International Journal of Knowledge Management
Volume 17 • Issue 3 • July-September 2021

Hunch Mining

Jim Nelson, Southern Illinois University, Carbondale, USA

ABSTRACT

Intuition and hunches are important tools for experts who make time-critical highly complex decisions in turbulent environments. However, hunches are also elusive and exist below the surface when not being used for immediate decision making. These latent hunches are valuable and can lead to creative solutions outside of a crisis. This paper uses a demonstration experiment to show how hunches can be "mined" using revealed causal mapping techniques. Fifty chief information officers and 88 programmer/analysts were interviewed during a very turbulent time in their organizations. The hunch mining results indicate that hunches can be found throughout experts' communications and can serve as valuable insights into strategic and tactical decision making. This research serves as the first manual step in developing natural language processing artificial intelligence tools for automated hunch mining in expert communications.

KEYWORDS

Expert Knowledge Management, Hunch, Intuition, Revealed Causal Mapping

INTRODUCTION

An organization's experts, whether executives at the strategic level or workers at the tactical level, have vast amounts of knowledge and years of experience that allow them to interpret the daily deluge of data they encounter. Their knowledge of their organization and its operation, its direction, and situations that arise from day to day is transformed into mental models that are indispensable for understanding the world. Mental models organize knowledge in both simple and robust ways "in a world awash with information of staggering complexity" (Vandenbosh & Higgins, 1996, p. 200). These mental models are the structures that allow experts to process new information and to make better decisions than novices who have less well-developed mental models.

Mental models are vital for understanding, organizing, and responding to our world (Bartlett, 1932). However mental models are also limiting as they channel people into selecting and using data that confirms and then reinforces existing models (Festinger, 1957). Experts are constrained by their mental models that act as blinders to anything "outside the box" (Pennington, 1987). They have trouble surfacing and examining the tacit, unconscious knowledge and experience needed to make creative decisions before a crisis hits.

While mental models channel and limit conscious thought, the mind is also unconsciously collecting, interpreting, and analyzing data from a vast array of diverse sources. This "conglomerate of perceptual, affective, and cognitive processes" form the "rapid, unconscious, nonlinear information processes" known as intuition (Lussier, 2016, p. 709). Intuition is an essential management trait that can bypass the limitations of executives' mental models and help them jump to creative solutions to novel problems.

DOI: 10.4018/IJKM.2021070102

Intuition is often dismissed as an "irrational mystical force" (Bergson, 1911). These intuitive hunches arise seemingly out of nowhere. They are cognitive leaps that seem right although there is no actual data to back them up. In fact, intuition is the mind's form of data mining. It is most often defined as "the act of cognition without rational inference." It is a way of learning that takes place beyond consciousness where a decision-maker acquires knowledge but is unable to identify the source of this knowledge (Malewska, 2015, p. 98). Experts spend a lifetime acquiring data (knowledge) that intuition sometimes forces to the surface as "hunches." While the usual definition of a hunch is "subjective, generalized, unreasoned and therefore unreliable" (Lerner, 2006, p. 407), we use the definition derived from cognitive science that a hunch is the product of intuition, which is "a capacity for attaining direct knowledge or understanding without the apparent intrusion of logical inference" (Sadler-Smith & Shefy, 2004, p. 77).

Experts' deep knowledge is tapped, and mental models are challenged, during times of crisis. When they need to make time-critical, highly complex decisions, experts often turn to intuition to come up with "out of the box" solutions (Dane & Pratt, 2007). Even in today's world of big data, analytics, and artificial intelligence, experts are encouraged to make *more* decisions using intuition to help train deep learning algorithms (Kahn, 2019). There is a considerable and growing body of research that explores intuition and its role in decision making in turbulent environments (Hodgkinson & Sadler-Smith, 2018; Khatri & Ng, 2000), and is seen as a key element that differentiates between successful top executives and lower level managers (Agor, 1986). However, virtually all this research examines the use of hunches and intuition in connection with decision making under pressure. This paper explores surfacing latent hunches: those hunches that are not being used for immediate decision making but can be exploited for building models useful for data mining, data analytics, and for training artificial intelligence algorithms.

The "hunch" is what emerges from the unconscious intuitive processes. It is the nagging feeling that we know something but cannot quite figure out why we know it. That hunch, when used, can be a powerful tool for directing business analytics efforts. This paper describes a demonstration experiment of using revealed causal mapping for mining executives' and workers' hunches outside of a crisis, classifying those hunches, and then explores future extensions of this research using natural language processing and artificial intelligence tools.

