



## Process standardization and error reduction: A revisit from a choice approach

Noa Nissinboim, Eitan Naveh\*

Faculty of Industrial Engineering and Management, Technion – Israel Institute of Technology, Technion City, Haifa 32000, Israel



### ARTICLE INFO

#### Keywords:

Standardization  
Errors in organizations  
Employees' discretion

### ABSTRACT

This study aims at advancing our understanding of the conditions under which standardization is associated with error reduction. Specifically, we identify a particular condition, referred to as employees' choice, which is associated with standardization. Standardization can, on the one hand, weaken the employees' choice by guiding them to operate uniformly and follow instructions in order not to make errors. On the other hand, counter-intuitively, standardization creates and strengthens situations of choice because employees decide the extent to which they adhere and execute said standardization. Following the choice approach, we distinguish between employees' perception of their unit's standardization rigidity as planned by their managers, and employees' actual adherence to standardization. We also refer to the situation in which, contrary to the use of standardization while enabling employees to cope with unexpected situations, organizations directly increase their employees' choice by encouraging them, especially professionals, to use and rely on their own discretion. Our study was made possible through the participation of 298 nurses from 37 departments in two hospitals. The results show that choice plays a significant role in determining the relationship between standardization and error reduction. The highest level of error reduction is found in circumstances in which employees are granted a high degree of discretion, standardization rigidity is intermediate and, as a result, adherence to standardization is high. Situations of high levels of standardization rigidity are not associated with error reduction.

### 1. Introduction

Errors in organizations are essentially unintended and potentially avoidable deviations from organizationally-specified goals and standards that can yield either adverse or positive organizational consequences (Frese and Keith, 2015; Hofmann and Frese, 2011). Errors harm organizational performance. Taking into consideration that a complete prevention of errors is impossible and that errors will always occur, the effort to continuously improve performance-wise is aimed at reducing the number of errors over time (Frese and Keith, 2015; Lei et al., 2016).

Processes standardization (to be distinguished from product and technology standardization, which deals in specifications for products or technologies; Sidak, 2015. Hereinafter, "Standardization") is one of the most acceptable common practices used to improve organizational performance (Naveh, 2007; Naveh and Marcus, 2005) and specifically to reduce error rates (Katz-Navon et al., 2005; Lei et al., 2016). A process that is standardized is constantly performed following the same steps in the same sequence. Standardization is achieved by setting formal rules to guide employees' activities, which are operationalized in

organizations by means of work instructions, guidelines, manuals, and work procedures.

Standardization assists in eliminating errors because it is a repository of organizational memory and expresses the best available knowledge and past experience (Haynes et al., 2009). Standardization turns the best available organizational knowledge into a formal routine and repetitive pattern of interdependent organizational actions (Parmigiani and Howard-Grenville, 2011; Ortmann, 2010). It brings control and coordination, improves knowledge transfer among employees, and provides a sense of structure and sequence to work that reduces ambiguity and eliminates forgetfulness and confusion (Naveh, 2007). In this sense, standardization is a good way to achieve employee homogeneity, uniformity, and coordinated activities, all of which are important for error reduction.

However, reports of reduced error rates are rare (e.g., in the health care sector; Makary and Daniel, 2016), and studies suggest the existence of more complex relationships between standardization and the occurrence of errors (Lei et al., 2016). Standardization allows employees to master their tasks better, but coercive standardization functions as a means by which management attempts to coerce

\* Corresponding author.

E-mail address: [naveh@ie.technion.ac.il](mailto:naveh@ie.technion.ac.il) (E. Naveh).

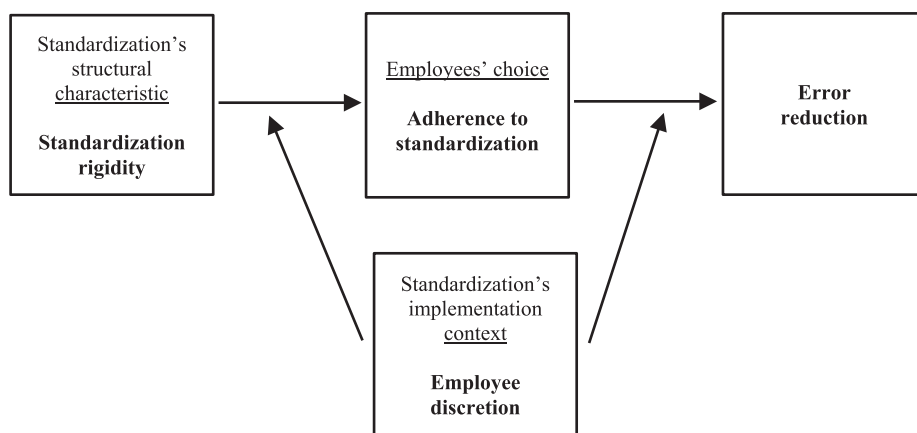


Fig. 1. Research model: the relationship between standardization and error reduction.

employees' efforts and compliance, and it has only a partial positive association with performance (Adler and Borys, 1996). When standardization impairs flexibility and employee discretion it may even be associated with more errors, because flexibility and discretion are required in order to react to uncertainty and unexpected situations (Katz-Navon et al., 2005). In contrast, certain studies suggest that there is a low risk of more standardization, compared to less, harming organizational performance (Davis et al., 2009).

In this study we combine the theories of standardization (Katz-Navon et al., 2005; Naveh and Marcus, 2005), errors in organizations (Lei et al., 2016), and decision making and choice (Yates and Potworowski, 2012) in order to enhance our understanding of the conditions under which standardization is associated with error reduction, and to explain earlier inconsistent results on the relationship between standardization and errors. Specifically, we identify conditions referring to employees' choice as a way to manage the paradox of the simultaneous existence of structure and flexibility and its association with error reduction. The need to balance between constrains and flexibility is a paradox organizations struggle with (Harrison and Rouse, 2014). To date, studies related to the structure-flexibility paradox refer to economic efficiency and innovation performances but neglect the association of this paradox with errors (Miron-Spektor et al., 2011).

