A Praxis Engine is a Visual User Interface that Converts Business Environment Measurements into Actionable Decisions: Strategic Business Visualization

Judd D. Bradbury
Naveen Jindal School of Management, University of Texas at Dallas, Richardson, Texas 75080, USA, judd.bradbury@utdallas.edu

A praxis engine is a real time user interface providing symbol based visual measurements for a business environment, an enterprise environment, and the information analysis required to lead an organization. Historically business dashboards and balanced scorecards have been designed with an exclusive focus on the internal performance measurements of an organization. Strategic industry analysis has typically been conducted for a static point in time. Praxis engines are designed to provide a dynamic view of the operating environment and the decisions available to an organization. We envision a dynamic visual interface providing a full panoramic view of environmental measurements, internal guidance measurements, and probability based decision analysis. This study will be the starting point for defining a new approach to visualizing the critical business information required to lead an organization.

Key words: Visualization, business intelligence, analytics, dashboards, balanced scorecard, big data, unstructured data, environmental scanning, sentiment analysis

1. Introduction

The ancient philosopher Aristotle held that Praxis is the practical branch of knowledge that leads to action. The purpose of this concept of Praxis is the transformation of practical ideas into actions. From this line of thinking we propose a new concept of strategic business visualization that provides a panoramic view of the holistic business environment using a series of key performance indicator measurements that drive prescriptive business decisions.

2. Historical Perspective

Over the course of the last twenty years a number important business concepts have formed a foundation of building blocks for the practice of strategic business visualization. These business concepts include the enterprise data warehouse, business intelligence, the balanced scorecard, and the business dashboard.

2.1 Enterprise Data Warehouse and Business Intelligence

The early path of business intelligence evolved from the strong desire of senior business executives to fully understand the strategic and operational dynamics that were functioning
within their organization. In an effort to understand these dynamics, executive teams pushed software vendors and internal information technology teams to construct computer software solutions that could organize, access and present information relevant to the leadership of the business. Out of this demand for improved understanding emerged the enterprise data warehouse. Similar to the concept of a physical warehouse to store the physical assets of a business, executives were asking for a logical warehouse to store the data assets of the business. The data assets included structured internal data sets collected and summarized from the operational information systems running the business processes of the organization. These enterprise data warehouses created the organizational capability to develop business intelligence using multi-dimensional reporting, data mining, and various analytical techniques on the data contained in the enterprise data warehouse.

Business Intelligence is a collection of computer software technologies that facilitate the process of making business decisions inside an organization. Negash and Gray defined Business Intelligence as “a data driven decision support system that combines data gathering, data storage, and knowledge management with analysis to provide input to the decision process. Business intelligence emphasizes analysis of large volumes of data about the firm and its operations. It includes competitive intelligence (monitoring competitors) as a subset. Business intelligence uses a large database, typically stored in a data warehouse or data mart, as its source of information and as the basis for sophisticated analysis.” (Negash and Gray 2008) More specifically, Olszak and Ziemb describe a Business Intelligence system as “an integrated set of tools, technologies, and software products that include the following modules; tools to extract, transform and load data (ETL), data warehouses, analytic tools (OLAP, Online Analytical Processing), data mining tools, tools for reporting and ad-hoc inquiring, and presentation layers”. (Olszak and Ziemb 2007)

The emergence of business intelligence systems provided significantly improved executive oversight of the decision making inside the business organization. The business was no longer a mysterious black box of trusted reporting relationships of its managers. Enterprise data warehouses and the business intelligence techniques that grew out of them now provided the ability for senior executives to trust and verify the decisions of their entrusted managers.

2.2 The Business Dashboard
Executive teams required summarization of this enterprise data into a collection of performance measurements that could be read through a software user interface at a glance. To facilitate this at a glance technique, the metaphor of a vehicle dashboard was used to frame an understanding of the current operational condition of the business organization. In a business dashboard, graphical symbols, dials, and visual components are used to present the current status of internal business measurements for reviewing, analyzing, and monitoring the tactics and strategies of a business. Stephen Few describes business dashboards as “a visual display of the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance.’ (Few 2006)