THEORETICAL FRAMEWORK

There are many words for intuition: hunch, gut feeling, seeing, insight, and "sixth sense" among others. Intuition is not rational and it is not analytical. Intuitive decisions seem to come out of nowhere, and there is no data that someone can point to and say that is what the decision is based on. Yet intuition is gaining importance as a key factor in decision making (Lufityanto, Donkin, & Pearson, 2016). There is a growing body of literature that deals with conscious and unconscious cognitive processes and the role of intuition in decision making (Loureiro & Garcia-Marques, 2018).

Intuition is hard to define and hard to analyze because it is *not* rational. We define rational thought as clear, well-defined knowledge and logical, analytical processes to arrive at carefully reasoned conclusions producing expected results (Betts, 2011). A goal is defined, all alternative paths are uncovered and developed, extensive scanning of the internal and external environment is performed, alternatives are considered, evaluated, and weighted, and finally a "choice" is made.

Intuitive thought uses internal, tacit knowledge and unconscious processes to arrive at conclusions that often produce unexpected but welcome results. We are constantly learning and unconsciously collecting data from our environment. Experts in an area can take this data and abstract it, categorize it, and integrate it into their existing knowledge guided by their mental models. Then, as situations arise, intuition is triggered and they unconsciously recognize and understand patterns and relationships in the apparently unrelated facts (Sauter, 1999). Even when people explicitly realize that it is irrational to do so, they still follow their intuition in making decisions (Walco & Risen, 2017).

An expert who has been in an organization for a while will develop the capacity to unconsciously collect and process data to develop his or her intuitive decision making. But to come to the surface, that intuition must be triggered (Sauter, 1999). This is the problem: the expert does not know what he or she needs to know to make an intuitive or even a rational decision.

This is where hunch mining becomes useful. The expert has the knowledge that, when triggered, leads to a hunch. The hunch is grounded in that knowledge and leads to the development of an analytical model. The analytical model directs the organization's data mining and data analytics processes which leads to results that can be interpreted through the expert's tacit knowledge. The results can then be shared with those who do not have the insight along with the data that justifies the results of the analysis.

The trick is to trigger and capture the hunches, find them in a sea of rational discourse, and then render them into analytical models.

Four Kinds of Organizational Hunches

An organization has two kinds of goals: tactical and strategic. Tactical goals are short range and short duration (Griffin, 2007). Tactical tasks form the business processes of the organization, and supporting data is found in organizational databases and enterprise systems. Data to support the tactical goals is (hopefully) structured, well-managed, and easy to obtain. On the other hand, strategic goals are long term and are the milestones that the organization uses to achieve its mission. Data to support the strategic goals is found primarily outside the organization. It is usually diverse, messy, incomplete, contradictory, often highly unstructured, and difficult to find.

The person making the hunch has two kinds of knowledge: explicit and implicit. Explicit knowledge is knowledge that has been externalized. It is easily broken down into rules, easily verbalized, and easily transmitted. It is knowledge embedded in procedure manuals, textbooks, and so on.

Implicit knowledge is knowledge that has been internalized. This knowledge is often experiential and is very difficult to transfer to others. A person may be able to perform a task based on implicit knowledge but cannot express knowledge explicitly and cannot articulate the "rules" for how the task should be done.

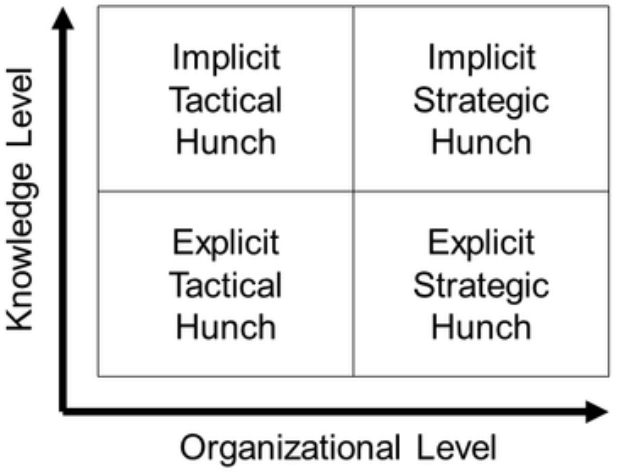
Tactical and strategic, explicit, and implicit define the four kinds of organizational hunches as shown in Figure 1.

The Knowledge Level axis ranges from explicit knowledge (easy to codify and to transmit) to implicit knowledge (internal and experiential). The Organizational Level axis ranges from tactical (local and immediate) to strategic (long range and long term).

Tactical hunches can be used for identifying models for making the organization more efficient. With explicit tactical hunches, the data is straightforward to get from corporate data warehouses and the model can be easy to define. Both the cause and the effect are clearly stated in the hunch, such as: "I think that all work and no play make Jack late for work." Implicit tactical hunches also use operational data, but the model is much more difficult to define. The cause is stated but the effect is less well defined: "I think that all work and no play make Jack a lazy boy" with lazy undefined and may be a very abstract concept.