Flexibility implies that a work process is different under varying conditions, and that these conditions themselves create the need for such differences. Earlier studies refer to flexibility within a context of adherence to standardization, i.e., once standardization is implemented and employees fully adhere to it. We refer to the structure-flexibility paradox in which, on the one hand, standardization weakens the employees' choice because it makes them operate uniformly and adhere to specific instructions in order not to make errors. However, on the other hand, and counterintuitively, standardization also creates and strengthens situations of choice. This is because employees may choose not to adhere to standardization, to break the rules, or to deviate from standards (Ballard et al., 2016; Lehman and Ramanujam, 2009; Martin et al., 2013). This occurs, for example, when they discover ways to carry out work that are more efficient or achieve better results than those mandated by the organization's formal standards.

Thus, as good as standardization can be, it is only a plan or a design, and for standardization to be associated with error reduction this is not enough (Naveh and Marcus, 2005; Tatikonda and Montoya-Weiss, 2001). Earlier studies make only a partial distinction, if any, between standardization rigidity, e.g., the extent to which a standard is detailed and inflexible, as it is planned by managers and perceived by employees (Naveh and Marcus, 2005) and as a main characteristic of standardization design, and employees' adherence to standardization, that is, standardization execution. Thus, they neglect the issue of employees' choice to decide whether to execute the rules and procedures. A common hidden assumption in organizational standardization studies is

that employees simply follow the rules and procedures (Martin et al., 2013; Naveh, 2007). However, this is not the true situation, and a gap does exist between a plan and adherence to it, and not only in the form of rare and forbidden rule-breaking phenomena (Katz-Navon et al., 2005; Lehman and Ramanujam, 2009; Martin et al., 2013). A gap exists between formal written rules and procedures and their execution because the employees' behavior is not separate from choice, and they choose their manner of behavior at any time (Glasser, 2010), and specifically the extent to which they follow procedures. Thus, given the choice approach, to explain the relationship between standardization and errors we distinguish between standardization rigidity and adherence to standardization.

The increased use and rigidity of standardization leads to the elimination of flexibility in employees' activities. Alongside this trend, organizations also increase their employees' choice directly by encouraging them to use their discretion and thus enabling them to cope with unexpected situations. This means that standardization and rule-breaking may be permitted or contested by those charged with standardization enforcement (Martin et al., 2013).

The gap between the level of standardization rigidity and executed standardization is particularly characteristic of professionals doing uncertain work like doctors and nurses in the health care system (Stern et al., 2008). Taking hospital departments as an example, this paper explores the relationship between standardization and medical errors.

## 2. Standardization and error reduction: Theory

In exploring the relationship between standardization and errors through the perspective of the choice approach, we refer to three factors that characterize modern work in organizations: standardization rigidity, adherence to standardization, and employees' discretion. We refer to the structure and context of standardization. Standardization rigidity refers to a structural characteristic of standardization, and employees' discretion refers to a characteristic of the context in which standardization is executed. The relationship between structure and context of the standardization are associated with employees' adherence to standardization and with error reduction, as described in Fig. 1.

### 2.1. How is standardization rigidity associated with adherence to standardization?

Standardization rigidity refers to employees' perception of the standardization as it is planned and designed by managers. It relates to the degree to which planned standardization is defined and stated in an inflexible, precise, detailed, and strict manner. The more the planned standardization is not easily modified, the more rigid it is (Gilbert, 2005). Employees' perception of standardization rigidity is a

continuous factor that has different levels and is not a dichotomous factor that either exists or not (Naveh and Marcus, 2005), and may vary across organizational units (Katz-Navon et al., 2005). Studies about standardization in general, and standardization and errors in particular, neglect the choice approach and thus do not distinguish between the standardization planned by managers and the extent to which employees actually adhere to the standardization (Martin et al., 2013; Naveh, 2007).

### 2.1.1. Adherence to standardization

Standardization and rules are not always followed, and situations where rules are not adhered to or are broken do occur (Feldman and Pentland, 2003; Lehman and Ramanujam, 2009; Martin et al., 2013). Adherence to standardization is the extent to which employees execute and follow the standardization (Miron-Spektor et al., 2011), and it represents the employees' choice regarding the standardization that was set by the organization's management. Choices are instances in which decision makers select a subset from a larger collection of alternatives and decide the extent to which they choose to pursue it (Yates and Potworowski, 2012). Employees may adhere to the standardization or may depart from or break with it. Not executing the standardization is sometimes a necessary possibility in order to secure the operation of organizations (Ortmann, 2010). The actual situations that employees deal with may get more attention in employees' decisions than potential low-probability events such as errors. Not adhering to the standardization may lead to an error, as is acceptable to assume according to the standardization and error theory (Lei et al., 2016). However, this is not necessarily the result of each deviation from standardization. Given that errors are rare events compared to more tangible conditions and cases that employees deal with as part of their daily work, they may choose not to follow the standardization.

Given the distinction between standardization rigidity and adherence to standardization, we suggest that standardization rigidity is not directly associated with error reduction but only through its relationship with adherence to standardization, that is, with the level of standardization implementation, and specifically, the way employees perceive the extent to which they implement the standardization. The existence of choice creates a gap between standardization rigidity – the plan, and standardization execution – adherence to standardization, so that only the actual implementation of standardization facilitates the occurrence of error reduction. Studies that do not refer to choice, and thus do not distinguish between standardization rigidity and adherence to standards (e.g., Katz-Navon et al., 2005), cannot identify the relationships suggested here.

### 2.1.2. Standardization rigidity and adherence to standardization

However, the nature of the relationship between standardization rigidity and adherence to standardization is not clear. Specifically, what happens when standardization rigidity increases? Surprisingly, as important as this question is to daily work in organizations, it still has not received a definite answer. One possible approach is that a high level of standardization rigidity harms the degree to which employees adhere to it, and adherence to standardization decreases when standardization rigidity is perceived to be high. Examples of such circumstances are those in which employees believe that standardization is not fitted to the situations they need to deal with (Lehman and Ramanujam, 2009), or that it makes their work more complicated in terms of the effort, time, and coordination that are required (Kownatzki et al., 2013), or when employees want to help customers, peers, or even the team and the organization, in terms of performance (Dahling et al., 2012). Employees see high standardization rigidity as interfering with their daily work, as a bureaucracy that complicates their jobs, and as a burden that demands an investment of time and excessive human resources (Adler and Borys, 1996; Stern et al., 2009). Employees may take the risk of not adhering to standardization when they believe that there are too many rules and, in some cases, that they can do better work when not

following the standardization. This is especially the case among professional employees, who may emphasize their profession over the organization in case of conflict between them (Katz-Navon et al., 2005).

