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Routine contraction in good times: An example of a typical prototype development routine

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ABSTRACT

The general wisdom in the routine literature is that routine contraction happens as a response to adverse situation. This study examines routine contraction even during non-adverse situations. Here, routine contraction is operationalized as the shrinkage of resources. The data is hand collected from the public website of the National SCRABBLE® Championship, 2010. Here, each SCRABBLE® routine is an analogy of a prototype development routine. The higher order relationships between SCRABBLE® routines and prototype development routines in a second generation Stage Gate® product development process are mapped following structure mapping theory. The results of panel regressions indicate that the performance of a routine at a particular time (t_0) positively affects contraction of the same routine at an immediately later time (t_1). Efficiency moderates this relationship. Routine contraction may happen even in good times. The paper closes with theoretical contribution and managerial implications of these results.

1. Introduction

Organizational routine is an important area of management that was promoted mainly since the 1980s (e.g. Nelson & Winter, 1982). Its application and use in new product development has rapidly increased (Benner, 2009). Organizational routines are at the heart of all organizations. Organizations learn by doing the same routine activities. A central debate in the organizational routines literature is on: Are organizational routines stable or changing? Under what conditions do organizational routines change? Under what conditions are organizational routines stable? What types of change (e.g. expansion and shrinkage) of organizational routines occur? As a response to this debate, Winter (1964) suggests that an organizational routine is a "pattern of behavior that is followed repeatedly, but is subject to change if conditions change" (p. 263). Several empirical studies found that routines are not inert and typically change over time (e.g. Feldman, 2000, 2003; Narduzzo, Rocco, & Warglien, 2000).

Routine replication and routine imitation involve change in routine. Extensive theory has been developed in these areas (e.g., Winter, Szulanski, Ringov, & Jensen, 2012). Routine contraction (i.e., shrinkage) also involves change in routine (Becker, 2004). However, theory development of routine contraction is in a nascent stage (Anand, Gray, & Siemsen, 2012). The present study is an effort to contribute to this gap. Here, routine shrinkage is operationalized by shrinkage of resources used in the routine. This study shows that routine contraction can happen in good times. This perspective extends the current wisdom in the literature that routine contraction is a "mandatory response to failure" (Nelson & Winter, 1982, p. 122).

This study uses an empirical context of the National SCRABBLE® Championship, 2010. Here, each step in each game of this championship is a SCRABBLE® routine. Each SCRABBLE® routine is an analogy for a prototype development routine in a second generation Stage-Gate® product development process. Panel regression results indicate that improved performance of a routine at a particular time (t_0) leads to increased routine contraction at an immediately later time (t_1). The results also show that the efficiency of a routine negatively moderates the relationship between the performance of a routine at time t_0 and its contraction at time t_1. These suggest that routine contraction may happen even in good times. These empirical findings indicate that managers need not panic when organizational routines contract.

In the rest of this paper, we discuss about the theoretical background and hypothesis development. This includes the existing literature on routines and their modification with special focus on routine contraction. Next, we describe about the source context: a typical SCRABBLE® routine and the target context: a typical prototype development routine. Using structure mapping theory (Gentner, 1983), we then map the higher order relations in the source context to the target context (i.e. a typical prototype development routine). Next, we empirically test the hypotheses and discuss about the findings. At the end, we conclude by discussing the key contributions of this study and identify some limitations.

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2. Theoretical background

2.1. Routines and their modification

Different schools of routine scholars define routines differently (Becker, 2005). The first school defines routines as recurrent behavior patterns (Nelson & Winter, 1982; Winter, 1964). The second school defines routines as rules and standard operating procedures (Cohen, 1991; Cyert & March, 1963). However, an entity cannot be appraised fully by what the entity does. If we just include observations to judge an entity, then an entity would cease to exist when it interrupts its characteristic activity. Think of a firm with working hours between 9 am and 5 pm when a number of routines are energized. When the firm is inactive, the routines do not disappear and the same routines do not mysteriously reappear at 9 am the next day. Hence, routines are dispositions to carry out repeated similar behavior in specific situations (Hodgson & Knudsen, 2010, p. 79) rather than observed behavior. For example, a SCRABBLE® player has a disposition to carry out the SCRABBLE® routine at all times. However, the player carries out the routine observably only when there is a SCRABBLE® board in front of the player. This paper focuses on the dispositional characteristic of routines. Though routines are relatively stable over time, they do change sometimes (Feldman, 2003). Routine contraction is a type of routine change. A routine contraction may involve shrinkage in resources allocated to the routine. This paper examines routine contraction in the context of a SCRABBLE® routine. The choice of SCRABBLE® routine is explained in the next section.

2.2. The source context: SCRABBLE® routine

SCRABBLE® is different from most other tournament games because everything related to the game including the tournaments are strictly controlled by Hasbro Inc., the company that manufactures the game and has the rights to the game in North America. Here, each game of SCRABBLE® includes a collection of routines. Each step in each SCRABBLE® game is a routine irrespective of whether it is played by player A or B. In a SCRABBLE® routine (Fig. 1), a player contracts the routine by using fewer resources even when there is a bonus of fifty points for using all allocated resources.

