Solid waste collection: Examining the impact of organizational routines on organizational performance

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Abstract

This study examines the effect of organizational routines, and changes in routines, on two dimensions of organizational performance: efficiency and effectiveness. The theoretical foundation draws from two alternative perspectives in the literature: (a) routine as a discrete organizational practice (i.e., routine as resource), and (b) routine as degree of consistency in executing the organizational practice (i.e., routine as process variation). Using a multiple-case, matched-pair design, I examine the solid waste collection practice in six municipal sanitation departments in the southeastern United States. The focal contribution of the study is a better understanding of the process by which change in an organizational routine influences organizational performance. The insights from this research can help in developing normative implications from routines-based theory.
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This study examines the effect of organizational routines, and changes in routines, on efficiency and effectiveness dimensions of organizational performance. Broadly routines are repetitive patterns of organizational behavior, and they are often examined in terms of discrete organizational practices (Knott, 2003). From this orientation, researchers have examined the effect of routines on organizational performance from the perspective of the resource-based view (Barney, 1991). Organizational practices are viewed as resources in the sense of profitable routines (Winter, 1995) or superior routines (Knott, 2003), and attention is directed to variance across routines.

Another stream of research with roots in organizational theory examines the processual nature of routines in the form of sequential variety (Becker, 2004; Pentland, 2003a, 2003b). This perspective focuses on consistency in repetitive execution of an organizational practice (i.e., routineness), rather than viewing the practice as discrete. While earlier foundations of the sequential variety perspective have performance implications (Taylor, 1911), the relationship has not been developed in the organizational routines literature. Yet, drawing on these principles, some practitioners believe the consequences to be quite important:

> Our challenge, as we move toward 2000, is to turn our Company vision “outside in,” to measure the parameters of customers’ needs and processes and work toward zero variability in serving them. *Variation is evil in any customer-touching process.*  
> (1998 Annual Report, General Electric, emphasis in original)

Overall the routines-performance relationship represents an area of increasing interest in the field, reflecting desire for greater development of the normative implications of routines-based theory (Winter, 1995). To date, scholars have examined performance implications from routines largely from the perspective of the resource-based view. Yet from a strategy vantage point, the processual aspect also has importance in terms of degree of adhering to a routine (i.e., minimizing sequential variety). The value of loose adherence to routine, or even departure from routine, emphasizes adaptation and innovation, which acknowledges the risks associated with strict maintenance of routines in changing environments (Starbuck and Hedberg, 1977). Yet research also suggests that organizations benefit from greater adherence to organizational routines, rather than departures in the form of competitive and marketplace reactions (Brown and Eisenhardt, 1997).

Further, the current literature is limited by examining these two perspectives, resource-based view and sequential variety, in isolation. Integrating the perspectives may substantially enhance our understanding of the influence of organizational routines on organizational performance. This represents the objective of this study, pulling together the two perspectives and examining two dimensions of organizational performance: efficiency (i.e., the ratio of work output to key process inputs) and effectiveness (i.e., the extent to which the work process meets customer demand). Specifically, by integrating these perspectives, this study informs our understanding of

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1 Throughout this paper, ‘performance’ refers to the performance of the organizational unit (i.e., efficiency, effectiveness), rather than performance as execution of the routine itself (Feldman and Pentland, 2003).
the process by which change in an organizational routine influences organizational performance. These process insights can be of great value in developing normative implications from routines-based theory.

A key factor that constrains our understanding of the process by which routines influence performance is difficulty in observing and measuring routines. To address the observation challenge, this study examines solid waste collection as the focal organizational routine, since it is a largely transparent organizational practice. In addition, similar actors and artifacts are typically involved in solid waste collection, such that provision of service is largely stable across time. Further, although a rare context of study in the social sciences, solid waste is a significant industry. For example, there are approximately 27,000 solid waste organizations in the United States across public and private sectors, generating $43 billion in revenue and representing approximately 0.5% of the gross domestic product. This study defines the solid waste industry to include organizations involved in collection, disposal, recycling, composting and/or other processing of solid waste (Beck/Chartwell, 2001).

This research project employs a theory-guided field study design. In terms of guidance, existing theory was particularly influential at the stage of conceptualizing the routine and change in the routine. Drawing from existing routines-based theory allowed this study to focus on the relationship of interest where our understanding is limited, rather than the concept of interest where the literature is more developed. Further, utilizing existing theory helped to guard against potential data overload (Miles and Huberman, 1994). The study examines routines in the context of government organizations, similar to research by Allison and Zelikow (1999) and Stene (1940).

Using a multiple case format (Eisenhardt, 1989; Yin, 1994), I examined the solid waste collection practice in sanitation departments within six cities in North Carolina, a state located in the southeastern United States. Cities were selected according to a matched-pair format: two small cities, two medium-sized cities, and two large cities. Each pair of city departments included one efficient department and one inefficient department. The study based efficiency assessments on two recent reports of government department performance within the state of North Carolina. The primary data source was semi-structured interviews with solid waste administrators and employees in the case study departments, and the focal level of analysis was the collection crew as organizational unit.

As an initial contribution, the study extends our understanding of change in routines. Extending from the Henderson and Clark (1990) typology, change in a focal routine results from changes in components and/or changes in process (i.e., the architecture of the routine). Essentially, these changes represent state shifts (i.e., from the initial routine to the changed routine). Further, within a given state, a focal routine can change with respect to the degree of consistency in its execution (i.e., its processual nature).

The primary contribution of this study is a heightened understanding of the process by which change in a routine influences organizational performance. More specifically, understanding whether change in a routine is beneficial or detrimental depends on the focal performance dimension, the type of change, and the temporal stage of the change. This orientation enriches
our ability to explain and predict performance consequences from change in routines. Further, it offers guidance to empirical researchers in terms of appropriate model structures and temporal gradation issues for data collection.

