ADVANTAGES OF ENTERPRISE KNOWLEDGE SYSTEMS

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ABSTRACT

Environmental organizations typically have some form of Environmental Management System (EMS) in place and these systems accumulate vast amounts of asset, financial, operational, and emission information. Agency requirements coupled with new Sarbanes-Oxley obligations and company data retention policies cause this information to rapidly accumulate to the point of unmanageability and many competing solutions arise from the need of storing, aggregating, analyzing, and reporting this information. Central to the efficiency of an organization is how it codifies this vast amount of localized information into usable knowledge that leads to wisdom at an enterprise level.

By being proactive and approaching environmental initiatives from a global perspective, organizations can move beyond simply enabling compliance. They can answer the moral imperative of being good corporate citizens while strengthening their businesses by recognizing hidden efficiencies and thus uncovering the economic benefits of sound environmental sustainability practices.

This is accomplished by implementing a system that manages their knowledge and evolves the processes to incorporate best practices, organizational, and environmental changes. The information gathered from the various processes must be continually available in a manner that is obvious, timely, and appropriate. This ultimate step is addressed by using data dashboards that allow for a completely customizable experience that is tailored to the user's area of responsibility. Armed with the appropriate metrics, key performance indicators, and analysis available at a glance, all members at every level of an organization are empowered and encouraged to improve the underlying processes, and thereby, the organization.

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INTRODUCTION

Environmental organizations typically have some form of Environmental Management System (EMS) in place and these systems accumulate vast amounts of asset, financial, operational, and emission information. Agency requirements coupled with new Sarbanes-Oxley obligations and company data retention policies cause this information to rapidly accumulate to the point of unmanageability and many competing solutions arise from the need of storing, aggregating, analyzing, and reporting this information. Central to the efficiency of an organization is how it codifies this vast amount of localized information into usable knowledge that leads to wisdom at an enterprise level.

This paper examines the benefits and drawbacks of several solutions that typical organizations utilize to tame the information that results from a typical EMS. It charts the evolution of thinking as an EMS grows and how to best organize the information and turn that raw data into knowledge and wisdom.

DISCUSSION

Environmental Management Systems

The United States Environmental Protection Agency (EPA) defines an Environmental Management System as a set of processes and practices that enable an organization to reduce its environmental impacts and increase its operating efficiency [1]. A well designed and executed EMS results in both business and environmental benefits, specifically:

- Improvements in environmental performance
- Mitigation of liability and risk
- Enhanced regulatory compliance
- Prevention of pollution
- Conservation of resources
- Increased efficiency
- Reduced costs
- Enhanced image with public, regulators, lenders, and investors
- Competitive advantage
- Potential to qualify for recognition/incentive programs such as the *EPA Performance Track Program*

In the Total Quality Management (TQM) world, they say that "quality is free" — as long as you are willing to make the investments that will let you reap the rewards. The same holds true for environmental management, as an effective EMS is built on TQM concepts. To improve environmental management, an organization needs to focus not only on **what** things happen, but also on **why** they happen. Over time, the systematic identification and correction of system deficiencies leads to better environmental and overall organizational performance. Most EMS models (including the ISO 14001 standard) are built on the "Plan, Do, Check, Act" model introduced by Shewart and Deming [2]. This model endorses the concept of **continual improvement**.

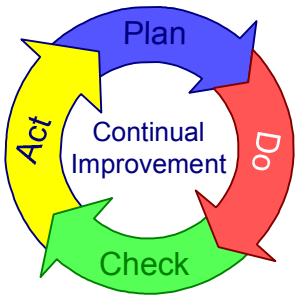

Figure 1 – The "Plan, Do, Check, Act" Model

The model breaks down the creation or alteration of EMS processes into four distinct phases that helps to better manage the scope, actions, verification, and improvements. Not only does this closed-loop model allow for improvements in each iteration, but it encourages breaking down a large scale EMS into smaller, easier-to-manage projects. Over the course of several projects, each with several iterations, the result is a comprehensive and finely-tuned EMS.