A SCRABBLE® routine has the key characteristics of a routine. It is guided by a twenty-five-page rule book, called The SCRABBLE® Players Handbook. The performance here is recurrent because every time a player finishes her turn, the second player starts his turn. Overall, a SCRABBLE® routine lies somewhere in between the two extremes of: mindfulness and mindlessness. In such a routine, some sub-routines are automatic, such as, “start clock”, “draw or replenish tiles”, “fill or manage rack”, and “stop clock” (Fig. 1). Some other sub-routines, such as, “form word”, “compute and note score” and “track tiles” involve mindfulness. The key sub-routine: “form word” is guided by cognitive mechanisms that are not fully automatic (Becker & Knudsen, 2005). The more skilled a player is, the more automatically is this key sub-routine carried out. This is because skilled players (especially the top two hundred and fifty players in North America) spend hours in learning wordlists and training for tournaments. The following anecdote indicates the quasi-automatic nature of a SCRABBLE® routine. “ …the most seasoned players don't concern themselves with word meanings. … I recall the time that Brian Cappelletto appeared on the Today Show after winning the 1998 Nationals. Katie Couric asked him for a word without vowels. He gave her CWM (a steep-walled basin). She asked, ‘What does that mean?’ He sheepishly responded, ‘I don't know.’” (McCarthy, 2008, p. 127). A SCRABBLE® routine is a process that is composed of several connected sub-routines. Here, a subroutine is defined as an intermediate part of a routine that acts as a building block (Pentland & Rueter, 1994, p. 490). A typical routine is dependent on the context of the developed board. It is path-dependent because earlier performances build the board situation and thereby, affects its subsequent performances. A SCRABBLE® routine is a disposition to act or think in regular patterns in particular situations where the players store representations (Cohen et al., 1996; Narduzzo et al., 2000) of the word lists, the board situation and their relations in their minds. The players then act quasi-automatically based on these representations (Akgun, Keskin, & Byrne, 2012; Becker & Knudsen, 2005).

The following two characteristics of a typical SCRABBLE® routine are infrequently discussed in the organizational routines literature – (1) competitive behavior; and (2) performance by an actor. The first characteristic - competitive behavior is observed in routines in non-organizational contexts, such as, games, warfare, and soccer (Egidi in Cohen et al., 1996) and in organizational contexts, such as, a budget routine in a large housing department in a public university (Feldman, 2003). The second characteristic - performance by an actor can happen in some routines. Consider an accounting routine in a start-up firm. It may now be done by an accountant. But, when the accountant is on leave, any of the founders performs the same accounting routine. The disposition to carry out the accounting routine in a patterned way is what makes it a routine. In sync with this line of thought, Pentland (1992) studied routines performed by individual technical support staff. Though a typical SCRABBLE® routine is performed by an actor, the initial sub-routines, such as, “start clock”, “draw or replenish tiles”, and “fill or manage rack” could well have been performed by different actors. However, in any variation of such a typical routine that involves a word challenge, an additional sub-routine: “settle challenge” is performed by an unbiased third person, usually a tournament official. Now that we have discussed the source context in the analogy, in the next section we discuss the target context in the analogy.

2.3. The target context: Prototype development routine

Prototype development is a part of a new product development process. A new product development process is “a formal blueprint, roadmap, template or thought process for driving a new product project from the idea stage through to market launch and beyond” (Cooper, 1994, p. 3). There are many parts of the new product development process that are fairly routinized (Adler, Mandelbaum, Nguyen, & Schwerer, 1995). For example - IBM's “red book” new product scheme includes detailed procedure in eleven loose-leaf binders (Cooper, 1994). In this study, in order to provide a context for the focal prototype development routine, we briefly describe a second generation Stage-

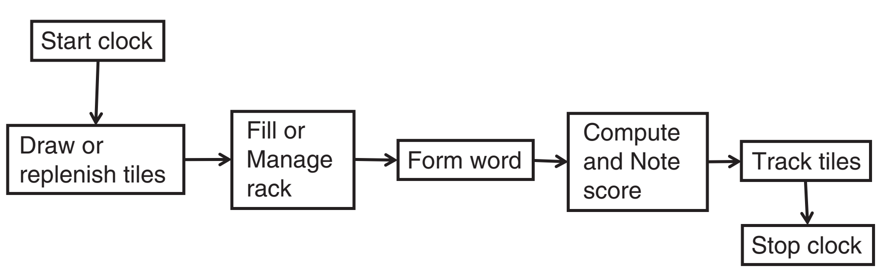

Fig. 1. A typical SCRABBLE® routine.

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Gate® new product development process (Biazzo, 2009; Cooper, 1994, 2008).

A formal Stage-Gate® system for new product development includes discrete stages that capture the entire process from idea to product launch preceded by review points or "gates". Each stage includes a set of recommended best-practices and involves a cross-functional team. The decision points or gates are also cross-functional. In each gate meeting, various senior managers who own the needed resources jointly decide on and commit to a project. 3M and IBM are some of the companies that employ Stage-Gate® systems (Cooper, 1994). Six Swedish companies in the automotive, aerospace, paper products, mechanical and electromechanical products are found to employ the Stage-Gate® system (Högman & Johannesson, 2013). Within a Stage-Gate® system, the "development" stage begins only after a product concept gets approved (Biazzo, 2009). This stage includes prototype development and some other activities, such as, "define materials", "finalize manufacturing processes", and "plan field trials" (Cooper, 2008).