Strategic hunches deal with organizational effectiveness. The data is much harder to find. It is in both organizational data warehouses and in formal and informal organizational communications, and conversations. Data can also be found outside the organization in newspapers, social media, and many other forms. Like explicit tactical hunches, the model can be easy to define and implicit strategic hunches are difficult to define.

Figure 1. Organizational Hunch Matrix (OHM)



METHODOLOGY

Research Approach

This study uses the design science / demonstration experiment research method (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). This method, common in the engineering and computer science disciplines, seeks to create an applicable solution to a problem rather than theory building and hypothesis testing. "Design science . . . creates and evaluates IT artifacts intended to solve identified organizational problems" (Hevner, March, & Park, 2004, p. 77). Here, we develop the context for finding and classifying hunches, and evaluate this artifact in a field study. This will serve as the foundation for automated natural language processing systems that locate, classify, and expand on hunches.

This study focuses on hunches using the general model "*if x then y*." These are causal models: *x* (the cause) results in *y* (the effect) in the past, present, or future. The first step in hunch mining is to identify causal statements in a transcript. We used a variation of revealed causal mapping techniques (Nelson, Nadkarni, Narayanan, & Ghods, 2000) to identify causal statements in text. Revealed causal mapping is ideal for this task since it specifically extracts causal relationships that exist in the subjects' minds (Axelrod, 1976).

Sample Selection

The data used in this study was taken from historical data that was collected in an earlier field study on information technology personnel transition issues (Nelson, Darais, Buche, & Rice, 2001). Data for the Organizational Hunch Matrix was collected from interviews of 50 CIOs across 22 organizations in the United States and in Canada. The initial CIO subjects from the United States were selected with a convenience sample (Stone, 1978) from the researchers' CIO personal contacts. The CIO community is relatively small and tightly knit. The first set of U.S. CIOs identified and contacted other CIOs for the study using a snowball technique (Shanteau, 1992). These CIOs identified and

contacted other CIOs and so on. Where the organization did not have an official job title of "CIO" we interviewed the person who most closely fulfilled the CIO role in the organization. The Canadian subjects were selected from the Conference Board CIO Council, a national organization of medium and large companies.

The domain of the study was relatively narrow with all the subjects involved with developing strategies for transitioning from one information technology development method to another. This had the advantage of consistency across the organizations and subjects and consistency in the domain of their hunches.

The CIOs were sent a list of questions in advance to allow enough time for them to reflect on the question and to gather data or examples they wished to share. The interviews were open-ended with probes (Rossi, Wright, & Anderson, 1983), and were conducted both in person and by telephone. Each interview took approximately 45 minutes and was taped and transcribed. Summaries of the interviews were sent to the subjects to allow them to review and revise their comments to ensure accuracy and to completely capture their ideas.

The CIOs granted access to analysis working under them. Eighty-eight programmer / analysts were interviewed to obtain the tactical data for this study. The same process as described for the CIOs was used for the analysts.

Data Analysis

Revealed causal mapping (RCM) techniques were used to reduce the interview text to a set of causal statements. In this case, it extracts those causal knowledge structures that describe the cause and effect relationship of the organization's strategy (the cause) and the eventual outcomes (the effect). The process for developing the revealed causal maps is described below.

Causal statements in the interview transcripts are identified primarily using keywords such as "if-then," "because," "so," and so on. Further analysis identifies and extracts the causal elements that may be separated by several lines of text. This process was performed by a team of twelve research assistants under the author's supervision. Two research assistants were randomly assigned to each transcript. The extracted causal statements were examined for consistency, and any differences were resolved by discussion.

Where revealed causal mapping continues with the development of a coding scheme, cross validation, and member validation, this research used just the identified causal statements. We identified 2,769 strategic causal statements from the 50 CIOs and 4,900 tactical causal statements from the 88 analysts.

Intuitive vs. Definitive Causal Statements

We examined each of the causal statements to determine if it was intuitive (indicating a hunch) or definitive. Most of the causal statements were definitive in the general form: "*this is how it is*." The speculative causal statements often have keywords that indicate the subject is uncertain or has doubts about the causal relationship. These are "reasoning words" that indicate speculation or making a proposal and include words and phrases such as: if, should, could, would, may, "I think," and might.

Classifying Causal Statements

The final step was to classify the intuitive causal statement as strategic or tactical and as explicit or implicit. Research assistants classified the causal statements into the four categories: Strategic Explicit, Strategic Implicit, Tactical Explicit and Tactical Explicit. Strategic vs. Tactical is as described above. An explicit causal statement comes in the general form: *x therefore y*. There is an explicit causal relationship between *x* and *y* that the subject knows and can verbalize. This causal statement leads relatively directly to an analytical model since we know what both *x* and *y* are. On the other hand, implicit causal statements are formed from tacit knowledge and are much more difficult to verbalize (Nonaka, 1994). There is a causal relationship, but it is unclear. The *y* may be known, but the *x* is

not: "*y is happening, but I don't know why*." This leads to data mining to discover the factors that lead to *y*. For example:

Well, one of the things I think that IT needs to do in general.... and I'm not talking about XXX, you do in general very much better, is they need to be more of somehow.... you still have your technical resources, but you need to be able to farm things out to do them quickly.

