UNDERSTANDING HIDDEN INTERDEPENDENCIES BETWEEN INFORMATION AND ORGANIZATIONAL PROCESSES IN PRACTICE

(Practice-oriented Paper, Research-in-Progress)

Raïssa Katz-Haas
Cambridge Research Group
rkh@infi.net

Yang Lee
Northeastern University
y.lee@neu.edu, ylee@mit.edu

Abstract
High-quality information is emerging as a competitive weapon in this information age. We recount one cross-functional team's effort to improve information quality through understanding interdependencies between information and organizational processes in practice. The team traced membership cancellation data and its process in a HMO. The team's root-cause analysis crystallized and operationalized their inquiry into the interdependencies. Their analysis also revealed major contributing factors of the interdependencies. We highlight the team's preliminary work as groundwork for further study.

Key Words: Interdependencies, information quality, data quality, organizational process, hypothesis building, root-cause analysis, data quality management

1. INTRODUCTION

Information quality has become a critical area for research and practice as demands for sharing data beyond conventional organizational boundaries have revealed the often-questionable quality of organizational data [1]. New perspectives and solutions to poor-quality data are becoming increasingly available. Organizations are also becoming aware of the problematic nature of their data, but many do not fully understand the tangled ways in which information and organizational processes relate to each other. Many information quality solutions address problems at the data element level within stored databases. While these solutions are useful under some circumstances, they fail to address underlying issues that span the entire information production process. To improve information quality, it is critical to understand the complexity and hidden relationships that make up this process [2].

We posit that information quality problems are difficult to understand and unravel, in part, because information, organizational processes, and policies are autonomously developed yet work interactively as an integral part of business processes in practice. Consequently, seemingly unrelated data, systems, work processes, and policies can impact data. Relationships between data, work processes, policies, and decisions are multi-layered and impact each other and the organization as a whole in seemingly unrelated

ways. Because these complex interdependencies appear to be either non-existent or unrelated, we call them "hidden interdependencies." Specifically, complex interdependencies between the organization and its information processes require understanding the "hiddenness" of causes to find a solution. These causes are hidden because often problems appear far from their causes, both in space and time [3].

We report one cross-functional project team's effort in probing the hidden interdependencies behind problematic data. Specifically, we analyze one set of data for one business process: membership data related to the Case Cancellation process in a health maintenance organization. We report on a 6-month period of work, which includes the team's probing root-cause analysis. The work was a part of process improvement initiative in the company that led to launching a meaningful data quality project.

2. RESEARCH METHOD AND STUDY SITE

We use a combination of participatory case analysis and action research methods. We describe the efforts of this project's team as a first step to understanding what it takes to uncover complex and hidden interdependencies between business processes and information. To study these interdependencies rigorously, we chose a company whose information/data flows both internally and externally. This HMO collects information from outside customers (employers), providers, members, etc., and uses the information both internally and externally. The business processes that use this information, in turn, produce additional information.

The company is one of the larger HMOs in the US, with a reputation among its competitors for generally managing data well. This paper closely follows the processes and findings of a project team looking at information quality and business process and practice issues as part of an improvement initiative in the company [4]. As is the case with an action research and participatory case analysis, we benefit from easy access to the site and familiarity with subjects and issues in the study. We also recognize the psychological proximity of the site and subjects as a possible source for biased interpretation of phenomena. To mitigate possible bias, we paid close attention to all standard precautions throughout the research process, such as collecting data from multiple stakeholders and triangulating interview results for data analysis. Overall, we view that this is a good first step towards revealing interdependencies embedded in a complex data quality problem in a large organization with data sharing practices.

2.1. The Company: The Right Hand and the Left Hand

Karen D[1], CEO of the HMO, was delivering a speech to an audience of shareholders. She referred to a particular program that had resulted in an ROI of 15 million dollars. Karen D. was unaware that, shortly before the speech, Scott L, whose responsibilities include the quality of the data in the enterprise data warehouse, had found data in the data warehouse showing 40,000 – 60,000 members per month as active when in fact their policies had been cancelled. An internal customer[2] had first brought this issue to Scott's attention. Further analysis showed that the company was paying approximately $4,000,000 annually in claims for members with cancelled policies.[3]

[1] The name of the company and the people involved will remain anonymous. As to the data problems, we would venture that they would be similar in most any HMO.

