Analysis and Improvement of Information-Intensive Services: Evidence from Insurance Claims Handling Operations

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Information-intensive services (IIS), such as financial services, business services, health care, and education, form a large and growing part of the service sector in the US economy. In this paper we present a classification of IIS based on their operational characteristics. We also propose empirically grounded conceptual analysis and prescriptive frameworks useful for the improvement of certain types of IIS. By conducting statistical analyses of a large sample of claims data from one of the largest property and casualty companies in the United States, we isolate key drivers of service performance and identify preemptive actions that can favorably impact performance metrics. Those results demonstrate the direct operationalization of the proposed frameworks with primary data. Our conceptual analysis, empirical findings, and the prescriptive framework that follow, provide an action plan that can lead to a systemic improvement in the performance of information and customer contact intensive services.

Key words: service operations; information-intensive services; service classification; insurance claims handling operations

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1. Introduction

The service sector represents the largest and the fastest-growing segment of the economies of the United States and other developed countries. For example, in the United States, services accounted for over 80% of employment in the year 2004 (Spohrer and Maglio 2008, US Department of Labor 2005). In the past few decades, information has also come to play an important role in almost every aspect of life. Apte and Nath (2007) estimate that in the United States the share of information economy in the total gross national product (GNP) grew from about 46% in 1967 to about 63% in 1997. They conclude that, in comparison with the total economy, the information economy has been growing at a faster rate. Moreover, within the information economy, information-intensive services (IIS) such as financial, business, health care, and education are growing at even faster rates. Apte et al. (2008) estimate that, in 1997, IIS accounted for 56% of GNP.

The paucity of research in operations management regarding services in general and IIS in particular, as well as the plausible reasons for this paucity, have been well documented (Apte et al. 2008, Chase and Apte 2007, Hayes 2002, Metters and Marucheck 2007, Roth and Menor 2003). The qualitatively different nature of IIS is similarly well documented (Hayes 2002, Karmarkar and Apte 2007). The purpose of this research, therefore, is to begin addressing the need for research in managing operations in IIS.

The first goal of this research is to propose conceptual frameworks useful for analyzing and improving certain types of IIS. We adopt an operations management viewpoint and consider issues such as representation and analysis of operational processes so as to identify actions that can lead to improved operational performance. Toward this end, we perform a simple but comprehensive conceptual analysis, which yields a descriptive framework that is a visual abstraction of the latent IIS processes highlighting the importance of co-production. This descriptive framework foreshadows our prescriptive framework, which provides an action plan that can lead to systemic improvement in the overall service outcomes in IIS.
The second goal of this research is to illustrate the proposed frameworks through their application to the insurance claims handling process (CHP) – an IIS process. In the insurance industry, in case of a loss, the insured files a claim with the insurance company, which performs the necessary investigation and evaluation of the claim before making the appropriate loss payment to the insured. The process of claims investigation, evaluation, and payment is known as the claims handling or claims adjustment process and is one of the most essential and basic functions of an insurance company. The CHP has a significant impact on the profitability of property and casualty (P&C) insurance companies, which sell automobile, homeowners, product liability, and workers compensation policies.

In the year 2007, P&C insurance companies collected about US$450 billion in premiums out of a total of about US$1.1 trillion of premiums for the entire insurance industry in the United States (Insurance Information Institute 2008). In P&C insurance companies, over 60 cents per dollar of premium are spent for loss payment with an additional 10 cents spent in claims handling operations. Thus, poor performance in claims handling can lead to excessively large loss payments in some cases and unfairly low payments in others. This results in both low profitability and unhappy customers. To our knowledge, other than a capacity planning model for the CHP (Apte and Cavaliere 1993), claims operations managers currently have scant help available in the form of analytical models and prescriptive methods to guide them in their operational activities. To address this situation, a large sample of claims from one of the largest P&C insurers in the United States was statistically analyzed. We isolated key drivers of service performance and identified actions that can favorably impact performance metrics, thereby demonstrating the direct operationalization of the proposed frameworks with primary data.

The remainder of the paper is organized as follows: In Section 2, we describe IIS and the characteristics that distinguish them from services in general. Subsequently, we present a new conceptual analysis and descriptive framework that includes formalizing and understanding IIS. In Section 3, we provide a careful and detailed application of our conceptual analysis to a specific IIS – the CHP of an insurance company. Bodily injury automobile claims are analyzed. In Section 4, we propose a prescriptive framework for improving the operational performance of IIS. The paper ends with a summary and conclusions in Section 5.

2. Conceptual Analysis of IIS

This section begins with a brief review of prior research related to IIS and builds upon it to develop a classification of IIS based on operational characteristics. Thereafter, we develop a conceptual analysis framework useful for improving the broad class of IIS, which encompasses the CHP.