The remainder of the paper is structured in the following manner. The first section presents a brief overview of routines-based theory as it pertains to this study. In particular, I focus the overview on types of change in organizational routines and performance implications of changing routines from resource-based view and sequential variety perspectives. The section concludes by illustrating the concepts within the empirical context of solid waste collection. Next, in the methodology section, I describe the multiple-case study design, followed by the techniques used in data collection and analysis. The subsequent section presents the analysis for the effect of change in a routine on efficiency and customer satisfaction. The paper concludes by discussing implications from the study.

ROUTINES-BASED THEORY AND PERFORMANCE IMPLICATIONS

The heart of routines-based theory is that the behavior of organizations can be explained by the routines that they employ (Nelson and Winter, 1982). Broadly routines are repetitive patterns of organizational behavior. Specifically, Cohen, et al. (1996: 683) define a routine as “an executable capability for repeated performance in some context that [has] been learned by an organization in response to selective pressures.” More recently, moving beyond descriptive accounts, researchers have directed attention to normative implications of the theory, specifically regarding the effect of routines on firm performance (Knott, 2003, Winter, 1995). In consideration of these implications, it helps to more finely consider the level of examination and type of routine.

Level of examination, or the grain size issue, refers to examining a focal routine, a repertoire of routines within an organization, or an organization as an interconnected bundle of routines (Aldrich, 1999; Cohen, et al., 1996). With respect to type, Nelson and Winter (1982) present two general classes of routines. Operating routines are standard patterns of organizational activity in a particular context. Modification routines are patterns of activity which systematically change the operating routines of an organization (Nelson, 1991; Nelson and Winter, 1982). This study examines the effect of a focal operating routine.

Change in Routines. The power of routines-based theory in explaining organizational behavior stems from the large degree of stability in organizational routines across time. Yet the literature also acknowledges and examines the ways in which routines change. Environmental selection represents one mode of change. For example, new routines arise following the failure of ill-suited routines (Aldrich, 1999). Alternatively, routines can change through adaptation. As a form of programmed adaptation, the employment of modification routines leads to systematic change in operating routines (Nelson and Winter, 1982; Zollo and Winter, 2002). Problem-solving is another form of adaptation. For example, as a routine is employed, difficulties or frictions in its execution can generate problem-solving actions that seek to change the routine (Feldman, 2000; Nelson and Winter, 1982). To further extend the conceptualization of change in routine, I draw from related research by Henderson and Clark (1990) and Pentland (2003a, 2003b).
Henderson and Clark (1990) developed a product innovation typology that consists of two dimensions: degree of change in core components, and degree of change in the linkages among components. In a similar vein, we can think of change in a routine in terms of (1) the degree of change in its core components (i.e., agents, artifacts), and (2) the degree of change in its work process. As an example of the former, change in a routine can stem from change in key employees, technologies or other inputs to the work process (Edmondson, et al., 2001; Nelson and Winter, 1982; Mukherjee, et al., 2000). As an example of the latter, in a card-playing game experiment, Cohen and Bacdayan (1994) manipulated the routine by changing the seating order of the participants. While the above studies illustrate component and process change, Edmondson, et al. (2001) provides an example of change involving both dimensions.

Edmondson, et al. (2001) examined the effect of introducing a new technology into an existing cardiac surgery routine. The researchers found that successful implementation of the new technology required fundamental change in the nature of the operating routine.2 For successful organizations, this aligned with making a radical innovation to an existing operating routine. The new technology overturned several core components from the existing operating routine, which required major changes in the work process. In the less-successful organizations, participants viewed the new technology as a modular innovation to the existing operating routine. In this case, organizational leaders tried to introduce the new surgical technique without changing the existing work flow.

Last, Pentland and colleagues have highlighted an alternative means of changing a routine. While process and component change are often viewed as discrete (e.g., replacement of an employee), we can also think of change in the routine without discrete changes in its work process or components. Specifically, routines can change in terms of the variance in their execution. This type of change aligns with the concept of sequential variety, which refers to variance in the sequence of actions within a work process (Pentland, 2003a, 2003b; Pentland and Reuter, 1994).

Effect of Routines on Performance. Relative to organizational performance, routines often have a negative connotation. For example, employing historically-successful routines can heighten the risk of organizational failure when the environment changes (Starbuck and Hedberg, 1977; Leonard-Barton, 1992). Similarly from the perspective of work process variance, routines are often viewed as rigid, and their presence inhibits innovation and adaptation. But routines also provide benefits to organizations.

This sub-section examines the routines-performance relationship from the resource-based view perspective (i.e., superior/inferior work processes) and the sequential variety perspective (i.e., low/high variance in the employment of work processes). First, from the resource-based view perspective, studies indicate that greater efficiency or profitability may be obtained from employing superior routines (Knott, 2003; Winter, 1995) or replicating superior routines (Winter, 1995; Winter and Szulanski, 2001). The second stream of research considers the effect of variance in execution of the work process (Pentland, 2003a, 2003b), and this work is much

2 Here the work process is an ‘operating routine’ in both the sense of routines-based theory and the operating room atmosphere of a surgical setting.
broader in conceptual scope. From this perspective, organizational performance advantages may stem from reliability (Hannan and Freeman, 1984; Perrow, 1970; Weick, 1987) and coordination (Stene, 1940; Nelson and Winter, 1982). Routines also provide governance value, both as a “truce” among partially-conflicting agent interests (Coriat and Dosi, 1994; Nelson and Winter, 1982) as well as within agents assuming potential conflict between short-term and long-term objectives (Postrel and Rumelt, 1992). Becker (2004: 654-661) provides a related review of this literature.

While researchers have identified a number of performance influences, from the perspective of normative implications, the overall picture remains cloudy. In part, this can be attributed to the variety of performance dimensions referenced in the various theoretical bases. As an exception, Winter (1995) provides a clear accounting of performance implications from routines-based theory, incorporating the resource-based view and standard economic analysis. Absent from Winter (1995), however, is an incorporation of variance in execution of routines.