[2] An internal customer in this particular case refers to a person or department in the company who uses the data stored in the enterprise data warehouse to carry out the company's business processes.

[3] A **policy** contains certain **benefits**, chosen by the customer. A customer can purchase more than one **policy**, e.g., medical, dental, vision, etc.—each with its own set of benefits. For this HMO, the term "**customer"** refers to an employer (business) who purchases one or more health care policies for its employees and their dependents. The employees (aka **subscribers**) and their dependents are called "**members,**" i.e., **subscribers + dependents = members**

2.1.1. Organizational structure, politics, and reward systems

Understanding the present often requires understanding the past. The HMO was formed via mergers and acquisitions. The last and largest merger was between the larger, West-coast company, and another fairly large East-coast company.

The East-coast company owned the current claim processing system. At that time, this system did much more than just pay claims. It combined its claim data with a robust amount of membership and benefit data. The West-coast company owned the eligibility system. At the time of the merger, this system was neither robust nor widely used. The East-coast claim system eventually became the claim system for the entire HMO. To appease the West coast-company, it was decided that its eligibility system would be the HMO's 'official' eligibility system. The two companies also compromised over other systems such as administration systems. At the time of the merger, the West-coast's eligibility system was not yet robust enough to carry business for the entire company, so the East-coast claim system continued to carry membership and benefit information. Because both the East-coast and the West-coast systems eventually contained the same eligibility data, disjoints between the two systems began to appear. These disjoints were addressed using 'realigns', but these realigns do no always work as expected.

2.1.2. Silos

Eventually the HMO divided itself into five business segments and a 'corporate' function. Each business segment has its own focus. Each segment is responsible for remaining financially viable. Most segments pushed the financial responsibility down even further so that departments within the segments bore responsibility for their own financial health. Consequently, there is enormous pressure on departments to ensure their own financial health. Each department became a 'silo' with a very narrow focus, and a short-term view. This system in part contributed to creating disconnects, redundancies, mis-communications, unnecessary time spent resolving problems, and so on. Each department is rewarded for being 'self-focused,' as a result, the organization as a whole suffers.

Each manager focuses on meeting their own numbers, which in turn, contributes to the sub-optimization of the whole as important issues 'fall through the cracks', particularly in-between structural, financial, reporting, and administrative boundaries.

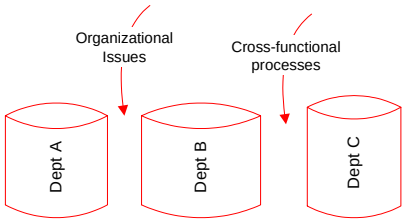

Figure 1. Falling through the cracks

Managing cross-functional business processes across an organization is a challenge in most organizations. All too often it is the organization chart being managed, not the business [5]. To the HMO's credit, this discrepancy between structure and processes has been partially recognized and the HMO initiated an organization-wide process improvement program, freeing some departments from their silos. Unfortunately, information value chains were not recognized as processes to be managed. The interdependencies between information and the organizational processes in practice were still largely hidden.

3. MEMBERSHIP DATA

3.1. The Importance of Membership Data to the Business

Membership data is core to the company's business. For example, membership data is used for business analysis of product and service performance, regulatory reporting, business and financial planning, and in member counts. In turn, these counts are used in a multitude of calculations. When member counts are inaccurate, the associated risks touch almost every business process, function, and decision in the company. The risks involved are costly: they include developing workarounds, time spent/wasted in rework, time lost not performing value-added activities, hiring additional resources, paying claims unnecessarily, inaccurate trending, programs that are either under-funded or over-funded, missed opportunities, lost customers, inappropriate rates, poor decisions resulting in a lower profit margin, and so on. Membership information is published in various internal and external documents. Inaccuracies & inconsistencies can have serious effects on how the company is viewed in the market place. In addition, inaccurate member data can lead to State and Federal regulatory penalties and fines.

4. PROBING INTERDEPENDENCIES

4.1. Hypothesis Building

Because the data warehouse is downstream from business processes across internal boundaries, a cross-functional team was necessary to dig out root-causes. Even with the cross-functional team, there were many challenges. For example, identifying root causes in departments that do not 'own' the 'symptoms' is akin to digging in one's neighbor's yard to determine why one has a plumbing problem.

