The Dynamics of IT Workaround Practices

A Theoretical Concept and an Empirical Assessment

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***Abstract*—An interesting phenomenon that has received limited attention in the extant literature is that of IT workaround practices. Based on Ashby's Law of Requisite Variety, workarounds were found to be used to accomplish the basic task of matching unmatched variety in the system. The Interaction Effectiveness (IE) ratio of 1.4 was used as a baseline to uncover potential sources of workarounds. The Echo method was used to collect data from 42 users in a high-technology company (HTC). Enablers of and barriers to workaround practices were divided into four main categories: flexibility, reliability, ease of use, and coordination whereas workarounds were divided into three categories: using other tools, seeking help, and accepting. The results of the case study indicate that "reliability" is the dominant category for both helpful and non-helpful incidents, whereas "coordination" was the least significant. Of the workaround mechanisms, "using other tools" was the most significant category for all users. The findings suggest cycles of continuous improvement to the IE ratio to alleviate the need for workarounds, but a more fundamental issue concerning the source of workaround behaviors is a function of misfits between input variety by users and variety handling capabilities of the system.**

Keywords—IT effectiveness; workarounds; cybernetics

I. Introduction

Despite broad recognition of ERP systems for their seamless integration of all information flows within organizations and their ability to standardize the processes of different departments [1], [2], substantial research has shown that many ERP systems are unexpectedly complex to adopt, and their ultimate benefits are uncertain, resulting in sub-optimal operating practices [3], [4]. The challenges to ERP system implementation and success include, but are not limited to, inflexibility [5]; disturbance to organizational culture [6]; the requirement of significant investments of money, time, and expertise [7]; strain on the organization [4]; and inadequate training and support for end users [8].

Even with the implementation of ERP systems, which were introduced as a means to enforce standardization and control, the probability of external activity beyond the system seems almost impossible to control. As [9] indicates, enterprise or computing systems often replace other legacy systems and processes, establishing "open systems" that are incapable of including all contingencies. When IT systems are perceived as a barrier, two distinct but related phenomena may be observed: resistance to change and workaround practices. Resistance to change is usually perceived as a negative behavior in which users oppose the disturbance of a perceived flaw in a system [10]. On the other hand, workaround practices are seen as a positive behavior in which users adapt in order to overcome the shortcomings of a system [10].

All workaround practices share common attributes. Whenever a user attempts to bypass formal system processes to overcome a barrier imposed by the system in order to complete a task, he or she is engaging in a workaround practice. Similarly, workaround practices occur at the post-implementation phase of any system, which may extend beyond the formal systems [11], [12]. In [13], author offers a broader and more inclusive definition of workaround as follows:

A workaround is a goal-driven adaptation, improvisation, or other change to one or more aspects of an existing work system in order to overcome, bypass, or minimize the impact of obstacles, exceptions, anomalies, mishaps, established practices, management expectations, or structural constraints that are perceived as preventing that work system or its participants from achieving a desired level of efficiency, effectiveness, or other organizational or personal goals (p. 1044).

Although workaround as an activity is well recognized in many fields such as nursery, project management, the military, and budgeting, some researchers have asserted that workaround theories remain somewhat understudied and underdeveloped [13]. Building a theory of workarounds will help to improve organizations, management, work practices, standards, and technology design and adoption and will also provide a unified view of workarounds and augment existing definitions.

To date, very little research has examined IT workaround practices from a qualitative perspective. The basic objective of this study, therefore, is to develop an in-depth understanding of workaround-related interactions and what governs such interactions. To this end, this study encompasses two primary objectives. First, this study presents a dynamic theory of workaround-related interactions within complex social networks. This study's theoretical development draws from Ashby's Law of Requisite Variety – to formulate the social and technical components of workaround practices as a network of task-related social interactions within an organizational context. Second, this study presents relevant quantitative and qualitative results from a field study in which the proposed theoretical framework is used. The data for this study is extracted from a high-technology company (hereafter referred to as HTC). Specifically, this study will uncover the motivations and preconditions for the occurrence of a workaround, as well as the main types of workaround strategies that users employ to overcome barriers to accomplishing their goals.

The paper is structured as follows. The next section reviews relevant literature on the subject of workaround practices in various fields. The section that follows discusses the study's methodology, which adopts a qualitative interview method known as the Echo method [14] to allow the study's participants to reflect on their unique interactions and experiences with these systems. The remaining sections of the paper present and discuss the findings of a case study for which data was obtained from a company that has implemented an ERP solution.