The Solid Waste Collection Routine. The objective of the solid waste collection routine is to gather solid waste materials for a given geographic region within a standard day of work. While collected materials include garbage, recyclables, yard waste, and bulk waste, this study concentrates on garbage and recyclables collection, which represent the majority of the work and the materials of dominant interest among service providers. The collection work is allocated to crews by material type and geographic area. Material type refers to garbage versus recycling, and geographic area refers to the division of a large region, such as a city, into smaller sub-regions for task allocation. Standard components for a solid waste collection routine include crew members, collection equipment (e.g., a collection truck), waste materials, and collection site locations within a focal geographic region.

Crews are small, typically ranging from one member to five members depending on the waste material and process technology. Process technology for garbage collection ranges from (a) fully-automated (i.e., 1-member crew in which a mechanical ‘arm’ raises and dumps garbage containers from curbside locations) to (b) semi-automated (i.e., multiple-person crews in which laborers manually roll containers to a truck, and hydraulic lifts dump the containers) to (c) manual (i.e., multiple-person crews in which laborers collect and dump the material in a truck without mechanical assistance). While the collection routine is stable and frequently-executed (i.e., typically covering the same geographic area, or “route,” one day each week), the routines change in terms of components (e.g., new crew members, truck replacements) and process (e.g., adopting new process technology, reorganizing collection within and across routes).

Solid waste collection has several advantages as a setting for examining the effect of change in routines on performance. First, the activity aligns well with the three boundary conditions suggested by Nelson and Winter (1982) for routines-based theory. The provision of service does not change over extended periods of time, and producing change is not the primary objective for collection crews. For this study, there is structured variance in terms of organizational size. While the crews themselves are not large, the organizations in which they operate are often large. In terms of complexity, while the nature of the task is not inherently complex, a significant degree of complexity is present in crew interactions with the surrounding environment. Further, the activity itself is largely transparent. This permits researchers to ask participants specific
questions about change in the routine and subsequent performance consequences. Last, the activity has variance on the focal concepts for this study.

**METHODOLOGY**

**Research Design.** The study employs a multiple case study design (Eisenhardt, 1989; Yin, 1994). This type of research is based on a replication logic, in which individual case studies are viewed as experiments. Researchers develop theory based on consistency and divergence, within and across case studies. The six organizations that participated as case study sites were sanitation departments within cities in North Carolina, a state in the southeastern United States.

The objective of this study is to understand the process by which different types of change in routines influence organizational performance. Therefore, drawing from existing theory and relevant context information (e.g., trade press), I identified a number of different types of change in routines in the solid waste collection context. These included change in crew members, change in collection equipment (e.g., truck breakdown, new truck purchase), change in the number of collection sites (i.e., annexation), change in the sequence of collection sites (i.e., reorganization), change in the process of collection (e.g., from manual to fully-automated). This approach differs from examining a single type of change within a larger set of organizations (Edmondson, et al., 2001). Here the study focuses on variance of change types, while the other approach examines variance in the process of incorporating a focal change (Edmondson, et al., 2001).

Another consideration is the nature of competition in this empirical context. While empirical contributions to routines-based theory come from both the private sector (Knott, 2003; Winter and Szulanski, 2001) and public sector (Feldman, 2000; Stene, 1940), selection factors may differ considerably between the two settings. Although not the focus of this study, selection is a core aspect of routines-based theory. In municipal collection of solid waste, competition is present in the form of competing for markets rather than competing within markets. Related, scholars of ‘new public management’ highlight increasing pressures for performance in the public sector, and greater management via contracting and quasi markets (Ferlie, 2002). For municipal sanitation departments, the threat of outsourcing is substantial. By 2003, 51% of North Carolina cities contracted with private firms for the provision of residential solid waste (N. C. League of Municipalities, 2003).

This study focuses on two dependent variables: efficiency in an operational sense and effectiveness in the form of customer satisfaction. Efficiency was the primary dependent variable, and the study referenced two recent government reports for relevant data: (1) a biannual survey report of solid waste practices among municipalities in the state of North Carolina (N. C. League of Municipalities, 2001), and (2) a report of local government performance for a select group of cities in the state of North Carolina (N. C. Local Government Performance Measurement Project, 2003). The N. C. League of Municipalities survey covers all municipalities in the state, while the N. C. Local Government Performance Measurement report

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3 At the time of study design, the 2001 report was the latest available. However, the 2003 report became available during the data collection period (N. C. League of Municipalities, 2003). Using data from the 2003 report, I confirmed that the efficient-inefficient matched pairs were consistent between the two time periods.
focuses on a smaller set of larger cities in the state. Where sources overlapped, data in the latter report was used for confirmation purposes, but the primary data source was the 2001 N. C. League of Municipalities report. From this data, I calculated five measures of operational efficiency (e.g., solid waste collection costs per site, recycling costs per site, total budget per employee).

Looking across the efficiency measures, I identified extreme departments within two size categories of the N. C. League of Municipalities report: (a) city populations greater than 25,000 residents, and (b) city populations between 10,000 and 24,999 residents. Smaller size categories were not considered because smaller cities are more likely to contract with private firms for service provision. Given the wide range of city size in the >25,000 category, I selected two pairs within it. In approximation, I considered large city populations as 200,000 or larger and medium-sized city populations as 50,000-100,000. My distinction between large and medium-sized cities took into consideration issues like city characteristics (i.e., population density) and study factors (i.e., having a sufficient number of cities to clearly identify efficiency contrasts and preserve department anonymity). Small city populations were based on the 10,000-24,999 category.