Each of the HMO's segments has a different business focus. Each segment, is made up of multiple departments. Putting together a middle-management level, cross-functional team was not a task that was natural to this company's culture. Scott L recruited members from business areas involved in the member cancellation process by offering to train them on root-cause analysis, process improvement, and quality methods and tools in exchange for their time. The team focused primarily on root cause analysis. To frame this work and to keep it on track, the team continually formulated and tested hypotheses. The case cancellation process was so complex, the team worked through the cycle below dozens of times.

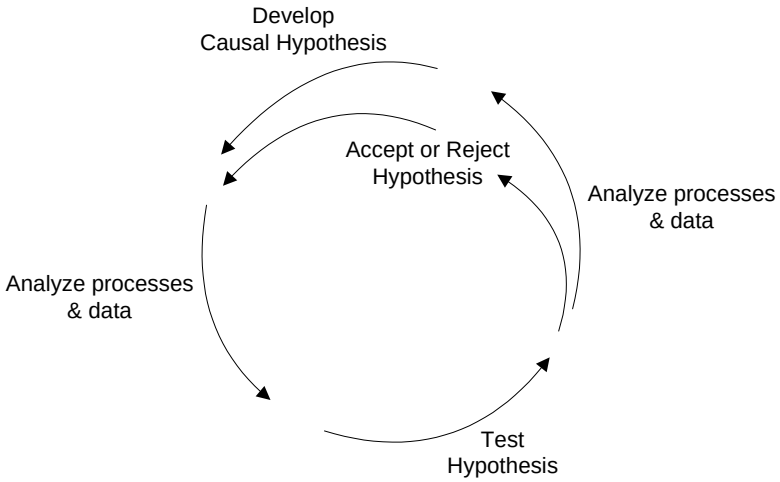

Figure 2. Root-Cause Analysis and Hypothesis Cycle

In this context, the team's work can be characterized by five types of processes: 1) generating ideas, 2) gathering information, 3) analysis, 4) problem-solving; process improvement/redesign, and 5) monitoring improvements. The team used a variety of tools and methods such as affinity diagramming, lateral thinking [6], ladder of abstraction, ethnographic interviewing [8] and contextual inquiry, the 'reporters 6' and the '5 whys'[7], sampling plans, flow charting, QFD[5], control barrier and causal factor analysis, FMECA[6] analysis [9], SPC[7], and SIPOC mapping.

4.2. Root Cause Analysis Tools: an example

SIPOC maps are one of the many tools that can be used in root cause analysis as well as in process improvement. The map in Figure 2 describes a high-level process as it exists, i.e., as it is *practiced*. These maps can also be broken down into sub-processes, (Figure 3) which can then be linked together—often the customer of one process is the supplier in the next process. At this point we can begin to see part of the complexity and hidden interdependencies: while it may seem obvious on paper that the customer can become the supplier, this fact is often missed in 'real' life.

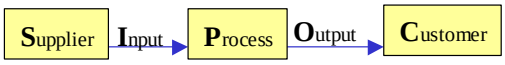

Figure 3. SIPOC map of current process (high-level)

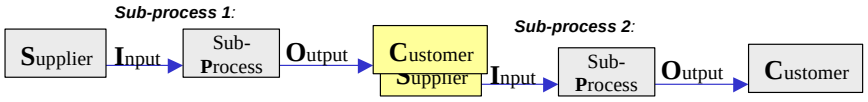

Figure 4. One sub-process feeding into the next. In this case, customer from Sub-process 1 is supplier in sub-process 2

[5] Quality Functional Deployment
[6] Failure, Mode Effects, and Criticality
[7] Statistical Process Control

4.3. Unpeeling the Layers

4. 3. 1. Case[8] Cancellation Process: Bird's-Eye View

This HMO's case cancellation process is highly complex, involving many departments, sub-processes, and systems. At a very high level, this process is triggered by notification from the customer that they are not renewing their policy(ies) with this HMO. The notification information winds its way through departments, functions, business processes, systems, and is ultimately used in such processes as making business decisions, stopping claim payments, recalculating member counts, management reports, provider notifications, and case management. The team refers this overarching view as a bird's-eye view.