2.1. Classification of IIS

While there exist a number of useful conceptual frameworks of service processes (see Fitzsimmons and Fitzsimmons 2006 for an overview), by and large these frameworks have been silent on their applicability to IIS. Nevertheless, there exist a handful of research publications that deal directly or indirectly with the role of information in operations and with IIS in general. For example, Roth and Menor (2003) offer a generalized research framework for designing, delivering, and evaluating services, while Karmarkar and Apte (2007) squarely deal with the topic of operations management in the information economy. They point out the need for research in this important emerging area and adopt a strategic perspective in analyzing the impact of modern information and communications technology on the industry structure in IIS.

The focus of this paper is on the operations of IIS. To better understand the operational level characteristics of such services, we refer to the classification framework proposed by Apte and Mason (1995) whereby the activities in a service process are divided in four categories based on the nature of work performed: Informational actions, Customer Contact actions, Material manipulation actions, and Other Indirect actions. Clearly, the above action types are not mutually exclusive. In a given activity, one may be collecting information while also interacting with a customer. Apte and Mason further propose that the relative amount of time spent in individual types of activities can be used to characterize a service process. For example, the information intensity of a process is defined as the ratio of time spent in dealing with information in a process to the total time spent in that process.

It should be noted here that characteristics such as information intensity are more applicable at the level of individual occupations or business processes than at the level of an entire industry. Thus, although it is customary to use a broad brush to paint banking and insurance industries as being information intensive, it is evident that not all jobs in those industries are information intensive. Following Apte and Mason (2004), we classify an occupation (or a business process) according to whether its information intensity is high (H) or low (L), its customer contact intensity is H or L, and its material intensity is H or L. Figure 1 gives examples of service occupations belonging to different occupational classes. As shown in Figure 1, information-intensive occupations and processes have a profile HHL, HLL, and HLH. It should be noted that,
in applying this classification framework, an occupation being considered should have a sufficiently narrow and well-defined scope of work so that the occupation can be unambiguously placed in a suitable class. The confirmatory test for this classification is to conduct an empirical study to measure the fractions of time spent in an occupation dealing with information, customers, and material. Finally, because most occupations and processes have at least one crucial factor and one less significant factor, the classifications of HHH and LLL, although possible, may be rarely encountered in practice and are not shown in Figure 1.

Table 1 describes the nature of work and the operations management challenges associated with three prototypical service occupation classes: information-intensive, customer-contact-intensive and material-intensive services. For example, the nature of work in IIS occupations involves collection, storage and processing of information, and intellectual activity requiring organization and use of knowledge. The typical managerial challenges for such occupations include employee selection based on intellectual abilities, training in analytical tools and techniques, and in problem solving. As we report later, the job of an insurance claims representative belongs to the HHL class. Therefore, in developing the conceptual analysis framework we will focus our attention mainly on services that are information- and customer-contact intensive.

2.2. Framework for Conceptual Analysis
IIS are frequently produced and consumed simultaneously as exemplified by entertainment services such as in the performance of an opera or a music concert. As in the case of other services, co-production is an important characteristic of IIS (Xue et al., 2005). Co-production implies that both the service provider and the customer participate in producing IIS. Thus, the production of IIS depends on the interaction of the processes of the service provider and the customer. This interaction contributes to the potential for a high degree of variability in the service creation process. Consider, for example, financial planning. The planning process consists of a series of steps, which involve asking questions and providing information on the part of both the parties. It is evident that, depending upon the decisions, actions, and information provided by the parties, the process could follow a large number of alternate paths.

Information plays at least three critical roles in IIS: as an input to the service creation process (e.g., a mortgage application), as an enabling factor in the service creation process (e.g., monitoring and control of information concerning the status of the process), and as an output of the service (e.g., a management consultant's report or a software program). With regard to the role of information as an input, a critically important challenge in IIS is the collection of appropriate information at the right time, and its correct use in making the myriad decisions essential to creating and delivering services.

The inherent intangibility of information makes IIS intangible. This leads to a fundamental difficulty in the measurement and quantification of IIS inputs and outputs (Karmarkar and Apte 2007). The traditional tools and concepts of operations management such as
productivity, quality, and cost, depend crucially on the ability to measure and quantify inputs and outputs of an operational process. Because this ability is elusive for IIS, it becomes hard to rely on traditional tools of operations management in analyzing and improving IIS. For example, counting the number of claims closed by an insurance claims representative without regard to the quality of that IIS process would be like counting the number of mortgage loans made by a loan officer without regard to the quality of that IIS process. In the former case, insurers can and do incur significant losses in the form of overpayment for losses (Lonkevich 1993, Cavaliere 1995). In the latter case, mortgage defaults can result, sometimes on a large scale as poignantly illustrated by the current crisis in the housing industry! In both cases, the quality of information and decision making is the central issue.

As Karmarkar and Apte (2007) suggest, a fundamental tenet of process management can help in this regard: if you manage the process correctly, the outcomes usually take care of themselves. Consequently, we adopt a process-centric viewpoint. Moreover, because the direct measurement of inputs and outputs is difficult in IIS, we rely upon managing the service creation process through indirect measures (Hatten and Rosenthal 1999, Shekelle et al. 2001, Wardlaw and Maine 2000). Specifically, to manage the service creation process in IIS, we identify and measure suitable process indicators that can convey if the process is functioning satisfactorily. These process indicators can include actions taken by the service provider or the customer as well as interim process outcomes, and operating/external conditions.