Prototype development has the main characteristics of an organizational routine. A prototype development routine is patterned, includes a set of sub-routines (Fig. 2) indicating its processual nature and is guided by product plans and product specifications (Carlile, 2002). Product specifications usually include target markets, target channels, product price, functionality, features, and technologies (Biazzo, 2009). A prototype development routine is triggered once an initial draft of product specifications that is agreed upon by all parties is completed. Prototype development shows recurrence because it usually involves several iterations from a crude prototype that may not include all functionalities to a final prototype that satisfies the customer (Cooper, 2008). This indicates that such a routine is path-dependent on its prior iterations (Bakker, van Lente, & Meeus, 2012). It is also path-dependent on the upstream stages of - "scoping" and "build business case" in a Stage-Gate® process (Carlile, 2002). A prototype development routine is dependent on its context. For example, such a routine in an uncertain and complex environment is more likely to be flexible (Biazzo, 2009). Both tacit and explicit knowledge are used in a prototype development routine. Tacit knowledge is especially relevant in complex projects where people with generational experiences are employed (Biazzo, 2009). Some of the explicit knowledge artifacts that are used in a prototype development routine are - (1) repositories: cost databases, materials and parts libraries, and CAD/CAM databases; (2) standardized forms and methods: such as standards for reporting findings, and engineering change forms; (3) objects or models: such as sketches, assembly drawings, parts, prototype assemblies, mockups, and computer simulations; and (4) maps of boundaries that include process maps, workflow matrices, and computer simulations (Carlile, 2002).

2.4. The analogy

Following structure-mapping-theory (Gentner, 1983; Gentner & Markman, 1997), here we draw an analogy between a SCRABBLE® routine and a prototype development routine. Analogy is "a device for conveying that two situations or domains share relational structure despite arbitrary degrees of difference in the objects that make up the domains" (Gentner & Markman, 1997, p. 46). The case method of teaching is an example of analogy. Through the method, students "are led to active consideration of a tremendous number of diverse and related real situations, which it would take them at least a lifetime of experience to encounter, and they are thus given a basis for comparison and analysis when they enter upon their careers of business action" (Gragg, 1940). Facing a novel opportunity, managers think back to some similar situation they faced or heard about. Then, they apply the lessons from prior situations to the present context. Analogical thinking may be seen as the best way for practitioners to cope with rapid change (Slywotzky & Morrison, 1999). Managers use analogy to tackle the twin challenges of novelty and complexity (Gavetti, Levinthal, & Rivkin, 2005).

In novel states, where deduction is difficult, lessons from prior contexts may be an important powerful source of wisdom to managers (Neustadt & May, 1986). One procedure for referring such wisdom is analogical reasoning (Gavetti et al., 2005).

Thagard (1996, p. 80) points out that "analogies can be computationally powerful in situations when conceptual and rule-based knowledge is not available." Analogy allows managers to take the insight developed in one setting and apply it to a new context (Gavetti et al., 2005). Analogy plays a significant role in problem solving such as decision making, perception, memory, and communication. For example, Lycos, with an objective "to grow rapidly and become a full-fledged new-media company" first acquired Tripod, a Web hosting service company. However, after the acquisition, Lycos' managers faced a decision problem - should Tripod be maintained as a separate operation with its own brand name or merge Tripod into Lycos-branded operations? After a debate for weeks, ultimately analogy helped managers to get the answer of the question. Traditional media companies generally maintain multiple divisions with separate brands but integrate back-office operations. Accordingly, Lycos kept alive Tripod's brand names but integrated the back offices (Gavetti & Rivkin, 2004). Analogy can be used also as the form of a solution seeking a problem. For example, Enron used analogy as the form of a solution to explain its failure in the broadband market (for details, refer Gavetti et al., 2005).

The analogy that this study develops is applicable for flexible prototype development that follows a formal new product development process, such as a Stage-Gate® process. Structure-mapping theory suggests mapping of higher-order relations between objects from a source domain to a target domain instead of mapping object attributes or lower-order relations. The higher-order relations are chosen based on a principle of "systematicity" (Gentner, 1983). The systematicity principle allows choosing systems of relations instead of individual relations. Here, each sub-routine represents a relationship between the objects of a domain. Therefore, higher-order relations are the relationships between sub-routines while lower-order relations are the attributes of sub-routines.

Following structure-mapping theory, we have mapped one-to-one (Tsoukas, 1991) the higher-order relations of a typical SCRABBLE® routine to those of a typical prototype development routine (Table 1).

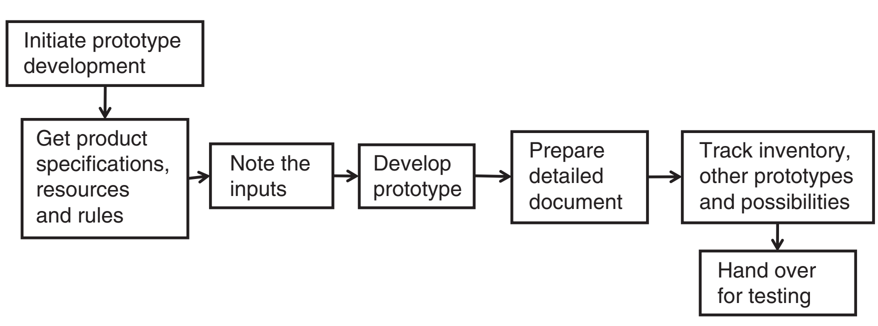

Fig. 2. A typical prototype development routine - an analogical mapping from a typical SCRABBLE® routine.

Table 1
Structure mapping of major relationships.

