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Dretske's Internal Maps: A Critical Component of Knowledge Management, Strategy, and AI

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Abstract

Over two decades ago, guided by Randles and Thachenkary's (2002) four-stage model, a video analysis of medical diagnostic teleconsultations was conducted. From this analysis came the knowledge combustion analogy of Randles and Fadlalla (2004) and the knowledge chemistry approach. The first tool of knowledge chemistry was the knowledge spectrum, and Randles, Miller, and Blades (2011) proposed that the knowledge spectrum could provide a framework for defining and assessing organization knowledge requirements and knowledge resources. Dretske' internal maps are the cornerstone of knowledge requirements fulfillment analysis (KRFA). In this paper, their central role is demonstrated using the sales process as an example. Still the importance of these maps is understated. This is because they serve as the intermediary between learning (which creates the maps) and intelligent behavior (which requires the maps). It will be explained that these maps provide a means to safeguard the integrity of employee knowledge profiles. Furthermore, while developing KRFA, it was realized that Dretske's internal maps were at the core of the knowledge chemistry approach. Based on these maps, two tools were developed. These tools are discussed at the close of the paper, which ends with a brief discussion of the relationship between this research and AI. (200)

Key Words: knowledge management, knowledge spectrum, knowledge resource allocation, knowledge resource assessment, knowledge resource planning, and AI)

Introduction

The ubiquity of production schedules that enable myriad employees to act in a timely manner demonstrates the importance of maps in the conduct of business. Early in the twenty-first century, a prominent task is to map things that were once invisible, such as the mind and DNA. With respect to knowledge management, the authors suggest that managers of critical knowledge intensive processes focus on Dretske's internal maps. These maps differ from atlases of the world and production schedules, which are recorded maps. Dretske's (1988) internal maps are small - composed of a small number of rules and signals. Yet, they guide all intelligent behavior.

The knowledge spectrum provides a common framework for categorizing and describing organizational knowledge requirements. Using this framework, Randles, Gardner, and Zhang (2023) introduced knowledge requirements fulfillment analysis (KRFA). To demonstrate the importance of Dretske's internal maps, several aspects of KRFA were implemented and described. This implementation revealed that the sales process (as well as the internal maps that guide it) grows increasingly complex and tacit. Conversely, early in the sales process, Dretske's internal maps are simple providing explicit step-by-step directions.

For over a decade, the development of several knowledge management tools has been undertaken. While their development was rigorous, it revealed the importance of internal maps, again and again. For each tool developed, a new understanding of Dretske's internal maps was realized. Beyond transporting rules and signals that enable an immediate response, maps are a critical component of higher-level knowledge types, coordinating thought and action through guiding the execution of rules and signals. By going beyond technical skill and describing the maps that guide the skill, that guide the process, knowledge intense processes can be studied in more depth. This depth and the importance of Dretske's internal maps in realizing it, is described in this paper.

From an understanding of the hypothesis testing task, Randles, Blades, and Fadlalla (2008) described the hypothesis testing knowledge blend (HTKB), which is now known as HTKB technologies. In this paper, HTKB technologies are described in brief, their adoption is advocated, and the prominent role of Dretske's internal maps in these technologies is explained. Finally, an incremental approach, to help move artificial intelligence (AI) across the knowledge spectrum has been proposed by Randles, Miller, and Sayeed (2017). The paper closes with a discussion of this approach and a knowledge management/AI alliance.

Literature Review

The knowledge spectrum of Randles, Blades, and Fadlalla (2012) was the first tool of the knowledge chemistry approach (Randles and Fadlalla, 2004) and served as the basis of knowledge requirements fulfillment analysis (KRFA) as well as the cognitive force equations. In developing these tools, the primacy of Dretske's internal maps was recognized. The formative research on which these tools are based, the recognition of primacy attained is summarized in the literature review.

The Four-stage Model of the Diagnostic Process and Knowledge Chemistry.

Randles and Thachenkary (2002) provided a four-stage model of the medical diagnostic process, proposing that each stage relied, primarily, on a different knowledge type to attain a different form of insight, and diagnostic milestone. The foundation of the four-stage model was Dretske's definition of knowledge. Dretske (1988) stated that behavior is a causal chain governed by three types of knowledge: the triggering cause, structuring cause, and map, attached to a belief that guides one's actions.

The four-stage model integrated epistemological, cognitive, and behavioural aspects of the diagnostic process. Problem framing is the first stage and relies on Dretske's triggering cause to attain Sternberg's (1987) selective encoding form of insight. This form of insight identifies relevant information from a large amount of information. The second diagnostic stage (problem formulation) is introspective representing a delay in action. The second stage is guided by an insight from the previous stage, and action is delayed while a map is formulated (Randles and Thachenkary, 2002).