EMS Adoption

Most organizations have some form of EMS in place. They typically range from ad hoc and loosely integrated processes and tools to comprehensive and mature systems based on the above model coupled with robust software and hardware implementations. Similar to any adoption curve, "leading" organizations are innovators in the field. Once they demonstrate that the various benefits and efficiencies vastly outweigh the initial costs, the "chasm" is crossed and the others eventually follow. Experience and "best practices" drive down the time and cost for subsequent implementations, adding to the benefits and return on the initial investment.

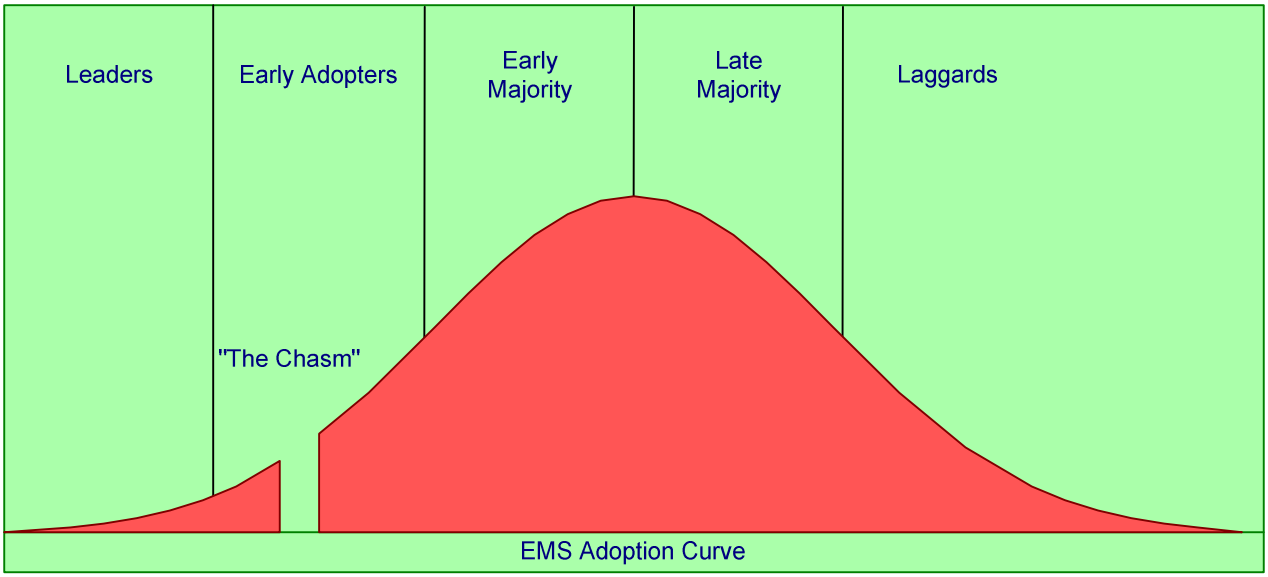

Figure 2 – The EMS Adoption Curve

Mountains of Data

As the EMS evolves and more processes are included that span the various departments, the supporting asset, employee, operational, emission, regulatory, and financial information accumulates.

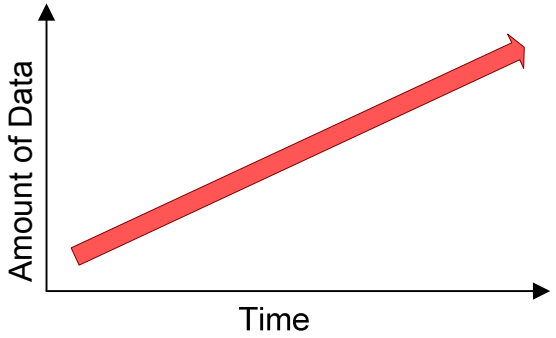

Figure 3 – Data Accumulation over Time

Central to the efficiency of an organization is how it codifies this vast amount of localized information into usable knowledge that leads to wisdom at an enterprise level. As a result, many competing solutions arise from the need of storing, aggregating, analyzing, and reporting this information, each with their benefits and drawbacks.