In Figure 2 we present a conceptual diagram of process management in IIS. The structure of the service creation process, the factors that influence the performance of the process, and the service outcomes are shown, respectively, in the left, middle, and right panels of Figure 2. As shown in the left panel of Figure 2, co-production leads to a common repetitive structure in the roles and the production processes of the service provider and the customer: each party takes an action so as to elicit or provide the information necessary in creating the service. This information is then used to diagnose the situation and to make a decision that leads to the next action, and so on. As a result of co-production, the actions taken by one party have an impact on the information, decisions, and actions of the other party. The specific process path followed in IIS and the realized outcomes are therefore determined by the series of actions taken by both parties in their respective production processes. For example, in the loan application process we can observe the iterative process as: Loan Application (Information) → Preliminary criteria satisfied? (Decision) → Assign to loan officer who requests more applicant information (Action) → Receive updated information (Information) → Decide to evaluate applicant assets (Decision) → Request asset information (Action), and so on.

It is within the service creation process that the impact of information intensity is most strongly felt. It is evident that consistently making correct decisions...
requires high-quality (i.e., relevant, accurate, timely, and credible) information. Hence, in taking actions required to create and deliver the service, the service provider should analyze the impact of those actions on the quality of information being received and ensure that suitable actions are taken so as to obtain the highest possible quality of information.

Harker and Zenios (1998) present a framework to better understand what is and what drives the performance of financial institutions. They suggest that the performance of financial institutions should be measured along two dimensions: quality of financial services delivered to clients, and efficiency of financial intermediation and risk management. Given the operations management perspective adopted in this research, we focus on the first dimension—service quality. Implicitly drawing from established and well-known approaches such as Balanced Scorecard (Kaplan and Norton 1992) and Key Performance Indicators (Jones et al. 2007), we plan to evaluate the performance of an organization by using multiple performance metrics and not just a single metric. Thus, as shown in the right panel of Figure 2, we use multiple performance metrics of a service, such as the cost, quality, customer satisfaction, and the cycle time.

The performance metrics depend on the actions taken by both parties during the process and the intermediate outcomes of the process as well as the inherent characteristics of the service provider and the customer. These are shown in the middle panel of Figure 2 under the heading of factors influencing performance. We should point out that the relationship between the service creation process and the process indicators is bi-directional. The service creation process clearly has an impact on process indicators, but the latter also has an influence on the former. For example, in insurance claims handling, if a lawsuit is filed by the claimant, the activities carried out by the employee handling the claim are substantially different. The critical factors influencing performance are called performance drivers. Management of the service creation process requires that we identify and measure suitable process indicators. Interestingly, the actions taken by the service provider and the customer as well as interim outcomes can serve as process indicators that show if the process is functioning properly or not. As depicted in Figure 2, inherent characteristics as well as process indicators constitute the factors affecting service performance. Unfortunately, by their definition, the service provider does not have an opportunity to control the inherent characteristics of the customer and thereby favorably influence service outcomes, except perhaps in a long-term strategic sense. Alternatively, some process indicators are adjustable, and give the service provider a powerful mechanism with which to influence service
outcomes. We further analyze this opportunity later in the paper.

With our conceptual analysis in place, we now have a structural roadmap to analyze the service creation and delivery process of an IIS and determine the performance drivers and adjustable process indicators for improving the operational performance of the service.

3. IIS Empirical Study and Application of Conceptual Analysis

In the several sub-sections below, we describe the CHP and methodically analyze primary data on bodily injury claims from one of the largest P&C insurers in the United States in order to test two process-driven hypotheses. We also suggest how to favorably influence a key adjustable process indicator.

3.1. Data Collection Methodology

The purpose of the data collection in our study was to discover the factors influencing performance (inherent characteristics, process indicators, and performance drivers) of the CHP for the insurance company. Data were collected on auto policies with bodily injury claims. The insurance company covered the entire United States. A test region on which to focus was identified by company management. We began the process of personal interviews with supervisors and claims representatives (or reps for short) throughout the region; in effect, harvesting their expertise to combine with our own. Our choice of performance metrics was mainly guided by the service outcomes shown in Figure 2. In our process-centric approach, service quality is determined by the quality of the claims adjustment process, which, in turn, is directly related to the number of work hours a rep spends adjusting the claim. Consequently, loss payout, closing age, and work hours were chosen as performance metrics. We note that service quality, embodied in work hours, has the potential to affect both loss payout and closing age of claims.

In order to better understand the collected claims data, an explanation of a certain claims property is necessary. A claim report, giving rise to a claim file, can involve multiple claimants. Thus, an insurance claim can be viewed at the file level and at the claimant level. At the file level, the claim is viewed as having certain characteristics without regard to the number of claimants. For example, the file level loss payout can involve multiple claimants. Thus, an insurance claim can be viewed at the file level and at the claimant level. Alternatively, at the claimant level, one claimant may have severe injuries while another claimant of the same claim may not. Frequently, a characteristic will be imputed to the file level of a claim if any one of the claimants in that claim has the characteristic. Most of our analyses occur at the file level. However, an important analysis concerning attorney presence discussed in Section 3.5 occurs at the claimant level.