This is an explicit tactical speculative causal statement: outsourcing leads to time efficiencies. This statement is interesting as it is a source of much debate in information technology research (Chang & Gurbaxani, 2012). Even if it was generally true, it may or may not be true in that organization. Data can be collected and analyzed, and the result can indicate if outsourcing truly does lead to time efficiencies.

On the other hand, a division IT manager of a Fortune 20 manufacturing company stated:

We are trying to fix that problem of people jumping from technologist to management. Some of my group and I are in the thick of it and I guess I'm leading the team or co-leading the team. We're pulling together a proposal for a legal set of definitions around career paths in IT that explicitly address that issue. We have had a technical specialist program. It was corporately administered. It was based around academic criteria. It failed to meet its ends as far as IT is concerned and so, delivering the career paths and so, we're had to pursue these things outside the process on an exception basis and we have some work to do.

This is an implicit strategic speculative causal statement. The technical specialist program did not work, and the CIO does not know why.

HUNCH MINING RESULTS

This research used the design science / demonstration experiment research method. This method has two main components: the information technology artifact and the theory behind the artifact that contains knowledge additional to the description of a materially existing artifact (Gregor & Hevner, 2013, p. 337). In this paper, the artifact is the method of using revealed causal mapping for identifying speculative causal statements (hunches) and the design science theory is the organizational hunch matrix used for classifying the extracted hunches.

Experts have limited time for explicit thought. Their time is much too valuable and there is too much to do for them to think of more than a few models that can be fed to data analysts and data miners. Hunch mining is a method of finding analytical models that lie in the experts' tacit, unconscious mind.

We manually hunch mined 50 CIOs who were asked to think about past, present, and future transitions that their personnel and their IT functions face. We found 791 speculative causal statements within the 2,769 causal statements mentioned. We categorized them into Strategic Explicit or Strategic Implicit speculative causal statements.

Strategic Explicit

The most common concern across the CIOs was the uncertainty of the business climate and how it would affect the internal IT function of their organizations. Thirty four of the fifty CIOs mentioned outsourcing, but few really knew what outsourcing would achieve for their organization. They did have hunches that could be translated directly into analytical models that could examine organizational efficiency. With outsourcing being a strategic decision and the direct translation to a model, these hunches were classified as Strategic Explicit.

There were two primary kinds of efficiency hunches: time and money. The larger IT departments with more than 500 employees tended to focus on shortening delivery time whereas small IT departments with less than 500 employees tended to focus on saving money. The larger IT groups knew why they outsourced and there was little speculation. From the CIO of a bank with 4,000 employees:

It's the technology that we didn't have a lot of experience with and we've in the past, had a few projects that needed to be done very, very aggressively in terms of the time frame and we've outsourced them.

There was much more speculation within the IT groups of smaller (less than 500 employee) organizations. There was outsourcing but they weren't sure what they were getting out of it.

We suspected it was an outsourcing, but no one would say. In other words, no clue as to exactly what the vision was. I'm not sure they knew. It had a lot more to do with cost cutting than technology, I think. I think that outsourcing is much more effective way to do it. For example, we've outsourced the day to day operation on the data center floor. XXX got the contract for all three of our major data centers. Three of our four data centers are now run that way and the fact that we did this over a period of about two or three years building up to this. Term employees is what we call them or contracted people and so that when the big day came and we went out on our RFP and hired one company to take on the whole thing, our people were not exposed. We have longer-term career employees this way.

Despite years of study, whether IT outsourcing saves money is still an open question with few studies that empirically examine the cost savings of IT outsourcing (Han & Mithas, 2013). While IT outsourcing can save money due to the vendor's production cost advantage, there is the considerable added costs of writing the contract which are inherently incomplete (Williamson, 1979) and have the added hazard costs of opportunism, inefficiencies, and disputes (Ang & Straub, 1998).

In both large and small IT organizations, these hunches about saving time and/or money can be directly translated into causal statements and then into analytical models. The size, nature, duration, vendor, and various other factors can be compared to the historical cost savings both before and after the outsourcing.