II. Literature Review

A workaround is a strategy of using a computer system in a manner that it was not designed to be used for or using alternative methods to accomplish a work task. A workaround is a useful strategy to solve an immediate and pressing problem [9]. In [15], author explained workaround by noting that "when a path to goal is blocked, people use their knowledge to create and execute an alternate path to that goal" (p. 71). In addition, they defined such a path, or workaround, as "a temporary fix that implies a genuine solution to the problem is needed" [15]. When users are unable to collect data they need from existing IT systems, they employ their own unique methods to collect such data [16]. In [17], author has defined a 'workaround' as a practice that "involves (1) a specific policy procedure or rule enforceable by bureaucratic superiors (2) that constrains or impedes local implementation and goal attainment and (3) prompts a local response that is counter to the procedure or rule but responsive to the underlying policy intent." Similarly, [18] defines a workaround as "the substitutive method that is used to overcome a constraint in information interaction in CIS with a specific motive to complete a work task" (p.381). They analyze workarounds in terms of the process involving the antecedent conditions, the actual workaround, and the consequences. They concluded that a workaround is a technical trick to interact with information systems, representing an everyday strategy used by workers to obtain better information in order to do their job [19], [20].

The workaround phenomenon has been discussed in many areas of organizational studies, such as public administration, healthcare, technology, finance, and accounting [21]. Workarounds have three forms: data adjustment, procedural adjustment, and backup systems [9]. In [21], author considers workarounds to be an essential expectation for those who rely upon open systems. In order for workarounds to be effective, some parameters should be established: educate employees about workarounds and the possibility of positive or negative impacts on the organization, observe the existing process of work, and encourage discussion among employees to identify the challenges [19], [21].

In [9], author identified three tactics users can adopt to overcome barriers imposed by any system. The first is fitting, which refers to any activity that attempts to modify the computing structure of the work by adapting to the computing error. Examples include adjusting work schedules and commitments due to the backlog of information requests demanded by users of the system. The second is augmenting, which basically entails supplementing or expanding the current system to cover for system discrepancies, such as consolidating data resources from multiple sources that are currently fragmented. Last are workarounds, which involve the deliberate use of the system in ways not initially intended to achieve a required target by utilizing other methods to accomplish tasks. Common examples of workarounds are data adjustment or data manipulation to arrive at the desired result. One the other hand, [10] classified workarounds into three types based upon their consequences to organizations. The first is a hindrance workaround, which is the bypassing of the formal system due to perceived time-consuming, tedious or problematic procedures and/or processes. The second is a harmless workaround, which basically does not significantly interrupt the workflow or the accuracy of data. The last is an essential workaround, which involves necessary actions to complete the task at hand.

The reasons that lead to workaround practices include barriers in workflow, additional demands for work, rigid organizational rules, and poorly designed systems, which in turn lead users to employ workaround tactics to overcome such barriers imposed by the system's rigidity, which inhibits users from fulfilling their work requirements [21], [22]. In addition, workarounds are used when the information needed to meet an external demand is limited or lacking [18]. Reasons that lead to workarounds include a block in workflow, additional demands for work, organizational rules, and poorly designed systems; in general, users employ workarounds to accomplish tasks when they perceive the system to be inflexible and incompatible with their workflow [21]. Workaround practices may be inspired by an expert opinion or website help page. Most often, however, they are discovered by trial and error [15]. Interestingly, when a workaround is not available, users may change their goal to conform to a work process they already know the system is capable of executing. For example, if sending a file through an email is not working, a possible workaround is to put it on a web server. Workarounds can occur not only because of software defects, but also when software and environment requirements are inadequate [15]. Technologies that are related to physical structure, such as the lack of wireless connectivity, may also lead to workarounds [21]. In addition, a lack of expert and well-trained users leads to an increase in the existence of poor conformance (i.e. workarounds) within the system [23].