It is common for an organization to make use of spreadsheets to handle most of their local data storage, and some have even built robust processes and procedures to augment such systems. While spreadsheets appear to offer a simple and flexible solution, as the depth and breadth of information increase, these types of systems begin to fail. Restrictions in size, aggregation, and consistency lead to knowledge asymmetry between the local and enterprise levels.

Knowledge Management Systems

As organizations evolve their EMS, they quickly realize the need to unify their separate local systems into a consistent and ubiquitous enterprise solution. In response, Knowledge Management Systems (KMS) were created to collate, store, and analyze the large amount of data that is generated from the many processes that encompass an EMS.

Before attempting to define knowledge management, it is appropriate to develop some perspective on what we consider "knowledge." Contemplate the following observations made by Neil Fleming [3] as a basis for thought:

- A collection of data is not information
- A collection of information is not knowledge
- A collection of knowledge is not wisdom
- A collection of wisdom is not truth

The idea is that information, knowledge, and wisdom are more than simple collections. Rather, the whole represents more than the sum of its parts.

While information entails an understanding of the relations between data, it generally does not provide a foundation for **why** the data is what it is. Nor does it provide an indication as to **how** the data is likely to change over time. Knowledge may be defined simply as understanding the patterns that develop from the gathered information. Wisdom arises only when one understands the foundational principles responsible for the patterns. With these definitions in mind, the following associations can reasonably be made:

- Information relates to description, definition, or perspective (what, who, when, where)
- Knowledge comprises strategy, method, or approach (how)

- Wisdom embodies principle and insight (why)

The value of a KMS relates directly to the effectiveness with which the managed knowledge enables the members of the organization to deal with today's situations and effectively envision and address tomorrow's needs. Without on-demand access to managed knowledge, every situation is addressed based on the individual's personal experience. With on-demand access to managed knowledge, every situation is addressed with the sum total of everything anyone in the organization has ever learned about a situation of a similar nature. Which approach do you perceive would make a more effective organization?

Data Dashboards

As the typical KMS progressed, the way we extract the managed knowledge also advanced. Early systems provided hard copy reports, which were faxed, copied, or included with other documents to support analysis. This led to soft copy reports which made it easier to copy the relevant portions of information easily into other documents. This progressed to custom spreadsheets, compartmentalized databases, data extracts, and production reporting. Recent advancements led us to the pinnacle of data presentation and interpretation with on-demand reporting, ad hoc analysis, and data dashboards. This completes the end goal of the KMS.

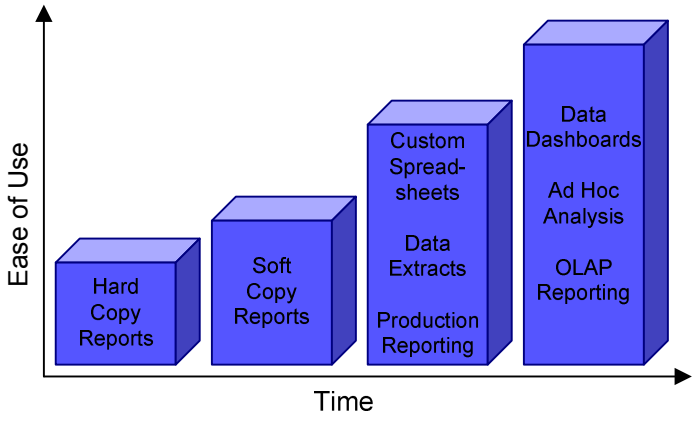

Figure 4 – The Evolution of Data Reporting

The term *dashboard* brings to mind that panel under the windshield of a vehicle that contains indicator dials, various compartments, and control instruments. Its beauty lies in its functionality and simplicity and allows us to monitor important data while performing the vital day-to-day tasks. Furthermore, it provides an ease of use and comfort so as to make the multitude of necessary decisions nearly automatic and effortless [4].

Key features of a dashboard are:

- Must be ergonomically and visually effective for a user to glean information about different aspects within a single screen view.
- Must display critical Key Performance Indicators (KPI) required for effective decision making for the domain to which a dashboard caters.
- The presented information must be entirely accurate in order to gain full user confidence in the dashboard. The supporting dashboard data must have been well tested and validated.
- Must respond to predefined thresholds by creating user alerts in addition to the visual presentation on the dashboard (e.g., sound alarms, emails, pages, etc) to draw immediate user attention to critical matters.

