firm may have the physical assets (the database) as well as the human expertise required to use these assets; however, standards provide the mechanisms that guide how these two assets interact.

Shared Information Technology Services. As illustrated in Figure 1, shared IT services are a result of the blending of physical and intellectual assets according to the rules and guidelines prescribed by standards. A shared IT service represents any IT capability that is available to the whole enterprise and not just to a single functional area or business unit. Some examples of shared IT services are: distributed databases, telecommunication networks, electronic data interchange, email, and video-conferencing (Scott Morton, 1991).

Business Application Systems. Shared IT services provide the springboard or platforms from which organizational sub-units are able to develop specific business applications. According to Weill (1993), it is the purpose of business systems to provide business functionality; however, the purpose of IT infrastructure and shared IT services is to provide a platform that enables future business application development. Although business applications may be functionally specific, they utilize the underlying shared IT services that have been provided by the central IS department.

CONCLUSION

The framework presented by this paper suggests that IT standards, in conjunction with physical and intellectual IT assets, form the basis for the development of infrastructure. Standards help to insure that both physical and intellectual IT assets are properly utilized and coordinated.

In practice, this suggests that the development of corporate IT standards should receive a high level of managerial attention to insure the development of more capable infrastructure. From an academic perspective, this framework helps to crystallize the somewhat vague concept of infrastructure and to illustrate the importance of standards in conducting future infrastructure research.

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