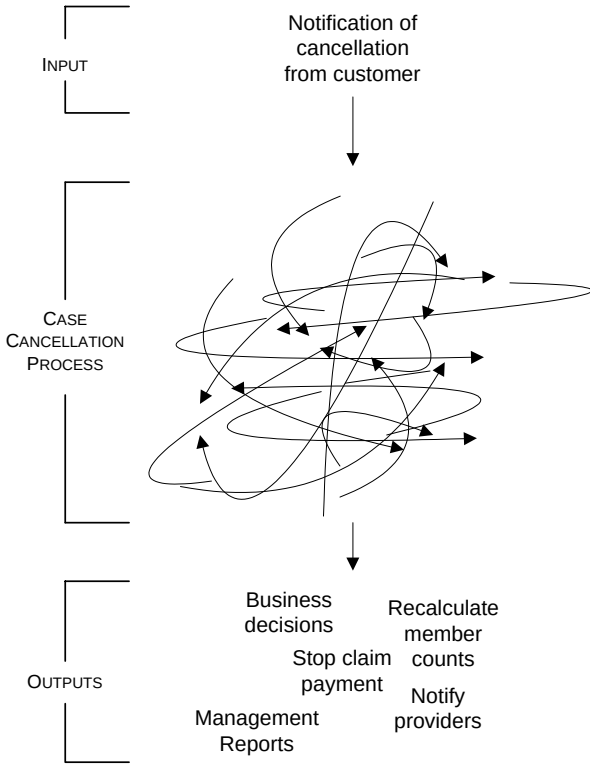

Figure 5. Case Cancellation process: **bird's-eye view**

[8] A **case** is primarily made up of information about the customer and its employees (subscribers) and their dependents, policies, contracts, and transactions and processes between the customer and the HMO.

4. 3. 2. Case Cancellation: Data, Systems, and Processes

Before proposing hypotheses, the team needed a thorough understanding of the whole process—both as it was supposed to be, and as actually practiced. After the team was able to unravel relationships, they performed several iterations of work & data-flow analysis.