Strategic Implicit

Implicit hunches were harder to discover in the interviews. Causes are generally straightforward, but the effects are not clearly articulated and translating the causal statement into an analytical model is much more difficult. Twenty-three of the fifty CIOs knew that they were losing "something" in the outsourcing, and they had a hunch that they were losing domain knowledge that would be hard to recover. For example:

The guys we deal with from XXX are the outsourcing experts. They're XXX services. So, we did this and then Jim got promoted and Bob came in who's an IT guy and Bob said, well you can't separate maintenance and development and I think you're going to lose all kinds of IT skills.
Low overhead. Certain costs, you pay the contractor to do everything and they've got to keep track and keep up everything. I don't know. Personally, I think you lose a lot of knowledge and oversight and control and over programs if you turn that over to contractors.

While the CIOs worry about losing in-house IT-related knowledge, a much greater concern was the loss of domain knowledge within their IT organization and the vendor's lack of domain knowledge. This was especially prevalent in the larger (more than 5000 employee) and knowledge-intensive (bank, insurance, etc.) companies.

Everything we do, and I believe every business initiative that we have is IT enabled and a fundamental part of those business initiatives is IT. But I think it's very important for us to dispel any thought process to continue outsourcing. Over there there's a whole bunch of IT people kind of sit around dreaming up IT solutions to problems that don't exist. So you combat that by really pushing hard. There are no IT initiatives. Everything we do is business related.
I think we continue to use our own talent they are going to be less technically software computer science schooled and more business requirements focused, then going on and doing your development too. I see a lot more outsourcing taking place within the IT organization and to do that, I think we'll see a lot stronger software requirement building coming up front. Maybe that paradigm shift in our staffing is the right thing to do where we become more requirements oriented and more requirements analytical than ones and zeros on the coding side.

This is much more difficult to examine and it will require deeper analysis in the requirements documents and communications between the IT group and the vendor to see how the vendor's lack of specific (or even general) domain knowledge affects the quality of the product. Data mining and text mining along with artificial intelligence and machine learning will be invaluable tools for examining these hunches.

Tactical Explicit

The programmer / analysts were much closer to the day-to-day operations than the CIOs. As a group, they went into much less detail in their interviews and were much less speculative in their answers. Out of 4,832 causal statements only 473, or less than 10%, were hunches. Their primary explicit hunches were about telecommuting and productivity.

<Hospital programmer / analyst>: They see no value in working away from the office and I think they are moving too slowly. Let's get a secure Intranet going so I can sign in and pull up medical records and you know, sign my dictation and do everything from the beach down in Florida, wherever I am. And they're saying, "I don't think we want to move quite that fast just yet"! There's some problems with that.

The key benefit of telecommuting is the worker's productivity. While the concept of telecommuting has been around for decades, the benefits are still an active research subject. However, workers are feeling increasingly tethered to the office by their smart phone, tablet, laptops, and other mobile devices. They are essentially "on call" twenty-four hours a day. Worker fatigue has been reported due to this "tethering."

These hunches are fairly easy to explore. Productivity can be defined through work schedules, call logs, time spent working vs. not working, assignments completed, and various other factors.

Tactical implicit

By far the most numerous tactical hunches were about bureaucracy and how it impacted their work.

<Very large manufacturing company>: I don't see any direction coming from the company in general. I see upper management floundering radically. The company's in great trouble. From a computing specific orientation I think we're all messed up.

These are implicit hunches. While bureaucracy is a clear cause, the effect is difficult to discern. Organizations strive to be nimble, flexible, and innovative, but bureaucracy and red tape is "killing organizations," especially those dealing with information technology (Moon & Bretschneider, 2002).

Once again, data mining and text mining along with artificial intelligence can identify and resolve the causal statements into analytical results.

DISCUSSION

The hard thing about retrieving data is deciding what question to ask, not asking it. (Brooks, 1987).

Hunch mining by hand is a tremendous amount of work. We had a very small dataset in a very limited domain. The transcripts represented dozens of hours of recording and transcribing interviews followed by hundreds of hours were spent identifying, extracting, and classifying causal statements, finding which statements were hunches, and then interpreting the various kinds of hunches across all the interviews.

As one rises through the corporate ranks, communication becomes a larger part of the day and it becomes much less structured. According to The Harvard Business Review, leadership is a conversation: "Traditional corporate communication must give way to a process that is more dynamic and more sophisticated. Most important, it must be conversational" (Groysbert & Slind, 2012, p. 77). Unstructured informal communication is becoming the norm.

Informal executive communications, if they can be captured, are rich in hunches that can be mined. Formal communication such as mission statements, directives, press releases, and letters to investors are relatively poor sources of hunches. They are easy to obtain but they represent thoughtful communications where speculation and uncertainty is discouraged. In fact, it is often used to suppress uncertainty in the organization. Less formal communications such as meeting notes and internal memos are washed of speculation.