A second and different approach suggests that increased standardization rigidity does not change the extent to which employees adhere to standardization. From this standpoint, employees perceive standardization to be an aid applicable on a daily basis in order to enable them to master their task, and therefore they choose to follow the standards (Adler and Borys, 1996), or they are unwilling to take the risk of the consequences of making an error when departing from the established standardization. In this respect, employees see standardization as their 'insurance policy'. By adhering to standardization, the error becomes not their fault (Naveh et al., 2006). Even when standardization is intensive, employees may see it as a way to help them perform their work, and they may follow it in order to eliminate errors.

A third approach suggests that increased standardization rigidity makes employees more willing to adhere to standardization. This approach is at the core of the explanation of team climate influence on employees' behavior and, eventually, on performance (Katz-Navon et al., 2005). When employees perceive that some behaviors are important to managers, they intensify those behaviors in order to gain the rewards associated with satisfying the managers or to avoid the sanctions connected with not satisfying them. Increased standardization, understood as a message from the management that standardization is important and useful, and that managers believe that standardization can prevent errors, may influence employees to increase their adherence to standardization in order to satisfy managers.

Each of the three approaches has reasonable justification. Therefore, the conditions that make each of them to be effective need to be understood. One such condition is the context under which the standardization is implemented, which is considered to be an important factor in explaining rule violations (Lehman and Ramanujam, 2009). Moreover, the standardization's operational and business results have been shown to be influenced by the context in which they are implemented (Naveh and Marcus, 2005).

### 2.2. Standardization context: discretion granted to employees as a moderator

An important context condition under which standardization is implemented is employee discretion (Naveh, 2007). Discretion is the freedom to decide what should be done in a particular situation. It refers to granting employees the right to choose the manner of action in a particular situation so that they can deal with the emergence of unanticipated situations. Employees have the freedom and the possibility to select an option based on their best judgment, which is defined as an opinion as to what was, is, or will be (Yates and Potworowski, 2012). Employees using their discretion are expected to be responsible for their decisions and careful about what they do. When discretion is high, employees have the option of expressing their knowledge, expertise, and skills and of choosing what to do in a particular situation as they see fit.

In the case of health care patients, for example, each patient is to some extent a unique case and requires medical treatments that are unique in some measure. For doctors, a high level of discretion is important in order to decide on executing additional, or sometime fewer, tests, consulting with other doctors, providing different kinds of medicine, or recommending longer hospitalization terms.

One line of studies envisions a continuum in which standardization is on one end, and flexibility and discretion are on the other, so that any change in one parameter is made at the expense of the other (Davis et al., 2009). However, modern perspectives on standardization provide a new definition of standards as 'simple rules' (Eisenhardt and Sull, 2015). According to this approach, rules are general guidelines that apply only to part of the events that employees operate at, while standardization relates to 'what to do' and not to 'how to do' the work

(ISO 9001:2015; Castka and Corbett, 2015; Naveh and Marcus, 2005). Modern safety standards even use the wording ‘do the safer thing’, which also leaves much space for discretion (The National Academy of Sciences, Engineering and Medicine, 2016). Discretion fills the empty parts that standardization does not cover, and it is not necessarily associated with not following the standardization. Thus, although there is a tension between standardization and flexibility (Lei et al., 2016) in modern work, these two operate as independent factors.

Managers define standards that they expect employees to follow in order to reduce errors. However, they must also allow employees to use discretion in order to deal with unexpected events. Managers grant employees the use of flexibility and discretion to do their work as they see fit because rules and procedures cannot respond to all the situations that employees deal with (Naveh, 2007). In this respect, rule-breaking may be unacceptable or acceptable, and even desired or called for, by the team or the organization (Ortmann, 2010). Dekker (2003) argues that rather than simply increasing pressure to adhere to standardization, organizations should help develop their employees' skills for adapting standardization to the actual circumstances. Woods and Shattuck (2000), referring to military command and control and air traffic management, explain the potential for failures and accidents when standardization is inadequate to cope with the potential for surprises in specific situations. They argue that in order to eliminate the consequences of such surprises, it is local actors, in contrast to distant supervisors, who must adapt standardization to the situation based on their understanding. In accordance with these works, the concept of employee discretion provides an answer to the question of the relationship between standardization rigidity and adherence to standardization. We suggest that the interaction between employee discretion, which is a characteristic of the contexts of implementation, and standardization rigidity, which is a characteristic of standardization, is associated with adherence to standardization.

### 2.2.1. Interaction between standardization rigidity and employee discretion

When the employees' discretion is high, there is an inverted U-curve relationship between standardization rigidity and adherence to standardization. When standardization rigidity is low, an increase in rigidity is associated with an increase in adherence. Employees understand increased standardization as a message from management, and follow it as a way of helping them prevent errors. However, this occurs up to the highest point in which the level of standardization rigidity is perceived as appropriate; from that point on, the higher the level of standardization rigidity, the lower the extent of adherence to standardization. A high level of standardization rigidity means that standardization is less suitable to the changing conditions that employees must cope with. Thus, knowing that they are expected to use discretion to solve daily work challenges and unexpected events, employees depart from standardization in order to deal with the changing conditions. Employees choose the extent to which they adhere to the standardization in order to deal with the changing conditions that exists on a daily basis in the workplace. Having high discretion signals to the employees that taking the initiative and going beyond standardization (Naveh and Marcus, 2005) is feasible. Discretion does not mean that employees have the authority to deviate from standardization; however, a high level of discretion is perceived by employees to permit rule-breaking and to be an instance of unofficial policy organized by top management (Glaser et al., 2015; Martin et al., 2013). In addition, employees with high levels of discretion place less emphasis on the difference between planned standardization and other aspects they need to deal with, and overall they react in a way that fits the actual conditions, either by following the standards or by departing from them.

Discretion strengthens the choice that employees have, and this choice perception results in less adherence to rules and procedures as employees see fit. For example, in the case of physicians in health care, as long as they exercise the normal standard of care practiced by a reasonable physician under similar circumstances, their decision may

be acceptable (Yates and Potworowski, 2012). A common example is a doctor who writes a note for a patient stating that an exam the patient needs to undergo is urgent, although it is not. In doing this, the doctor tries to help the patient because otherwise the waiting time is too long. This affects the entire organization by creating a larger workload for the lab, meaning that the real-urgent tests take longer to be performed. In this case, the doctor wants to help the patient and uses discretion. Of course, the physician may think that the test is really urgent, based on his or her discretion.