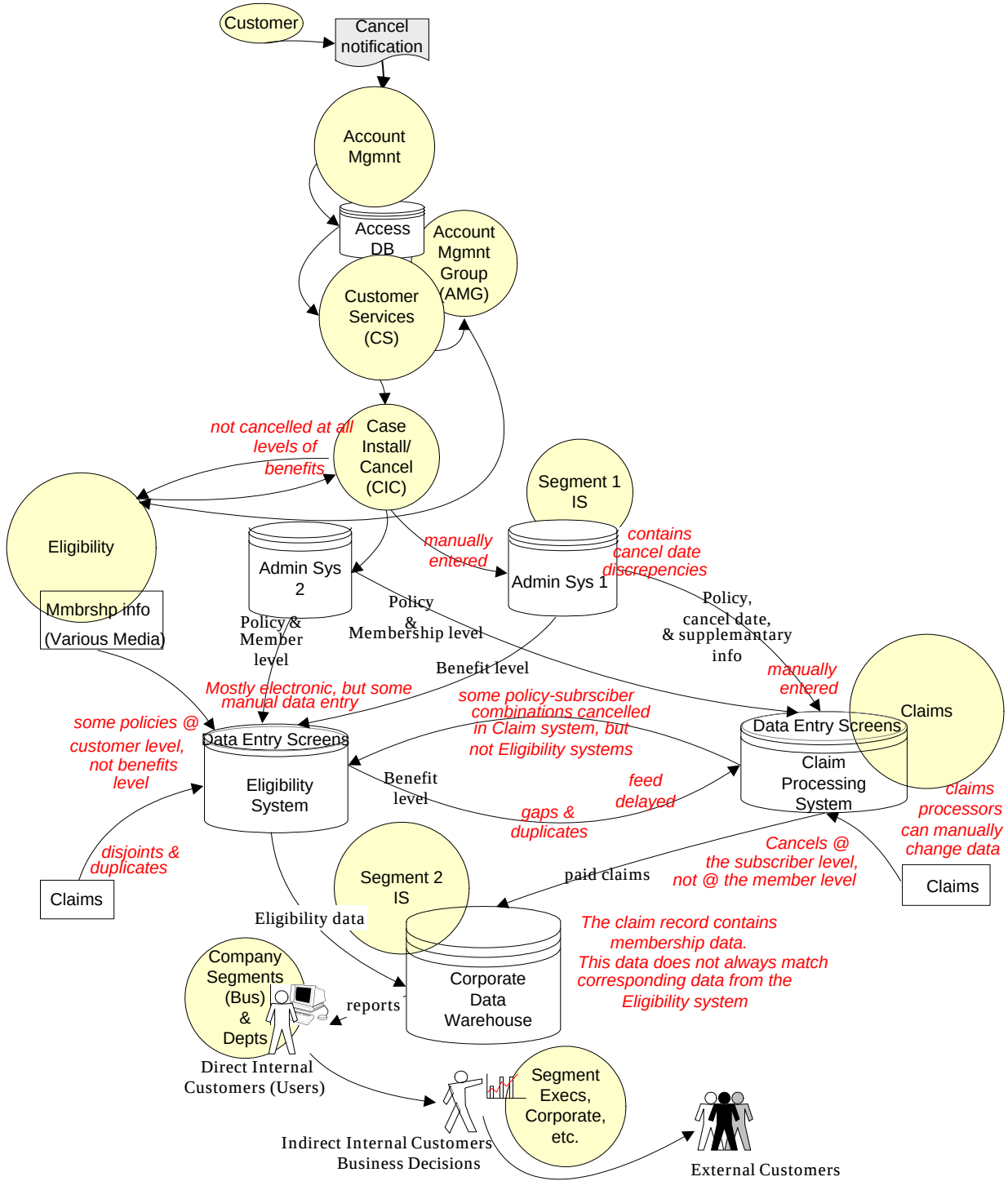

Figure 6. Case Cancellation process, departments, and systems

4. 3. 3. Revisiting Root-causes

1. Why do 40,000 – 60,000 members per month show up as active in the data warehouse when in fact these members' policies have been cancelled in the administrative systems?
2. Why is the HMO paying $4,000,000 annually on claims for members whose policies have been cancelled?

The team had gathered such a mountain of intertwined data that it was necessary to categorize the data into problem types (even then, many of the problems could fit into more than one category):

Complexity The case cancellation process, a relatively 'small' process, involves and/or touches 15+ departments, 18+ sub-processes, 50-60 3rd-level processes, 7 systems, 3 of the 5 company segments/businesses, and 300+ employees. Another type of complexity exists when there are unnecessary hand-offs, such as when a Case Install & Cancel analyst fills out part of the required Change Form and turns it over to an Eligibility analyst to enter the load date and cancellation reason. The Eligibility analyst then notifies the Case Install & Cancel analyst that the form is complete. The CIC analyst must then remember to go back into the Eligibility system to enter the appropriate data. Without this step, or if there are errors in this step, the feed to propagate to the membership level is prevented—and others involved in this process or in downstream processes are unaware of the members who were *not* cancelled. Neither the CIC nor Eligibility departments were unaware of downstream consequences.

Also adding to the complexity, information from the original cancellation notification is propagated as data into three different, yet parallel flows, causing redundancies and disjoints. (Figure 5 shows two of these flows.)

Disjoints & Systems Issues The Eligibility system contains membership data that does not always match corresponding data from the Claim Processing system; the Claim Processing system contains cancellation data that are inconsistent between policy & membership levels; Eligibility system termination jobs do not generate error reports; Admin system 2 cancellations are not applied to all levels of Claim Processing system policies; cases are cancelled at different levels in different systems, leading to disjoints. Examples of cancellation levels:

- Admin system 2 to Eligibility system = report code level
- Admin system 2 to Claim processing system = customer & coverage levels
- Admin system to Eligibility & Claim Processing system = policy & member levels
- Eligibility system to Claim Processing system = policy level
- Claim Processing system to Eligibility system = membership level

'Realigns' are run to correct disjoints, but the realigns do not always work. The most serious system issue is that the Eligibility system cannot accept tapes electronically when these tapes contain future cancellation dates. (We will show why this is serious when we get to the section on timing issues.)