Some researchers argue that workarounds have both positive and negative consequences. Positive consequences include increased awareness, the availability of better information, and saved time [18]. Additionally, workarounds help to identify defects that need to be addressed, and they can be employed to speed up the processes of an organization and help to avoid unnecessary barriers to quality service and care [23]. In addition, a workaround is essential to the integration of IS; otherwise, service and performance will decrease dramatically. Thus, workaround practices are dependent upon the relationships between users, specialists, and key actors [9]. In [18], author considers workaround practices to be an innovative means of customizing IS in ways that will not affect the accuracy of data. Reference [13] asserts that workaround practices are essential for performing everyday work. Additionally, IT workarounds may provide benefits to the individual and the organization as a whole, such as through the identification of existing gaps in IS between what centralized information systems offer and what users would like to have [11], [16].

However, workarounds may also represent an obstacle to improvements and result in decreased effectiveness [21]. Reference [13] argues that workaround practices might be viewed as undesirable and unethical or illegal violations of procedures. Workarounds may include some sophisticated technological solutions, such as designing local databases that are able to provide needed information. However, such practices may result in significant costs related to the use of workarounds [16], [22]. Along the same line, [12] has found that some applications originally designed to reduce process variations in healthcare settings (e.g., medication ordering and dispensing systems) actually resulted in increased process variations. This may obstruct the objectivity and reliability of the system, generating inaccurate or inconsistent reports when required by users.

Overall, review of the extant literature on workaround practices indicates that the workaround phenomenon thus far lacks theoretical elucidation necessary to provide a deeper understanding and predictive explanations. In support of this view, [13] asserts that there is no published comprehensive theory of workarounds.

III. THEORETICAL BACKGROUND

The cybernetics theory, specifically, Ashby's Law of Requisite Variety, is used to develop a theoretical approach to modeling workaround practices. This model views the social and technical component of workaround practices as a task-related social network within an organizational context. Such a model helps in understanding Human-Computer interactions, as well as what governs such interactions [26].

Ashby's Law is a part of the cybernetics theory that advocates for the ability of any system to achieve its goals while maintaining viability [24]. In other words, any open system must adapt to its environment in order to survive. Ashby's Law of Requisite Variety states, "Only variety can destroy variety" [25], (p. 207). Reference [26] explained Ashby's Law of Requisite Variety as follows:

A system survives to the extent that the range of responses it is able to marshal – as it attempts to adapt to imposing tensions – successfully matches the range of situations – threats and opportunities – confronting it (p. 282).

Variety is defined as the number of different possible states the system can assume and their relative probability of occurring, which is indicative of the level of complexity a system can handle [25]. Thus, the internal complexity of a system must match the external complexity it provokes to remain stable [25]. Input variety can be seen as a disturbance to the system's stability. There are two sources of input variety: external variety and internal variety. External variety refers to variety generated by the organization's environment. An example is variability in a supplier's behavior, such as late deliveries and inconsistent quality. Internal variety, on the other hand, refers to variety generated by the system itself that affects its own performance, such as poorly designed systems, machinery breakdowns, and human error.

In general, [27] suggested two approaches to maintain the stability of any system: reducing variety at the source and/or increasing the variety handling capability of the system. For example, a manufacturing organization can cope with a certain amount of raw material variability from suppliers by either implementing policies to force suppliers to ship parts on time (i.e. stimulus simplification) or increasing inventory levels as a buffer against any future variability in shipment arrivals (i.e. response complexification). Reference [26] summarized how a system is capable of responding to its environment in adaptive ways as follows:

1) Simplify the complexity of incoming stimuli so as to economize on the resources that need to be expended in responding.

2) Invest more resources in the response than they judge to be strictly necessary so as to ensure some degree of adaptation (p. 279).

On an abstract level, ERP systems may be viewed as a set of predefined assumptions and preconditions about what organizations are and how they should function. Such rule-based systems can become static and difficult to change, much like organizational bureaucracy. In order to overcome such rigidity in the system, users may engage in machine-like behaviors and permit their behaviors to be formalized, or users may engage in informal workaround practices to realign the system with organizational requirements. In a way, workaround practices enable ERP systems to be flexible enough to adjust to dynamic changes in organizational requirements and the environment.

In this context, any ERP system is originally designed to effectively conform to organizational requirements by handling input variety. That is, ERP systems are variety regulating systems to the extent that input variety is continuously absorbed (destroyed) in order to regulate the output. However, while ERP systems produce this requisite variety, it inevitably creates some unintended and undesirable variety due to changes in organizational requirements or environmental demands. Therefore, the effectiveness of the system is dependent upon the fit between the input variety and the variety handling capabilities of the system [28]. That is, as the organization adapts to internal (e.g., business requirements) and external (e.g., environmental demands) changes, ERP systems are employed as a variety handling mechanism to match new variety. However, amplified misfits between variety and variety handling will result in the generation of more unpredictable outputs and more unstable systems.