Based on interviews, management input, and our modeling experience, we created a list of CHP characteristics and performance metrics—variables on which to gather information. As an important step in process assessment, rep activity data were analyzed to determine the process flowchart for the claims handling operation. To the extent that each claim has unique characteristics, the claims handling operation takes on the character of a customized process. Hence, it was not surprising to find that the activities involved in the process and their sequence changed depending upon the characteristics of the claim. For example, the CHP followed a different path depending on whether or not a claimant was represented by an attorney.

The data collection project lasted 10 days. Each day, times were recorded for the rep's various activities: meeting with claimants, updating file logs, driving to meet claimants ("windshield time"), attending administrative meetings, etc. Using the information intensity classification explained earlier (Apte and Mason 1995), the data were analyzed to estimate the relative amount of time a rep spends on information and customer-contact activities. These activities are not mutually exclusive, and to that extent, claims handling is both information- and customer-contact-intensive. Approximately 66.4% of a rep's time is spent in dealing with information and approximately 30.4% of time is spent on customer contact activities. There exists an overlap of 24.2% of time between the informational and the customer-contact activities.

In addition to collecting daily activity information, claims managers were asked to select, in conjunction with reps and rep supervisors, a representative sample of closed claims. Forms were designed so that reps could collect information on these closed claims. A pilot study was conducted to debug the forms, validate the choice of variables and train the supervisors who would oversee the reps during the data collection project.

There were practical constraints to collecting the data. The claim files were paper files and there was no effective sampling frame from which to choose a random sample. Nevertheless, in our data collection, steps were taken to ensure a representative claims sample.

The population sampled was the insurer's collection of recently closed claims (within the last 6 months) which were adjusted by experienced reps in the test region. The CHP can be significantly influenced by the experience level of the rep handling the process. During the training period, which can last up to two years for bodily injury claims, reps are given a reduced workload and are assigned simpler claims. In
contrast, fully experienced reps, which constitute over 90% of all reps, handle claims of differing types and difficulty levels. Hence, to ensure a representative sample of claims and claim adjustment work, we confined our data collection to claims closed by experienced reps.

Each claims rep reports to a supervisor who, in addition to supervising five or six reps, carries a reduced claims caseload. Each supervisor in the region randomly selected two experienced reps to participate in the data collection exercise. In addition to providing daily activity information, each selected rep chose 20 recently closed claims on which to collect information. Reps recorded objectively classified characteristics on closed claims. Additionally, claim work hour information was recorded, which called for subjective judgments. Reps reviewed claim log files, prepared a chronological list of activities, estimated duration of each activity, and finally computed the total work hours for each claim. In conjunction with their supervisor, reps selected claims that represent the various types of claims encountered by the rep.

In this data collection project, there were two main areas where bias was a risk: Selectivity bias in choosing a claim to be included in the sample, and information bias in accurately reporting the information for that claim.

In order to reduce selectivity bias, reps selected claims in conjunction with their supervisors who were responsible for assigning claims to their reps on a daily basis. The supervisor was familiar with the rep’s claims, having initially reviewed and then assigned them to the rep. The supervisor’s assessment of and feedback on the rep’s choice of claims would provide an independent check that the claims sample was representative. Consequently, the judgments of the two people most familiar with the rep’s body of claims were used to ensure a representative sample.

In regards to information bias, reps could be reluctant to provide accurate information on their work hours since it could be used during their performance reviews. Great care was taken to assure reps that that was not the case. Rep identities were coded on the data collection forms, which were securely collected by external personnel. Management agreed to remain unaware of the coding. All of this was explained to the reps at the outset.

The data collection was conducted and the results entered into a database. The resulting data set contained 1094 file level claims which yielded 1442 claimant level claims. Our original list of variables was adjusted (in consultation with claims reps and management) to include the performance metrics and the variables that impacted these metrics. The final list appears in Table 2. The first three variables were identified as performance metrics and the remaining ones were identified as factors influencing performance. Classification of inherent characteristics and process indicators (adjustable or otherwise) was accomplished in consultation with claims reps and their supervisors. The opinions of claims reps and their supervisors on actions that could influence adjustable process indicators were also carefully recorded.

