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Enterprise Architecture Maturity: The Story of the Veterans Health Administration[1]

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Executive Summary

The Veterans Health Administration's (VHA) health care system was once considered one of the worst in the United States. For many veterans, it was the last resort. In the early 1990s, in fact, its system had deteriorated so much that Congress considered disbanding it. However, since then, it has undergone a dramatic transformation and is now considered one of the best health care systems in the nation and a leader in almost every health care performance metric.

We conducted an in-depth investigation of the VHA for about a year to understand its dramatic turnaround. We found that information technology (IT) played a key role. In particular, we found that by increasing the maturity of its enterprise architecture, the VHA achieved a high degree of integration and standardization in its business processes, which helped it transform its operations.

Based on our study of the VHA, we postulate six catalysts for successfully evolving enterprise architecture maturity: (1) formulate a strategic vision for enterprise architecture and gain long-term commitment from top management; (2) involve central and local groups; (3) take an evolutionary, rather than a revolutionary, approach; (4) have a strategy for supporting IT systems and business processes; (5) require local accountability for implementing global objectives; and (6) implement an effective performance management program. Once an enterprise architecture is mature, it can be used for strategic advantage.

ENTERPRISE ARCHITECTURE: A STRATEGIC WEAPON

Notwithstanding the recent debate about the value of information technology (IT) for organizations,[2] it is generally agreed that IT is crucial for any organization to survive and prosper in the hypercompetitive business environment that many organizations currently experience. There is some evidence that IT investments can lead to profitability and productivity.[3] However, one question remains largely unanswered: *can IT be a strategic weapon, rather than just a productivity-enhancing tool, for organizations?*

Some have argued that IT is only an infrastructural commodity, like electricity, and is needed just for organizational activities and operations. IT cannot provide strategic advantage. In contrast, others cite Wal-Mart, Dell, and Amazon.com to argue that IT capabilities can, indeed, be used to achieve strategic benefits. This paradox leads to the question, "Why do some organizations successfully use IT strategically while

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1 Jack Rockart was the accepting Senior Editor for this article.

2 This debate was started by Carr. See Carr, N.G. *Does IT Matter? Information Technology and the Corrosion of Competitive Advantage*, Harvard Business School Press, Boston, MA, 2004. The debate and rebuttals by many others include Smith and Fingar. See Smith, H., and Fingar, P. *IT Doesn't Matter: Business Processes Do*, Meghan-Kiffer Press, Tampa, FL, 2003.

3 For more details on IT investments and organizational performance, see Devaraj, S., and Kohli, R. "Performance Impacts of Information Technology: Is Actual Usage the Missing Link?" *Management Science* (49:3), 2003, pp. 273-289.

others don't?" One recent answer is that organizations that succeed in using IT strategically have done so by designing and implementing an *effective enterprise architecture*.[4]

Enterprise architecture is defined as the organizing logic for an organization's IT infrastructure and business process capabilities to address a firm's need for IT and business process integration and standardization.[5] Organizations with a mature enterprise architecture possess a strong foundation for execution. This foundation results from carefully institutionalizing IT infrastructure and coupling it with digitized business processes. These organizations successfully identify their core activities and implement IT systems to digitize them. They implement cross-functional, end-to-end, IT-enabled business processes and standardize these processes to avoid variations across the organization. Such a strong foundation for execution has been achieved by Cemex, Dow Chemicals, and ING Direct, resulting in higher profitability, more agility, and greater return on IT investments compared to their competitors.[6] These organizations also have better customer intelligence, higher employee and senior management satisfaction, and lower IT costs. Overall, a well-designed and implemented enterprise architecture can be a strategic weapon.

Many organizations across industries and economic sectors (e.g., retailers, high-tech firms, financial services) have embraced the need to develop an effective enterprise architecture. But our review of various industry reports suggests that the health care sector still lags in this regard. One way health care can improve the quality of information and maximize the benefits of IT is to design and implement a *better, more mature* enterprise architecture.

To discuss the role of enterprise architecture in designing health care IT, we present the case[7] of the Veterans Health Administration (VHA), the health care arm of the Department of Veterans Affairs (VA) that serves the needs of U.S. veterans. Over the past two decades, the VHA has perfected its enterprise architecture, become more efficient, and has moved from one of the worst to one of the best health care systems in the U.S.

ENTERPRISE ARCHITECTURE MATURITY

Enterprise architecture has four stages of maturity, see Figure 1:

1. *Business silos:* In this stage, an organization develops and deploys disparate IT applications that address the needs of local business units and functional entities (e.g., product line, region). These applications are not necessarily integrated, and they typically do not share enterprise-wide data sources.

2. *Standardized technology:* In this stage, an organization develops and implements a set of standards that helps it implement different IT applications and improve its data capabilities throughout the organization. The primary objective of such standardization is to reduce disparate local efforts of developing or modifying IT applications. Instead, the core IT standards are shared by all IT applications, which improves organizational efficiency and cost effectiveness.

3. *Rationalized processes:* When firms reach this stage, they begin implementing enterprise-wide IT systems that support standardized business processes for their core business operations. These systems are built on top of the standardized technology introduced in Stage 2, resulting in better enterprise-wide sharing of data and processes.