In contrast, when discretion is low, standardization rigidity is positively correlated to adherence to standardization. If increased standardization is understood to be a message from management defining standardization as important and useful, and at the same time employees perceive that they are not expected to use their discretion, they tend to increase their adherence to standardization in order to satisfy managers. The fit between the manager's activities that increase standardization rigidity and those that grant a low level of discretion intensifies the employees' perception that managers are serious about adherence to standardization, and also increases the perceived risks and consequences of committing an error when not following standardization (Erev and Roth, 2014). Therefore, employees simply increase adherence to standardization.

At intermediate levels of discretion, higher levels of standardization rigidity do not influence the employees' adherence to standardization, because none of the above-mentioned reasons for the existence of high and low levels of employee discretion is dominant, and overall they cancel each other. The management's increase of standardization rigidity suggests that standardization is important; on the other hand, granting employee discretion weakens that message. This is a mixed, contradicting message that employees perceive. In addition, higher levels of standardization rigidity may be harder to follow, which pushes employees not to adhere to standardization. But there are risks in not following standardization, and employees tend not to take the unnecessary risk of not following procedures (Erev and Roth, 2014). Thus, we hypothesize the following,

**Hypothesis 1.** Employee discretion moderates the relationship between standardization rigidity and adherence to standardization so that, when employee discretion is high, this relationship is curvilinear (inverse U-shaped), with the highest adherence to standardization occurring at intermediate levels of standardization rigidity. When employee discretion is low, the higher the level of standardization rigidity, the higher the level of adherence to standardization. At intermediate levels of employee discretion, there is no change in adherence to standardization when standardization rigidity changes.

### 2.2.2. Interaction between adherence to standardization and employee discretion

We suggest that employee discretion also moderates the relationship between adherence to standardization and error reduction. Learning theory suggests that the combination of learning by planning together with learning by doing is associated with the highest performances (Argote, 1999). Equating adherence to standardization to learning by planning, and employee discretion to learning by doing (Naveh, 2007), when the level of employee discretion is high, the more the employees adhere to standardization, the better error reduction works. Error research finds that the combination of sufficient guidance (in this case, standardization as guidance) and a good response to changing conditions (provided in this case by the use of discretion) reduces errors (Frese and Keith, 2015; Haynes et al., 2009; Van Dyck et al., 2005). Following this reasoning, it can be assumed that the same pattern of relationship also exists at intermediate levels of employees' discretion, but with less error reduction compared to the results at high levels of employee discretion.

When the level of employee discretion is low, a higher extent of adherence to standardization is not be associated with error reduction



because this combination does not allow employees to best deal with the changing conditions that must be taken into consideration for standardization to be beneficial (for example, [Tatikonda and Montoya-Weiss, 2001](#), as regards operational performance). Thus, we hypothesize the following,

**Hypothesis 2.** Employee discretion moderates the relationship between adherence to standardization and error reduction so that, at high and intermediate levels of employee discretion, the higher the level of adherence to standardization, the higher the error reduction. At low levels of employee discretion, error reduction is not affected by changes in adherence to standardization.

### 3. Methods

#### 3.1. Sample and procedure

Two major teaching hospitals in Israel participated in the research. The two hospitals belong to the same organization, and are under one joint central management. Anonymous questionnaires were distributed manually to staff members in the different departments at the beginning of the morning shift. The participants had no incentive to complete the survey. Staff members of 37 departments completed a total of 298 questionnaires. In 24 of the questionnaires no department was indicated, and they were extracted for the model analysis tests. Of these, no hospital was indicated in 12 questionnaires. At one hospital we received completed questionnaires from 17 departments (9 questionnaires with no department indicated). At the second hospital, 20 departments were involved (3 questionnaires with no department indicated). Respondents' average work experience in years was 17. For the model analysis tests, 10 questionnaires were excluded due to missing data.

In addition, data regarding the number of errors per department were independently collected from the reported errors in the hospitals' archival data accumulated by the Risk Management unit. The number of reported errors is commonly used as an error measure in errors studies ([Lei et al., 2016](#)). The errors were taken for the year in which the questionnaires were distributed and the year before.

Three questionnaires per department were determined to be the minimum for analysis, therefore four departments were extracted. The number of questionnaires per department that entered the regression analysis was between 3 and 13, with an average of 8.3 questionnaires per department. All the questionnaires were used for measurement reliability, and 249 were used in the regression analysis, the agreement index, and interclass correlations.

#### 3.2. Measurements

The questionnaires used a 5-point Likert scale. All questions referred to the departmental level, a group level variable.

##### 3.2.1. Independent variables

We measured *standardization rigidity* using two items developed by [Katz-Navon et al. \(2005\)](#). For example: "In your unit, to what extent are the safety procedures extensive?" (Cronbach's alpha 0.86). We measured *adherence to standardization* using three items developed by [Miron-Spektor et al., 2011](#). Example: "Do you adhere to specifications and standards" (Cronbach's alpha 0.81).

##### 3.2.2. Moderator

We measured *employee discretion* using two items developed by [Naveh \(2007\)](#). Example: "You apply discretion" (Cronbach's alpha 0.63).

##### 3.2.3. Dependent variable

We measured annual *error reduction* using data from the hospitals'

archival data accumulated by the Risk Management unit that refer to the number of errors in the departments in two sequential years. An error was defined as any error in the performance of an operation, procedure, or test; or in the administration of treatment; or in the dosage or method of using a drug; and also as generally inappropriate care that resulted in an accident—that is, in harm to a patient ([Katz-Navon et al., 2005](#)). We tallied the number of errors per department using the hospitals' archival data accumulated by the Risk Management unit. The hospital's Risk Management unit collects and handles all error reports within the hospital. Its experts, together with other hospital staff, study reports and events, and classify and count them as errors only if they conclude upon their investigation that said events are indeed errors. The unit's collection of errors enables the hospital to manage risk and prepare for possible malpractice suits. The material it collects includes reports from any source within the hospital, whether it comes from within a department, outside a department, or from patients.