Initially I contacted six department directors to request the participation of their departments in the study, indicating that all participating organizations would receive a copy of the final report. Five of the six departments agreed to participate in the study. Despite numerous inquiries, one department director never replied, and that department was replaced by inviting another city department of similar size and efficiency level. Thus, the overall participation rate was 86%. This process generated three matched pairs of efficient-inefficient city departments across the three size classes. Corresponding with size, the cities were also similar in terms of rural/urban settings.

Collecting reliable customer satisfaction data proved to be a more difficult task. The N. C. Local Government Department Measurement Project included resident complaint data as an effectiveness measure for participating cities, separating resident complaints into two categories: total complaints and valid complaints. Unfortunately, this data source covers only a subset of the participating organizations, and missing data was also common for these customer complaint measures.

Given the importance of customer satisfaction during the interview accounts, I attempted to collect additional quantitative data on this dimension toward the end of the data collection period. Specifically, I requested historical data for resident complaint contacts in the most recent two fiscal years from the participating organizations. After I did not receive related responses, a department director informed me that they did not track this information historically. Therefore, I adjusted the request by asking department directors to report, for a typical month, the total number of resident contacts, whether contacts were complaints about solid waste pick-ups or inquiries as to when their collection pick-up would occur. The revised request generated

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4 In the paper, I use the terms, resident and customer, interchangeably, given similar usage by interview respondents.
5 The valid complaint distinction is common in the industry, referring to resident concerns that are determined to be the responsibility of the collector (i.e., a collection crew missed a set-out garbage container) rather than the responsibility of the resident (i.e., the resident did not have the garbage container ready by the appropriate time).
responses from five of the six sanitation departments, but the supplied data did not align well
with overlapping data from the N. C. Local Government Department Performance report,
suggesting weak reliability for the data. As such, I did not utilize this data, and I have relied on
descriptive accounts from the interview respondents.

Identifying the appropriate level of analysis for routines-based theory can be challenging.
Related research ranges from the individual level to the industry level (i.e., Gersick and
Hackman, 1990; Nelson and Winter, 1982; Wood, et al., 2002), and individual-level metaphors
are often elevated to higher levels of analysis (Nelson and Winter, 1982). In this study, the six
case study participants were identified at the level of the organization (i.e., the sanitation
department). During interviews, I collected data from multiple levels within the organization,
from the director level to the level of the field laborer. While there are signals of routines
occurring at multiple levels, the majority of reference was to routines occurring at the crew level.
Thus for the purposes of this study, I concentrated on theory development at the group level (i.e.,
collection crews as the focal organizational unit).

Data Collection. Data collection involved interviews, survey responses, and secondary data
sources. The primary source of data was semi-structured interviews, which were conducted at
three levels within the organizations: director level, supervisor level, and field-employee level.
Drawing from theory and context-specific information, I developed an initial interview guide
that focused on the research question of interest. Then, to refine the initial interview guides, I
conducted ten preliminary interviews. The preliminary interviews were conducted in the
Research Triangle Park area of North Carolina, and interviewees included presidents of solid
waste firms, directors of public and non-profit solid waste organizations, state government
leaders and faculty experts.

Case study interview data was collected over a 10-month period, beginning in December 2003.
Data collection was primarily concentrated in single-day site visits, but additional information
was obtained through subsequent correspondence with department directors by phone or email. I
developed three interview guides with several objectives in mind: (a) focusing on relevant
questions given likely experiences for the interviewee, (b) obtaining multiple responses for
certain questions given the potential for response differences based on level within the
organization, and (c) minimizing the time imposition on interviewees. The focal level of
analysis for theory development was the collection crew. Interviews concentrated in three areas:
(a) attributes of, and changes in, the collection routine, (b) dimensions of organizational
performance, and (c) how and why change in the collection routine impacted organizational
performance. I conducted twenty-eight interviews across the six organizations, which were
recorded and later transcribed. In addition, I took field notes during the interviews, which were
transcribed within one day of the site visit. In approximation, the average length of each
interview was 1.5 hours, and the range was 30 minutes to 4 hours.

Data Analysis. Data analysis was consistent with recommendations in Eisenhardt (1989) and
Miles and Huberman (1994). There were two primary objectives. The first objective was to
develop the theory that underlies the effect of change in a routine on efficiency and customer
satisfaction, as seen by participants at multiple levels within the six case study organizations.
The second objective was to compare the emergent theory against available quantitative data for
points of consistency and divergence. Given reliability concerns with reported customer satisfaction data, the latter objective is limited to the efficiency model.

The within-case analysis proceeded in several stages. For additional information on the diagramming, see Miles and Huberman (1994). First, I created contact sheets that recorded case insights from field notes and transcripts, prior to any structured analysis. Second, I coded interview transcripts with category codes in the left-hand margin and related comments in the right-hand margin. The next step was the creation of concept checklist matrices for the routine and performance concepts. Then I developed two sets of explanatory effects matrices that examined the effect of change in the routine on performance. The first set were dense multiple-page matrices that included all relevant cause-effect comments mentioned by participants, while the second set of matrices were aggregated, one-page matrices at a higher level of abstraction. The last stage of within-case analysis was the creation of causal process diagrams underlying the effect of change in a routine on efficiency and customer satisfaction.

Cross-case analysis began with the creation of a summary sheet of relevant quantitative or discrete information for the six municipal departments. Next, using the within-case explanatory effects matrices and causal diagrams, I generated a cross-case effects summary table focusing on rationales underlying each linkage in the process and attributing the rationales to respective case sites. The next step was the creation of a content-analytic summary table, identifying rationales and case attributions for the emerging model: process change and component change as independent variables, consistency as a mediating variable, and efficiency and customer satisfaction as dependent variables. Next I created case-ordered displays, using available data for efficiency and consistency variables to order the displays. In the last stage, I iterated between the emerging case insights and the literature.