4. *Business modularity:* To date, this stage of maturity has proven the most elusive for enterprises. Ross and her colleagues found that only about six percent of firms have reached it. In this stage, an organization begins to develop and leverage capabilities to integrate customized and/or industry-standard components for greater organizational benefits. The key characteristic of this stage is achieving a "plug-and-play" capability of integrating internal or external business processes.[8]

4 For more information on enterprise architecture, see Ross, J.W. "Creating a Strategic IT Architecture Competency: Learning in Stages," *MIS Quarterly Executive* (2:1), 2003, pp. 31-43; Ross, J.W., and Beath, C.M., "Sustainable IT Outsourcing Success: Let Enterprise Architecture be Your Guide," *MIS Quarterly Executive* (5:4), 2006, pp. 181-192; and Ross, J.W., Weill, P., and Robertson, D.C. *Enterprise Architecture as Strategy: Creating A Foundation for Business Execution*, Harvard Business School Process, Boston, MA, 2006.

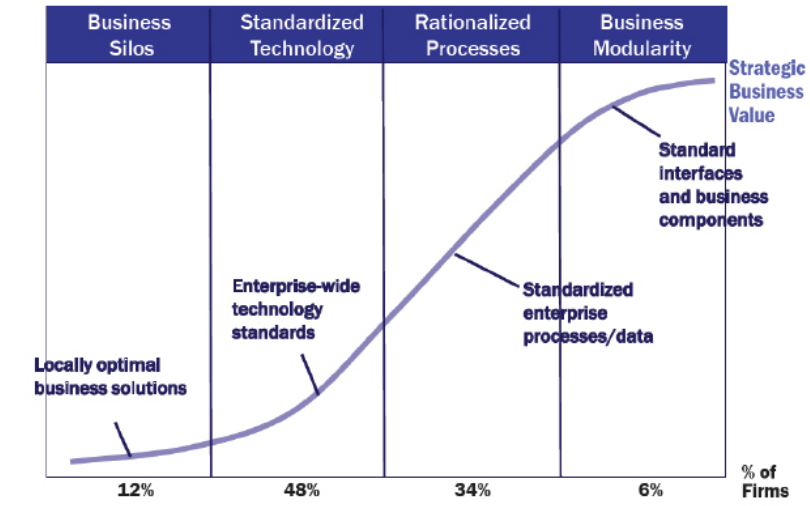
5 Ibid.

6 Ibid.

7 We conducted an in-depth case study at the VHA that spanned over a year. We collected both primary (e.g., interviews) and secondary (e.g., corporate documents) data.

8 Ross, Weill, and Robertson, op. cit. 2006

Figure 1: Enterprise Architecture Maturity



As organizations progress through these stages, they appreciate the strategic value of IT and the role IT plays in improving their business effectiveness. Prior research has suggested that organizations cannot skip a stage in increasing their maturity because important lessons in each stage—both technology and organizational—help organizations prepare for the next stage. Prior research has also noted that large firms typically require five years per stage. Next, we discuss the importance of enterprise architecture for health care and then how it has been important to the VHA.

ENTERPRISE ARCHITECTURE FOR HEALTH CARE

Like most other sectors of the economy, health care has benefited enormously from IT. IT plays a major role in improving the nature and quality of services rendered and in enhancing the efficiency and effectiveness of internal operations of health care providers.[9] Health care providers were initially slow to adopt IT when compared to organizations in other sectors. Over the past two decades, though, there has been a rapid deployment of IT applications that support clinical, research, finance, and administrative operations.[10]

Recent reports[11] by HIMSS (Healthcare Information and Management Systems Society) and Dorenfest Institute suggest that a medium-sized health care provider may have approximately 90 different IT applications to handle various clinical and non-clinical processes.[12] These applications, however, are largely unstandardized (e.g., different applications use different data sources) and lack integration or interoperability (i.e., the different applications do not coordinate with one another). This lack of standardization and integration prohibit health care providers from developing effective end-to-end business processes. For example, without coordination among order entry, laboratory, pharmacy, and electronic claim applications, each patient's record must be entered into each of these applications separately. The result is fragmented or ad-hoc clinical processes for each patient because there is no single source of clinical data. Different business units, responsible for different aspects of processes, may not have a shared understanding of a patient's clinical condition, history, and financial status.[13]

With some exceptions, primarily in large academic medical centers, hospitals today are far from effective in their clinical use of IT. Various reports suggest

9 For more information on the role of IT in health care, see Raghupathi, W., and Tan, J. "Strategic IT Application in Health Care," *Communications of the ACM* (45:12), 2002, pp. 56-61, and Spear, S.J. "Fixing Health Care from the Inside, Today," *Harvard Business Review* (83:9), 2005, pp. 78-91.

10 Spear, op. cit. 2005, and Arnst, C. The Best Medical Care in the U.S. *BusinessWeek*, July 17, 2006, pp. 50-56.

11 See http://www.himss.org/DorenfestInstitute/default.aspx for HIMSS and Dorenfest Institute reports on the U.S. Hospital IT Market 2004-2005, the Clinical Systems Hospital IT Market 1998-2005, and the Financial Systems Hospital IT Market, 1998-2005.