HCI[9]: **ACCELERATORS, OBSTACLES, & CONTROLS** In data entry screens, a**ccelerators** allow operators to work more accurately and quickly. They also take care of routine tasks and allow analysts to spend more of their time on 'knowledge work'. **Obstacles** get in the way of the operator's work, or slow it down. **Controls** prevent errors. Without UCD (User-Centered Design), a user interface typically has around forty flaws that . . . slow users and lead to errors [10]. Using the Eligibility data entry screens as an example, all text is uppercase, slowing reading and information finding; fields are not organized & lined up in an understandable way; difficulty telling the difference between field names and the fields themselves, especially when they are filled in—it is also difficult to distinguish required fields from optional fields; screens are highly cluttered with little white space to differentiate types of information;

[9] HCI = Human-Computer Interaction

the analyst has to stop data entry to look up codes instead of these codes being easily accessible in an online pick-list; most fields lack controls—the operator can easily enter typos or other incorrect data.

MANUAL PROCESSES Manual processes such as data entry are error-prone for a variety of reasons such as 'typos', confusing screens, lack of easily accessible information, lack of training, etc. The Case Cancellation process contains manual processes such as data entry *even* in systems that are supposed to be 'electronic'—for example—Admin system 2 feeds the stop date in the customer/coverage record to the Eligibility system electronically, but it is necessary to manually go into the customer/coverage record and manually remove the stop date until the tape from the customer is complete. Once the tape is complete, it is then necessary to manually re-enter the stop date, which in turn generates a job id to retrieve associated membership. Without this step, or if there are errors in this step, the Eligibility system cannot propagate the feed to the membership level. In addition, the Eligibility system does not generate error reports—the Eligibility analyst must manually pull this information, and must *manually cancel* any remaining membership. If Eligibility neglects this step, we find another instance of members not being appropriately cancelled, and of others in this process or downstream processes unaware of the situation. Again, neither the Eligibility departments nor other departments it works with are aware of the downstream consequences.

OPEN FEEDBACK LOOPS/HANDOFFS/INAPPROPRIATE OR LACK OF CONTROL BARRIERS/LACK OF TRIGGERS Open feedback loops, handoffs, and missing or weak triggers invite the introduction of errors. The Eligibility department does not always inform the Account Management Group (AMG) when all members relating to a case are cancelled. There are no triggers in place to remind Eligibility to do so, or controls that would prevent Eligibility from going to the next step before they do so, leaving this feedback loop wide open. Other situations contain similar problems, such as when more tape apply jobs are run than the Eligibility system can handle. Some of these jobs are 'bumped' (cancelled). Since the Eligibility system does not generate error reports, a Case Install & Cancel department analyst must *remember* to try the job again the next day. Should the analysts forget to check, there is no trigger to remind them and membership is not all cancelled. The most serious problem with this is that no one else involved in this process or downstream processes has any way of knowing about the 'non-cancelled' members.

CYCLE TIME Timing turned out to be the primary reason that $4,000,000 in suspect claims are paid annually. The time between when the cancellation notification is received from the customer, and that information reaches the Claims Processing system is too long: a cancelled member's claim, with 1st service date past the cancellation date can arrive in the Claim Processing system before related cancellation information. (See Figure 6.)

Why?

According to CIC staff interviewed, they do not always receive notification of cancellations in a timely manner, delaying cancellation updates.

Why?

1. The Account management department is supposed to notify Customer Services *and* enter the information in an Access DB form within 3 days of receipt of notification. Sometimes they take longer.

> ***Why?***
>
> Because new accounts are more important to this department than cancelled accounts.
>
> ***Why?***
>
> That is what they are rewarded for—in commissions.

2. The Customer Services department holds cancellations for up to 1 week before the effective date of the cancellation.

Why?

To prevent a large number of reinstatements. Sometimes customers cancel their policies only to change their minds; then Customer Services must reinstate them. There is a fair amount of work and time involved.

Why not hire the necessary resources? (It would cost a fraction of the $4 million annually.)

a. Customer Services is supposed to release cancellations at least 2 weeks before the cancellation effective date: other business areas were not aware that, to avoid reinstatements, Customer Services was waiting to release cancellations until 1 week before the effective date. This problem could have been solved by hiring just a few more resources, but the extra cost would not have looked good on Customer Service's bottom line. Customer Services was rewarded for their bottom line, not for saving the company millions of dollars: another instance of the 'silo effect'.

b. Because of the inability of the Eligibility system to handle future cancellation dates via tape