WHAT UNDERLIES THE ROUTINES-PERFORMANCE LINKAGE

The objective of this research is more narrow in scope relative to many mid-range theory-building studies. Specifically, to contribute to routines-based theory, the aim was to develop theory for the process underlying the effect of a change in a routine on performance. While a number of studies examine the consequences of routines on performance, with few exceptions, this relationship has not been the focus of the work. As a result, the literature lacks clarity relative to performance dimensions, effect levels, and effect timing (Mitchell and James, 2001; Winter, 1995). These issues present substantial limitations in the development of normative implications from routines-based theory.

This study focuses on performance implications from routines at the crew (i.e., group) level. The model that emerges from the analysis integrates the resource-based view and sequential variety perspectives on organizational routines. See Figure 1 for an overview of the model. Given qualitative analysis challenges associated with examining more than one dependent variable (Miles and Huberman, 1994), the remainder of the section presents the models separately for the two dependent variables. The first sub-section examines the linkages between concepts for the efficiency model, and the second concentrates on corresponding linkages for the customer satisfaction model.
Efficiency as Dependent Variable

Effect of Consistency. Table 1 shows that organizations exhibiting greater consistency have greater efficiency, but the source of this association (e.g., causal relationship, spurious relationship) was unknown. I was able to gain additional insights into the relationship by examining respondent accounts.

In the less-efficient organizations, respondents described three paths underlying a positive effect of consistency on efficiency (see Figure 2). First, respondents reported that consistency led to less conscious attention on inter-agent coordination, which increased crew efficiency (Suburban, Centre City). A field-level employee at Centre City described a positive consistency effect in terms of coordination as “each laborer just knows where the next laborer is going.” Further, two Suburban field-level drivers described the resident as an important agent in the activity, indicating that inconsistency in collection crew behavior created friction with established set-out behaviors by residents. And without consistent collection, the crews would have to go back for missed collections.

Second, respondents indicated that consistency led to less task-related search (Suburban, Centre City). A Centre City field-level employee described that consistency resulted in “better performance for the crew because you always know where you are going. You don’t have to think about that part of it.” Last, another Centre City field-level respondent described that consistency led to greater accountability by providing a more efficient means of governance, indicating that “when you run the same way, if you do get a complaint, you are held accountable because you know who went down which street.”

In the efficient organizations, respondents also described a positive effect of consistency on efficiency. However, the nature of the effect was quite different. For these organizations, the value came not from consistency in its own right; rather it resulted from repeated execution of a better routine. The department director at Independence described consistency as valuable because “we know that the truck is operating probably at its most peak point.” At Mercury, a supervisor indicated consistency of collection led to better performance due to traffic avoidance, “cause you’ve got guys that watch their watches, and they know they need to be in a certain area by a certain time... you get traffic coming in different areas at different times... they like to be in that area before that traffic [starts] getting in there.”

At first glance, the results seem surprising. While we find greater efficiency among more consistent organizations, respondents in the less-efficient organizations are the only ones that describe a positive effect of consistency, in its own right, on efficiency. But crews in less-efficient organizations also provided backyard collection of solid waste, which requires larger average crew sizes: 3.3 members/crew for backyard collection vs. 1.3 members/crew for curbside collection. Crews in the less-efficient organizations also performed in-field sorting of recyclable materials, which require larger average crew sizes: 2.3 members/crew for collection with in-field sorting vs. 1.3 members/crew for commingled collection. Thus, the benefits of consistency on crew efficiency are mentioned in the 2-4 member crews, rather than the 1-2

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6 In a commingled collection process, sorting of recyclable materials occurs at a materials recovery facility (MRF), rather than on the collection route.
member crews. This finding aligns with the idea of performance benefits from consistency in multi-agent interactions, but it also raises the possibility that other characteristics are influencing both consistency and efficiency, a point that will be returned to later in the paper.

**Effect of Process Change.** Understanding the effect of process and component change on efficiency depends on the temporal phase of the change. The analysis indicated three related phases. First, there is an immediate effect of change on efficiency. This effect can be viewed as a switch between states of the routine (i.e., from the initial routine to the changed routine). The second phase is the initial stage of operation in the changed routine. Last, there is an established phase of operating in the changed routine. The established phase effect stems from the inherent efficiency difference between the initial and changed routines. For clarity purposes, the remainder of the paper refers to these three stages as immediate, initial and established phases.

Table 1 shows that organizations exhibiting greater efficiency employed curbside collection of solid waste, either by automated (Metropolis, Mercury) or semi-automated (Independence) processes. For the established phase, respondents described a positive influence of process change on efficiency. In three cases, respondents indicated that the process change to automation led to substantial labor reduction, which increased organizational efficiency. Metropolis and Mercury had years of experience with automation, while Centre City was employing automation as a pilot program at the time of the study. A Mercury administrator described the change to automation in terms of reduction in personnel: “it took fifteen people to do what two people are now doing.” An alternative process change, to the quad-based system, allowed Independence supervisors to concentrate their monitoring attention in a given area each day. A quad system divides the city into four distinct regions, and all waste crews operate in the same region on a given day of the week.

With respect to the direct effect of process change, three cases described disruptions that resulted in reduced efficiency. Respondents also described corresponding negative effects of process change on efficiency through consistency during the immediate and initial phases. The immediate effect resulted from the break in consistency between the initial and changed processes, and the initial effect stemmed from an adaptation phase in which employees and residents were learning the new system. In two cases, respondents reported that the negative effect of changing processes was minimized by involving employees with the change (Middletown) and educating residents about the change (Centre City).

**Effect of Component Change.** Respondents described consistent effects of component change on efficiency for certain types of change. For example, all organizations indicated that truck breakdowns had a negative effect on efficiency. However, employees gave mixed responses when describing the effect of replacing an old truck with a new truck. Classifying change events according to the uncertainty of the timing of event occurrence and classifying effects in terms of the three temporal phases helps clarify our understanding of the effect of component change on efficiency.