12 Examples of these systems include, but are not limited to, computerized patient record systems (CPRS), computerized patient order entry (CPOE) systems, various pharmacy and laboratory systems, ambulatory EMR systems, electronic claims systems, payroll, accounts receivable, materials management, patient billing systems, etc.

13 Ross, Weill, and Robertson, op. cit. 2006.

that only about eight percent of health care providers use *integrated* IT applications to record and manage clinical care. Errors and poor patient care are attributed to several factors. One is lack of access to complete information about drugs, patients, processes, and procedures. A report by the *Institute of Medicine* in 1999 suggested that three out of every four medical errors could have been avoided by "better information systems that disseminate knowledge about drug and patient information readily accessible at the time it is needed."[14] In 2007, the situation has changed for the better, but much remains to be done.

The VHA has successfully standardized and integrated its IT applications and created end-to-end business processes, thus moving into the third stage of enterprise architecture. The VHA, once known for its poor quality of care and inefficient operations, has transformed itself into one of the best U.S. health care providers. This transformation was facilitated, in large part, by its proactive design and implementation of enterprise architecture.

THE VETERANS HEALTH ADIMINISTRATION'S ARCHITECTURAL EVOLUTION

The VHA is one of three organizations of the Department of Veterans Affairs (VA), a department of the U.S. federal government dedicated to serving U.S. veterans.[15] The VHA's annual budget is over $26 billion, and it has 158 medical centers, 877 outpatient clinics, 137 nursing homes, 43 domiciliaries,[16] 73 home care programs, 207 readjustment counseling centers, and various other facilities in 21 regions across the U.S. The VHA is the largest integrated health care system in the U.S. Its core mission is to "serve the needs of America's veterans by providing primary care, specialized care, and related medical and social support services."

The VHA is headed by the Under Secretary for Health, who reports to the Secretary of Veterans Affairs. The organization chart of the VHA at the time of our data collection is shown in Figure 2.[17] The VHA is organized as 14 different business units or offices (e.g., Office of Information, Office of Patient Care Service) to serve various administrative and operational needs. It has about 200,000 employees who annually serve more than 5 million veterans nationwide. The number of patients has increased more than 100 percent over the past 10 years. Apart from providing health care, the VHA is a major contributor to medical research. A majority of medical graduates in the U.S. undergo training at VHA hospitals.[18] For decades, these hospitals were known for "filthy conditions, shortages of everything, and treatment bordering on barbarism".[19] In the early 1990s, Congress considered disbanding the VHA.[20]

The Maturation of the VHA's Enterprise Architecture

The VHA's evolution in enterprise architecture is shown in Figure 3.

Stage 1: Business Silos. The VHA's enterprise architecture evolution began in the late 1970s when the Office of Data Management and Telecommunications (ODM&T), a federal government agency, developed a set of centralized batch transaction-based IT applications for the VHA. During the same time, the local VHA facilities began computerizing, primarily to facilitate research activities.

We connote this period as *Stage 1* of enterprise architecture maturity because the different IT applications developed by ODM&T supported different clinical functions (e.g., lab and pharmacy), and these applications were not developed based on technology standards or a shared infrastructure.[21] In addition, these applications did not share enterprise-wide data sources.

Stage 2: Standardized Technology. The applications developed by ODM&T had several shortcomings, including the lack of local control and the inability to meet local needs. In 1978, a group known as Computer Assisted System Stuff (CASS),[22] from the

14 Institute of Medicine, "To Err is Human: Building a Safer Health System," in Cohn, L.T., Corrigan. J.M., and Donaldson, M.S. (Eds.), *Committee on the Quality of Health Care in America*, National Academies Press, Washington, D.C., 1999.

15 The other two organizations under the VA are the Veterans Benefits Administration and National Cemetery Administration.

16 An institutional home for aged and disabled veterans who cannot care for themselves.

17 The VHA is currently undergoing a major organizational restructuring as a part of its continuing efforts to improve the quality of patient care. However, the recent organizational restructuring took place after we completed our case study.

18 Brown, S.A., Lincoln, M.J., Groen, P.J., and Kolodner R.M. "VistA—U.S. Department of Veterans Affairs National-scale HIS," *International Journal of Medical Informatics* (69), 2003, pp. 135-156.

19 Longman, P. "The Best Care Anywhere," *Washington Monthly,* January/February 2005.

20 Gardner J. "VA on the Spot: Care Quality, Oversight to be Probed by Congress," *Modern Healthcare* (28), 1998, pp. 39.

21 Ross, Weill, and Robertson, op. cit. 2006.

22 CASS was formed by the Department of Medicine and Surgery (DM&S) of the VHA outside the scope of ODM&T, the central IT organization of the VA, to develop IT applications to meet the