In practice the emphasis in business dashboard design is to present the most important measurements with prominent visual indicators. The business dashboard is focused on a single view containing only the most important measurements for the business. Effective dashboard
design turns mundane columnar data into symbolic representations that have deep historic points of reference. Business dashboards leverage these historic reference points to communicate information at a high rate of speed. Charts, gauges, and colors are used as intellectual hobby horses to project summaries of measurements without long conversations about the business rules or philosophies that guide them. A gauge symbol, using a red needle, pointing to a green zone, over the word *Revenue* is loaded with cultural understanding to instantly communicate that *sales are good.*

The purpose of a business dashboard is to provide visual monitoring of key measurements encouraging adjustment that will improve the performance of the organization. Strong emphasis is placed on the monitoring of previously agreed metrics that will effectively illustrate the condition of the business. Malik makes clear that “It is a well established principle that you cannot manage what you cannot measure. It is equally true that you cannot manage well what you cannot monitor.” (Malik 2005) The business dashboard using a set of key performance indicators, monitor the performance of the business organization in a single view.

### 2.3 The Balanced Scorecard

On a parallel track, academics in the accounting field, improved upon existing performance monitoring systems with a visualization concept known as the Balanced Scorecard. The Balanced Scorecard is an executive performance management system designed to balance the focus on financial measurements like *revenue* and *profit* with additional measurements from internal operations. The Balanced Scorecard presents a chart of financial measurements at the top of a cross-shaped diagram. In the center lies a statement of vision and business strategy. A chart of customer measurements is presented on the left cross bar with a corresponding chart of internal business process measurements on the right cross bar. A chart of learning and growth measurements is presented at the bottom of the cross. Each chart of measurements includes objectives, measurements, targets, and initiatives. The measurements within a chart can be linked to supporting measurements in other charts. Kaplan and Norton suggest the following causal links between the charts of measurements “The measures of organizational learning and growth are therefore the drivers of the measures of the internal business processes. The measures of these processes are in turn the drivers of the measures of the customer perspective, while these measures are the drivers of the financial measures. (Kaplan and Norton 1996)

The Balanced scorecard is innovative in its ability to see how improvement in one performance measurement might improve or degrade performance measurements in other areas of the business. It properly positions business strategy and vision at the center of the performance management system. The Balanced Scorecard also focuses on the stated objectives of the business, encouraging employee autonomy. Traditionally financial monitoring systems functioned with strong monitoring of employee behavior. This difference in focus allows employees to act independently in their quest to achieve the stated objectives of the business. Using this approach, the Balanced Scorecard leaves behind many of the problems associated with monitoring employee behavior with traditional financial control systems.

### 2.4 Limitations of Dashboards and Scorecards

The innovations of the business dashboard and the balanced scorecard are significant advancements in the practice of monitoring business performance. These technologies are
responsible for bringing the use of strategic visualizations into the mainstream business community. However these technologies do have some limitations that provide opportunities for new concepts of strategic business visualization.

The first major limitation of the business dashboard and the balanced scorecard comes from their point of view. The business dashboard and the balanced scorecard draw their measurements and visualization from data captured inside the business organization. These internal measurements only provide a fraction of the information available to assist in the navigation of the business entity. Throughout the balanced scorecard definition there is no mention of monitoring the competitive landscape. When Kaplan and Norton suggest “That information was available internally, but certain other measures forced the company to get data from outside” they are only speaking about establishing benchmarks for competitive performance. (Kaplan and Norton 1992) Benchmark information is valuable but it is also static and will soon become dated. A static approach often falls short of the dynamic monitoring of competitive performance that most businesses require. Reviewing internal metrics exclusively provides a myopic point of view that does not fully reflect the true condition of the operating environment.

The business dashboard and the balanced scorecard both use the metaphor of a vehicle dashboard to illustrate their usage. Usage of this metaphor suggests we use these tools to help us navigate the direction for the business in the same way that we navigate the direction for a vehicle. In thinking about this metaphor more practically, we realize that the navigation of a vehicle is much different. It is true that periodically the navigator will glance at the dashboard to verify the internal workings of the vehicle. However, the majority of the navigator’s time will be spent reading the operational dynamics coming from above and beside the dashboard. It would be nearly impossible to navigate a vehicle by viewing the dashboard only. The probability of an accident occurring would be so high that we could essentially guarantee the collusion. Practically speaking we navigate the direction of a vehicle with a limited amount of information coming from the dashboard and a significant amount of information coming through the windshield and the side windows. This suggests that a large portion of the visualization required to navigate a business is currently missing. A full panoramic view is required, one that significantly expands measurements from external environment.