The third and fourth stages are most relevant for this paper. The third stage of the diagnostic process is hypothesis testing which is an iterative process that corresponds to Sternberg's (1987) selective comparison form of insight. This form of insight relates information that is current to information acquired in the past. The fourth stage is the confirmation stage. Confirmation requires Sternberg's (1987) selective combination form of insight. This form of insight identifies the relationship between seemingly unrelated things and is related to the structuring cause. This form of insight requires the processing of a vast amount of textbook knowledge which is embedded in the structuring cause (Dretske, 1988).

To generalize the four-stage model, Randles and Fadlalla (2004) described a knowledge combustion and vehicle analogy. This analogy led to their proposition that different knowledge types were required to extract value from information and to generate systematic action. Furthermore, the authors stated that each form of knowledge combustion required a different gasoline (knowledge blend). A knowledge chemistry approach was proposed, and its fuel and force specifications provided rudimentary principles regarding the dissipation of information (Randles and Fadlalla, 2004).

Knowledge Spectrum

The knowledge spectrum places five knowledge types (rules, signals, maps, technical knowledge, and the structuring cause) and three forms of insight on a continuum according to their explicitness, technical feasibility, and ability to generate cognitive force (Randles, Blades, and Fadlalla, 2012).

Based on the definitions of other researchers, Randles, Blades, and Fadlalla (2012) defined the five knowledge types of the knowledge spectrum. For rule-based knowledge, Randles, Blades, and Fadlalla (2012) cited Weick and Bougon (1986), who stated that predictive and associative knowledge were a collection of rules for processing information. Rules were also described by Covington (1998), who described pragmatic rules as rules of knowing what to say when. Drawing from Polanyi (1966), tacit knowledge was described as having a component that is technical. This is the knowledge of how to do something and is also referred to as procedural knowledge (Fetzer and Almeder, 1993). Technical knowledge resides in the mind and the body (Polanyi, 1966) and is placed in the middle of the knowledge spectrum establishing a broad boundary between tacit and explicit knowledge types (Randles, Blades, and Fadlalla, 2012).

The focus of this paper is Dretske’s internal maps. These internal maps differ from atlases of the world and production schedules. Atlases and schedules are recorded maps. Their creation requires great effort, and they are valuable sources of information. However, Dretske’s internal maps are small and are composed of a small number of rules and signals. Furthermore, each of these rules and signals possesses a small amount of embedded declarative knowledge (a label). Signals serve as beacons marking positions (sub-states) in a problem space. At each sub-state, there are several alternate paths. A set of rules is used to process collected data and determine the next path to take as well as its associated map. This map will guide the collection of data that is required at the next problem sub-state (Randles, Gardner, and Allison, 2022).

Dretske's Internal Maps

The intent of this paper, to advance a claim of primacy for Dretske's internal maps because these maps are an integral component of knowledge management (KM), organization strategy, and AI. Borrowing from the sales texts, several stages (a part of the sales process) are used to build a business process knowledge requirements tree (BPKR tree). The description of a BPKR tree will demonstrate the understandings gained through a description of Dretske's internal maps.

A Critical Component of Knowledge Management

A process can be described as a sequence of stages, and each stage can be described in more detail by determining the maps that guide it. For example, sales textbooks stated that the seller should identify each place the buyer cannot move forward without the assistance of a salesperson. These touch points were considered mile markers. From a knowledge perspective, the mile markers are stages, and each stage requires a specific form of insight which imposes different knowledge requirements.

The textbooks identified and described the various stages and tasks of the sales process. Several stages: lead generation, prospect search, and customer needs assessment were selected for explication representing about one third of the stages of the sales process. To define knowledge requirements, knowledge spectrum information is used to establish a dialogue with a firm's process managers. For example, the knowledge required to develop a set of data flow diagrams was provided by a systems analyst who was guided by the following dialogue - *the conduct of a technical skill requires maps,* and, from this spectrum information, a query was generated that asked - *which maps guide the development of data flow diagrams* (Randles, Gardner, and Zhang, 2023). While a simple question, when asked repeatedly about different processes, stages, and technical skills, a great amount of valuable information can be collected, and this will be demonstrated through a description of the stages, skills, and maps of a part of the sales process.

The **lead generation stage** requires a process analysis. This process analysis (a technical skill) requires an analysis of existing accounts to identify customers within a specific industry who have the potential for expansion or upgrade. The primary map for this task links existing processes to emerging ones (within a specific industry) and is described in Appendix 1.

In describing the maps that support the sales process, the benefits became clear. From the depiction of the map required to generate leads, it was realized that organized information about maps provided more detailed selection criteria for managers to use when assigning knowledge workers to projects.