First, for uncertain timing events, respondents described the immediate effect as negative. For example, this effect was present as collection trucks breakdown in the field. The exact timing of a breakdown event is uncertain, and its occurrence results in work delays until the truck has been
repaired or a replacement truck has been brought on line. Respondents indicated that this delay may be in the one-to-two hour range, assuming the availability of mechanical assistance or reserve trucks. Without this availability, at the end of the day, several crews had to converge to collect the unserved route.

Second, while respondents described mixed effects of certain component changes, the picture becomes clearer by viewing in terms of initial and established phases of the change. During the initial phase, respondents described a negative effect of component change on efficiency due to learning and adjustment effects. The initial phase begins with the return to operations following a component change. Suburban and Independence field-level employees described the initial phase as four-to-six weeks in duration. During this time period, new employees were learning an existing route or established employees were learning a new area, and both resulted in more mistakes and slow route coverage. Residents also had to learn and adjust their behavior following component changes (e.g., changing their recycling behavior after recycling for a particular material type was discontinued).

With established effects from component change, a key issue was whether corresponding capacity changes were present. For example, a Middletown supervisor reported a positive effect of a new truck due to its capacity increase (i.e., requiring fewer landfill trips). Alternatively, when the capacity of the truck did not change, respondents reported no established effect from the change to a new truck.

Related, the established effect of an annexation on efficiency depended on corresponding changes in capacity. While an annexation results in increased sites for service provision (i.e., an increase in the operating domain for the routine), whether it had an established effect on efficiency depended on corresponding increases in labor, equipment, etc. While respondents did not describe it explicitly, an annexation had a positive effect on efficiency when additional labor and equipment were not provided. Respondents typically described annexation as an increase in workload (“just add extra cans is all it is” according to a Mercury field-level employee). Yet by definition, there is no effect on efficiency when increases in domain size are offset by corresponding increases in labor and equipment.

When the component change was one of uncertain timing, its effect on consistency was negative. For truck breakdowns, there was a negative change effect in the form of work delay. For new employees, there was a negative effect during the initial stage (e.g., new employees made mistakes as they were learning the routes). When timing of the component change was certain, respondents reported a null effect of component change on consistency. For example, employees indicated that annexations were not disruptive because they could be planned for. But annexations also generate pressure for process change (reorganization), and as described above, process change does have an effect on consistency. When new truck replacements did not differ from existing trucks, there was no described effect. However, one Independence respondent indicated a positive effect of a new truck on consistency because the newer truck was more reliable and less prone to breakdowns.

Interestingly, in two cases, respondents also reported a positive effect of new employees on consistency. While there was a negative learning effect, a positive effect stemmed from new employees adhering very closely to a prescribed operating plan (i.e., a mapped driving path for a given route).
Summary for Efficiency. For crews with one or two employees, there was not a perceived effect of consistency on efficiency. For crews with two or more employees, there were perceived benefits of consistency on efficiency.

For process change, there was a negative immediate effect on consistency (i.e., switching states from the initial routine to the changed routine), and the initial effect of the process change was negative. But in two cases, the negative effects in the immediate and initial phases were minimized though employee involvement with the change and resident education about the change. Respondents described positive established effects from the changed process, likely resulting from their selective adoption of processes with perceived efficiency benefits.

For component change, there was a negative immediate effect when the timing of component change was uncertain (e.g., truck breakdowns). When component change timing was certain, it was not perceived as having a negative effect due to time for planning. In the initial phase following a change, respondents reported negative effects associated with learning and adjustment activities (e.g., new employee becoming familiar with an established route, established employee learning unfamiliar features on a new truck). For the established effect, in one instance when component capacity changed, a respondent reported a positive influence (e.g., increased truck capacity results in fewer landfill trips). Otherwise, there were not established efficiency effects from component change.

Customer Satisfaction as Dependent Variable

Effect of Consistency. Given concerns with data reliability, for customer satisfaction as the dependent variable, I have presented the paths as described by the respondents. In five of the six organizations, respondents described that greater consistency of collection led to the development of customer expectations for specific collection times and the development of corresponding set-out behavior. Set-out behavior refers to when the customer has the waste materials ready for collection (e.g., at the curbside). Respondents at Metropolis indicated that this development of expectations for specific collection times was particularly common for elderly or retired residents. In turn, resident expectations and set-out behaviors constrained the organization to collect solid waste in a manner consistent with the established pattern. Essentially consistent crew behavior led to entrained customer set-out behavior, such that consistent collection behavior by crews led to greater customer satisfaction. Yet, at the same time, the development of related customer expectations and behaviors ultimately constrained crews to operate within the established patterns.

Figure 3 presents the basic casual diagram as described by five of the six organizations. In all five organizations, respondents described that collection routines led to the development of corresponding customer expectations and set-out behavior, which then positively moderated the effect of consistency on customer satisfaction. Although less uniform across the organizations, two respondents each described the following effects: a positive main effect of consistency on customer satisfaction, a positive effect of the development of customer expectations/behavior on the consistency of collection behavior, and a negative effect of customer education on customer expectations and set-up behavior.
However, as an outlying position, Independence respondents expressed strong views that their employees were not required to follow a particular pattern of collection. Respondents diverged, though, as to whether collection employees actually did follow consistent patterns of collection. Surprisingly, this case ranked near in the median on the consistency dimension, rather than at the low end of the dimension. While organizational respondents did not feel customer constraints for consistent collection, crew collection behavior was fairly consistent.

**Effect of Process Change.** Respondents did not describe consistent effects of process change on customer satisfaction. At Suburban, respondents described a positive effect of process change. This change involved the adoption of a quad-based system, which employees perceived as clearer for customers. In the pre-quad system, collection trucks frequently crossed one another. By observing passing trucks, some residents assumed that their collection had been missed. At Independence, respondents described a negative effect from process change. This change involved the switch from collecting garbage twice per week to collecting it once per week. Here the negative effect was in terms of perceived service reduction.