### 3.2. Process-Driven Hypotheses

In our field interviews we found that claims reps and managers considered the inherent characteristics and process indicators in Table 2 to have considerable influence on the performance metrics. For the sake of simplicity, and as seen in Figure 2, we collectively label the inherent characteristics and process indicators as factors influencing performance or simply factors. Our interviews revealed that most reps and managers believed that among inherent characteristics and process indicators, the presence of an attorney was the most important performance driver. This naturally led

<table>
<thead>
<tr>
<th>Variable</th>
<th>Explanation</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance metrics</td>
<td>Loss payout for claim</td>
<td>Dollars</td>
</tr>
<tr>
<td></td>
<td>Closing age of claim</td>
<td>Days</td>
</tr>
<tr>
<td></td>
<td>Rep work-hours required to close claim</td>
<td>Hours</td>
</tr>
<tr>
<td>Inherent characteristics</td>
<td>Number of claimants</td>
<td>0 = &gt;2 claimants, 1 = up to 2 claimants</td>
</tr>
<tr>
<td></td>
<td>Coverage type</td>
<td>0 = non-bodily injury, 1 = bodily injury</td>
</tr>
<tr>
<td></td>
<td>Coverage complexity</td>
<td>0 = not complex, 1 = complex</td>
</tr>
<tr>
<td></td>
<td>Injury severity</td>
<td>0 = not severe, 1 = severe</td>
</tr>
<tr>
<td></td>
<td>Short treatment duration</td>
<td>0, 1</td>
</tr>
<tr>
<td></td>
<td>Medium treatment duration</td>
<td>0, 1</td>
</tr>
<tr>
<td></td>
<td>Long treatment duration</td>
<td>0, 1</td>
</tr>
<tr>
<td></td>
<td>Presence of clear liability</td>
<td>0, 1</td>
</tr>
<tr>
<td></td>
<td>Rural claimant location</td>
<td>0, 1</td>
</tr>
<tr>
<td>Adjustable process indicators</td>
<td>Presence of chiro. or therapist</td>
<td>0, 1</td>
</tr>
<tr>
<td></td>
<td>Presence of attorney</td>
<td>0, 1</td>
</tr>
<tr>
<td></td>
<td>Lawsuit filed</td>
<td>0, 1</td>
</tr>
</tbody>
</table>
us to formulate the following testable hypothesis:

Hypothesis 1: Among the subset of factors influencing performance, i.e., among the subset of inherent characteristics and process indicators that explain a significant portion of the variation in the performance metrics, attorney presence has the most significant impact on each performance metric.

The data were subjected to statistical modeling, analysis, and inferential techniques. The next section and supporting information Appendix SA1 present the procedures adopted and also highlight some of the difficulties faced when developing explanatory statistical models for the CHP.

3.3. Statistical Analysis, Observations, and Modeling of Claims Data
In the data collection project we identified three performance metrics: Loss Payout, Closing Age, and Work Hours. It is our understanding, corroborated by claims managers, that these metrics collectively serve as surrogates for the cost, quality, cycle time, and customer satisfaction shown in Figure 2. A simple correlation analysis of the dependent (performance metrics) and independent (inherent characteristics and process indicators) variables is discussed in Appendix SA1. Note that variable transformations have been applied to the dependent variables. The basis for these transformations and their practical significance is also explained in Appendix SA1. We developed simultaneous equation models to explain the variation in performance metrics and to better understand the CHP. If loss payouts were partially explained by both hours of work and closing age of the claim, we could have developed recursive simultaneous equation models (Greene 2003) using the method of ordinary least squares (OLS).

We now focus our attention on the problem of model specification and estimation. Let $X$ be the $1084 \times 13$ matrix of independent variables including the intercept. Let $x, \beta, \gamma$ each represent $13 \times 1$ column vectors of regression coefficients. The dependent variables and any transformations of them are expressed as column vectors of the order $1084 \times 1$. Initial model specification assumed the following structure, where $\text{Hours of Work}, \text{Closing Age},$ and $\text{Loss Payout}$ are used interchangeably with their respective mathematical counterparts $y_{\text{HrsWrk}}, y_{\text{ClosAge}},$ and $y_{\text{LossPty}}$.

\[
\text{Hours of Work} = X\alpha + \epsilon \quad (1)
\]
\[
\text{Closing Age} = X\beta + \zeta \quad (2)
\]
\[
\text{Loss Payout} = X\gamma + \theta \quad (3)
\]

where $\epsilon, \zeta, \gamma$ and $\theta$ are column vectors of stochastic disturbance terms.

At the outset, the model specification in equations (1)-(3) was the simplest possible and did not involve estimating simultaneous equations. The models were simply analysis of variance models. However, we found that such an overly simplistic specification in equations (1)-(3) resulted in considerable heteroscedasticity and non-normality of the error terms in addition to poor explanatory power as indicated by the respective coefficients of determination. We estimated simultaneous equations and conducted specification tests resulting in the final equations shown in equations (4)-(6) below. Details on estimation are relegated to Appendix SA1. In the estimation procedure described in Appendix SA1, the equations (1)-(3) are shown as equations (A1)-(A3), respectively, and so on.