Drawing on [Katz-Navon et al. \(2005\)](#) we calculated the percentage of change in error numbers between the first year data (Time1\_err) and the following year data (Time2\_err):

$$\text{Error reduction} = (\text{Time1err} - \text{Time2err}) / \text{Time1err}$$

### 4. Results

#### 4.1. Construct validity

To test the structure of the variables we conducted a confirmatory factor analysis (CFA) using SAS's 9.4 CALIS procedure on the individual level. We compared it to a model as if all the variables were the same factor. The analysis was run as covariance structure analysis with a maximum likelihood estimation method. The CFA returned an acceptable fit level ([Hu and Bentler, 1999](#)) of  $\chi^2 (21, N = 257) = 22.31$ ,  $p < .05$ , NNFI = 0.96, CFI = 0.98, and RMSEA = 0.06. The standardized factor loadings were greater than 0.72 and significant according to the *T*-test (except one factor loading of 0.43 that was also significant). In the one-factor model all indexes were less significant and unacceptable:  $\chi^2 (23, N = 257) = 405.6$ ,  $p < .001$ , NNFI = 0.03, CFI = 0.36, and RMSEA = 0.33. Most of the standardized factor loadings were not significant according to the *T*-test and ranged between 0.05 and 0.4.

#### 4.2. Aggregation

The independent and the moderator variables are group-level variables. Therefore, all the items in the questionnaires had a referent shift, meaning that the respondents were asked about the behavior of their department ([Chan, 1998](#)). In order to support the aggregation of the variables from the individual level to the average department level, a within-department agreement must be established using the  $r_{wg}$  agreement index ([James et al., 1993](#)). In addition, interclass correlation coefficients are used to imply whether the dependent and control variables are adequately reliable to aggregate the effect to the department level ([Bliese, 2000](#)).

All the independent variables (standardization rigidity, adherence to standardization, and employee discretion) had adequately high average agreement coefficients (mean  $r_{wg} = 0.80, 0.92, \text{ and } 0.82$ , respectively). ICC1 values for standardization rigidity, adherence to standardization, and employee discretion were 0.06, 0.07, and 0.09, respectively. ICC2 values for standardization rigidity, adherence to standardization, and employee discretion were 0.35, 0.39, and 0.55, respectively. Interclass correlation coefficients were significant for  $p < .05$ . Subsequently, the independent and moderator variables were aggregated to the department level.

**Table 1**  
Means, standard deviations, and correlations.

|                                 | Mean  | SD   | 1     | 2      | 3     |
|---------------------------------|-------|------|-------|--------|-------|
| 1. Standardization rigidity     | 3.67  | 0.36 |       |        |       |
| 2. Adherence to standardization | 4.21  | 0.24 | -0.18 |        |       |
| 3. Employee discretion          | 4.12  | 0.28 | 0.30  | -0.12  |       |
| 5. Error reduction              | -0.05 | 0.64 | -0.01 | 0.55** | -0.08 |

N = 33.  
\*\* p < .01.

4.3. Hypotheses testing

Table 1 displays the means, standard deviations, and correlations between the variables.

To examine the suggested moderation models, we performed a multiple regressions analysis using Process macro version 2.15 for SPSS version 20, Model 1 (Hayes, 2013). We used Hayes' (2015) method for detecting quadratic effects. To test the hypotheses in accordance with the Process macro (Hayes, 2013), we first regressed adherence to standardization on quadratic standardization rigidity with employee discretion as moderator (Model 1, Table 2). In addition, we run the Process macro regressing error reduction on adherence to standardization, with employee discretion as moderator (Model 2, Table 2).

For adherence to standardization the regression was significant (F(5, 27) = 2.76, p < .05, R<sup>2</sup> = 0.34; see Table 2). The regression was also significant for error reduction (F(3, 29) = 6.86, p < .01, R<sup>2</sup> = 0.41). The interaction patterns are illustrated in Figs. 2 and 3.

Regarding the adherence to standardization regression (Fig. 2) according to the Johnson-Neyman technique as suggested by Hayes (2015), the moderation was significant for employee discretion values that equal 3.93 or below or 4.6 and above, i.e., values that can be interpreted as low and high but not as intermediate levels of employee discretion. Regarding error reduction regression (Fig. 3) according to the Johnson-Neyman technique (Hayes, 2015), the moderation was significant for discretion values that equal 4 and above, i.e., values that can be interpreted as average and high but not as low levels of employee discretion.

The results of the moderation of quadratic effect estimations (Fig. 2) showed that when employee discretion was high (approximately over 1.7 SD above mean), there was significant support for the assertion that average, rather than low or high, levels of standardization rigidity were associated with a higher adherence to standardization (b

**Table 2**  
Results of moderated regression.

| Variable  | Model 1<br>Extent of standardization execution | Model 2<br>Error reduction |
|---|--|----------------------------|
| Intercept   | 147.14 <sup>†</sup> (57.42)                    | 41.96 <sup>†</sup> (20.10) |
| Standardization rigidity                                    | -82.48 <sup>†</sup> (31.00)                    |                            |
| Standardization rigidity <sup>2</sup>                       | 11.78 <sup>†</sup> (4.18)                      |                            |
| Adherence to standardization                                |  | -10.14 <sup>†</sup> (4.84) |
| Employee discretion   | -34.45 <sup>†</sup> (14.16)                    | -11.45 <sup>†</sup> (4.77) |
| Standardization rigidity X Employee discretion              | 19.84 <sup>†</sup> (7.62)                      |                            |
| Standardization rigidity <sup>2</sup> X Employee discretion | -2.83 <sup>†</sup> (1.02)                      |                            |
| Adherence to standardization X Employee discretion          |  | 2.76 <sup>†</sup> (1.15)   |

Coefficient estimate with standard error in parentheses.

N = 33.  
p < .1.  
\* p < .05.  
\*\* p < .01.

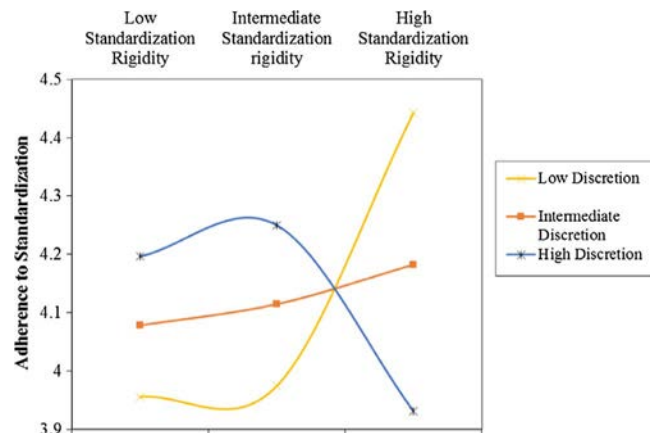


Fig. 2. Interaction between standardization rigidity and employee discretion on adherence to standardization.