The second major limitation of the balanced scorecard comes from an inability to read and adjust to a significant shift in the competitive or environmental landscape. Norreklit highlights the limitation in this way “It is even more problematic that the scorecard does not monitor the competition or technological developments. During the planning stage the measure variables may be benchmarked against those of the competition, but the scorecard does not presuppose any continuous observation of competitors’ actions and results or the monitoring of technological developments, which means that the focus of the model is static rather than dynamic.” (Norreklit 2000)

While the balanced scorecard does move from a behavior monitoring system to a measurement system for business objectives, it still has a difficult time throwing off the historic top down command and control found in traditional financial control systems. The static nature of performance monitoring against benchmarks creates a type of blindness to the environmental dynamics that have not been captured in the measurement structure of the balanced scorecard. In
his article *Toward a Comprehensive System of Strategic Control*, Preble speaks persuasively about this dynamic need for information from the strategic environment. He suggests “Providing for special alert control represents a key addition to the strategic control process because it is designed to deal separately with a rapidly changing business environment that may be full of unwelcome surprises or discontinuous leaps of change (Lorange et al.1986) that might call for immediate and intense strategic review and a 'wartime' response.” (Preble 1992)

3. Strategic Business Visualization

A substantial amount of progress has been made over the last two decades in visualizing strategic business information. The balanced scorecard taught us that a comprehensive system of business measurements could be highly effective in controlling the strategic perspective. The business dashboard has expanded visualization to create a flexible view of internal measurements at a glance. Unfortunately, the balanced scorecard and the business dashboard, while significant achievements in their time, are limited in their view. These tools do not contain dynamic feed forward mechanisms from the outside world to inform executive users of the wider strategic picture. The current incarnation of these visualization tools presents the executive user with the reality of “driving while blind”. Executive users are able to see the internal guidance measurements coming from the business. However they are unable to visualize measurements from the larger environment and their emerging strategic requirements.

A visualization concept with a full panoramic view has yet to be established. A new generation of visualization tools has the potential to bring the larger world into an executive focus. Executive teams would be well served with a strategic business visualization that joined internal measurements from the existing business dashboard concept with a variety of new environmental measurements coming through metaphoric windshield. The union of these internal and external measurements could provide a more complete picture capable of visualizing emerging prescriptive business decisions.

The new visualization concept would be constructed of critical success factors from the total environment including measurements from inside and outside the walls of the enterprise data warehouse. A complete environmental view and navigation view of measures would be merged into a common visualization.
4. Emergence of Big Data

Along an exponential growth trajectory the volume of data available for strategic analysis has grown. The path of growth can be traced from the beginning of the internet, through the rise of electronic commerce transactions, and now spreading out to essentially anything a digital citizen touches, speaks, or connects. At present there are billions of electronic commerce transactions, posts to social media, mobile phone transactions, and internet-based sensor readings. The greater majority of this data can be identified to a particular user or organizational entity.

Finding common definitions is challenging and it is often the eye of the beholder that influences the definition. With this said there are generally two primary definitions of Big Data that are emerging. The first definition focuses on the size of data sets. A report by the McKinsey Global Institute defines Big Data as “datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyze.” (Manyika et al. 2011) This first definition defines Big Data more for what it is not (structured, relational, and dimensional) than for what it is.

Which immediately gives rise to second more technical definition offered by Chen defining Big Data as “detailed and IP-specific user search and interaction logs that are collected seamlessly through cookies and server logs”. Chen provides examples of these web logs as “Web based, unstructured content; Information retrieval and extraction, Opinion mining, Question answering, Web analytics and web intelligence, Social media analytics, Social network analysis, and Spatial-temporal analysis.” Chen goes on to identify the new frontier for Big Data as the internet of things with “Mobile and sensor based content; Location aware analysis, Person centered analysis, Context-relevant analysis, Mobile visualization and HCI (Human to Computer Interface)”. (Chen et al. 2012)

A large number of new and exciting possibilities are emerging for strategic data visualizations based on these new oceans of data. The environmental analysis of old that was once static, manual, and disparate, now makes way for digital environmental analysis with integrated, dynamic streams of data providing real time monitoring of the strategic environment. For the first time firms are now in the position to bring together rich data from the external environment and blend it with internal data from the enterprise to create a panoramic view of the complete business environment.