3.4. Inferences and Observations
As described in detail in Appendix SA1, we used formal estimation procedures to derive equations (4)-(6). It is clear from equations (4)-(6) that only a subset of the factors influencing performance significantly affects the performance metrics. Moreover, we confirmed during the stepwise regression stage that attorney presence has the highest partial correlation coefficient among the partial correlation coefficients of all inherent characteristics and process indicators.

\[
\ln(\text{Hours of Work}) = -2.18 - 0.395 \times x_{1}\text{ClmtVol}
+ 0.267 \times x_{4}\text{InjSev}
+ 0.35 \times x_{7}\text{TrtLow}
+ 0.364 \times x_{10}\text{Attorney}
+ 0.386 \times x_{11}\text{Suit} \quad (4)
\]
\[
(Closing Age)^{1/2} = 6.78 + 2.89 \times \ln(\text{Hours of Work})
- 2.75 \times x_{5}\text{TrtLow}
+ 1.95 \times x_{8}\text{MedPers}
+ 5.79 \times x_{10}\text{Attorney}
+ 4.90 \times x_{11}\text{Suit} \quad (5)
\]
\[
\ln(\text{Loss Payout}) = 5.83 + 0.527 \times \ln(\text{Hours of Work})
+ 1.20 \times x_{4}\text{InjSev}
- 0.46 \times x_{5}\text{TrtLow}
+ 0.597 \times x_{8}\text{MedPers}
+ 1.37 \times x_{10}\text{Attorney} \quad (6)
\]

For equation (4), we observe that five performance drivers collectively explain (based on adjusted $R^2$) about 30% of the variation in $\ln(\text{Hours of Work})$ using the OLS estimates. The overall adjusted $R^2$ using all factors influencing performance is 35.3. The coeffi-
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Table 3. Impact of Claims Characteristics on Operating Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>% Increase</th>
<th>In Operating Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attorney presence</td>
<td>294</td>
<td>Loss payout</td>
</tr>
<tr>
<td>Injury severity</td>
<td>232</td>
<td>Loss payout</td>
</tr>
<tr>
<td>Medical personnel presence</td>
<td>52</td>
<td>Loss payout</td>
</tr>
<tr>
<td>Claimants per claim</td>
<td>48</td>
<td>Work hours</td>
</tr>
<tr>
<td>Lawsuit</td>
<td>47</td>
<td>Work hours</td>
</tr>
<tr>
<td>Attorney presence</td>
<td>44</td>
<td>Work hours</td>
</tr>
<tr>
<td>Long treatment duration</td>
<td>42</td>
<td>Work hours</td>
</tr>
<tr>
<td>Injury severity</td>
<td>31</td>
<td>Work hours</td>
</tr>
</tbody>
</table>

one or more performance metric(s). This is discussed in the next section.

3.5. Identification of Preemptive Actions Affecting Adjustable Process Indicators

Are there any other indirect factors, perhaps not measured up to this point, that significantly affect the likelihood that a claimant will hire an attorney? This is an important question. Claims managers and reps felt that the severity of the injury and the location of a claimant (rural vs. not rural) were highly correlated with the claimant's decision to hire an attorney. Clearly, as indicated by their inherent status in Table 2, these two factors were out of the control of the managers and the reps. If we consider the stressful conditions that affect and help to define the claimant's decision-making process, then any actions that mitigate the uncertainty and anxiety of a claimant in that process will likely reduce the claimant's need to seek legal representation. The key process indicator, attorney presence, is adjustable. The service provider (insurance company) can therefore initiate preemptive actions to influence the process indicator in favor of the service provider. In the current study this would mean taking actions to minimize the likelihood of the claimant hiring an attorney.

Once more, our observations at the interview stage led us to believe that the Time-to-contact, i.e., the time to the first attempt (measured on a temporal scale) of any kind to contact the claimant, was instrumental in affecting the presence or absence of an attorney. We were also able to develop an analytical justification of early contact as an important adjustable process indicator. This analysis is presented in Appendix SA2. Moreover, recent accounts (Sack 2008) indicate that effective customer contact can have verifiable impact on a claimant's willingness to pursue litigation. We should point out that this early contact is designed to influence the decision to engage an attorney in the first place. Frequently, such decisions are made early on and under duress. The early reclamation contact we consider here is preemptive in nature and antecedent to the multistep negotiation process between the insurer and claimant in pre-discovery or pre-trial settlement attempts. Several models of those negotiations exist which explain how information asymmetries can affect settlement delay and increase costs (Brown and Puelz 1996, Fenn and Rickman 2001, Nalebuff 1987). They are beyond the scope of the present work. Consequently, we hypothesize the following:

Hypothesis 2: Attorney presence can be preemptively and significantly affected by Time-to-contact.

Hypothesis 2 claims that Time-to-contact is an indirect but important factor affecting attorney presence. If we fail to reject Hypothesis 2, the importance of Time-to-contact would be further highlighted. This is because, in conjunction with our failing to reject Hypothesis 1, it would establish the (indirect) impact of Time-to-contact on one or more performance metrics even if it is "via" attorney presence.

We theorized that the sooner a claims rep makes contact with the claimant and provides feedback and reassurance on the claim status, the less likely it is for the claimant to hire an attorney, ceteris paribus. This conjecture needed further testing in order to provide recommendations to the managers and reps. It had not been anticipated during the data collection and database design. The necessary information was not recorded in our original database. We had to re-examine archived hard copies of our claim files sample. Using 1442 claimant level claims with non-zero loss payout and where the claimant was either contacted in person and/or via a two-way phone conversation and/or a one-way phone call or a letter, we derived the following additional variables (all measurements in days):

- **Time to one-way contact**: The initial time lag between the filing of the claim and the rep writing to the claimant, or the time lag until the rep calls the claimant and leaves a voicemail.
- **Time to two-way phone contact**: The initial time lag between the filing of the claim and the rep speaking to the claimant on phone.
- **Time to personal contact**: The initial time lag between the filing of the claim and the rep making direct face-to-face contact with the claimant.
- **Time-to-contact**: The arithmetic minimum of Time to one-way, two-way phone and personal contact.