Figure 2: Organizational Chart of the VHA

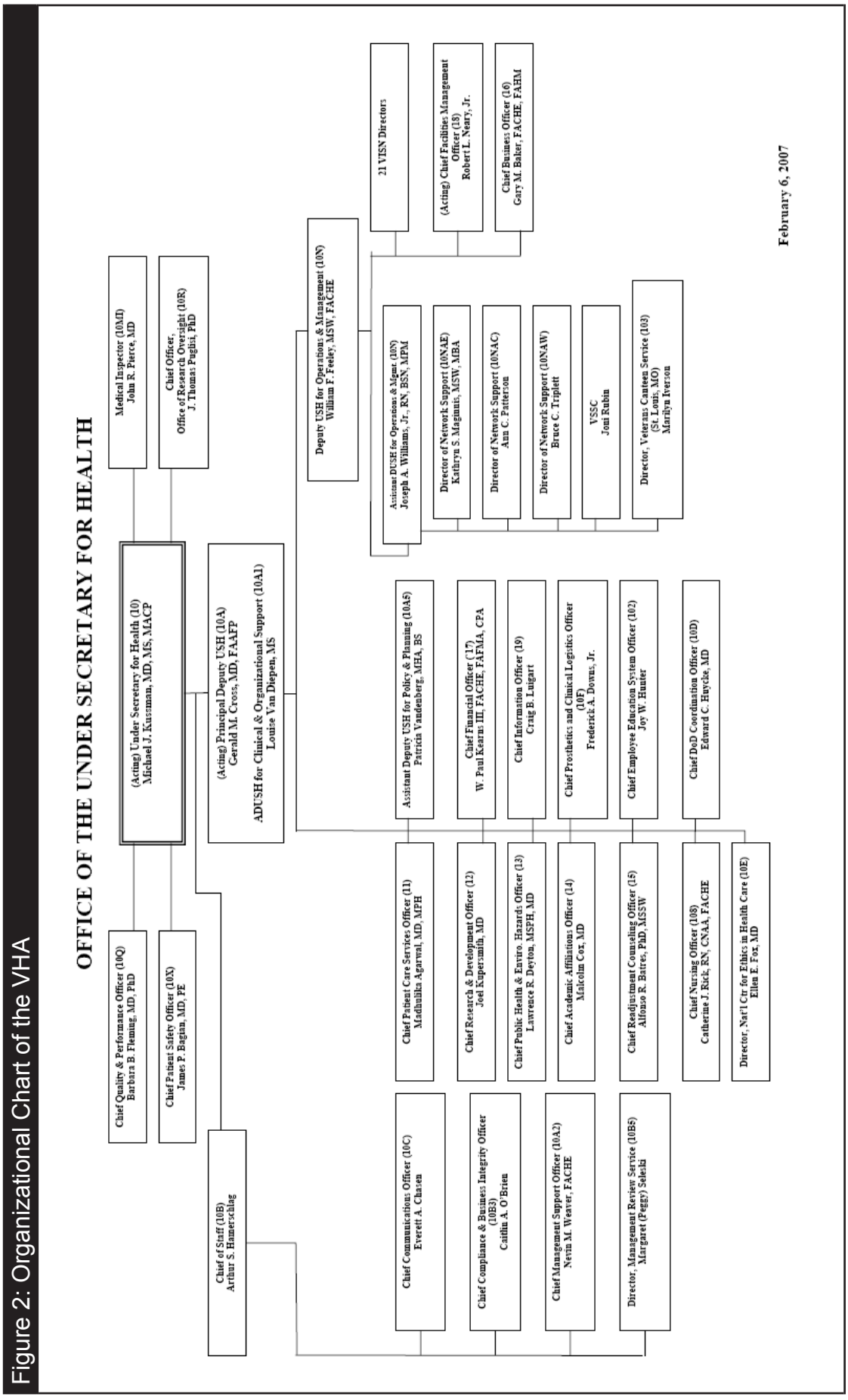
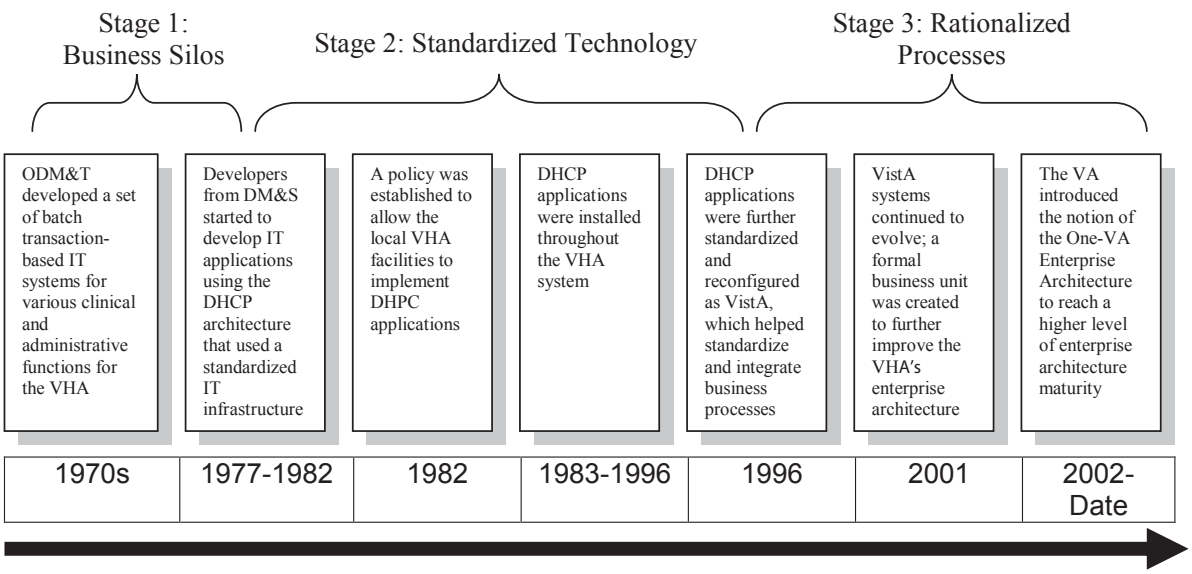


Figure 3: The VHA's Enterprise Architecture Evolution



Department of Medicine and Surgery (DM&S) of the VHA, proposed an IT architecture known as the Decentralized Hospital Computer Program (DHCP), and started developing IT applications using it.