However, informal often unguarded communication is heavy with speculation. Formal meetings are often recorded as a source for meeting notes, but the full recordings include discussions, comments, arguments, and speculation. Speech recognition artificial intelligence software today is powerful enough to transcribe natural language with surprising accuracy. IBM set a record of a 5.5 percent word error rate with technology that "could eventually live in smartphones and voice assistants like Siri, Alexa, and Google Assistant" (Weller, 2017). Compare this with humans who have a 5.9 percent word error rate in their speech recognition. Telephone and other conversations can also be recorded and automatically transcribed for hunch mining by AI.

Tactical workers communicate less and through fewer channels than executives. Written communication "up" tends to be very formal and even verbal communication has little speculation. Even when expressly called for, speculation must be thoughtful and based on hard data. However, communication between colleagues is often dense with speculation as workers try to figure out what's going on around them. This is much more difficult to capture due to the obvious privacy concerns. We are approaching the day where all formally scheduled meetings are automatically recorded. All this data can be readied for analysis using the same methods as with executive communications. In addition, problem or project specific documentation may be rich in hunches, especially client documents.

Once captured, Artificial Intelligence can augment analytics and text mining / text analytics software to find embedded causal statements. Natural language processing is becoming increasingly sophisticated. Where speech recognition translates sounds into text, natural language processing takes text and extracts meaning. For example, IBM's Watson Artificial Intelligence engine is performing ground-breaking cancer research: A version of Watson "includes medical literature, patents, genomics, and chemical and pharmacological data that researchers would typically use in their work. Watson has also been developed with specific comprehension of scientific terminology so it can make novel connections in millions of pages of text" (Chen, Argentinis, & Weber, 2016, p. 688). It should be possible to configure Watson (or a similar powerful text analysis AI machine) with specific comprehension of corporate terminology so that it cannot only identify causal statements but also

make novel connections across all corporate communications. While this is now being performed on unique supercomputers, Artificial Intelligence enabled data analytics will soon be available on corporate servers or through the cloud.

Text analysis can locate the key words, phrases, and hints that find hunches. In the future, this analysis can be extended to recognize tiny facial and body language cues and subtle voice inflections that indicate that the speaker is not quite sure and is speculating about something.

But this is just the beginning of the analytics journey. From here the hunches need to be resolved into models and the models need to be used as guides for data analytics and data mining efforts. However, all this work is worth it as the results will be grounded in expert knowledge from executives (for strategic hunches) or workers (for tactical hunches). When the results are returned to the source, they can be more easily interpreted than a data mining excursion that produces "*the data shows that x leads to y*" with no real idea of why *x* and *y* are important or why their relationship matters.

RECOMMENDATIONS

Implications For Practice

Hunches are the mind's way of signaling that, based on experience, something is wrong or different, and here's what it is. But to be truly useful, those hunches must be able to be freely offered and freely accepted by the organization. This is often hindered by corporate hierarchy, politics, and groupthink.

For example, an IT director (who the research team collaborated with several decades) had strategic explicit and implicit hunches about a proposed Enterprise Resource Planning (ERP) system. The explicit hunch was that the 500+ person IT organization was unwilling and unable to implement the system. The explicit hunch was both observed and felt. The implicit hunch was that the company had neither sufficiently clarity of data or clarity of information streams to implement the ERP. The director could not prove it beyond the span of the IT organization they controlled.

In 1997 this type of knowledge was not reliably at hand in large corporations. The director tried several times to alert more senior executives to these potential problems and was rebuffed and threatened because political waves were not allowed. The implementation failed. Between 1997 and 2002 the company spent more than $1 billion on this failed ERP. Between 2002 and now they tried to implement an ERP two more times. Each time they failed. Now in 2017 they are trying again.

Implications For Research

We used a variation on revealed causal mapping to expose hunches in open-ended interviews. Where causal mapping identifies if-then relationships in text, we extended it to degrees of speculation in the relationship. We identified "I think if-then" relationships which is useful beyond the strict number of relationships that revealed causal mapping uses.

The data sources mentioned above work well in a business environment as they provide the context needed to categorize and focus the modeling and analytics. However, a richer source of data could be completely unstructured "stream of consciousness" context-free hunch mining.

The interviews in this study were open-ended with verbal probes. However, research indicates that thinking aloud, introspection, and stream of consciousness cognitive interview techniques allow the subjects to cover a wider range of topics and can be a more authentic reflection of the subjects' thought processes (Priede & Farrall, 2011).

Speech recognition, text analysis, and AI can speed the process of finding hunches that can be explored later with automated business analytics.