IT misalignment, or IT misfit, within the organization will result in excess variety, which must be addressed either by reduced variety at the source (e.g., customization) or increased variety handling (e.g., workarounds) to reduce such input variety. On the one hand, IT fit needs to be managed on a continuous basis. On the other hand, ERP systems are complex system that are difficult to modify, even if needed, because of costs associated with the changes, lack of accurate documentation, lack of highly skilled programmers, and the risk of possible dysfunctional effects [29]. Thus, organizations may instead employ micro-level informal mechanisms (i.e. workarounds) to maintain IT's alignment with changing organizational requirements. This is, in principle, matching variety. From this viewpoint, workarounds address excesses generated by the ERP system in order to maintain the stability of the organization.

IV. Methodology

This study was conducted at a leading high-technology company (HTC) in the Middle East. The HTC's primary business includes selling computer hardware, software, electronics, semiconductors, and computer services. The company has implemented an ERP solution in an attempt to streamline current processes and improve business operations.

Semi- structured interviews based on the Echo method originally developed by [14] were conducted. The Echo method is designed to investigate users' task-related interactions with an ERP system. Reference [30] defined the Echo method as follows:

A way of observing, quantifying, and describing what people value and believe is a way to describe the patterns of value and influence that are felt, verbally expressed, and often acted upon in groups or organizations (p. 4).

This method is a qualitative socio-technical interview method that identifies positive and negative aspects of any system by eliciting concrete examples of others' "helpful" and "non-helpful" task-related interactions [31]. The use of "helpful" and "non-helpful" incidents is a practical way of representing the concept of "variety" to participants, since helpful incidents from one node reduce variety on the part of the recipient node, and non-helpful incidents increase variety to the recipient node [32], [33]. That is, helpful and non-helpful incidents are situational factors that can be associated with workarounds performed within the enterprise system environment. In addition, participants were asked about the manner in which they handle each type of non-helpful incident. Corrective actions available at the recipient node are used to indicate variety handling mechanisms employed (i.e., workarounds). The purpose of this question is to find any patterns of workarounds that are specific to ERP systems.

Forty-four employees from different departments and with various hierarchal ranks in the HTC constituted the sample frame of this study (see Table 1).

TABLE. I. Participants by Department and Managerial Position

Department	Number of Participants	Managers	Non-managers
Sales	6	6	-
Accounting	5	1	4
Marketing	4	2	2
Operations/ Planning	13	6	7
Production	4	-	4
IT	10	2	8
Total	42	17	25

V. Results

After all of the interviews were transcribed, data were coded systematically into three main categories in accordance with the structure of the interview questions: helpful incidents, non-helpful incidents, and corrective actions to non-helpful incidents (i.e., workarounds). Summarizing data in this way is essential to preparing the data for analysis and extracting meaning. The following Table 2 summarizes the number of examples provided by participants and presents a typical example for each category.

TABLE. II. Frequency of Examples Per Qualitative Categories

Category	# of Examples	Typical Example
Helpful	229	User-friendly, easy to enter and modify data
Non-helpful	163	Lack of integration between different processes
Workaround	161	Export the file and manually copy and paste required records in MS Excel
Total	553	

A. *Macro-level Analysis: Organizational IE Average Ratio*

This study used a quantitative measure that indicates the relative effectiveness of the link between nodes in the task-related social network. Reference [34] referred to this ratio as the link's interaction effectiveness (IE) ratio. Mathematically, IE ratio is calculated by dividing the total number of helpful incidents by the total number of non-helpful incidents for all nodes. In the HTC's case, the organizational IE average ratio was estimated at 1.4. An IE ratio of 1.4 indicates that approximately three helpful incidents exist for approximately every two non-helpful incidents.

B. *Micro-level Analysis: Departmental-level IE Average Ratio*

At the departmental level of analysis, the range of IE ratios (from 0.86 for the marketing department to 4.5 for the production department) reflects variability in the relationships between ERP and other nodes.