- Must be timely and display the most current information possible for effective decision making. The information must be both *real*-time and *right*-time.

A *data* dashboard has similar features in that it consists of a collection of metrics, benchmarks, goals, results, and alerts presented in a visually effective manner. Enterprise systems must go beyond the simple characteristics of the basic dashboard concept and also incorporate these additional elements:

- It should be interactive and allow the user to drill down and get to details, root causes, and more. Imagine if an engine analyst could click on the current fuel flow of an engine to view the consumption rate graph during the last hour, only to find that the consumption rate doubled during the last 15 minutes, indicating a sudden fuel leak.
- It should allow users to review the historical trend for a given KPI. For example, facility operating cost over the short term may indicate a problem, but when put into a yearly context, it may simply indicate seasonal fluctuations.
- The dashboard presentation should be personalized to each user's domain of responsibility, privileges, data restrictions, etc. For a better user experience, other aspects of personalization should be available as well, such as language and visual preferences for colors and background style.
- It should allow users to perform guided analysis such as "what if" scenarios. The dashboard should make it effortless for a user to visually navigate through different drill-down paths, compare, contrast, and make analytical inferences. In this way, the dashboard can facilitate better comprehension within a set of interdependent business variables.
- The dashboard should be collaborative and facilitate users' ability to exchange notes regarding specific observations. They could also be enhanced to accomplish workflow checks and process controls, where a well-designed collaboration would serve as a communication platform for task management and compliance control.
- It should allow each user to customize the metrics they choose to track. Such customized tracking could then be incorporated within the default dashboard view presented to the user.

Sample Data Dashboards

Armed with the understanding of the basics behind a data dashboard, let us project these requirements to an example that a plant manager may use to monitor key items about his facility. In this example, we assume that the manager is tracking engine performance in an effort to apply the best practices of preventative engine maintenance in his region.