4. Praxis Engine

A significant new opportunity exists for visualization of measurements from the external environment, combined with internal guidance information, creating a basis for prescriptive leadership decisions. The Praxis Engine is a concept for visualizing the most important key performance indicators affecting the business and connecting these ideas to actionable probability based decisions available to the executive team.

The Praxis engine is constructed of three primary views or panels for visualization. The Environment panel is composed of external measurements, the Navigation panel is composed of
internal measurements, and the Information Analysis panel combines both sets of measurements into a set of influencing factors for decision analysis.

Figure 2. Praxis Engine

The Environment panel is designed to visualize the most important social, industry, and political measurements with importance to the business. The Environment panel draws heavily from Big Data generated from web, mobile phone, and internet sensor based data sources. These data sources are data mined, electronically scraped from their source, and structured into summarized key performance indicators. Environment key performance indicators are then represented with a set of appropriate charts or symbols that effectively communicate their meaning at a glance. The Environment panel will rely heavily on indices of sentiment in the areas of customer, brand, corporate, product, industry forces, political stability, and social unrest. The combined picture will visualize the current state of the external environment.

The Navigation panel is designed to visualize the most important customer, financial, and operational measurements from the business enterprise. The Navigation panel draws on data from the data warehouse or other internal information systems. These data sources are summarized into key performance indicators that are critical for leadership of the business. Navigation key performance indicators are then represented with a set of appropriate charts or symbols that effectively communicate their meaning at a glance. The Navigation panel will illustrate the current state of the internal environment.
The *Information Analysis* panel is designed to visualize a set of critical decisions that could or should be made regarding the underlying measurements in the *Environment* and *Navigation* panels. This panel creates a prescriptive analytical technique “prescribing” a particular decision based on the influence from the underlying key performance indicators. The *Information Analysis* panel is visualized as a decision analysis influence diagram. Influence diagrams create a decision-making model by connecting a set of general variables, chance variables, and a decision with a business objective for optimization. The influence of the variables and the decision is represented with arrows pointing toward the business objective. Separate colors are assigned to each model component. The *Information Analysis* panel will illustrate a set of key decisions available to the executive team.

These three visualization panels create the framework for *Strategic Business Visualization* of the current dynamic situation for the business. The visualization panels are designed to tell the story of the current dynamic situation of the business. The arrangement of the panels is designed to be flexible based on the needs of the user. All three panels can be displayed together for a panoramic view of the business situation, or the panels can be sequenced and sub-sequenced into micro sized visualizations of a larger narrative.

### 4. Monitoring the Business Environment

Proper business leadership requires careful attention to a large cross section of forces external to the business organization. The macro-economic environmental factors that affect most modern businesses include political and regulatory, economic, technological, social, cultural, demographic, and the natural environment. The micro-economic environmental factors that must be managed include suppliers, customers, shareholders, employee relations, and competitors.

The demands placed on a business to properly manage these forces gave rise to the need for *Environmental Scanning* by the executive team. (Choo 1999, Preble 1992, El Sawy 1985, McEwan 2008, Albright 2004, Yasai-Ardekani and Nystrom 1996) Choo defines environmental scanning as “the acquisition and use of information about events, trends and relationships in an organization’s external environment, the knowledge of which would assist management in planning the organization’s future course of action.” (Choo 1999)

Preble defines more specifically that “the process of environmental scanning begins by partitioning the environment into manageable sectors {e.g. economic, industry, social, market, governmental}. Selected environmental sectors are then broken down into a cluster of variables representing various aspects of that particular dimension {e.g. economic-interest rates, inflation rates, business cycle, income trends, employment trends, money supply etc.). Sectors and variables are chosen based on their relevance to a particular organization and then scanned continuously with the objective of early detection of events, trends, and constituent demands as they become discernible.” (Preble 1992)

The strong case for environmental scanning is joining the new capabilities of big data to provide electronic environmental data sources that can be summarized as key performance indicators. These key performance indicators complete the missing views of the panoramic visualization
required. The dynamic nature of the Praxis Engine will help organizations to deal with strategic situations that emerge on the environmental frontier.