Last, with the switch to automatic, respondents described a negative effect in the form of perceived service reduction, but they also described a positive effect in the form of greater clarity for residents (i.e., residents received all waste service on same day). For process changes, respondents indicated that the primary driver of change was perceived efficiency benefits. In their trial automation program, Centre City promoted the positive effects of the process change, such that the implementation would be well-received and allow the organization to obtain the efficiency benefits, which also corresponded with resident perceptions of service reduction, on a larger scale. A Centre City supervisor described the related decisions as “[giving the pilot program] the best equipment... some of our best men... so that you can project the image of this program [as] good... that really helps sell us.”

As described above, process changes typically had negative immediate and initial effects on consistency. Given that the majority of cases described a positive effect of consistency on customer satisfaction, this suggests that process changes have a negative immediate and initial effect on customer satisfaction through consistency.

**Effect of Component Change.** Respondents did not describe a direct effect of component change on customer satisfaction. As described earlier, component changes typically have negative immediate and initial effects on consistency, and consistency has a positive effect on customer satisfaction. As such, this suggests that component change had negative immediate and initial effects on customer satisfaction through consistency.

**Summary for Customer Satisfaction.** For five of the six case organizations, respondents described a positive effect of consistency on customer satisfaction. This stems from crew collection behavior adhering to customer expectations and behaviors, which are themselves a product of prior consistency in crew behavior. At the same time, though, this process generated a constraint that inhibited crews’ ability to adapt to changing conditions. For one of the organizations (Independence), respondents did not indicate a related effect on customer satisfaction. However, among the six organizations, Independence was near the median on the
consistency dimension, suggesting that internal pressures, in addition to customer pressures, also influence consistency.

For process change, respondents described mixed effects for the established effect. It was described as positive when the change resulted in greater clarity for residents. It was reported as negative when residents perceived a service reduction from the change. Immediate and initial effects of process and component change on customer satisfaction were negative through consistency. For component change, there was not a direct effect on customer satisfaction.

DISCUSSION

The objective of this study was to enhance our understanding of the influence of routines on performance using an inductive theory-building approach. Regarding this relationship, key findings emerged in terms of the nature of performance, the type of routine change, and the temporal stages of the effect. Regarding performance, it is important to highlight that solid waste collection is a services industry. As such, the study examines the effect of a service innovation, which is a relatively-undeveloped area of the literature (Drejer, 2004). From a services perspective, the study sheds light on a complex demand effect of routines via customer satisfaction.

Analysis of the majority of cases indicated that consistent collection of solid waste within crews led to the development of customer expectations for timing of collection and corresponding set-out behaviors. Essentially a significant portion of customers entrained their set-out of waste containers to the established collection pattern of the crew (Ancona and Chong, 1996). Once this relationship became established, crew departures from the historical collection pattern resulted in dissatisfaction among this set of customers. As a result, crews performed well by consistently providing service within the established pattern. But at the same, they reinforced the pattern, helping to further solidify the constraints within which they were operating.

An interesting open question is whether customers inherently prefer a consistent pattern of collection or whether they develop the preference based on consistency in initial collection behavior. The potential for the latter is suggested by the outlying position of Independence, an efficient organization that offered no support for customer pressure as a driver of collection consistency. If customers do not have an inherent preference for consistent collection, organizations may be well-served to avoid consistent service patterns, perhaps even using inconsistent patterns in a semi-structured way. For example, many organizations develop ‘optimal path’ models using heuristic-routing, either manually or with software assistance. However, it may be the case that randomly alternating between at least two good, but less than optimized, paths is a better option. To the extent that the use of multiple paths prevents customers from developing collection time expectations, this approach would preserve the organization’s ability to adapt, which may be of particular value in environments with frequent change.

A second key finding focuses on the type and timing of the change in the routine. From the literature, alternative perspectives of ‘routine’ have been developed based on the resource-based view and sequential variety perspectives. From the sequential variety lens, respondents
described positive effects of consistency on customer satisfaction and efficiency. For customer satisfaction, this effect was based on co-alignment of routines between collection crews and residents. For efficiency, this effect was described by larger crews.

As highlighted earlier, the consistency-efficiency findings do not preclude the possibility that process technology influences both consistency and efficiency. This point is raised given the alignment of consistency, efficiency and degree of automation in process technology. This is consistent with the idea that automation reduces process variance by reducing opportunities for the occurrence of human mistakes (i.e., Anthony, 1986). If the degree of automation in process technology has a positive effect on both consistency and efficiency, this suggests that automation of process technology results in a superior routine. While this implies that its adoption should be widespread, in fact, it may run contrary to alternative performance dimensions at some municipalities. For example, Independence employed a semi-automated process technology, and a mid-level administrator indicated that they faced pressure from City Council to maintain their existing number of employees. The reasoning was (a) not to increase because there was not funding to expand the employee base and (b) not to decrease because of potential political repercussions from substantial job reductions.

The sequential variety lens also helped describe the effect of component changes. When component changes were unexpected (e.g., truck breakdowns), they often resulted in short-term inefficiencies. When component changes were expected (e.g., annexation, employee on vacation), respondents did not describe disruptive effects on efficiency. This was due to a-priori planning that smoothed over the change effect.

Incorporating the resource-based view provides a clearer view of process change. Here the most referenced process change was the switch to automated process technology, which provided a positive established effect on efficiency. However, both component and process changes typically resulted in negative near-term effects on consistency, which tended to flow through to performance in a negative fashion.