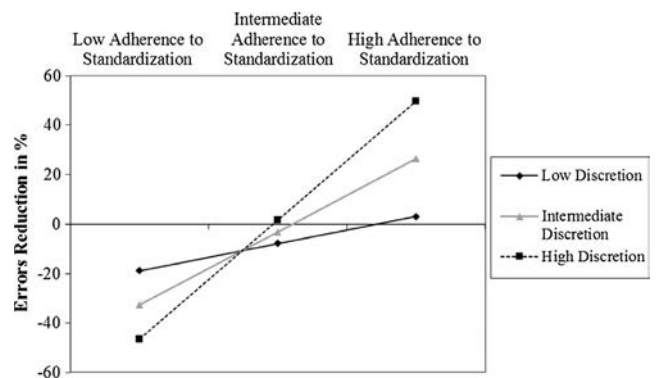


Fig. 3. Interaction between adherence to standardization and employee discretion on error reduction.

(discretion = 4.67) = -1.42, t(27) = -2.15, p < .05). When employee discretion was average, there was no significant quadratic moderated association with adherence to standardization when standardization rigidity changed (b(mean discretion) = 0.12, t(27) = 0.43, p > .1). When employee discretion was low (approximately under 0.7 SD below mean), there was significant support for the assertion that the higher the standardization rigidity, the higher the adherence to standardization (b(discretion = 3.55) = 1.75, t(27) = 2.83, p < .01). Therefore, hypothesis 1 was supported.

The results of the simple slope of the interaction between adherence to standardization and employee discretion (Fig. 3) show that when employee discretion was high there was significant support for the assertion that the higher the adherence to standardization, the more the error rate was reduced (b = 2.0, t(29) = 4.5, p < .001). When employee discretion was at an intermediate level, again higher adherence to standardization was significantly associated with a reduction in the error rate (b = 1.23, t(29) = 3.19, p < .01). However, when employee discretion was low, higher adherence to standardization was not significantly associated with a reduction in the error rate (b = 0.46, t(29) = 0.84, p > .1). Therefore, hypothesis 2 was supported.

5. Discussion

Errors in organizations are an understudied topic that has serious consequences (Frese and Keith, 2015), and this study contributes above all to our understanding of this important phenomenon. Although recent works suggested the understanding of the structure-flexibility paradox as a way to advance the theory of errors in organizations (Lei et al., 2016), and although standardization in organizations is associated with choice and with flexibility-structure paradoxes on a daily

basis, so far this paradox has received limited attention in the theory of errors in organizations (Lei et al., 2016). The body of knowledge on standardization refers to standardization mainly as eliminating choice (Martin et al., 2013; Naveh, 2007) and not as providing choice situations. These paradoxes were used as building blocks to develop the thesis presented in this paper. The results showed that standardization rigidity, adherence to standardization, and employee discretion make a significant difference in error rates. On average, the error rate increased by 5% between the two years of measurements. Given the probabilistic nature of errors, this may suggest a lack of change in the error rate. Our research model suggests that departments with intermediate standardization rigidity and high employee discretion achieved a decrease of about 50% in the error rate as a result of adhering to standardization – the highest decrease in error rates among all combinations. Given that error is a complex, hard to predict phenomenon (Lei et al., 2016), a research model that shows such a significant association between predictors of error and errors is a meaningful and important result.

Specifically, this study contributes to theories on errors in organizations (Frese and Keith, 2015; Lei et al., 2016) and standardization (Lehman and Ramanujam, 2009; Katz-Navon et al., 2005; Martin et al., 2013) using a choice approach to explore the complicated relationship between standardization and errors. The study's main contributions are threefold. First, the significant difference between standardization rigidity and adherence to standardization showed here was not taken into consideration by many of the studies dealing with standardization (Katz-Navon et al., 2005; Lehman and Ramanujam, 2009; Martin et al., 2013). We explained earlier inconsistent results regarding the relationship between standardization and performance by referring to the assumption that the standardization that is planned is the same standardization that is implemented. Adopting a choice approach, according to which employees decide whether to adhere, totally or partially, to standardization, we suggested an answer to the question of the extent to which adherence to standardization is a function of standardization rigidity. We found support for our first hypothesis that states that employee' discretion moderates the relationship between standardization rigidity and adherence to standardization.

Second, granting employees discretion allows them to balance the demands of standardization rigidity and daily work in a way that leads to the best error reduction rate. Organizations cannot achieve as good an error reduction rate when granting low discretion as they do with high discretion: standardization was associated with the best error reduction when the level of standardization rigidity was intermediate and employees were granted a high degree of discretion. Counterintuitively, the high-high combination, i.e., a high level of standardization rigidity and a high degree of employee discretion, is the combination that led to the worst performance. An intuitive tendency that can also be seen in the error literature tends to suggest that high levels of standardization rigidity are associated with low error rates (Lei et al., 2016; Naveh, 2007). This study showed a more developed and complex approach. High levels of standardization rigidity are not a good way to reduce error rates. When employee discretion was intermediate or high, increased levels of standardization rigidity (from intermediate and above) were associated with either no significant change or a decrease in adherence to standardization. We found support for the second hypothesis that states that employee discretion moderates the relationship between adherence to standardization and error rate. When employee discretion was low, there was no association between adherence to standardization and error rate. Only when employee discretion was at intermediate or high levels, higher levels of adherence to standardization were associated with error reduction. These are important results in terms of the way in which organizations should cope with errors, as we describe next in the Implementation to Practice section.

Finally, the study's results go beyond the field of error management because they contribute to the understanding of how structure and flexibility jointly influence performance. Studies on ways to balance and manage the tension between structure and flexibility suggest the

establishment of formal mechanisms that organizations should implement, such as the creation of local deliberation structures that force organizational actors to question standardization in light of daily realities (Canales, 2013; Harrison and Rouse, 2014). We showed that professional employees who were granted discretion used standardization in a way they attained a superior performance without the organization having to develop an extensive formal mechanism. Thus, our answer to the question of how to balance the contradictory requirements of structure and flexibility is to leave the issue to the employees to deal with it at their level. In this respect, our results fit the concept of contextual ambidexterity (Gibson and Birkinshaw, 2004) and also offer a specific mechanism for the operation of contextual ambidexterity. In accordance with contextual ambidexterity, we suggest that although managers define the system's rules, eventually the employees are the ones who reach a balance between structure and flexibility. We expand the concept of contextual ambidexterity by suggesting a specific mechanism through which managerial activities and employees' reactions jointly balance flexibility and structure in a way that leads to error reduction.