A typical SCRABBLE® routine		A typical prototype development routine	
Sub-routine	Relationships with the prior sub-routine	Sub-routine	Relationships with the prior sub-routine
2 Draw or replenish tiles	Only happens after sub-routine 1: "Start Clock" gets completed.	2 Get product specifications, resources and rules	Only happens after sub-routine 1: "Initiate prototype development" gets completed (where the sub-routine 1 is the trigger from the product design team to start developing prototype).
3 Fill or manage rack	Only happens after sub-routine 2 gets completed. The outputs from sub-routine 2 are received as inputs.	3 Note the inputs	Only happens after sub-routine 2 gets completed. The outputs from sub-routine 2 are received as inputs.
4 Form word	There can be an overlap between sub-routines 3 and 4. Many times, a player manages the rack in sub-routine 3 in such a way that he or she can form a word then. This sub-routine is guided by the board situation, the resources in the player's rack and the rules of SCRABBLE®. A player may keep complementary tiles in the rack for a future play even if it is possible to use all seven tiles to earn a bonus of fifty points. This allows flexibility in the sub-routine.	4 Develop prototype	There can be an overlap between sub-routines 3 and 4. Many times, a routine actor while noting the inputs in sub-routine 3 quasi-automatically starts figuring out how to perform sub-routine 4. This sub-routine is guided by the product specifications but need not always strictly adhere to them. Some of the product specifications may be altered. This allows some amount of flexibility.
5 Compute and note score	Only happens after sub-routine 4 gets completed. The outputs of sub-routine 4 serve as inputs to this sub-routine.	5 Prepare detail document	Only happens after sub-routine 4 gets completed. The outputs of sub-routine 4 serve as inputs to this sub-routine. This document includes details, such as: time taken to develop the prototype, product specifications that are exactly adhered to, product specifications that are altered, the cost of resources used and the probable price of the product.
6 Track tiles	Can happen any time after sub-routine 4 gets completed. Therefore, this sub-routine can overlap with or occur simultaneously with sub-routine 5. But, the outputs from sub-routine 4 are not the only inputs here. All prior words that have been formed on the SCRABBLE® board are relevant here.	6 Track inventory, other prototypes and possibilities	Can happen any time after sub-routine 4 gets completed. Therefore, this sub-routine can overlap with or can occur simultaneously with sub-routine 5. But, the outputs from sub-routine 4 are not the only inputs here. All prototypes that have been formed before are relevant here.
7 Stop clock	Can happen any time after sub-routine 5. Therefore, sub-routines 6 and 7 may be performed simultaneously.	7 Hand over for testing	Can happen any time after sub-routine 5. Therefore, sub-routines 6 and 7 may be performed simultaneously.

A prototype development routine need not be performed by a single actor. Each of the sub-routines may be carried out by different actors. Though the pictorial representations show sequential inter-dependence between the sub-routines, there can be overlaps between some of them. For example - sub-routines 3: "note the inputs" and 4: "develop prototype" may have overlaps (Fig. 2). In some cases, a routine actor while noting the inputs may quasi-automatically start figuring out how to develop a prototype. Again, sub-routine 6: "track inventory, other prototypes and possibilities" can overlap with or be carried out simultaneously with sub-routine 5: "prepare detail document". Similarly, the subroutine: "track inventory, other prototypes and possibilities" may be carried out simultaneously with the sub-routine: "hand over for testing." This means that after a prototype is developed and a detailed document is prepared, it may be handed over for testing.

3. Hypotheses development

3.1. Routine contraction

Routine contraction is one of the several types of routine modification. In this study, contraction of a routine involves shrinkage of resources. Very well performing routines may gather organizational slack (Love & Nohria, 2005) because they far exceed expected performance (Levinthal & March, 1993). Organizational slack is that "cushion of actual or potential resources which allows an organization to adapt successfully to internal pressures for adjustment or to external pressures for change in policy, as well as to initiate changes in strategy with respect to the external environment" (Bourgeois, 1981, p. 30). There are three types of slack: unabsorbed slack, absorbed slack and potential slack. Unabsorbed slack consists of the excess resources that are not yet absorbed into the technical design of the organization (Bourgeois & Singh, 1983, p. 43). An example of unabsorbed slack is excess liquidity. Absorbed slack consists of "resources that are already absorbed into the system design as excess costs, but may be recovered during adverse times" (Bourgeois & Singh, 1983, p. 43). An example of absorbed slack is general and administrative expense. Potential slack consists of extra resources that can be raised from the environment (Bourgeois & Singh, 1983). An example of potential slack is debt as a percent of equity. The higher the performance of the routine, the greater is likely to be the extent of its organizational slack. This slack is a combined measure of all three types of slack. Therefore, the selection mechanism may work in such a way that the absorbed slack is reduced thereby contracting the routine. Reduction in absorbed slack will be in the form of freeing up internalized resources from the routine. This then will lead to increase in the extent of unabsorbed slack in the firm. Since very well performing routines include greater amount of slack than other routines, the extent of contraction in very well performing routines will be greater than in other well performing routines. A well performing routine may also contract temporarily while searching for a better routine. Such a routine will search for a better routine in order to improve its performance further. In contrast, a less performing routine will focus more on carrying out the existing routine. This is because inertia will occur (Brusoni & Rosenkranz, 2014; Gersick & Hackman, 1990) when the routine faces the threat of earning low profits or even negative profits (Staw, Sandelands, & Dutton, 1981). In addition, well performing routines can get better at using resources when it is performed by actors who have learned the routine well (Helfat & Peteraf, 2003). These actors can improve the routine over time. In contrast, poor performing routines are carried out by less expert routine actors. When actors of the routine carry out the routine repeatedly, learning occurs and that allows the actors to carry out the routine more proficiently and with fewer resources (Levitt & March, 1988). Therefore, well performing routines can be carried out with fewer resources and involve greater routine contraction than poor performing routines. Thus, H1: A positive relationship occurs between the performance (i.e., score) of an organizational routine at time t_0 and the amount of routine contraction (i.e. shrinkage of resources) at time t_1, after controlling for all other factors.