The core architectural characteristics of DHCP were: minicomputers, interactive programs, table-driven reusable modules, and decentralized rapid prototype development.[23] This development of DHCP marked the beginning of the VHA's transition to standardized technology—*Stage 2* of enterprise architecture maturity.

The developers from CASS adopted a rapid development methodology to quickly develop IT applications based on a standardized IT platform and to bypass bureaucratic processes. The ODM&T, which was serving as the VA's central IT organization at that time, strongly opposed the development of DHCP applications because they saw the new architecture as a threat to their control over the VHA's IT systems and infrastructure. To stop DHCP application development and deployment, ODM&T took such steps as cutting IT budgets and dismissing participating employees. But physicians and local administrators wanted to deploy these applications because they saw several advantages. In particular, the applications addressed their local needs. They won the battle. The approach was favorably mentioned in a report to the U.S. Congress, suggesting that these applications should be deployed immediately to improve VHA performance and allow the VHA to better compete with private health care providers.[24] As a result, in 1982, Robert Nimmo, VA administrator, approved a policy that allowed the local facilities to select and deploy DHCP-compliant IT applications. This policy was a key step in transitioning to Stage 2.

This standardized technology stage also required agreeing on basic programming and data dictionary standards. An active data dictionary was developed to map data and to support code portability across applications and organizations. In 1983, the VHA facilities began deploying DHCP applications, such as clinical lab and inpatient pharmacy. By the end of 1989, VHA facilities nationwide had deployed a full suite of DHCP applications—medical center management, medical records, radiology, and surgery.

So the local facilities deployed the standard set of IT applications on standard platforms. In addition, the local managers were given responsibility for several aspects of the systems: they were to suggest changes to the applications, they controlled the data in their local dictionary (but not the dictionary structure), they performed some local development (e.g., many IT applications were designed and developed locally but deployed in the VHA locations across the country), they managed their local hardware and servers,

needs of DM&S. CASS recruited developers who specialized in the programming languages suitable for clinical applications development.

23 For more information on the DHCP architecture, see op. cit, Brown, et al., 2003.

24 Ibid.

and they paid some of the costs of developing and deploying these shared applications.

The VHA developed mechanisms to incorporate the user inputs to improve the applications.[25] These mechanisms allowed local users to request modifications or feature extensions, which, if feasible, were added to subsequent versions of these applications. The VHA believed that this increased local accountability actually improved VHA-wide cooperation with the transformation.

Stage 3: Rationalized Processes. The VHA medical centers and other facilities operated relatively independently, even competing against each other in many ways. But in 1996, the *Veterans Health Care Eligibility Reform Act* was passed by Congress, enabling the VHA to restructure itself from a system of hospitals into a single health care system. It created 21 regions, which together were called the *Veterans Integrated Services Network (VISN)*. The aim was to effectively manage and organize the operations of all the VHA medical centers. The VHA also began reengineering efforts to improve use of IT, measure and report performance, and integrate services[26] to improve the efficiency and effectiveness of patient care. Importantly, the VHA also developed a full-scale information architecture for the first time.

At this time, the VHA also reconfigured the DHCP architecture, renaming it the Veterans Health Information Systems and Technology Architecture (VistA). Introduction of VistA marked the beginning of the VHA's transition to *Stage 3* (rationalized processes) of enterprise architecture maturity. Applications developed under VistA had a three-tier architecture—presentation tier, business rule tier, and data tier.[27] Together, the VistA applications formed an enterprise system[28] because they supported different VHA functional aspects and business processes.

The organization-wide reengineering and restructuring efforts aligned with the new IT architecture. Significantly, top management made it very clear that the design and implementation of the new IT architecture was critical to the success of the organizational restructuring. This proclamation eased the assimilation of the architecture throughout the organization. The alignment and timing helped the VHA achieve a higher degree of acceptance of the IT applications throughout the organization because employees understood the strategic value of the transformation.[29]

Currently, 128 independent but interoperable VistA applications are available to VHA hospitals and clinics to store, access, and process data pertaining to clinical, operational, administrative, and financial processes. Local VistA applications were integrated with the Computerized Patient Record Systems (CPRS), a medical record system used by physicians to enter and access patient data. VistAWeb—a Web-based remote data view that provides access to the medical records—was developed to provide health care to veterans at various locations across the country. The VHA also implemented several regional data warehouses that regularly update subsets of clinical and operational data extracted from the individual VistA applications. In 2005, the VHA started to implement an enterprise data warehouse (EDW) that serves as a central data repository for the entire VHA health care system.