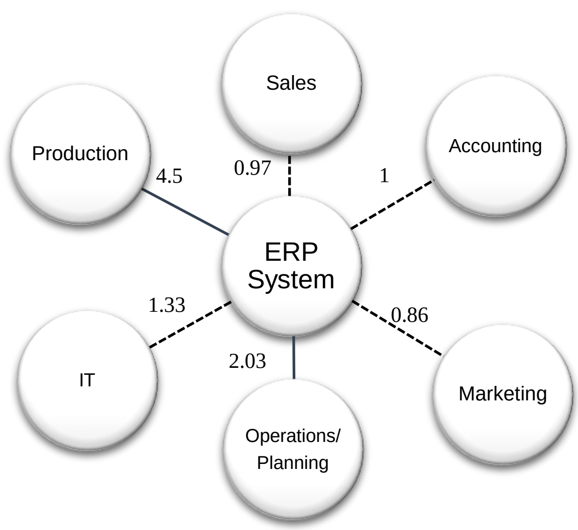

Fig. 1. IE ratios for all departments.

In Fig. 1, ratios of greater than 1.4 (indicating that effectiveness is above the organizational average) are shown as solid lines, while ratios of less than 1.4 (indicating that effectiveness is below the organizational average) are shown as dashed lines. Fig. 1 shows the IE ratio for all nodes within the HTC's task-related social network in relation to the ERP system.

C. Categorical Analysis of the Qualitative Data

Thematic analysis was used to identify, analyze, and report patterns (themes) within data. Interview responses were classified into categories that emerged from the data, rather than relying upon predetermined categories imposed by the researcher. The collected helpful and non-helpful examples were found to cluster around four major categories: flexibility, reliability, ease of use and coordination. In addition, workaround mechanisms were found to have three common forms: using other tools, seeking help and accepting. Table 3 shows the basic properties for each category.

TABLE. III. SUBCATEGORIES FOR EACH QUALITATIVE CATEGORY AND RELATED CONTENT PROPERTY

Qualitative Category	Properties of Messages
Helpful Category Labels	
Flexibility	The ability of the system to be modified and to be responsive to different types of requests
Coordination	The ability to transfer information from one unit to another, and the ability of different functions/parts to work together
Reliability	The quality of being dependable
Ease of use	Requiring little effort from the user
Non-helpful Category Labels	
Inflexibility	The inability of the system to be modified or to respond to different types of requests
Lack of coordination	The inability to transfer information from one unit to another or for different functions/parts to work together
Unreliability	The quality of not being dependable
Not easy to use	Requiring great effort from the user
Workaround Category Labels	
Seeking help	Involving a third party to help solve the problem
Using other tools	The use of other means (manual or automated) to fix the problem
Accepting	Problems beyond the control of the recipient node

The collected data were presented under each category, and the percentages of each category were calculated to determine the category's importance, as well as how it affects the interaction with the ERP system. Understanding these incidents may uncover flaws in ERP system design or in the implementation of ERP systems. In the following section, categories of helpful and non-helpful incidents and workaround mechanisms are discussed in more detail.

D. Enablers Alleviating Workaround Practices: Helpful Categories

As a proportion of total helpful incidents, "Reliability" (39.52%) received the highest number of favorable comments, followed by "Ease of use" (26.66%) and "Flexibility" (24.76%). "Coordination" (9.04%) was mentioned the least. Table 4 shows the distribution of all helpful examples as perceived by all departments.

TABLE. IV. CATEGORIES OF HELPFUL EXAMPLES WITH PERCENTAGES

Helpful Categories	%	Typical Example
Reliability	39.52%	The data produced by the system is accurate and complete
Ease of use	26.66%	Easy to monitor production information
Flexibility	24.76%	Ability to upload all required documents directly to the system
Coordination	9.04%	Customers are able to report their feedback about product performance through the system

E. Barriers Elevating Workaround Practices: Non-helpful Categories

As a proportion of total non-helpful behavioral examples, "Unreliability" (42.26%) received the highest number of unfavorable comments, followed by "Inflexibility" (30.35%) and "Not easy to use" (18.45%). "Lack of Coordination" (8.92%) received the fewest examples. The following Table 5 shows the distribution of all non-helpful examples as perceived by all units.