Thus, as mentioned earlier and detailed above, the Time-to-contact represents the first attempt of any kind to contact the claimant and is expected to be under the control of the claims rep. This helped us investigate whether a proactive approach by the claims rep could...
effect the interim outcome of an attorney being hired by the claimant. We therefore chose to use Time-to-contact along with location and injury severity for predicting the probability of attorney presence. We first conducted a rough-cut analysis by dividing the Time-to-contact into classes of roughly 5 days each as shown in Figure 4. A simple probability measure was calculated for each time class by dividing the number of records with an attorney present by the total number of records in the class. Figure 4 indicates the likelihood of attorney presence increases with Time-to-contact.

We conducted a multiple logistic regression, the results of which are shown in Table 4 and further technical discussion is given in Appendix SA.1. The four variables defined below were used in the logistic regression. ATTORNEY (0 = Attorney not present, 1 = Attorney present) is the dependent variable

- INJSEV (0 = Non-severe injury, 1 = Severe injury)
- LOCATION (0 = Rural, 1 = Urban/Suburban)
- Time_to_Contact (Time-to-contact in days)

Note that the coding scheme of Table 2 was reversed for the location variable seen above. Additionally, the correlation coefficients were not representative as we were now working with claimant level rather than file level data. As observed in Table 4, all explanatory variables were significant based upon the Wald statistic. Moreover, Table 4 shows that all odds ratios have confidence intervals, which do not contain 1. Several observations are possible. While we are more interested in the Time_to_Contact variable because it is under rep control, we include discussion on the impact of location and injury severity variables for completeness.

Let us examine the 95% confidence intervals for odds ratios. They indicate that, all else held constant, the odds are between 2.1 and 3.8 times higher that a claimant belonging to an urban location will hire an attorney. Similarly, the odds are between about 4.0 and 8.3 times higher that a claimant with a severe injury will hire an attorney. Finally, the odds that the claimant will hire an attorney increase between 4.9% and 10.3% for each day that passes without contact by a rep. Using the point estimate of the logistic regression parameter for Time_to_Contact, we can calculate that the odds of hiring an attorney double at about 4.9% and 10.3% for each day that passes without contact by a rep. Late contact can make things worse from the claims handling perspective. It is now apparent that we fail to reject Hypothesis 2.

The impact of Time-to-contact on attorney presence is an important finding. It provides management with a lever that it can use to influence the performance metrics and the overall CHP. Timely interaction between claims rep and claimant can preempt attorney involvement, which is arguably the most important performance driver. Moreover, this timely interaction has several other potential benefits: it can preserve factual information quality, which usually degrades over time, it can mitigate claimant anxiety, and it can foster a cooperative rep-claimant relationship. All these benefits improve the service creation process of the service provider.

### 4. A Prescriptive Framework for Improving the Performance of Information and Customer Contact

Intensive Services (ICCIS)

Earlier we presented a conceptual analysis framework useful for representing and analyzing IIS and...
empirically tested it using the real life data gathered at one of the largest P&C insurance companies in the United States. We now propose a prescriptive framework for improving services that are both information and customer contact intensive.

Using Figure 2 as our guide to process management in ICCIS, we envision two complementary approaches for improving the operational performance of ICCIS (see Figure 5). The first is targeted at favorably influencing the performance drivers, while the second is directed at improving the quality of information gathered in the service creation process.

As illustrated in the top portion of Figure 5, the factors influencing performance must be identified before process improvement can begin. An empirical study of completed cases of ICCIS should be undertaken to collect data on inherent characteristics, process indicators, and the associated performance metrics. The collected data should then be analyzed to determine performance drivers. As illustrated in the empirical study, an interesting aspect of the proposed framework would be to determine if there exist some performance drivers that can be influenced or controlled by service provider actions. These adjustable performance drivers are potentially very important since they represent an opportunity for the service provider to favorably influence the performance of the process.

The lower portion of Figure 5 is targeted at collecting high quality information, which is essential for making correct decisions in creating and delivering IIS. In this task, the provider should identify the decisions critical to service performance and further identify the information needed to make those decisions. Finally, the provider should identify the specific actions that can improve the quality of the needed information and implement them. These steps are represented in the lower portion of Figure 5.

As we noted earlier in the empirical study, certain actions cannot only favorably influence the performance drivers but also help to collect high-quality information. In insurance claims handling, when the rep telephones or makes personal contact with the claimant early on, the action not only reduces the likelihood of the claimant hiring an attorney (the upper branch of Figure 5) but it also improves the likelihood that the claimant will develop a more trustworthy relationship with the rep. This can result in useful and credible information when solicited by the rep. Hence, this early contact is an action which can also improve information quality and, consequently, allow improved decisions (the lower branch of Figure 5). We should point out that in our empirical study we did not implement and study the steps shown in the lower portion of Figure 5. But we believe that these steps can be very beneficial to the gathering of high-quality information, which is the life-blood of IIS.