5.0 Sentiment Analysis

Central to the ability of organizations to monitor the environment is sentiment analysis. Sentiment analysis is a type of language analysis that scores the level of positive and negative opinion that exists for a stated topic. Montoyo defines sentiment analysis in the following way “we can define it as the task of detecting, extracting and classifying opinions, sentiments and attitudes concerning different topics, as expressed in textual input.” (Montoyo et al 2012)

Comments made on social media websites, web logs, news media articles, and e-mails have all become content rich sources of opinion text that can be mined for sentiment indicators. Billions of these individual comment messages are created every month, available for text mining. (Manyika et al 2011) The basic process of sentiment analysis is to scrape postings or comments from a particular site, evaluate them with a coding engine, and then tabulate the results of positive, negative or neutral sentiment. (Balhur et al 2008, Montoyo et al 2012, Duric and Song 2011, Maks and Vossen 2012) The outcome for sentiment analysis is typically a set of scores based on the summarization of positive, negative, and neutral statements.

5.1 Customer Sentiment Analysis

Positive customer opinions are critical in the ability of an organization to acquire new customers and retain existing customers. Customer sentiment analysis monitoring can help organizations uncover immediate, short term, or long term risks for departing customers. Customer sentiment regarding a recent increase in price from a competitor can create an opportunity for customer acquisition. Customer sentiment regarding a recent increase in price can help to gauge the level of dis-satisfaction or need for a customer retention marking campaign. Strongly negative sentiment regarding customer service wait times can instruct an organization to increase staff promptly.

5.2 Brand Sentiment Analysis

Defining accurate sentiment about a brand or product can help an organization to make adjustments to sales, marketing, and product development approaches. Negative sentiment regarding a particular product feature or failure in a product launch can help an organization regroup and adjust in the appropriate areas.

5.3 Corporate Sentiment Analysis

The opinions of stakeholders in the financial community can help to lower the costs of raising capital. Positive options with the public at large can help to mitigate certain risks in the operating environment.

5.3 Industry Analysis

Michael Porter defined an elegant technique to determine the attractiveness of an industry through analysis of the strength of five forces acting on a business. Porter defined the 5 forces as “the entry of new competitors, the threat of substitutes, the bargaining power of buyers, the bargaining power of suppliers, and the rivalry among existing competitors.” (Porter 1985) In
Porter’s words “the strength of the five forces can vary from industry to industry and can change as an industry evolves.” (Porter 1985)

“Porter suggested that industry structure is relatively stable but can change over time.” (Porter 1985) This stable nature may have been true at the time but this reality has changed a great deal in a number of industries. Considering the examples of change to industry structure in electronic music, movie rentals, and health insurance we learned that industry structure can change at a very high rate of speed. All three industries experienced massive discontinuous leaps of change in a short period of time. (Lorange et al. 1986) Environmental monitoring of trends leading toward these discontinuous leaps of change provide the type of special alert control defined by Preble. (Preble 1992)

Defining and monitoring these five forces on a real time basis is becoming a reality. In a recent Issue of MIS Quarterly, Lau presents a model of relationship mining potential merger & acquisition targets using the five forces model. Each of the five forces; new competitors, substitutes, buyers, suppliers, and rivalry are provided with a measurement of the number of relationships that exist for each force. “For instance, the number of suppliers connected to a targeted company determines the bargaining power of the target; the more suppliers are connected to the target, the less bargaining power each individual supplier has with respect to the target (i.e., the target enjoys a greater competitive advantage).” (Lau etal. 2012) The next logical step required to visualize these forces is to simply select an appropriate symbol for the measurement, create a data source, and include it in the Praxis Engine.

5.3 Political Analysis

When a business enterprise operates internationally in a number of countries the conversation of political risk enters the picture. Political risk as defined by Robock is “the likelihood that political forces will cause drastic changes in a country’s business environment that affect the profit and other goals of a particular business enterprise”. (Robock et al 1989) Foreign countries may enact policies that are a threat to a foreign business, government actions may cause issues with joint venture funding, operating assets could be nationalized or the government itself may change or be overthrown.

At a macro level the Economist has created a political instability index that is a combination of economic vulnerability and economic distress. This index could be used as a key performance indicator for countries where the enterprise operates. At a micro level a number of new techniques is emerging that could be helpful with real time monitoring of the political areas of the operating environment. Sentiment analysis and text mining can help to define the general opinions or trends prevalent among government leaders and the general public in those countries.