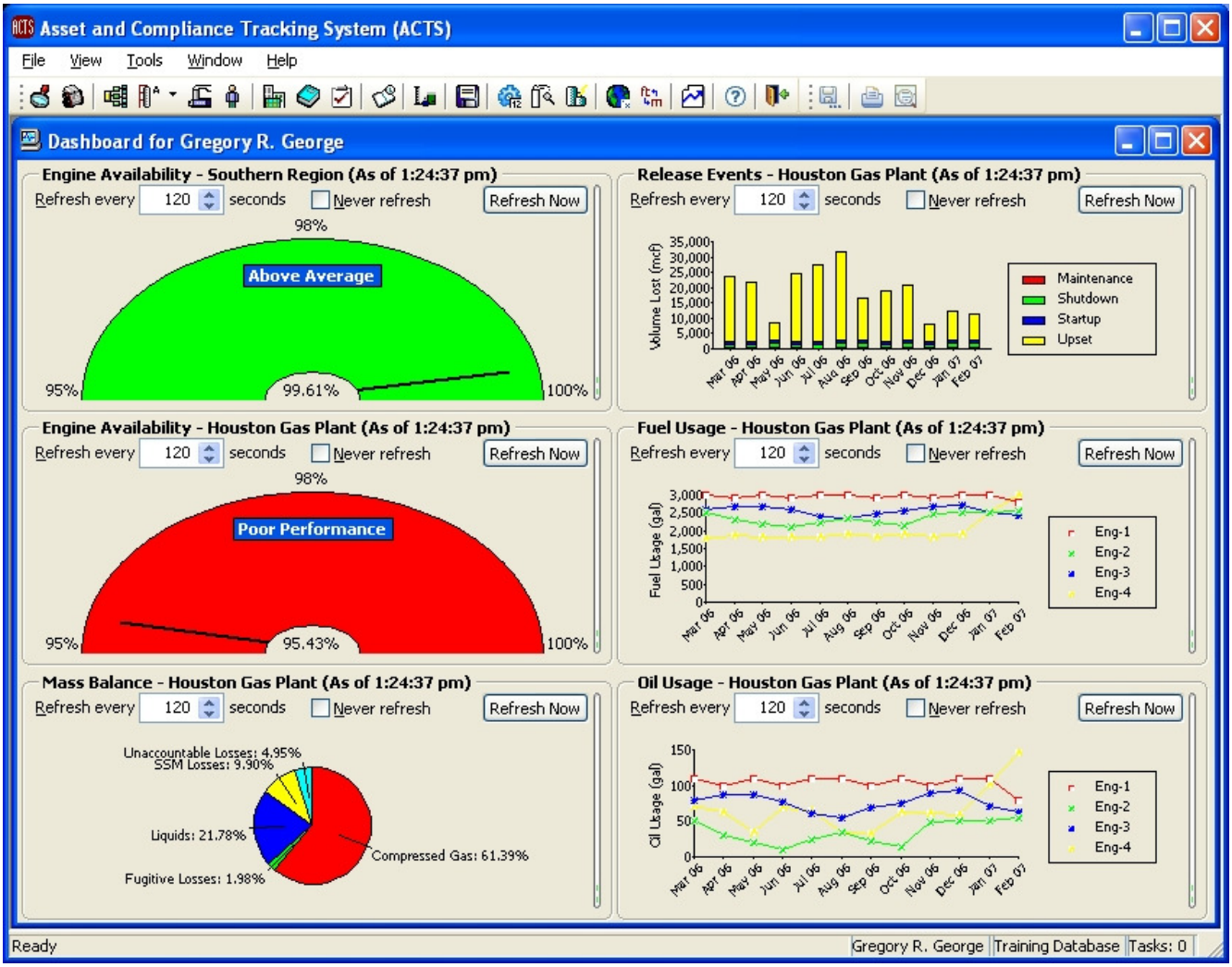

Figure 5 – Sample Data Dashboard for a Plant Manager

The manager chooses to show the current engine availability of his plant, compared to the regional average. He also adds controls that illustrate losses due to engine upset, startup, shutdown, and maintenance events. Finally, he includes controls to show the historical fuel and oil usage for all the engines at the facility.

At a glance, we can see that the current engine availability is well below the average for the other facilities in the region. Also of notice, is that both the fuel and oil consumption for Eng-4 have dramatically increased in the last two months. In order to further research the problem, the manager drills down into the detailed information for the engine by double-clicking on the January value in the oil usage graph to reveal the following:

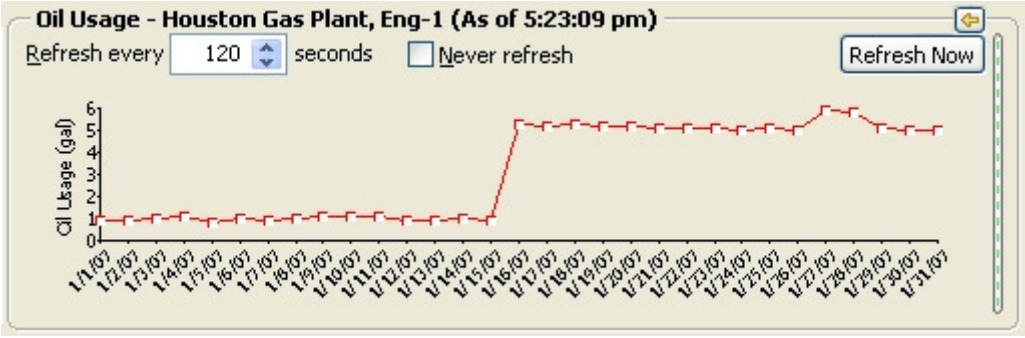

Figure 6 – Daily Oil Usage for Eng-1

This quickly reveals that there was an issue with the engine on January 16 that caused it to consume more oil than normal. Drilling down into the fuel consumption confirms that the fuel usage also increased on the same day.