3.2. Efficiency

Efficiency may be a signal of a better transformation process involved in the routine. Therefore, there is easier search in an efficient routine and fewer interdependencies. Therefore, an efficient routine will contract to a greater extent than a not-so-efficient routine. Efficiency involves achieving the goal of the routine without wasting materials, time and energy (Merriam-Webster's Dictionary accessed online on 20th May 2015). Therefore, resource contraction is one way of achieving efficiency but is not the only way.

A well performing routine may have improved quality of prototype development, which in turn reduces the number of iterations (Eisenhardt & Tabrizi, 1995). Such a well performing routine may lead to increased efficiency (i.e. fewer iterations). Fewer iterations would use fewer resources to complete the prototype development, thereby, increasing routine contraction. Use of high quality input resources that need to be used in smaller quantities can also lead to improved efficiency. Such efficiency improvement increases resource contraction of the routine. In addition, use of modular parts that are easy-to-assemble and create fewer interdependencies between parts makes revision less cumbersome and hence faster. This, in turn, increases efficiency and increases routine contraction. Therefore, in the presence of efficiency, the effect of performance of a routine on the extent of routine contraction is likely to be enhanced. Thus, H2: The efficiency of a routine positively moderates the relationship between the performance of the routine (i.e. score) at time t_0 and the amount of routine contraction (i.e. shrinkage of resources) at time t_1, after controlling for all other factors.

4. Empirical analysis

4.1. Data and methods

The study uses thirty one SCRABBLE® games played in the National SCRABBLE® Championship (NSC), 2010. This is an annual competition for expert SCRABBLE® players in the US. We collected the data from the official website of the National SCRABBLE® Association (NSA) (www2.scrabble-assoc.com, accessed on June 2013). This organization runs as a partnership between SCRABBLE® enthusiasts in North America and Hasbro (www.hasbro.com, accessed on June 2013), the company that manufactures the SCRABBLE® game. We have also collected some information from the North American SCRABBLE® Players Association (NASPA) website (www.scrabbleplayers.org, accessed on June 2013). In order to collect additional data, we replayed each and every game on our SCRABBLE® board. The total number of steps in each of the thirty-one games varies from twenty-five to thirty-six. Overall, seven games have more than thirty steps. All steps in the thirty-one games are included in the dataset. Overall, the dataset contains a total of eight hundred and sixty-three rows of data. Each step of a game is a routine irrespective of whether it is played by Player A or Player B (Fig. 1). Therefore, metaphorically, this dataset includes thirty-one firms (where each game represents a firm) where the unfolding of one prototype development routine over time is studied. Hence, this is an unbalanced panel dataset where the panel variable is the game number and the time variable is the step number. Each step is nested within each game. The level of analysis is a step. The steps are numbered chronologically because Step 0 always comes before Step 1, Step 1 always comes before Step 2, and so on. We have used Stata 11 to analyze the hypotheses. The panel regression commands that we mainly used is: xtreg, fe (for static panel regression with fixed effects estimator). Fixed effect regression controls for omitted variables that differ between cases but are constant over time. We used the fixed effects (FE) estimator because of three reasons. First, the FE estimator allows the unobserved effect to be correlated with one or more of the explanatory variables (Woolridge, 2006, p. 494). This is likely to be the case here because the thirty one games used in this study may not be randomly selected from the whole population of all SCRABBLE® games. The website of the championship mentioned the details of these thirty one games only. It, however, does not mention on what basis these games are chosen. Second, the FE estimator allowed us to skip some of the time-constant controls. Third, the FE estimator allows attrition to be correlated with the unobserved effect (Woolridge, 2006, p. 493). This takes into consideration the fact that not all games are observed for all steps because the number of steps varies in each SCRABBLE® game. For each and every model, we conducted Hausman tests (using the Hausman command in Stata 11) to check whether or not the fixed effects model is better suited. We found that each of the models (Models 1 to 4) is better suited for the FE estimators. We also tested for serial correlation (using xtserial in Stata 11) and for heteroscedasticity (using xttest3 in Stata 11). Heteroscedasticity occurs when the variance of the unobservable error "changes across different segments of the population, where the segments are determined by the different values of the explanatory variables" (Woolridge, 2006, p. 271). For those models with evidence of heteroscedasticity (i.e. Models 3 and 4 in Table 4), we controlled for heteroscedasticity by using the vce (robust) option in Stata 11. The vce (robust) option uses the sandwich estimator of variance. If the observations are independent, this option controls for certain types of misspecifications. None of the models have first order auto-correlation. We used the vce (robust) option to get the robust standard errors for all models.