### 5.1. Implication for practice

Our results suggest that the balance between structure and flexibility influences performance. In order to reduce errors, managers should institute a mechanism that provides an intermediate level of structure via standardization, and balances it with flexibility obtained by granting employees a high level of discretion. From the employees' point of view, the structure refers to their perception of standardization rigidity and of flexibility and choice understood as the extent to which they adhere to standardization and the degree of discretions they use. Thus, according to our study, managing the structure-flexibility paradox requires the involvement of both management and employees in a joint effort to balance the extremes.

Moreover, this study suggests not only the mechanism but also the level to which flexibility and structure should be set to. The implication for practice seems to be a simple rule about a complicated topic that gets much daily attention and interest. Both managers and policy makers in different sectors use standardization in order to eliminate errors. This study shows that, in order to reduce error rates, standardization rigidity is not beneficial after a point, a fact that not many managers seem to be aware of at present (Naveh and Marcus, 2005). The results suggest that the optimal level of standardization rigidity is an intermediate level, and that employees should be granted a high degree of discretion. Thus, managers should be careful about the level of standardization rigidity they set. In the health care context researched here, policy makers aiming to reduce medical errors should develop procedures that instruct staff member on how to do their work in a way that will be perceived as neither too strict nor too lax, and in addition they should encourage medical teams to use their discretion.

### 5.2. Limitation and future research

This study contributes to our understanding and advances the theory of standardization and errors while also raising new directions and challenges that need to be explored.

Methodologically, a major advantage of this study is that we varied the sources of the data by using questionnaires for the independent variables and a longitudinal objective variable provided by the hospitals' Risk Management unit for the dependent variable, errors, for the year in which the questionnaires were distributed and the year before. Thought we used acceptable and solid measurements and methods for measuring and collecting the independent variables, future studies may benefit from developing additional sources of data for these variables. For example, in addition to carrying out subjective measurements, objective measurements may possible be developed, enabling the collection of data from customers, suppliers, and auditors. Additional

sectors may be included in order to check possible context influence. For example, a comparison with aviation and other service or manufacturing sectors may be interesting, as well as concentrating on specific units within organizations such as Research and Development departments.

From the standpoint of theory, three directions for further research can be explored: the understanding of standardization, choices, and error reduction. First, future studies may further develop the understanding of the interaction between standardization and discretion. Different additional research lenses can be adopted; a dynamic lens may explore whether the relationship presented in this study is dynamic and changes over time, i.e., whether the degree of adherence to standardization is different over time. Using a level-of-analysis lens may allow researchers to find out whether all employees are equally good at practicing each combination of structure and flexibility, or whether some are better at specific combinations, and why.

Second, the results of this study contradict earlier studies that suggested that the risk of more, compared to less, standardization harming organizational performance is low (Davis et al., 2009). The source of this contradiction might be, as we claim above, that earlier studies neglect the issue of employees' choice and the mechanism we suggest in this study. However, it also may be related to the performance dimension researched in those earlier studies – that is, economic efficiency. So far, studies on the balance between structure and flexibility and the paradox between these two factors ignore the influence of this paradox on error. Thus, future research should also relate simultaneously both to errors and to additional performance dimensions. For example, while we found that when the level of discretion is low there is no association between adherence to standardization and error reduction, this situation may be associated with other performance dimension such as efficiency. What if an organization would like to compromise on errors in order to enhance innovation? We believe that a better understanding of errors may be achieved when studying them together with other performance dimensions.

Finally, in light of the theoretical questions presented above, we believe that advancements in data science suggest referring to previously non-existing data sets that can provide a better understanding of errors in general and of standardization in particular. The forecast of risk based on big data sets may improve the understanding of errors.

To sum, by theoretically developing the choice approach to standardization and by providing empirical support for it, this study improves our understanding of the important under-researched phenomenon of errors in organizations. It suggests that the counterintuitive combination of an intermediate level of standardization rigidity together with granting employees high levels of discretion is associated with a high degree of adherence to standardization and finally assists in developing better ways of coping with errors.

## Acknowledgements

This work was supported in part by the European Union's Horizon 2020 Research and Innovation Program under the Marie Skłodowska-Curie Grant Agreement 702285, and by The Israel National Institute for Health Policy Research under Grant 48-13.