TABLE. V. CATEGORIES OF NON-HELPFUL EXAMPLES WITH PERCENTAGES

Non-helpful Categories	%	Typical Example
Unreliability	42.26%	Some of the data is not accurate (e.g., equipment descriptions)
Inflexibility	30.35%	Unable to see the subtotal in the cost field
Not easy to use	18.45%	The are no clear standards for end users to follow
Lack of coordination	8.92%	The system does not support tracking the movement of the products between the warehouse and the printing shop in order to print the labels

F. Variety Handling Mechanisms: Types of Workaround Practices

Each participant was asked about the manner in which they address non-helpful incidents. As a proportion of total workaround mechanism examples, "Using other tools" (57.14%) received the highest number of comments, followed by "Seeking help" (23.60%). On the other hand, the lowest proportion of workaround mechanism examples fell into the category of "Accepting" (19.25%). Table 6 presents the distribution of all workaround mechanism examples as perceived by all units.

TABLE. VI. CATEGORIES OF WORKAROUND MECHANISMS WITH PERCENTAGES

Workaround Mechanisms Categories	%	Typical Example
Using other tools	57.14%	Using Microsoft Excel application to store and back up data
Seeking help	23.60%	Asking the manager to intervene
Accepting	19.25%	It is beyond our control

VI. Discussion

This study demonstrates that the interaction effectiveness (IE) ratio can be used in several ways to assess the interaction between users and ERP systems within organizations. One of this study's most important findings relates to the estimated organizational IE ratio (1.4), which is based on the total number of helpful and non-helpful incidents identified by respondents from all departments. The IE ratio can aid in understanding the quality of interactions with the ERP system, as well as potential sources of workarounds. This IE ratio is very important, because it is often difficult to detect and measure the quality of human-computer interactions.

In the HTC's case, the range of interaction effectiveness ratios (from 0.86 to 4.5) reflects variability in the relationships with the ERP system. Departments with an IE ratio below the organizational average of 1.4 (sales, accounting, and marketing) are considered to be ineffective, whereas nodes above the organizational average (operations/planning and production) are considered to be effective. The IT staff department falls almost on the average. Ineffective links indicate that the ERP system is perceived by users as a variety generator and is therefore sending excess input variety beyond the capacity of the users. Conceptually, the IE ratio may be used as an indicator to assess the volume of workaround practices within the organization.

One possible explanation for this wide range of IE ratios may be linked to the organizational design of tasks in terms of both personal elements (knowledge and skills the employee should possess) and structural elements (job design and requirements). For example, the skills, knowledge, and job requirements for production are different from accounting or sales job requirements. Thus, the design and the requirements of the job may affect how a user will interact with the ERP system. Moreover, the level of dependence on the technology to deliver the required work may affect the volume of interaction. For example, the production department, which yielded the highest IE ratio, may not depend on the system as much as other departments in all of its daily tasks; thus, it may see the system as effective. On the other hand, the marketing, sales, and accounting departments, whose IE ratios were less than the average, are generally more dependent upon the system to perform their daily tasks, which enables them to realize the shortcomings of the system. Also, the non-helpful incidents may have different impacts on different departments based on the routine, structure, and complexity of the work. During the interviews, one comment from production (IE 4.5) that was related to the unreliability of the system was: "It is totally dependent on the Internet; thus, if the Internet is slow or shuts down, our work performance will suffer." On the other hand, a comment from the sales department (IE 0.97) relevant to the same category was: "Delivery of items in the invoices cannot be tracked." These two comments reveal how job tasks and requirements affect different departments' interactions with the system. Moreover, the comments demonstrate the nature of the problems confronted by each department. The production problem can be easily fixed by providing a stable Internet connection, while the sales department's problem requires more work and greater customization to fix.

In terms of the qualitative data, "Reliability" (39.52%) received the highest number of comments in the helpful category, while "Coordination" (9.04%) received the lowest number of comments. Conversely, "Unreliability" (42.26%) received the highest number of comments in the non-helpful category, whereas "Lack of coordination" (8.92%) received the lowest number of comments. The high proportion of comments pertaining to "Reliability" reflects the relative importance of this factor in ERP systems.

These results indicate that users tend to have more concerns about the reliability of the system (e.g., performance, shutdown, speed, and accuracy of results), which has a direct and high impact on the continuity of the work. Moreover, coordination received less attention, because users seem to focus more on their local goals in performing their tasks and are less concerned about relationships with or the performance of other departments. In the same way, [33] assert that coordination difficulties are common, because each department has its own goals and tends to speak its own specialized language. According to the data collected, users were less concerned about their interactions or coordination with others inside or outside the organization.