4.2. Analysis of Hypothesis 1

Hypothesis 1 proposed that there is a distinct positive relationship between the amount of routine contraction at time t_1 and the performance of the routine at time t_0, when all else is held constant. In order to test this hypothesis, we used the dependent variable of: "Contraction of routine at time t_1". This is measured in terms of the number of tiles that remain unused in the player's rack after he or she has formed a word. A player earns a bonus of fifty points by using all seven alphabets in his or her rack. If the case of using all seven tiles in the player's rack is considered as a case of no contraction, then any number of tiles that remains on the player's rack is a measure of routine contraction. Consider the tiles that remain in a player's rack after he or she has formed a word as unabsorbed slack. Unabsorbed slack includes assets that are not committed to any organizational activities and can be readily deployed, such as, cash funds (Lavie, Stettner, & Tushman, 2010; Love & Nohria, 2005; Singh, 1986). In this perspective, a routine that uses fewer resources has more unabsorbed slack. Therefore, a contracted routine has unabsorbed slack where as a routine that has not contracted has no slack.

The main explanatory variable is: "Routine performance at time t_0". This is the cumulative score of the player at the beginning of that specific step of the game. The control variables used here are: (1) "Routine actor's skill level": This is the rating of the player who forms the word in that specific step. This rating is provided for any player who has played at least in one SCRABBLE® tournament that is featured in the NSA's tournament calendar; (2) "Advantage gained from special use of machinery": This is the additional score that a player earned because of positioning his or her tiles on any of the premium squares on the board: double letter, triple letter, double word, and triple word; (3) "Benefits from by-products": This is the additional score that a player earned from the additional words that he or she formed piggybacking on prior words already formed on the board; (4) "Resource availability": This is the total number of tiles that remain in the bag and the total number of tiles that remain in the two racks of the players; and (5) "Last few iterations": This is a dummy variable that takes a value of 1 at the endgame situation (i.e. when the bag of tiles does not have any remaining tiles). For all models, we have used the natural logarithmic transformations of the first four control variables. We have used a natural logarithmic transformation of these variables because it narrows the range of variables. This increases the sensitivity of the regression models toward extreme observations (Woolridge, 2006, p. 199). Refer Table 2 for the descriptive statistics on the variables and

Table 2
Descriptive statistics and correlation matrix.

Variable	Mean	s.d.	1	2	3	4	5	6	7	8
Routine performance at time t_0	202.620	134.130	1.000							
Efficiency of the routine	0.280	0.150	0.023	1.000						
Routine performance at time t_0* Efficiency of the routine	56.970	54.840	0.708*	0.615*	1.000					
Routine actor's skill level (logged)	7.570	0.070	0.076*	−0.042	0.015	1.000				
Advantage gained from special use of machinery (logged)	2.120	0.920	−0.096*	−0.138*	−0.171*	0.001	1.000			
Benefits from by-products (logged)	2.210	0.620	−0.119*	−0.315*	−0.282*	0.042	−0.079	1.000		
Resource availability (logged)	3.490	1.080	−0.833*	−0.002	−0.586*	−0.053	0.160*	0.145*	1.000	
Last few iterations	0.150	0.360	0.487*	0.013	0.356*	0.027	−0.173*	−0.107*	−0.816*	1.000

* $p < 0.05$

their pairwise correlations. Refer Table 3 for the results of testing Hypothesis 1.

Each model indicates that the performance of a routine at time t_0 statistically significantly and linearly affects contraction of that routine at time t_1. This strongly supports Hypothesis 1. As per Model 1, if "Routine performance at time t_0" increases by its one standard deviation, then "Contraction of routine at time t_1" will increase statistically significantly by about 0.5 times its standard deviation. Using the AIC statistics, here we arranged the models in order from the best fitted to the worst fitted one as Models 2 and 1 (Table 3). Toward the end of a SCRABBLE® game, when there are very few tiles that remain in the players' racks and the bag of tiles does not have any remaining tiles, it is difficult to play. Therefore, we control for this situation by adding the control of "Last few iterations" in Model 2.

4.3. Analysis of Hypothesis 2

Hypothesis 2 proposes that the efficiency of a routine positively moderates the relationship between the performance of the routine at time t_0 and the amount of routine contraction at time t_1, all else being equal.