## References

- Adler, P.S., Borys, B., 1996. Two types of bureaucracy: enabling and coercive. *Adm. Sci. Q.* 61–89.
- Argote, L., 1999. *Organizational Learning: Creating, Retaining and Transferring Knowledge*. Kluwer Academic, Boston.
- Ballard, T., Yeo, G., Loft, S., Vancouver, J.B., & Neal, A., 2016. An Integrative Formal Model of Motivation and Decision Making: The MGPM. *JAP*.
- Bliese, P.D., 2000. Within-group agreement, non-independence, and reliability. In: Klein, K.J., Kozlowski, S.W.J. (Eds.), *Multilevel Theory, Research, and Methods in Organizations*. Jossey-Bass, San Francisco, CA, pp. 349–381.
- Canales, R., 2013. Weaving straw into gold: managing organizational tensions between standardization and flexibility in microfinance. *Organ. Sci.* 25 (1), 1–28.
- Castka, P., Corbett, C.J., 2015. Management systems standards: diffusion, impact and governance of ISO 9000, ISO 14000, and other management standards. *Foundations and Trends (R) in Technology, Information and Operations Management* 7 (3–4), 161–379.
- Chan, D., 1998. Functional relations among constructs in the same content domain at different levels of analysis: a typology of composition models. *J. Appl. Psychol.* 83, 234–246.
- Dahling, J.J., Chau, S.L., Mayer, D.M., Gregory, J.B., 2012. Breaking rules for the right reasons? An investigation of pro-social rule breaking. *J. Organ. Behav.* 33 (1), 21–42.
- Davis, J.P., Eisenhardt, K.M., Bingham, C.B., 2009. Optimal structure, market dynamism, and the strategy of simple rules. *Adm. Sci. Q.* 54 (3), 413–452.
- Dekker, S.W.A., 2003. Failure to adapt or adaptations that fail: contrasting models on procedures and safety. *Appl. Ergon.* 34 (3), 233–238.
- Eisenhardt, K., Sull, D.N., 2015. *Simple Rules*. John Murray Publishers Lt.
- Erev, I., Roth, A.E., 2014. Maximization, learning, and economic behavior. *Proc. Natl. Acad. Sci.* 111 (Supplement 3), 10818–10825.
- Feldman, M.S., Pentland, B.T., 2003. Reconceptualizing organizational routines as a source of flexibility and change. *Adm. Sci. Q.* 48 (1), 94–118.
- Frese, M., Keith, N., 2015. Action errors, error management, and learning in organizations. *Annu. Rev. Psychol.* 66, 661–687.
- Gibson, C.B., Birkinshaw, J., 2004. The antecedents, consequences, and mediating role of organizational ambidexterity. *Acad. Manag. J.* 47 (2), 209–226.
- Gilbert, C.G., 2005. Unbundling the structure of inertia: resource versus routine rigidity. *Acad. Manag. J.* 48 (5), 741–763.
- Glaser, L., Stam, W., Takeuchi, R., 2015. Managing the risks of proactivity: a multilevel study of initiative and performance in the middle management context. *Acad. Manage. J.*, amj-2014.
- Glaser, W., 2010. *Choice Theory: A New Psychology of Personal Freedom*. Harper Collins.
- Harrison, S.H., Rouse, E.D., 2014. Let's dance! elastic coordination in creative group work: a qualitative study of modern dancers. *Acad. Manag. J.* 57 (5), 1256–1283.
- Hayes, A.F., 2013. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. Guilford Press.
- Hayes, A.F., 2015. Hacking PROCESS for estimation and probing of linear moderation of quadratic effects and quadratic moderation of linear effects. Unpublished Paper.
- Haynes, A.B., Weiser, T.G., Berry, W.R., Lipsitz, S.R., Breizat, A.H.S., Dellinger, E.P., et al., 2009. A surgical safety checklist to reduce morbidity and mortality in a global population. *N. Engl. J. Med.* 360 (5), 491–499.
- Hofmann, D.A., Frese, M. (Eds.), 2011. *Error in Organizations*. Routledge.
- Hu, L.T., Bentler, P., 1999. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equ. Model.* 6, 1–55.
- ISO 9001, 2015. *Quality Management Systems (2015)*. International Standard Organization, Geneva, Switzerland.
- James, L.R., Demaree, R.G., Wolf, G., 1993. Rwg: an assessment of within-group interrater agreement. *J. Appl. Psychol.* 78, 306–309.
- Katz-Navon, T.A.L., Naveh, E., Stern, Z., 2005. Safety climate in health care organizations: a multidimensional approach. *Acad. Manag. J.* 48 (6), 1075–1089.
- Kownatzki, M., Walter, J., Floyd, S.W., Lechner, C., 2013. Corporate control and the speed of strategic business unit decision making. *Acad. Manag. J.* 56 (5), 1295–1324.
- Lehman, D.W., Ramanujam, R., 2009. Selectivity in organizational rule violations. *Acad. Manag. Rev.* 34 (4), 643–657.
- Lei, Z., Naveh, E., Novikov, Z., 2016. Errors in organizations an integrative review via level of analysis, temporal dynamism, and priority lenses. *J. Manage.*
- Makary, M.A., Daniel, M., 2016. Medical error—the third leading cause of death in the US. *BMJ* 353, i2139.
- Martin, A.W., Lopez, S.H., Roscigno, V.J., Hodson, R., 2013. Against the rules: synthesizing types and processes of bureaucratic rule-breaking. *Acad. Manag. Rev.* 38 (4), 550–574.
- Miron-Spektor, E., Erez, M., Naveh, E., 2011. The effect of conformist and attentive-to-detail members on team innovation: reconciling the innovation paradox. *Acad. Manag. J.* 54 (4), 740–760.
- Naveh, E., 2007. Formality and discretion in successful R&D projects. *J. Oper. Manage.* 25 (1), 110–125.
- Naveh, E., Katz-Navon, T., Stern, Z., 2006. Readiness to report medical treatment errors: the effects of safety procedures, safety information, and priority of safety. *Med. Care* 44 (2), 117–123.
- Naveh, E., Marcus, A., 2005. Achieving competitive advantage through implementing a replicable management standard: installing and using ISO 9000. *J. Oper. Manage.* 24 (1), 1–26.
- Ortmann, G., 2010. On drifting rules and standards. *Scand. J. Manag.* 26 (2), 204–214.
- Parmigiani, A., Howard-Grenville, J., 2011. Routines revisited: exploring the capabilities and practice perspectives. *Acad. Manage. Ann.* 5 (1), 413–453.
- Sidak, J.G., 2015. The value of a standard versus the value of standardization. *Baylor Law Rev.* 68, 1.
- Stern, Z., Katz-Navon, T., Naveh, E., 2008. The influence of situational learning orientation, autonomy, and voice on error making: the case of resident physicians. *Manage. Sci.* 54 (9), 1553–1564.
- Stern, Z., Katz-Navon, T., Levzion-Korach, O., Naveh, E., 2009. Resident physicians' level of fatigue and medical errors: the role of standardisation. *Int. J. Behav. Healthcare Res.* 1 (3), 223–233.
- Tatikonda, M.V., Montoya-Weiss, M.M., 2001. Integrating operations and marketing perspectives of product innovation: the influence of organizational process factors and capabilities on development performance. *Manage. Sci.* 47, 151–172.
- The National Academy of Sciences, Engineering and Medicine, 2016. *Beyond compliance: strengthening the safety culture of the offshore oil and gas industry*.
- Van Dyck, C., Frese, M., Baer, M., Sonnentag, S., 2005. Organizational error management culture and its impact on performance: a two-study replication. *J. Appl. Psychol.* 90 (6), 1228–1240.
- Woods, D.D., Shattuck, L.G., 2000. Distant supervision-local action given the potential for surprise. *Cogn. Technol. Work* 2 (4), 242–245.
- Yates, J.F., Potworowski, G.A., 2012. *Evidence-based decision management*. The Oxford Handbook of Evidence-Based Management 716–790.