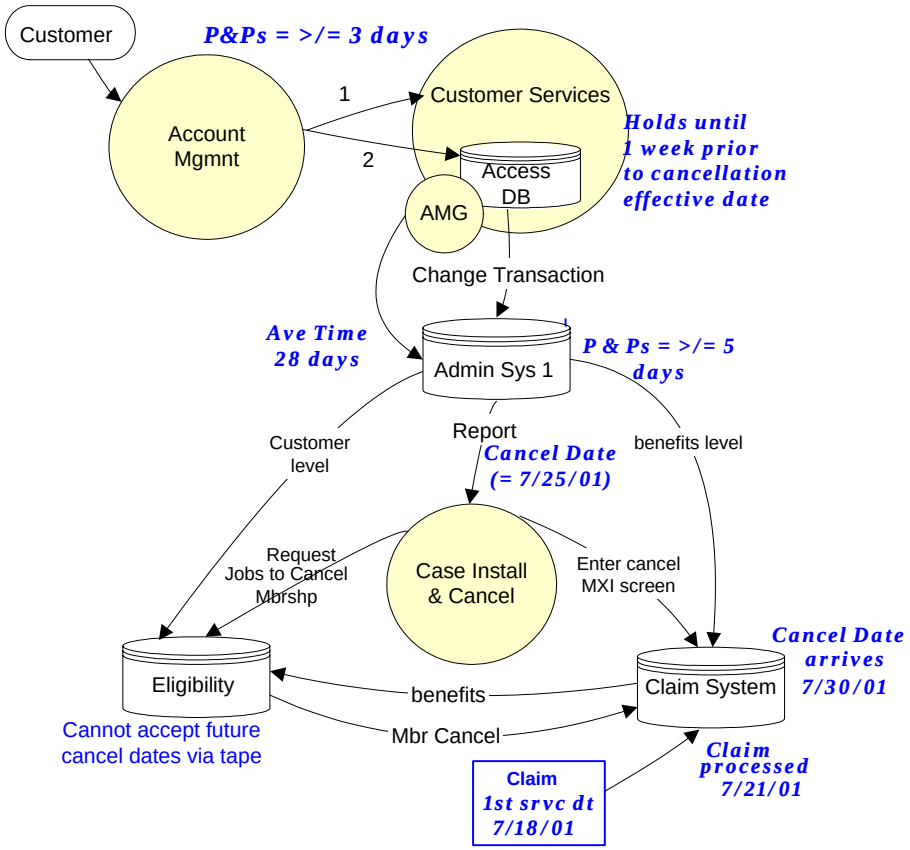

Figure 7. Case Cancellation Cycle Time

Why not enhance the system?

This was a business decision made by the Eligibility department to save money—the decision is currently being reviewed. Eligibility was not aware of the enormous downstream consequences ($4 million annually) of its system's inability to accept future cancellation dates.

4.4. Root-cause analysis

Several factors come into play when solving complex organizational problems, which make root-cause analysis critical.

Figures 4 and 5 give some insight into the complexities and interdependencies of the issues. To stay focused and not waste time, Scott recommended that while mapping, the team start looking at those areas/sub-processes that are known to typically cause or permit errors, such as functional interfaces, breakdown in communications, complexity, cycle times, data entry screens and/or forms, hand-offs, extra steps, inappropriate rewards systems, lack of adequate training, lack of or inappropriate control barriers, lack of or inappropriate triggers, obstacles, open feed-back loops, policies and procedures not being followed, same terms used differently depending on department or geographical location, among others.

PROBLEMS AND SYMPTOMS Often problems are merely *symptoms* of deeper issues. Just fixing the problem does not prevent its re-occurrence or get at the deeper issues. The visible problems are akin to medical symptoms. Suppose a patient presents with the following self-reported symptoms: fever, aching joints, chills, fatigue . . . the physician, having seen these symptoms hundreds of times, assumes she knows the cause and therefore performs a somewhat perfunctory examination, diagnosing the patient with the flu. A week or two later, the patient comes back with the same symptoms, only much worse. This time, the physician decides to get at the bottom (root) of the problem. It turns out that the patient has Lyme disease. When caught early, this disease is highly treatable, but if not caught early can cause life-long problems and even death. Prevention would have been even better.