The Organizational Hunch Matrix has two dimensions: Strategic / Tactical and Implicit / Explicit. While this is very useful in identifying and classifying organizational hunches, the Implicit / Explicit dimension has limited utility in the decision-making process. An extension to the Organizational Hunch Matrix would eliminate that dimension in favor of a dimension consisting of analytical types:

descriptive, diagnostic, predictive, prescriptive, and decisive. This classification scheme and revised Organizational Hunch Matrix would be useful in routing the hunch to the organizational unit that would be most effective in interpreting and exploring that hunch.[1]

CONCLUSION

Hunch mining is a method to bring cognitive science into the organization. In addition to the structed data that corporations hold within their data warehouses, adding both text and voice data will enhance the chances of hunch mining accessing into the individual decision maker's intuition. Cognitive Computing Engineers will have to work with corporate leaders to create a politically safe environment for hunches that question conventional wisdom and favored corporate direction. If companies want to be efficient, effective, innovative, and nimble they need to understand the power of hunches. Hunch mining could potentially save billions of dollars or in the field of medicine, actual lives.

This research serves as the first step in a long program of research. Its purpose was to identify hunches in interviews of organizational executives and to classify them into a theoretical model. This manual process serves as a proof of concept for natural language processing artificial intelligence software that can do the same thing much faster and more efficiently with a wider variety of text.

If organizations wait until a crisis to have executives surface their hunches about what do to, it's too late. Latent hunches, those hunches that live just below the surface, are valuable organizational resources that can be mined well before the crisis emerges.

REFERENCES

Agor, W. A. (1986). The Logic of Intution: How Top Executives Make Important Decisions. *Organizational Dynamics*, *14*(3), 5–18. doi:10.1016/0090-2616(86)90028-8

Ang, S., & Straub, D. (1998). Production and Transaction Economies and IS Outsourcing: A Study of the U.S. Banking Industry. *Management Information Systems Quarterly*, *22*(4), 535–552. doi:10.2307/249554

Axelrod, R. (Ed.). (1976). *Structure of Decision: The Cognitive Maps of Political Elites*. Princeton University Press.

Bartlett, F. C. (1932). *Remembering: A Study in Experimental and Social Psychology*. University Press.

Bergson, H. (1911). *Creative Evolution*. Henry Holt. doi:10.5962/bhl.title.166289

Betts, S. C. (2011). Lucky Rolls, Leaps of Faith and Hunches: Luck, Faith, and Intution in Decision Making. *Business Studies Journal*, *3*(2), 77–87.

Brooks, F. (1987). No Silver Bullet: Essence and Accidents of Software Engineering. *IEEE Computer Magazine*, *21*(4), 10–19. doi:10.1109/MC.1987.1663532

Chang, Y. B., & Gurbaxani, V. (2012). Information Technology Outsourcing, Knowledge Transfer, and Firm Prodoctivity: An Empirical Analysis. *Management Information Systems Quarterly*, *36*(4), 1043–1063. doi:10.2307/41703497

Chen, Y., Argentinis, J. E., & Weber, G. (2016). IBM Watson: How Cognitive Computing Can Be Applied to Big Data Challenges in Life Sciences Research. *Clinical Therapeutics*, *38*(4), 688–701. doi:10.1016/j.clinthera.2015.12.001 PMID:27130797

Dane, E., & Pratt, M. G. (2007). Exploring Intuition and Its Role in Managerial Decision Making. *Academy of Management Review*, *32*(1), 33–54. doi:10.5465/amr.2007.23463682

Festinger, L. (1957). *A Theory of Cognitive Dissonance*. Stanford University Press.

Gregor, S., & Hevner, A. (2013). Positioning and Presenting Design Science Research for Maximum Impact. *Management Information Systems Quarterly*, *37*(2), 337–355. doi:10.25300/MISQ/2013/37.2.01

Griffin, K. (2007). *Fundamentals of Management*. Houghton Mifflin.

Groysbert, B., & Slind, M. (2012). Leadership is a Conversation. *Harvard Business Review*, (June), 76–84. PMID:22741420

Han, K., & Mithas, S. (2013). Information Technology Outsourcing and Non-IT Operating Costs: An Empirical Investigation. *Management Information Systems Quarterly*, *37*(1), 315–331. doi:10.25300/MISQ/2013/37.1.14

Hevner, A., March, S., Park, J., & Ram, . (2004). Design Research in Information Systems Research. *Management Information Systems Quarterly*, *28*(1), 75–105. doi:10.2307/25148625

Hodgkinson, G. P., & Sadler-Smith, E. (2018). The Dynamics of Intuition and Analysis in Managerial and Organizational Decision Making. *The Academy of Management Perspectives*, *22*(4), 473–492. doi:10.5465/amp.2016.0140

Kahn, J. (2019). Learning to Love the Bot: Managers Need to Understand A.I. Logic Before Using It as a Business Tool. *Forbes*, (October), 9–10.

Khatri, N., & Ng, H. A. (2000). Thr Role of Intution in Strategic Decision Making. *Human Relations*, *53*(1), 57–86. doi:10.1177/0018726700531004

Lerner, C. S. (2006). Reasonable Suspicion and Mere Hunches. *Vanderbilt Law Review*, *59*(2), 407–473.