In analyzing the workaround mechanisms, "Using other tools" (57.14%) was found to be most commonly employed, followed by "Seeking help" (23.60%) and, finally, "Accepting" (19.25%). In other words, users tend to first seek to solve problems by using other tools, such as manuals or other technological solutions. If the problem is not solved by this method, users tend to seek help from others (e.g., colleagues, superiors, IT staff, etc.). If the problem is still not solved, users then tend to accept the hindrance of the system [22]. These mechanisms seem to follow a logical order depending on the cost of coordination. Seeking help involves some costs, such as time, money, effort, and delay of work, which may explain the tendency of users to employ other tools before seeking help. Seeking help as a requisite variety appears to be more difficult to execute and may create additional undesirable variety. That is, reducing the input variety is perceived as better than addressing it, and internal input variety is easier to control than external input variety. For example, undesirable variety may appear in the form of favors in which one individual expects to gain the advantage of benefiting from someone else based on a previous service. In this context, favors themselves can take the form of workaround behaviors, in which people use social mechanisms to bend rules in order to reduce input variety on the recipient end; hence resulting in reciprocal cycles of favors.

VII. Conclusion and Recommendations

To summarize, Ashby's Law of Requisite Variety was used to illustrate how workarounds serve to maintain stability within an organization. According to Ashby's Law of Requisite Variety, "Only variety can destroy variety" [25] (p. 207). Organizational environments are becoming more difficult to handle and predict, particularly with ongoing, dramatic changes in technology. These ongoing changes to organizations may result in unforeseen variety that cannot be handled by a formal system. Organizations must respond to such dynamic changes with an increase in variety handling capabilities. One possible way is to engage in informal adjustments to address unmatched external variety generated by ERP systems: namely, workarounds. Workaround practices appear to be derived from misfits between input variety and variety handling capabilities. Workaround practices were found to be a useful mechanism to maintain a good fit between IT and organizational requirements, thus ensuring stability within the organization. Workarounds appear to play a significant role in adding requisite variety to the organization if implemented appropriately and communicated effectively.

The helpful and non-helpful examples provided by interviewees were divided into four main categories: flexibility, reliability, ease of use, and coordination. "Reliability" and "flexibility" are the most important categories from the users' point of view, and they received the highest number of comments from users. In light of these findings, they should be taken into account in the development of ERP systems. All findings show that workarounds are positively employed to eliminate interruptions and errors and to maintain performance throughout day-to-day tasks. The actions taken by users to solve the non-helpful behaviors were divided into three categories: using other tools, seeking help, and accepting. "Using other tools" appeared to be the best workaround mechanism for all users in all positions within the organization. Non-helpful incidents within the system (Unreliability, Inflexibility, Not easy to use, and Lack of coordination) appeared to be the main reasons that lead users to employ workarounds. In addition, users differ in the way that they interact with the ERP and in those workaround mechanisms they choose to employ. These differences stem from the nature of the tasks assigned to each department, the nature of the problems confronting users, and the power structure. These disparities lead to discrepancies in how users view the system.

Based on the analysis of the responses gathered through the interviews, three recommendations are offered to improve the usage of ERP systems. First, to increase the interaction effectiveness (IE) between ERP systems and various departments, non-helpful incidents noted in ERP systems should be reduced. The results indicate that unreliability is the major source of non-helpful incidents in terms of shutdown, poor speed, and poor performance of such systems. These problems can be solved by providing high-speed connections, scheduling preventive maintenance, and so on.

Second, the interaction between users and ERP systems should be enhanced by focusing on the helpful features and increasing their frequency of occurrence. For example, developers of ERP systems should invest more time and money into enhancing the user interface so as to increase the user-friendliness of such systems thus increasing positive interactions between the user and the system.

Third, workaround practices appear to be temporal in nature. Therefore, there is a need to provide a platform to help transform such temporary and localized solutions into planned change. Knowledge management systems (KMS) will help to spread localized workaround experiences across the organization over longer time periods. Over time, this will help users overcome barriers imposed by the formal or centralized system, which is primarily due to the associated less flexible capabilities inherent in such organization-wide solutions (e.g., ERP systems). Establishing a knowledge management system to share information and answer users' questions will increase helpful behaviors and decrease non-helpful behaviors, and it will also offer users quick solutions to the problems they confront, thereby reducing the cost of seeking help.

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