The next stage in the sales process is prospect search. The maps for prospect-search guide the intelligence gathering and the prospect scoring tasks. Because intelligence gathering requires good communication skills while the scoring of prospect information is more analytical, the assignment of sales analysts would seem clear (communications skills versus analytical skills). However, the prospect search maps (Appendix 2) revealed that prospect scoring required greater breadth and depth of knowledge and required more experienced analysts than intelligence gathering.

Once recognized, a qualified prospect is more intensely analyzed through a customer needs assessment. Product service specifications must be negotiated, and the customer motivated to accept the proposed specifications. Otherwise, the sales process must be terminated – the customer deemed a poor fit. The needs assessment requires creative thinking to meet the evolving expectations of the customer, which will often test the firm's product/service norms. As shown in Appendix 3, two maps are required: a map of a specific industry's processes and a map showing product/ service usage norms for each process.

The maps presented in Appendix 2 and Appendix 3 are different. Prospect search is a structured, procedural task while the customer needs assessment requires novel thinking. The acquisition and scoring of prospect information requires maps that provide cookbook instructions for several steps and several items. These maps are explicit. Their content can be described. For the customer needs assessment, a large amount of information is required. This information is sub-divided into many (small) internal maps which guide the salesperson's performance of the customer process analysis and the negotiation of product/service specifications. Each internal map only provides a small part of the process, product, service relationship. Creative thinking requires an adroit management of these small internal maps, and studying the use of these maps through audio and video analysis is advocated.

Dretske' internal maps serve as the cornerstone of KRFA, as well as knowledge micro analysis. Micro analysis focuses on the interactions between maps, rules, and signals, as well as between maps and skills. For over a decade, this research has focused on developing the tools of micro analysis. The cognitive force equations have been completed, and detailed descriptions of business process knowledge requirements trees, as well as several simple examples of the conduct of knowledge requirements fulfillment analysis (KRFA) have been presented in Randles, Gardner, and Zhang (2023).

Randles, Gardner and Allison (2022) presented the force equations providing a short-hand method for determining the cognitive force which is generated by five pragmatic knowledge types: rules, triggering causes (signals), maps, technical knowledge (of the mind not the body), and structuring causes. For example, the feasibility assessment task of the sales process required knowledge of product and service usage across many industries for many different customers. Four maps were required with each map providing critical information across many industries.

Using the four maps of the feasibility assessment task as input, the cognitive force of this task was estimated. While this measure of cognitive force would require context, when similar numbers are generated for many skills, processes, and scenarios, a number such as 2,842,000 (cognitive force of feasibility assessment task) will be helpful to managers of knowledge-intense organizations or processes. In the middle of the knowledge spectrum are myriad skills performed by humans and machines that generate cognitive force. The estimates of this force are based on characteristics of knowledge. KRFA demonstrates that a dialogue about maps can produce BPKR trees, and the use of these maps to estimate cognitive force was demonstrated by Randles, Gardner and Allison (2022).

Adamson (2005) stated that the knowledge management approach (KM) was poised to replace total quality management (TQM) as a quality approach measurement tool. This was the objective in developing KRFA and the cognitive force equations with cognitive force serving as an additional quality measure. KRFA and the cognitive force equations provide tools to support process, project, human resource, risk, and strategic managers.

A Critical Component of Strategy and AI

The hypothesis testing task is information rather than knowledge intensive. The requirement to collect and analyse information (the procedural knowledge requirement) is great. However, procedural knowledge is required to combust a knowledge blend. It is not a component of the knowledge blend. Furthermore, hypothesis testing is structured and routine. The role of the structuring cause is limited. Only the appropriate explanation, from a set of existing ones, is required (requires no novel thinking). Because of these factors, HTKB technologies are easily implemented (Randles, Blades, and Fadlalla, 2008).

HTKB technologies would require: 1) the development of pragmatic rules that indicate what to say when, 2) the development of problem space and sub-state maps of complex diagnoses, 3) the development of a set of explanations that motivate diagnosticians to adhere to the sub-state maps, and 4) the development of a system that provides the sub-state maps and communicates the explanations of experts in a timely manner. A process to transform the artifacts of the diagnostic process into valuable specialty knowledge was proposed by Randles, Blades, and Fadlalla (2008).

HTKB technologies would move organizations from the codification and procedural mapping levels (current state) to the first advanced level of mapping (governance) - which elevates firms to greater consistency and agreement (congruence). For years, the authors have advocated that knowledge intense organizations conduct audio and video analysis and develop HTKB technologies for critical processes. By enabling less expert knowledge workers to act more like experts, experts will be able to focus on the most complex cases as well as on research. Through HTKB technologies organizations will gain greater congruence in the conduct of critical processes, will have greater access to specialty knowledge, and will become more scientific in nature.