Loureiro, F., & Garcia-Marques, T. (2018). I Know the Rule, But I'll Just Go With My Gut: Is There a Rational Use of Intuition? *Thinking & Reasoning*, *24*(4), 469–497. doi:10.1080/13546783.2018.1448300

Lufityanto, G., Donkin, C., & Pearson, J. (2016). Measuring Intuition: Nonconscious Information Boosts Decision Accuracy and Confidence. *Psychological Science*, *27*(5), 622–634. doi:10.1177/0956797616629403 PMID:27052557

Lussier, K. (2016). Managing Intuition. *Business History Review*, *90*(4), 708–718. doi:10.1017/S0007680517000058

Malewska, K. (2015). Intuition in Decision Making — Theoretical and Empirical Aspects. *International Journal of Business & Economic Development*, *3*(3), 97–105.

Moon, M. J., & Bretschneider, S. (2002). Does the Perception of Red Tape Constrain IT Innovativeness in Organizations? Unexpected Results from a Simultaneous Equation Model and Implications. *Journal of Public Administration: Research and Theory*, *12*(2), 273–292. doi:10.1093/oxfordjournals.jpart.a003532

Nelson, K. M., Darais, K. M., Buche, M. W., & Rice, S. (2001). *Identifying the Constructs of IT Personnel Transition.* Paper presented at the Americas Conference on Information Systems presentation, Boston, MA.

Nelson, K. M., Nadkarni, S., Narayanan, V. K., & Ghods, M. (2000). Understanding Software Operations Support Expertise: A Revealed Causal Mapping Approach. *Management Information Systems Quarterly*, *24*(3), 475–507. doi:10.2307/3250971

Nonaka, I. (1994). A Dynamic Theory of Organizational Knowledge Creation. *Organization Science*, *5*(1), 14–37. doi:10.1287/orsc.5.1.14

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, *24*(3), 45–77. doi:10.2753/MIS0742-1222240302

Pennington, N. (1987). Stimulus structures and mental representations in expert comprehension of computer programs. *Cognitive Psychology*, *19*(3), 295–341. doi:10.1016/0010-0285(87)90007-7

Priede, C., & Farrall, S. (2011). Comparing results from different styles of cognitive interviewing: 'verbal probing' vs. 'thinking aloud'. *International Journal of Social Research Methodology*, *14*(4), 271–287. doi:10.1080/13645579.2010.523187

Rossi, P. H., Wright, J. D., & Anderson, A. B. (1983). *Handbook of Research Methods*. Academic Press.

Sadler-Smith, E., & Shefy, E. (2004). The intuitive executive: Understanding and applying "gut feel" in decision-making. *Academy of Management Executive, 18*(4), 76-91.

Sauter, V. L. (1999). Intuitive Decision Making. *Communications of the ACM*, *42*(6), 109–115. doi:10.1145/303849.303869

Shanteau, J. (1992). Competence in Experts: The Role of Task Characteristics. *Organizational Behavior and Human Decision Processes*, *53*(2), 252–266. doi:10.1016/0749-5978(92)90064-E

Stone, E. (1978). *Research Methods in Organizational Behavior*. Scott, Foresman, and Company.

Vandenbosh, B., & Higgins, C. (1996). Information Acquisition and Mental Models: An Investigation into the Relationship Between Behavior and Learning. *Information Systems Research*, *7*(2), 198–214. doi:10.1287/isre.7.2.198

Walco, D. K., & Risen, J. L. (2017). The Empirical Case for Acquiescing to Intuition. *Psychological Science*, *28*(12), 1807–1820. doi:10.1177/0956797617723377 PMID:29040055

Weller, C. (2017). *IBM Speech Recognition is on the Verge of Super-Human Accuracy*. Business Insider.

Williamson, O. E. (1979). Transaction cost economics: The governance of contractual relations. *The Journal of Law & Economics*, *22*(2), 233–261. doi:10.1086/466942

ENDNOTE

[1] Many thanks to an anonymous reviewer for this suggestion.

Jim Nelson is the Director of the Pontikes Center for Advanced Analytics and Artificial Intelligence and an associate professor at SIU, Carbondale. He joined SIU in 2005 after more than ten years of industry experience and more than fifteen years of teaching and research experience. He earned a BS in Computer Science from California Polytechnic State University San Luis Obispo and worked as an "operating system pathologist" at IBM Santa Teresa Labs and then as a project manager at a California software startup. He went back to school at the University of Colorado, Boulder, and earned a master's degree and a Ph.D. in information systems. It was at Colorado where he began his research career of conceptual modeling, cognitive science, very large databases, artificial intelligence, expert systems, and text mining. He is now considered one of the leading researchers worldwide on cognitive and behavioral issues involving conceptual modeling.