ADAPTIVE CHANGES Consider an ordinary business form. Even the most recently printed has boxes or fields that are no longer used, categories that no longer apply. These redundant boxes are signposts of change. Employees quickly devise ways to 'fix' the slightly out-of-date process [11]. While the employee may have appropriately modified a process in that particular situation, the rest of the business has no way of knowing what happened. While this is an insignificant change in itself, multiplied hundreds and thousands of times, these types of adaptive changes can cause problems across an organization because they are not documented and shared.

INTERDEPENDENCIES Work practices, organizational structures, and the way information systems are developed and deployed are all interdependent, but also independent in that none can be reduced to the others [12]. This means that when an information system problem presents itself, it cannot be assumed that the problem is uniquely with the system or even with the system at all.

UNIQUENESS OF PROBLEMS & THEIR ROOT CAUSE(S) Julian Orr, formerly an anthropologist at Xerox's Palo Alto Research Center (PARC) studied what reps actually did, not what they were assumed to do. While the reps' work is organized by business processes, they succeeded in solving problems primarily by departing from formal processes. For example, the company's documented repair processes assume that machines work predictably. Yet large machines, made up of multiple subsystems, are not so predictable . . . Reps know the machines they work with, Orr suggests, as shepherds know their sheep. While everyone else assumes one machine is like the next, a rep knows each by its peculiarities and sorts out general failings from particular ones [11]. Even when a problem is the same as a previous problem, it cannot be assumed that the cause(s) are the same.

[10] Policies & Procedures

VARIATION Statistically speaking, root causes are usually 'special causes'. It is possible to determine if these causes exist by tracking a process on a control chart and determining the amount and type of variation.

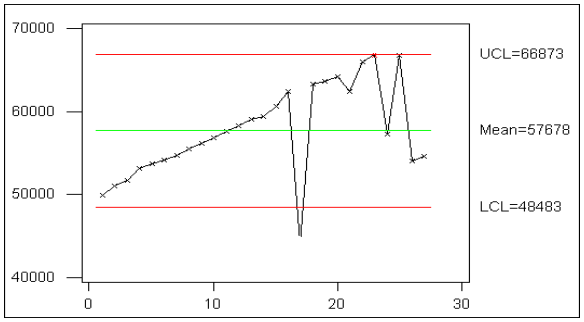

Figure 8. Control Chart of the Case Cancellation Process

The control chart above contains 27 data points representing 27 consecutive months. The height of the chart (y axis) shows the number of members whose policies were cancelled according to the administrative systems, but who showed up as active in the data warehouse. The number of members = the number of process errors. As we can see from the control chart, the Case Cancellation process contains 'special causes' (quite a bit of variation). Special causes must be removed before processes can be improved. An interesting question the team did not have time to pursue: What caused the dips in the control chart? In this instance the dips represent times of *improvement*.

5. DISCUSSION

Why was Customer Services concerned about its departmental bottom line instead of the company's bottom line? How could the Claim department, not to mention Finance not be aware that the company was bleeding $4,000,000 a year? Why does this one process (Case Cancellation) send its information through three redundant data flows? Why does the same membership information exist in both the Eligibility and Claim Processing systems? By asking such questions, the team learned that many of the organization's processes are hidden and at such cross-purposes; that organizational structure, culture, and reward systems do not facilitates cross-functional cooperation necessary for improving information quality; that information is not seen in its context of information value chain, and therefore not seen as a process to be managed. By learning what is at the root of their quality problems, the organization is in a position to address these problems.

6. CONCLUSION

We present the results of one team's efforts in identifying root-causes of organizational poor information quality. One factor that ties plans, providers, employers and consumers together is information. Health Plans need it to show they are improving outcomes; providers need it to prove they are practicing evidence-based medicine; Senior Management needs it to make more informed healthcare decisions [13], and so on.

To improve information quality, organizations must understand and address the big picture, root-cause details, how processes affect each other, and manage the information value chain. Until the complete story is understood, even well managed improvement projects can mask subtle but real underlying causes and even generate new problems.

The analysis performed by Scott and the team highlights how important it is to uncover the layers of information and business. Recognizing that information processes must be managed, and fully understanding interdependencies and layers of root-causes will set a foundation for comprehensive information quality improvement programs. We recognize that analyzing data and its hidden interdependencies is a major undertaking, and not one that can be done overnight or without resistance. Introducing one team's effort, we believe, is a step in the right direction.

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