Consider the 2011 revolution in Egypt. Multinational corporations operating in Egypt at the time had a significant interest in understanding exactly what might happen to the government and their leadership. Using tweets from the social media site Twitter, Choudhary presented how the positive and negative sentiment for the topics of cairo, egypt, hosni_mubarak, and tahrir could be monitored over the key period of January 25th 2011 through February 6th, 2011. (Choudhary et al. 2012) A sentiment index on Hosni Mubarak could provide the business enterprise with advanced alerts on actions they may wish to take in the event of an overthrow of the Egyptian
government. Similarly the specific social media entries of foreign leaders could be text mined to provide trends or directions on key policies important to the business enterprise.

6. Guidance

The subject of guidance regarding internal performance measurements has been considered and determined to be covered well in the academic literature on business dashboards. We assume the trends regarding usage of customer, financial, and product measurements in business visualizations will continue on their consistent path. The future may contain a re-order of priorities along the dimensions of customer measurements and time measurements in relation to their financial counterparts. This is a broad area for future research.

6. Information Analysis

Information analysis in the Praxis Engine is designed to be a combination of assessments of the underlying information obtained in the Guidance and Environment panels. The key performance indicators from internal and external data sources are leveraged to create models of Decision Analysis.

Goodwin explained decision analysis in this way. “Decision analysis therefore involves the decomposition of a decision problem into a smaller (and, hopefully easier to handle) set of problems.” (Goodwin and Wright 2007) Howard adds that the analysis has a “decision basis” and that the decision basis “has three parts: the choices or alternatives the decision maker faces, the information that is relevant, and the preferences of the decision maker.” (Howard 1998) The choices would be the possible decisions that could be made by the decision maker. The relevant information would contain models of decisions connected to outcomes with assigned probabilities. And the preferences of the decision maker would contain possible outcomes with values assigned to each. The best decision would be selected by logical operations. (Howard 1998)

An inference diagram is the visual representation of a decision analysis. Shachter defines influence diagrams as “a network consisting of a network graph” of nodes where “each node in the graph represents a variable in the model. This variable can be a constant, uncertain quantity, a decision to be made, or an objective…in which there is a finite set of outcomes.” (Shachter 1988)

Lumina a software provider of inference diagrams describes the clinical application of the influence diagram nodes in the following way.
“A *Decision* is a variable that you as the decision maker have the power to modify directly.” (Lumina 2013) Decisions are typically represented as rectangles. These are the strategic choices of decisions available to the executive team.

“A *Chance Variable* is uncertain, whose value you don’t know, because you don’t have complete information” (Lumina 2013) Chance variables are typically represented as ovals. These variables can be integrated with the key performance indicators of internal measurements in the Guidance panel of the Praxis Engine. Examples of key performance indicators might include revenue, market share, cost of goods sold or other similar measurements. Symbols for knobs or sliders could be used to change the underlying values to represent sensitivity to changes in these measurements.

“A *General Variable* is a deterministic function of the quantities it depends on.” (Lumina 2013) General variables are typically represented as rounded rectangles. These variables can be integrated with the key performance indicators of internal measurements in the Guidance and Environmental panel of the Praxis Engine. Examples of key performance indicators might include unit sales, costs, scores from sentiment readings or other similar measurements.
“An **Objective** is a measure of your satisfaction with possible outcomes.” These are often business objectives that the executive team is working to optimize or improve. Examples might include profit, customer lifetime value, earnings or other strategic measurements. The Information Analysis pane of the Praxis Engine is designed to provide visualization of the strategic objectives of the enterprise combined with the key strategic decisions available to the executive team.

### 7. Summary

The Praxis Engine is designed to be a business concept for strategic business visualization. The Praxis Engine combines an Environmental panel, a Guidance panel, and an Information Analysis panel to create a panoramic view of the dynamic environment for the executive team. Sentiment analysis and business entity relationship mining are illustrated as effective data sources for dynamic illustrations of key performance indicators from the external business environment. Decision analysis is highlighted as a technique for developing prescriptive analysis based on the internal and external measurements captured in the Praxis Engine. Future studies in guidance metrics, abduction rules and black swan events may provide fertile ground for advances in the areas of business dashboards and various Praxis Engines.

### References