Here, the dependent variable is: "Contraction of routine at time t_1". The three main explanatory variables are: (1) "Routine performance at time t_0": This is the cumulative score of the player before he or she plays in that specific step of the SCRABBLE® game; (2) "Efficiency of the routine": This is the cost-benefit ratio of the routine. The cost of resources used in performing the routine is measured by the summed up values of the tiles that are used in forming a word. The benefit derived from the routine is the total points earned from the word formed; and (3) "Routine performance at time t_0 * Efficiency of the routine": An interaction term that is a product of the first two explanatory variables. The control variables are the same five that we have used for testing H1: "routine actor's skill level", "advantage gained from special use of machinery", "benefits from by-products", "resource availability", and "last few iterations". In all models, the study uses natural logarithmic transformations of the first four control variables. For detailed results, refer Table 4. All the models (Models 3 and 4 in Table 4) indicate that while other things are controlled for, "routine performance at time t_0" statistically significantly affects "Contraction of the routine at time t_1" and this relationship is moderated negatively and statistically significantly by the "Efficiency of the routine". Therefore, Hypothesis 2 is not supported. In all these models (Models 3 and 4 in Table 4), the coefficients on the interaction term: "Routine performance at time t_0 * Efficiency of the routine" are negative and statistically significant. In the same models (Models 3 and 4), the coefficients on the main explanatory variables: "Routine performance at time t_0" and "Efficiency of the routine" are positive and statistically significant. Greater efficiency is indicated by a lower ratio. Therefore, routines with high efficiency contract to a less extent than routines of low efficiency. Also, improved efficiency of the routine reduces the magnitude of the effect of "Routine contraction at time t_0" on "Contraction of routine at time t_1". We also tested whether or not the combined effect of the two variables: "Efficiency of the routine", and "Routine performance at time t_0 ∗ Efficiency of the routine" are different from zero. We used two different methods for testing this. First, we used the post-estimation command test in Stata 11. test performs Wald tests of simple hypotheses about the parameters of the most recently fitted model (Stata manual, 2009). Second, we used the post-estimation command lrtest in Stata 11 to compare Models 3 and 4 with their corresponding nested models without these two variables. lrtest performs a likelihood ratio test of the null hypothesis that the parameter vectors of a model satisfy a smooth constraint (Stata manual, 2009). The results from both tests indicated that the combined effect of the above-mentioned two-variables is statistically significantly different from zero in each of these models. The models can be written in order, from the best fitted model to the worst fitted one (using the AIC

Table 3
Panel regressions for testing Hypothesis 1: a positive linear relationship.

Explanatory variables	Model 1		Model 2	
Routine performance at time t_0	0.007**	(0.001)	0.008**	(0.001)
Last few iterations			0.710	(0.483)
Routine actor's skill level (logged)	−2.682	(1.624)	−2.678	(1.692)
Advantage gained from special use of machinery (logged)	−0.290**	(0.095)	−0.275**	(0.097)
Benefits from by-products (logged)	0.549**	(0.144)	0.549**	(0.142)
Resource availability (logged)	1.099**	(0.133)	1.385**	(0.262)
Model fit and Serial correlation statistics				
AIC	1489.172		1488.698	
BIC	1509.079		1512.586	

Robust standard errors are mentioned in parentheses.
* $p < 0.05$
** $p < 0.01$

Table 4
Panel regressions for testing Hypothesis 2: moderation of a positive linear relationship.

Explanatory variables	Model 3		Model 4	
Routine performance at time t_0	0.010**	(0.002)	0.011**	(0.002)
Efficiency of the routine	8.192**	(1.920)	8.120**	(1.922)
Routine performance at time t_0 * Efficiency of the routine	−0.016*	(0.006)	−0.016*	(0.006)
Last few iterations			0.512	(0.487)
Routine actor's skill level (logged)	−1.725	(1.600)	−1.735	(1.651)
Advantage gained from special use of machinery (logged)	−0.242*	(0.088)	−0.232*	(0.089)
Benefits from by-products (logged)	0.797**	(0.156)	0.792**	(0.154)
Resource availability (logged)	1.008**	(0.135)	1.216**	(0.260)
Model fit and serial correlation statistics				
AIC	1455.110		1455.704	
BIC	1482.980		1487.555	

Robust standard errors are mentioned in parentheses.
* $p < 0.05$
** $p < 0.01$

statistics) as: Models 3 and 4. According to the results from Model 4, if all other things remain the same, when "Routine performance at time t_0" increases by its one standard deviation, "Contraction of routine at time t_1" increases by about 0.8 times its standard deviation. All other things being equal, when "Efficiency of the routine" increases by its one standard deviation, "Contraction of routine at time t_1" increases by about 0.66 times its standard deviation. If all other variables are controlled for, when "Routine performance at time t_0" increases by its one standard deviation, "Efficiency of the routine" increases by its one standard deviation, and the interaction term: "Routine performance at time t_0 * Efficiency of the routine" increases by its one standard deviation, the "Contraction of routine at time t_1" increases by about 1.005 times its standard deviation.

Overall, the results indicate that well performing routines tend to contract their resources to a greater extent than "not-so-well" performing routines. However, efficient routines tend to contract their resources to a less extent than "not-so-efficient" routines. More efficient well performing routines contract their resources to a lesser extent than less efficient well performing routines. Refer Fig. 3 for a look at the moderating effect. Here, we arrived at the values of routine contraction at t_1 by considering the following values and substituting them in the equation for Model 3 – high performance (32), low performance (30), high efficiency (1/4) and low efficiency (1/2).

5. Discussion and conclusion

The results of this study indicate that improved performance of a routine at time t_0 leads to increased routine contraction at time t_1. This implies that an organizational routine can shrink because of healthy happenings, such as, (1) selecting out organizational slack (Singh, 1986) from profitable routines and thereby achieving "more from less"; (2) using costly but fewer resources; (3) taking advantage of intelligent machinery or new technology that requires fewer resources or steps; (4) taking advantage of accumulated experiential learning or gains already made elsewhere in the firm, such as, using a common resource within the firm instead of buying a new resource; (5) making byproducts that are saleable; and (6) contracting the existing routine temporarily while searching for a better routine. The results also show that the efficiency of a routine negatively moderates the relationship between the performance of a routine at time t_0 and its contraction at time t_1. These empirical findings indicate that managers need not panic when organizational routines contract.