Building upon our earlier conceptual analysis of Figure 2, the prescriptive framework presented in Figure 5 also involves formally analyzing the overall service process using both branches presented therein. Its importance lies in targeting the improvement of ICCIS. Specifically, it provides a sound action plan to improve information quality, favorably influence adjustable process indicators, and ultimately improve the service performance.

We feel compelled to point out that the theoretical contributions of this paper informed, and were informed by, the analysis that took place within the insurance application. This was a discovery process. The famous philosopher John Dewey (1934) asserts and we quote, “In any experiment of thinking, premises emerge only as conclusions become manifest.” This was indeed our experience in developing the conceptual analysis approach and proposed prescriptive framework for managing and improving ICCIS.

5. Summary and Conclusions

IIS form a large and growing part of the services economy. We evaluated the fundamental characteristics
of IIS such as intangibility and co-production and found that these characteristics make it particularly challenging to manage and improve IIS. The traditional tools and concepts of operations management, such as productivity, quality, and cost, depend crucially on the ability to measure and quantify the inputs and outputs of an operational process. However, the intangibility and co-production characteristics of IIS cause a fundamental difficulty in the quantification of IIS inputs and outputs. Consequently, it becomes hard to rely on traditional tools of operations management in managing and improving IIS. Hence, there exists the need for sound conceptual analysis and a prescriptive framework for operations improvement.

We adopted a process-centric viewpoint to argue that the service creation process in IIS should be managed through indirect process measures. Specifically, we suggest that suitable process indicators, which can convey if the process is functioning properly, be identified, measured and monitored. In addition to process indicators, inherent characteristics of the service provider and the customer also influence process performance and outcomes. Our conceptual analysis of IIS depicts the service creation process, the factors influencing performance and the service outcomes, along with the interrelationships between them. The critical factors influencing performance are designated as performance drivers. We also embrace the notion that if some performance drivers (specifically, process indicators) are adjustable, it is particularly advantageous to identify actions affecting those performance drivers because they represent a significant opportunity for the service provider to favorably influence service performance and outcomes.

The prescriptive framework for process improvement (Figure 5) takes advantage of the conceptual analysis presented in Figure 2 in two ways: First, it prescribes a procedure that a service provider can use to isolate a set of performance drivers that critically influence the process performance and outcomes. Furthermore, identification of adjustable performance drivers assumes particular importance. Second, within each party’s production process, information plays a crucial role. Consequently, we suggest that the service provider identify and adopt the specific actions and procedures that can improve the quality of information. These are the two paths to process improvement identified in the prescriptive framework of Figure 5. It should be noted that there is symmetry of roles in the service creation process induced by co-production. Thus, the service provider as well as the customer can equally well seek to improve her production process and take preemptive actions to influence service outcomes.

We illustrated and formalized the conceptual analysis through an application to a specific ICCIS— the insurance CHP. We investigated the impact of various claim characteristics on three important performance metrics: claim loss payout, work hours needed to close a claim, and claim closing age. Work hours and closing ages are directly linked to claims division’s staffing levels through capacity planning models while the loss payouts are linked to overall profitability of the insurer. Two of our most significant findings in managing and improving the CHP are: First, attorney presence is the key performance driver that has the largest impact on process performance. Second, early claimant contact can significantly reduce the chance of attorney presence. Early contact can also facilitate the claimant’s cooperation and improve information quality. Because high-quality information is crucial for successful claims investigation and assessment, process performance and outcomes are improved. Interestingly, in the CHP, the same action provides process improvement along both branches in Figure 5.

Finally, Figure 3 represents, to the best of our knowledge, the first methodical attempt at understanding the performance metrics and factors affecting those metrics for P&C insurance claims handling—an important IIS in the US economy. Moreover, the CHP application represents one of the early attempts at understanding and representing an IIS with the aid of a conceptual analysis (Figure 2) and formalizing it more fully by developing a complementary prescriptive framework (Figure 5) that targets process improvement.

Avenues for future research are numerous and include extension of this research to other types of IIS, specifically to HLL and HLL classes of IIS. Applications to P&C insurance claims different from bodily injury, or even applications to the life/health insurance industry can also be undertaken. We believe any case-based ICCIS such as governmental social service or loan processing in banking can profit from the proposed conceptual analysis and prescriptive framework.

There are limitations to our study. Claims handling operations share a large part of their process and information flow infrastructure with the general corpus of financial services. However, our findings may need to be modified when the levels of customer contact and material intensity are markedly different from those observed in a claims handling operation. As other instances of IIS are analyzed and theory developed further, we eagerly anticipate extension and refinement of our work.

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References

Supporting Information
Additional supporting information may be found in the online version of this article:

Appendix A. Statistical Analysis.

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