The development of enterprise systems, such as EDW and other strategic IT applications (e.g., CPRS, VistA Imaging,[30] and Barcode Medication Administration[31]), helped the VHA standardize and integrate clinical and administrative processes across the VHA and gain tremendous efficiencies in day-to-day operations. By mandating use of VistA applications that shared the standard data architecture and dictionary, VHA standardized business processes.

25 The VHA developed a mechanism called Electronic Error and Enhancement Reporting (E3R) to identify and prioritize requirements for its IT systems. E3R helped the VA maintain the same standards for incorporating user inputs into the IT transformation processes and involving users in various IT initiatives across different locations and departments.

26 For more details on the VHA's reengineering efforts, see Jha, A.K., Perlin, J.B., Kizer, K.W., and Dudley, R.A. "Effect of the Transformation of the Veterans Affairs Health Care System on the Quality of Care," *New England Journal of Medicine* (348:22), 2003, pp. 18-27; Kizer, K.W. "The 'new VA': A National Laboratory for Health Care Quality Management," *American Journal of Medical Quality* (14), 1999, pp. 3-20; and Kizer, K. W. "Reengineering the Veterans Healthcare System," in Ramsaroop, P., Ball, M.J., Beaulieu, D, and Douglas J.V. (Eds.), *Advancing Federal Sector Health Care: A Model for Technology Transfer*, Springer-Verlag, NY, 2001, pp. 79-96.

27 The presentation tier is the graphical user interface (GUI) that end users use to access the system. The business rule tier handles the specific processing rules and logic pertinent to a system. The data tier provides the necessary data services to the business rule and presentation tiers based on user requests.

28 Enterprise systems (ES) are software packages that provide seamless integration of all the information flowing through a company across different work units and business processes. An example of an enterprise system is an enterprise resource planning (ERP) system.

29 Jha et al., op. cit. 2003; and Kizer, op. cit. 1999, 2001

30 VistA imaging is an online multimedia application that integrates traditional medical chart information with a variety of medical images, such as X-rays, pathology slides, cardiology motion views, wound photos, and pictures acquired through endoscopy, surgery, and eye exams.

31 The Bar Code Medication Administration (BCMA) system validates and documents medications and associated instructions for patients.

One of the defining characteristics of standardized business processes is that a customer should experience a single face of a process no matter when and where the process is executed.[32] The standard applications for clinical processes across the VHA ensured that the local facilities were executing standard clinical processes. For example, the VHA mandated the use of a Bar Code Medication Administration (BCMA) system in the medication process. By electronically validating and documenting medications and associated instructions for patients, the VHA reduced the serious problem of inpatient medication errors.

These applications helped the VHA make the clinical processes patient-centered rather than department-centered. Clinicians could easily track the history of a patient using these applications and make informed decisions irrespective of the times and locations of a patient's visits. The VA developed global performance measures centrally and made the local managers accountable for these measures.[33] Each year, the VHA identifies the most important performance metrics for the various functional areas—clinical, operational, administrative, and financial. Both local and national managers can see and validate these performance metrics. This process made IT a critical part of the business processes.

The VHA also initiated a support structure to promote the IT applications and standard business processes and to assist users in using these applications or executing the processes. This support structure included champions in each business unit or group and national training programs for the applications and business processes.[34]

In 2001, the VA's top management created an Enterprise Architecture Innovation Team (EAIT) to design and implement what is currently known as the *One-VA Enterprise Architecture*. It presents a blueprint for (1) systematically defining and documenting the VA's current and future operational and strategic environment and (2) modifying and developing IT systems to align with the VA's business goals and values. More recently, the VA created a formal business unit—the Office of Enterprise Architecture Management (OEAM)—within the central IT organization to maintain the One-VA Enterprise Architecture and to ensure integration between IT and business processes.[35]

The fundamental objective of the One-VA Enterprise Architecture is to develop and deploy IT applications and associated infrastructure so that veterans receive the highest possible quality of care without interruptions and frustration.[36] The architecture will enable the VA "to provide an accessible source of consistent, reliable, accurate, useful, and secure information and knowledge to veterans and their families, . . . workforce, and stakeholders to support effective delivery of services and benefits, enabling effective decision making and understanding of . . . capabilities and accomplishments."[37] We believe that successfully implementing the One-VA Enterprise Architecture and other technical (e.g., VistA applications) and organizational (e.g., formation of EAIT) capabilities may help the VHA reach Stage 4 (business modularity) and beyond (e.g., dynamic venturing)[38] of enterprise architecture maturity.

The New and Transformed VHA

The VHA's enterprise architecture maturity, along with other organization-wide reengineering and restructuring efforts, had a far-reaching impact on the quality and efficiency of the VHA's health care services. *BusinessWeek* recently reported that the VHA has the most advanced electronic health record system

32 Ross, Weill, and Robertson, op. cit. 2006.

33 As part of the Government Performance and Results Act, the VA, as a federal government agency, has engaged in a performance agreement with the White House, administered through the Office of Management and Budget. Since 1995, an annual performance contract has been in place between the Under Secretary for Health and senior VA leaders.