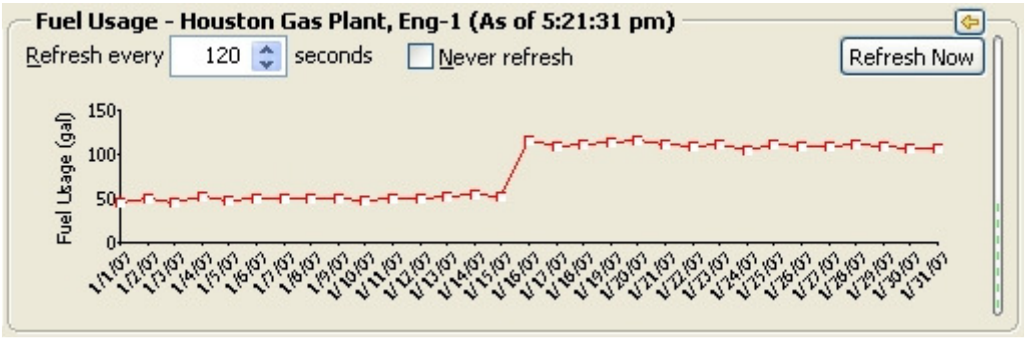

Figure 7 – Daily Fuel Usage for Eng-1

Armed with this precise and timely information, the plant manager may choose to print, export, or email the graphs directly to his mechanic for immediate inspection and repair. By performing scheduled maintenance on the engine and thereby avoiding unplanned downtime, the manager increases his overall engine availability. Furthermore, the manager may improve the process by configuring an alert that will immediately notify the appropriate personnel whenever a spike in fuel or oil usage occurs.

The above dashboard has relevance for the plant manager, but all the controls do not apply to everyone in the organization. For example, senior management may be interested in controls that show:

- Risk
- Budget Forecast vs. Actual Spend
- Budget vs. Employee Headcount

Compliance managers may be interested in controls that show:

- Permit Counts (Pending, Issued, Voided)
- Upcoming Permit Renewals
- Cost per Permit
- Permit Turnaround Time
- Incidents/Upsets

Operators may be interested in controls that show:

- Temperature vs. Permitted and Operating Limits
- Pressure vs. Permitted and Operating Limits

- Emissions vs. Permitted and Operating Limits

By providing a broad assortment of dashboard controls, all users of the system may tailor the screen to their specific needs.

Dashboard Trends

To further demonstrate the value of data dashboards, at Convergence 2006 EMEA, Satya Nadella, corporate vice president of Microsoft Business Solutions at Microsoft Corp., discussed how businesses are looking to software as key tools for achieving environmental initiatives in their companies. As part of his speech, Nadella revealed the results of a survey conducted in Europe by AMR Research [5] that showed an increase in IT spending to reduce environmental impact. The key points from the study show the following:

- Environmental sustainability initiatives are a top issue for most if not all companies surveyed, commanding 16 percent of IT budgets in 2004 and growing to 21 percent of IT budgets in 2007 — 31 percent growth for the period. There is some discrepancy between what IT managers and what the managers of specific lines of business think they are investing in, underscoring a lack of cohesiveness in the initiatives across organizations.
- Key technology tools to advance these initiatives are compliance management, financials and operations.
- Due to the increasing requirements of regulatory compliance, most initiatives in this area have been the result of reactive needs as opposed to a proactive approach to the issue.
- Environmental dashboards were considered useful by 92 percent of respondents, with 77 percent determined to develop one in the near future.

"It makes sense for companies to do this," Nadella said. "If you want to track energy, waste and emissions, and engage in sustainable practices, then you need to harness back-end processes to increase productivity and make this happen."

CONCLUSIONS

By being proactive and approaching environmental initiatives from a global perspective, organizations can move beyond simply enabling compliance. They can answer the moral imperative of being good corporate citizens while strengthening their businesses by recognizing hidden efficiencies and thus, uncovering the economic benefits of sound environmental sustainability practices.

This is accomplished by implementing a system that manages their knowledge and evolves the processes to incorporate best practices, organizational, and environmental changes. The information gathered from the various processes must be continually available in a manner that is obvious, timely, and appropriate. This ultimate step is addressed by using data dashboards that allow for a completely customizable experience that is tailored to the user's area of responsibility. Armed with the appropriate metrics, key performance indicators, and analysis available at a glance, all members at every level of an organization are empowered and encouraged to improve the underlying processes, and thereby, the organization.

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