The results of this study challenge the existing general wisdom in the routine literature that contraction of organizational routines happens only as a response to adverse conditions (e.g. Becker, Lazaric, Nelson, & Winter, 2005; Zollo & Winter, 2002), such as: turnover of personnel, high costs of carrying out the routine, low benefits from

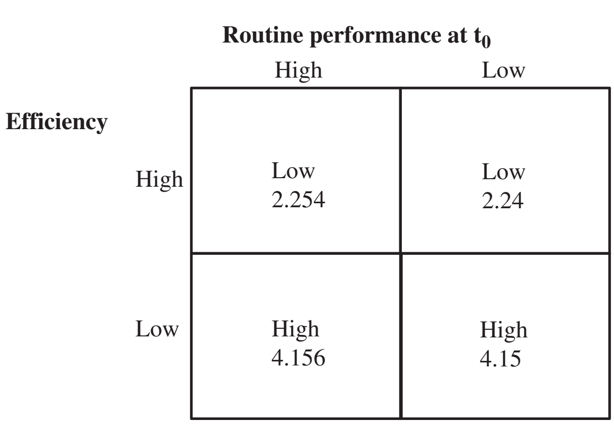

Fig. 3. The moderating effect of efficiency on routine contraction at t_1.

the routine when compared to the costs incurred, and sudden change in the market conditions. Here, we find that organizational routines may contract even in "non-adverse" situations. The results indicate that when other factors are controlled for, well performing routines contract to a greater extent than poor performing routines.

In this study, contrary to our expectations (H2), we find that less efficient well performing routines contract to a greater extent than more efficient well performing routines. A probable reason for the finding is as follows. More efficient routines involve lower cost-benefit ratios when compared to less efficient routines. Cost-benefit ratios can be lowered by any of the following means: lowering the costs of the routine, improving the benefits from the routine, and lowering the costs as well as improving the benefits from the routine. Routine contraction here is not driven by just cost considerations only.[1] Highly efficient well performing routines are likely to focus on improving benefits rather than lowering costs. This is because well performing routines are not tight pressed for finances. Therefore, well performing routines with high efficiency do not contract more than well performing routines with low efficiency. Well performing routines with low efficiency involve relative higher costs compared to their realized benefits. Higher costs may involve using fewer costly resources, which in turn, leads to high routine contraction. This indicates how less efficient well performing routines contract to a greater extent than more efficient well performing routines.

This study has several managerial implications. The results indicate that routine contraction is not necessarily a negative phenomenon. Therefore, noticing routine contraction should not unnecessarily worry managers. They need to understand the underlying reasons that lead to routine contraction. Further, managers need to manage routine contraction in order to achieve their goals. Several underlying reasons can be healthy happenings, such as: using shared resources within the firm instead of buying new resources, using special machinery that requires fewer resources than before and reusing parts of prior iterations of the routine. For example, a well performing prototype development routine may initially be using three iterations to arrive at the final prototype. However, over time, a prototype development manager may allow the routine actors to reuse parts from prior iterations to arrive at the final prototype in only two iterations. This, then, allows the routine to cut down on the total amount of resources used leading to greater routine contraction than a poor performing routine. In contrast, a poor performing routine may continue with its existing number of iterations.

This study has implications for routine scholars as well. Scholars need to realize that the current wisdom in the routine literature that routine contraction happens only under adverse conditions need not be true. Routine contraction may happen in healthy situations as well. Scholars also need to realize that organizational settings may not be suitable for a posteriori empirical examination of some phenomena, such as: routine death and routine contraction. This is because such phenomena are rare, causally ambiguous and are associated with failure. Therefore, it is very difficult to observe or get detailed micro-level data on such phenomena. In order to overcome such barriers, we suggest that routine scholars develop a plausible set of hypotheses and find relevant results by studying these phenomena in a suitable metaphorical context. Metaphors and analogies are widely used by scholars in several fields of studies, including subject areas of science (Costello, 2000), artificial intelligence (Greiner, 1988), organizational theory

[1] We looked at the summary statistics of cost savings for poor performing routines and well performing routines. The mean of cost savings for well performing routines is very slightly greater than that for poor performing routines. We conducted a t test to compare the means of the two groups: well performing routines and poor performing routines. The results indicate that the means of the two groups do not statistically significantly differ from each other (p-value = 0.8363). We conducted an sdtest in order to compare the standard deviations of the same two groups of routines. We found that the standard deviations do not differ statistically significantly from each other (p-value = 0.2895).

(Tsoukas, 1993), management (Morgan, 1986), marketing (Hunt & Menon, 1995) and in real-life business practices (Gavetti et al., 2005). Now, it is time to use suitable metaphors and analogies to progress conceptual and theoretical development (Oswick, Keenoy, & Grant, 2002) in the field of organizational routines.

5.1. Limitations

Just like any other study, this study is not without its limitations. A thorough examination of the metaphorical context of a SCRABBLE® routine allowed us to arrive at a plausible set of hypotheses and corresponding results about a prototype development routine. As most proponents of metaphors and analogies have pointed out before, the strength of metaphors lies in the strength and relevance of its findings (Clement, 1988; Greiner, 1988). Therefore, the strength of the findings of this study can be verified by any future research that examines routine contraction in another suitable metaphorical context or in an organizational setting. In addition, in this study, we examine only one type of routine contraction: resource contraction. Future studies can examine other possible types of routine contraction, such as contraction of frequency, reduction of time and contraction of the size of routines. Last, this study considers the shrinkage of the quantity of resources. It does not consider the effect on the quality of resources. The investigation of the effect of quality of resources can be taken up in a future study.

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