Thus, while consistency can have a beneficial direct effect, changes in process and component are likely to have short-term negative effects. Following calls for more explicit attention to effect timing (Mitchell and James, 2001), within this data set, approximate time frames for learning and behavior adjustment were 4-6 weeks. This finding is consistent with research by Tyre and Orlikowski (1994), which found a significant period of adaptation by employees shortly after a process innovation. The researchers reported “a striking finding across the three research sites was that adaptation efforts appeared to fall off abruptly after a short initial introduction period” (Tyre and Orlikowski, 1994: 104). Thus process changes with longer-term promise first result in short-term consistency costs.

However, several of the sites offered ways to help minimize the short-term disruptions. One approach was to involve employees in the change process. Another was to educate customers about the upcoming change. From Figure 3, this results in a reduction of customer expectations for behavior consistency. Last, Centre City placed explicit attention on delivering short-term positives (i.e., utilizing their best employees on the pilot program) in order to offset the negative short-term disruptions.
Limitations and Future Research

Here I highlight two limitations associated with the research project, which suggest future research opportunities. First, examining the process of routine change in an inductive manner provides only one angle on the phenomena (McGrath, 1982). Related, while many changes were frequent and on-going, some changes required retrospective accounts from respondents. While the richness of this approach proved quite helpful in developing the process underlying the change effect, future research needs to test the nature of the change process using longitudinal data.

Second, the research project examines organizational routines in a single context, a services-oriented business in which producer and customer relations are interwoven (i.e., before producers can provide service, customers must have taken certain actions). In related work, Kotabe, et al. (2003) examined supply chain routines, where similar supplier-producer interactions are present. Further, similar interactions may be present between departments within firms (Brown and Eisenhardt, 1997), and we might expect similar producer-customer relations in businesses where services are delivered according to a schedule (e.g., logistics, teaching). Future research can help to identify bounds for generalizability by examining the effect of routines on performance in settings with minimal behavioral interdependence between producers and customers.

CONCLUSION

Our understanding of the performance consequences from routines-based theory has been limited. Existing literature directs much attention to efficiency advantages of routines, exploitation-through-growth advantages for superior routines, and consequences of persistent routines despite changing conditions. From an efficiency perspective, this study highlights that routine changes typically have negative near-term impacts prior to attainment of any potential long-term benefits. From the customer satisfaction perspective, this study also suggests that customers may be conditioned to appreciate routines, which subsequently constrain service providers to work within historical behavior patterns.

These findings suggest several avenues for further development of routines-based theory. First, it suggests that researchers need to devote significantly more attention to the idea of ‘routine as target’ (Nelson and Winter, 1982). While studies typically indicate either performance advantages or disadvantages from routines, this study highlights the presence of both positive and negative effects across time. Related, we need more insight in terms of how organizations can reap the advantages from employing routines, yet also maintain the capability to change routines. While some factors may inhibit routine change like near-term disruptions and long-term constraints due to entrained behaviors, activities like involving employees in planning a change and educating customers about an upcoming change appear to offer promise for managing disruptions.

Longer-term constraints like entrainment are perhaps more challenging. When coordination for both parties benefits from entrained behavior, adhering to a single best routine may simply be
required. But in cases where entrained behavior does not offer benefits to the service provider, employing multiple satisficing routines (rather than one optimal routine) may limit the development of customer expectations and entraining behaviors, which ultimately give the service provider more degrees of freedom for adaptation.
REFERENCES


Table 1. Matched Pairs of City Sanitation Departments

<table>
<thead>
<tr>
<th>City</th>
<th>City Population</th>
<th>Efficiency</th>
<th>Consistency</th>
<th>Dominant Garbage Collection Process</th>
<th>Recycling Sorting</th>
<th>Typical Crew Size (garbage/recycling)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolis</td>
<td>Large</td>
<td>High</td>
<td>8.4</td>
<td>automated</td>
<td>one-sort commingled</td>
<td>1/1</td>
</tr>
<tr>
<td>Centre City</td>
<td>Large</td>
<td>Low</td>
<td>6.6</td>
<td>manual</td>
<td>multi-sort on route</td>
<td>4/2</td>
</tr>
<tr>
<td>Independence</td>
<td>Medium</td>
<td>High</td>
<td>8.3</td>
<td>semi-automated</td>
<td>no-sort commingled</td>
<td>2/1</td>
</tr>
<tr>
<td>Suburban</td>
<td>Medium</td>
<td>Low</td>
<td>7.0</td>
<td>manual</td>
<td>multi-sort on route</td>
<td>4/3</td>
</tr>
<tr>
<td>Mercury</td>
<td>Small</td>
<td>High</td>
<td>9.1</td>
<td>automated</td>
<td>no-sort commingled</td>
<td>1/2</td>
</tr>
<tr>
<td>Middletown</td>
<td>Small</td>
<td>Low</td>
<td>7.8</td>
<td>manual</td>
<td>multi-sort on route</td>
<td>2/2</td>
</tr>
</tbody>
</table>

(1) Department size corresponds with city population.

(2) For the consistency dimensions, respondents were asked the following question on a 0-10 scale. How repetitive is the process of collecting (garbage or recycling) in your organization in terms of timing (0: very little repetition, 10: very high repetition)? For example, to what extent is a given collection point made at the same time each week?

(3) No-sort commingled refers to dumping all recyclable materials in the same truck bin. One-sort refers to a single-sort dumping process, where paper/cardboard are separated from all other recyclable materials (e.g., plastics, metals).
Figure 1. Model of Routine Effects

- Process Change
- Component Change

Consistency

- Crew Performance
  - Efficiency
  - Customer Satisfaction
Figure 2. Effect of Consistency on Efficiency

- Consistency
- Task-related search
- Conscious inter-agent coordination
- Efficiency
+ Agent accountability
Figure 3. Effect of Consistency on Customer Satisfaction

- Consistency
  - Customer Knowledge of Upcoming Changes
  - Customer Expectations and Set-out Behavior
  +

+ Customer Satisfaction

-