34 For example, the VA organizes an annual Information Technology Conference (ITC) that has an intensive schedule of presentations, tutorials, and demonstrations of IT systems for VA staff, developers, and vendors. Each medical center typically sends at least one clinical application coordinator and a clinical champion, in addition to a chief or associate chief information officer, to participate in this conference. In addition, the VA developed several dedicated IT support groups, including (1) a capacity management group that provides national system resource monitoring data; (2) a central hardware support group that provides all hardware-related support; (3) a customer support office that provides central software support to all VA sites and access to leading application experts and problem solvers; and (4) a national database integration team that merges the VA's IT systems in response to organizational mandates.

35 For more details on the One-VA Enterprise Architecture, see Department of Veterans Affairs, "Enterprise Architecture: Strategy, Governance, & Implementation", VA Enterprise Architecture Innovation Team, Washington, D.C., August 2001. While EAIT and OEAM work closely with the VA's central IT organization, members in these teams come from different business units of the VA and VHA. These teams report to the VA's Strategic Management Council, which has broader membership and is responsible for reviewing all major policy and management issues, assessing options, and making recommendations to the Secretary through VA's Executive Board.

36 Ibid.

37 Ibid.

38 Ross, Weill, and Robertson, op. cit. 2006. Ross et al. (2006) suggested dynamic venturing as the fifth stage of enterprise architecture maturity. In dynamic venturing, organizations develop seamless integration of IT and business processes with trading partners.

in the U.S.[39] A *New York Times* article mentioned that the VHA "has managed to improve nearly every benchmark of quality in health care" using IT systems.[40] Recently, the VHA received the prestigious *Innovations in American Government Award* presented by the Ash Institute for Democratic Governance and Innovation at Harvard University's John F. Kennedy School of Government for its IT systems.

The VHA has also been frequently touted as the nation's best IT-enabled health care provider by several media outlets, including the *Washington Post* and *Wall Street Journal*.[41] A study published in the *New England Journal of Medicine* found that the VHA's quality of care substantially improved after the organization-wide reengineering, and it was statistically significantly better (based on a mean-difference test) than the *Medicare* fee-for-service program when pre- and post-implementation key performance indicators (KPIs) were compared.[42]

While several components of the reengineering could be attributed to this success, several articles published in medical and trade journals have indicated that the enterprise architecture evolution (i.e., standardized IT applications and business processes) was a key driver to improving performance.[43] Recent statistics suggest that the VHA's patient satisfaction rate is 83% for inpatient and 80% for outpatient, care which is significantly higher than the national average of private sector health care providers (73% and 75% respectively for inpatient and outpatient). According to a Rand Corporation study, the VHA system provides 67% of the care recommended by national standards, whereas private sector hospitals provide only 50% of the recommended care (see Figure 4). The VHA's prescription accuracy rate is 99.997%, which is significantly higher than the national average. It is noteworthy that while the VHA has a much higher patient satisfaction record, its average cost per patient of about $5,000 per year is substantially lower than the national average of $6,300. These statistics clearly indicate that the VHA's transformation efforts have improved patient care and made the VHA one of the best and most cost-effective health care providers.

Figure 4: Quality of Care Comparison[44]

Health Indicator	VHA Score	National Sample
Overall	67%	51%
Chronic care	72	59
Lung disease	69	59
Heart disease	73	70
Depression	80	62
Diabetes	70	47
Hypertension	78	65
High cholesterol	64	53
Osteoarthritis	65	57
Preventive care	64	44
Acute care	53	55
Screening	68	46
Diagnosis	73	61
Treatment	56	41
Follow-up	73	58

SIX CATALYSTS FOR SUCCESS

The VHA's journey and the evidence of impact suggest that achieving enterprise architecture maturity, as a major part of organizational change, can be of great value to organizations. If the VHA had not matured its enterprise architecture (i.e., to standardized technology and rationalized processes), it might not have become one of the best health care providers in the U.S. The following key factors served as the catalysts for the VHA's dramatic transformation.

Success Catalyst #1: Formulating a Strategic Vision for Enterprise Architecture and Gaining Long-term Commitment from Top Management. The VHA's effort to reinvent itself during the 1990s as a model system characterized by patient-centered and high-quality health care was only possible due to the strategic vision developed and championed by the VHA and VA leaders. Development of the strategic enterprise architecture was a key priority in this vision.

While a strategic vision is necessary, that vision cannot be achieved without top management commitment—in this case, for the long term. There are many examples of organizational leaders initially buying into a strategic vision for enterprise architecture only to withdraw that support when they see no immediate return on investment. Top management of the VHA, however, ensured that its vision would be implemented

39 Arnst, C. "The Best Medical Care in the U.S.," *BusinessWeek*, July 17, 2006, pp. 50-56.
40 Goetz, T. "Physician, Upgrade Thyself," *New York Times*, May 30, 2007.
41 Longman, op. cit. 2005.
42 Jha, et al., op. cit. 2003.
43 For more details on the VHA's performance improvement, see Longman, op. cit. 2005; Arnst, op. cit. 2006; and Jha, et al. op. cit. 2003.
44 Adapted from Arnst, op. cit. 2006.

by understanding that the architecture would need to evolve and its full benefits would not materialize for several years. The strategic teams (i.e., EAIT) and the formal business unit (i.e., OEAM) to support and further improve the architecture also illustrate top management's commitment.

Success Catalyst #2: Involving central and local groups. The VHA involved both central and local IT groups in design and implementation while maturing its enterprise architecture.[45] The following three areas of central-local work stand out.