For knowledge micro analysis, maps are paramount. Unfortunately, efforts to map knowledge can be difficult. Lenat and Feigenbaum (1991) recognized this unfortunate characteristic of knowledge and articulated an important principle, which is as follows. If a computer program is to perform a complex task, it must know a great deal about the world it operates. Furthermore, in unexpected situations, an intelligent agent must be capable of falling back on increasingly general knowledge.

Lenat and Feigenbaum suggested that AI research slowly hand-code a large, broad knowledge base. However, the authors recognized that this was an unpalatable task that would entail personal centuries of hard knowledge-entry work. Fortunately, for implementation of the knowledge chemistry approach, a large, broad knowledge base is not necessary. Rules, signals, maps, and explanations are the components of HTKB technologies. The intelligent agents who process HTKB maps and explanations provide the broad knowledge.

Randles, Miller, and Sayeed (2017) proposed that problem space maps, information processing rules, and pragmatic rules were critical in performing complex technical skills. These lower-level knowledge types of the knowledge spectrum serve as stepping-stones toward replication of complex technical skills. An incremental approach to move artificial intelligence (AI) across the knowledge spectrum was proposed. This approach would require researchers (and knowledge workers) to study complex skills through audio and video analysis and create Dretske's internal maps for use by machines.

By focusing on the development of internal mental models (maps), an intermediary, specialized task would be performed. Knowledge micro analysis would support AI researchers - who focus on replicating the bodily components (arms, legs, hands, fingers, thumbs, elbows, and knees) and sensory components (eyes and ears) of technical knowledge. In alliance, AI and KM might rapidly advance AI research to the creation of machines that perform skills that are moderately complex.

Closing Remarks

In closing the paper closes with a brief introduction of the SccoB process (pronounced Scoh-Bee) which focuses on the creation and maintenance of the small internal maps that guide knowledge workers. The SccoB process is a vehicle to implement the tools of knowledge micro analysis and HTKB technologies through a self-sustaining process of knowledge creation (Randles, Zhang, and Miller, 2018).

Six desirable qualities of knowledge emerge from a study of the design of the four-stroke engine and the four-stage model of the diagnostic process. These qualities are implemented by the SccoB process, which is simultaneous, continuous, complementary, ordered, and balanced. In closing this paper, one aspect of the SccoB process highlights another critical role for Dretske's internal maps, which is to create stress in the organization by identifying process anomalies. Maps (the norm) are required to identify these anomalies, and, at an underlying level, the SccoB process is a mapping operation. The SccoB process requires relevant workers to explain an anomaly, and, to refine relevant maps (Randles, Zhang, and Miller, 2018). Stress is intentionally created, and rewards are provided for solving the puzzle.

Similarly, the sales process is designed to create conflict between two teams. The sales team assessing the needs of the customer serves as the customer's advocate. The other team assesses the feasibility of the proposed solution taking a corporate perspective. Together the two teams must reach a consensus on the proposal. Both stress and conflict increase relevance. A situation is personalized, intensifying focus and commitment. This increased relevance should result in profound explanations, new understandings, and greater creativity in the development of sales proposals or the governance of knowledge intense processes. In a future paper, cognitive force will be the focus. It will be explained that it is the interaction of knowledge that generates cognitive force. A means to apply the force equations and to study knowledge interactions and the generation of cognitive force will be presented.

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Appendix 1

Lead Generation Process Analysis	How confident are you in your ability to conduct an analysis of existing accounts to identify customers that have the potential for process expansion (or upgrade) and additional sales?
Map of Industry XX Emerging Processes	This map relates existing to emerging processes for industry: XX. How confident are you in your ability to construct this map?

Appendix 2

Prospect Search Cold Call	How confident are you in your ability to gather prospect information in the manner specified by the firm for cold call sales?
Map of Intelligence Gathering Protocols	This map provides cold call procedures for gathering and recording prospect information. How confident are you in your ability to construct this map?
Prospect Search Qualification	How confident are you in your ability to evaluate prospect contact and cold call information using the firm's scoring methods?
Map of Prospect Scoring Procedures	This map provides the methods for scoring prospect information (personal contact and cold call). How confident are you in your ability to construct this map?

Appendix 3

Needs Assessment Customer Process Analysis	How confident are you in your ability to analyze the business processes of a customer in industry XX to identify their product and service requirements?
Map of Industry XX Processes, Products, and Services	This map relates industry XX processes to the products and services of the firm. How confident are you in your ability to construct this map?
Needs Assessment Product/Service Specification	How confident are you in your ability to obtain and refine a customer's product/service specifications for industry XX?
Map of Industry XX Product/Service Norms	This map relates processes to established norms regarding industry XX product/service use. How confident are you in your ability to construct this map?