One, the VHA involved central and local groups to increase configuration flexibility. The VHA allowed local configuration flexibility of its IT applications by permitting local managers to configure some aspects of the applications. For example, the local managers were given "control over the content, but not the structure, of data dictionaries."[46] Thus each local facility could have its own data definition files to meet its local needs. This responsibility for local data configuration increased the local users' acceptance of the applications, the standard business processes, and the associated infrastructural technologies.

Two, the VHA involved central and local IT groups in development. The VHA initiated development of enterprise architecture components centrally by designing the architecture and implementation blueprints centrally. But it delegated a substantial part of the other development activities, which greatly increased local managers' and employees' participation and involvement.

Three, the VHA balanced central with local control of infrastructure technologies. The VHA permitted local management to manage and control the infrastructure technologies (e.g., the hardware and servers). This local technology control proved to be more beneficial than central control because it created local accountability. The local managers felt empowered and motivated to maintain these technologies in conformance with the expectations of top management.

Success Catalyst #3: Taking an Evolutionary, Rather than a Revolutionary, Approach. Research has suggested that for the transition between enterprise architecture stages to be effective, it should be evolutionary (i.e., gradual and slow) rather than revolutionary (i.e., radical and quick).[47] The VHA's transitions to the higher levels were evolutionary, which proved effective in its environment because performance improved greatly and the VHA did not encounter the employee resistance and performance degradation that almost always occurs in the early stages of revolutionary change.

Its evolutionary change approach also improved customer satisfaction because veterans did not experience sudden changes in the way they received VHA services. The earlier stages of enterprise architecture evolution served as launching pads for the later stages because the new components were not substantially different from the old ones. The new VistA applications benefited from the previously standardized DHCP architecture.

Success Catalyst #4: Having a Strategy for Supporting IT Systems and Business Processes. A support strategy is essential for any organization to improve user acceptance of IT systems and their associated business processes, and to ensure that IT is used appropriately and the business processes are executed properly. The VHA developed several local and national support programs for its IT systems and business processes (see footnote 35 for more details). The objective of this strategy was to help employees understand the value of the architectural transition and facilitate their use of the IT applications and the standard business processes. A key reason for the VHA's success has been the end users' ability to use the IT applications and execute the business processes effectively. The strong support structure developed by the VHA was instrumental in assisting the end users in this regard.

Success Catalyst #5: Requiring Local Accountability for Implementing Global Objectives. A defining characteristic of the VHA's enterprise architecture is its local accountability for global objectives. The VHA developed organizational objectives by developing the strategic vision and goals using a top-down approach. The vision and goals were then translated into local objectives and delegated to local managers and employees.

The core architecture of the VistA systems was developed centrally. However, each VistA application was independently installed and maintained by local managers. Local managers were responsible for ensuring that local clinicians and other employees used the systems and standard business processes. This local accountability is a critical success factor for increasing enterprise architecture maturity because it fosters buy-in to the transformative changes.

45 Brown, et al., op. cit. 2003.
46 Ibid.
47 Ross, Weill, and Robertson, op. cit. 2006.

Success Catalyst #6: Implementing an Effective Performance Management Program. The VHA developed a performance management program to reduce variations in clinical practices and processes, increase consistency among services across the organization, improve the quality of care delivered to the veterans and their families, and achieve continuous process improvement. The performance measures were built into the IT applications so that these applications could effectively monitor and report the measures to the pertinent stakeholders.[48] Management mandated the use of the IT applications and standardized business processes. The data from the IT applications is used to understand performance variations and how the standard processes are executed.

THE BENEFITS OF ENTERPRISE ARCHITECTURE

Over the years, many health care providers have deployed IT applications that have not been integrated or interoperable because they have been built to fix local problems rather than create long-term solutions that support and digitize end-to-end business processes. Without standardization and integration, these health care providers face data-redundancy and process-efficiency problems, which limit their effectiveness. A well-designed enterprise architecture can help health care providers become more effective across the business and more cost effective in IT by lowering their IT maintenance costs.

Similarly, by standardizing and integrating IT applications and business processes, enterprises can achieve economies of scale. With single sources of data, an enterprise architecture can improve information quality, which is increasingly important for health care providers because of today's emphasis on high-quality patient care. We believe that those health care providers that have low enterprise architecture maturity (e.g., business silos or standardized technology) should consider moving to the next stage to realize the value of IT and IT-enabled business processes.

The VHA's experiences can help others, especially large organizations with geographically dispersed locations. To reduce process variations and ensure a single face of business processes, like the VHA, other organizations can allow local configurations of IT applications while mandating use of standard business processes. However, local configurations should not come at the expense of standardization and integration of IT applications and business processes. Both are critical to increasing enterprise architecture maturity. To successfully transition to a higher stage, organizations must provide the appropriate support processes during the transition. Finally, they must have a strategic vision and a strategy that are conceived and championed by top management.

48 For 2006, the VA identified 92 performance measures. Nine of them are: (1) new patient wait time; (2) revenue collections; (3) breast cancer screening; (4) colon cancer screening; (5) acute coronary syndrome; (6) inpatient mortality; (7) heart failure; (8) immunizations; and (9) veteran satisfaction.

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