Proceedings of Student/Faculty Research Day, CSIS, Pace University, May 4th, 2007

Extending the Life of Legacy Software Systems Through the Addition of Internet Components

David Fronckowiak

Seidenberg School of CSIS, Pace University, New York

Abstract

This paper contains the research plan that will analyze the context and type of internet inventions that have been used to extend the lifetimes of legacy systems. Certain types of legacy systems, or certain types of internet inventions, may be more amenable to extending the life of a legacy system. It is anticipated that this analysis will result in a framework or model that tabulates such types of legacy systems with their expected years of legacy system extension. The Technology Life Cycle model will be used to analyze the different internet components that are used in the extension of the legacy systems.

Introduction

Companies have long been confronted with the decision either to extend the life of a legacy system or to retire the system, planning either to develop a new customized system or to use a commercially available one. The literature contains numerous works on those factors which must be considered when extending the life of a legacy system in light of the Technology Life Cycle (TLC) model. This paper will detail the plan that will be used to study the use of internet components in the extension of legacy systems.

Technology Life Cycle Models

Technology is defined as the application of scientific knowledge, especially in industry and business. Ray Kurzweil [5] presented a modified definition of technology along with seven phases of the technology life cycle. Kurzweil's view of technology is that it "is the continuation of evolution by other means. One interpretation of technology is the study of crafting, in which crafting refers to the shaping of resources for a practical purpose." Kenneth Kendall [4] presented another version of the technology life cycle that contains five phases. Table 1 lists the phases for the Kurzweil and Kendall technology life cycles.

TLC from Ray Kurzweil	TLC from Kenneth Kendall
Precursor	
Invention	Innovation or discovery
Development	Emergence
Maturity	Acceptance
Pretenders	Sublime
Obsolescence	Surplus
Antiquity	

Table 1. Technology Life Cycle Phases.

TLC from Ray Kurzweil	TLC from Kenneth Kendall	State of Pa. Office of IT	Utterback	Roberts and Liu	SEI
Precursor					
Invention	Innovation or discovery	Research/E merging	Fluid Phase	Fluid Phase	Exploration
Development	Emergence		Transitional Phase	Transitional Phase	
Maturity	Acceptance	Current	Mature Phase	Mature Phase	Maturation
Pretenders	Sublime	Contain	Discontinuities Phase	Discontinuities Phase	Outreach
Obsolescence	Surplus	Retire			Support
Antiquity					

Table 2. Comparison of Technology Life Cycle Models

The models of Kurzweil and Kendall are similar except for Kurzweil's initial precursor stage and ending antiquity stage. Kurzweil refers to the precursor stage as the prerequisite of a technology where the elements of a technology invention are contemplated. In the Kurzweil obsolescence and Kendall surplus stages, a new technology is introduced which renders the older technology obsolete. Kurzweil then adds his final stage of antiquity where the original functionality of the older technology is overcome by the newer technology competitor.

Many other versions of the Technology Life Cycle model have also been presented. The Office of Administration for the State of Pennsylvania [8], Abernathy and Utterback [1], Ansoff and Stewart [2], and Roberts and Liu [6, 7] have developed a classification system for Technology Life Cycle. Table 2 contains a comparison of several different Technology Life Cycle models. The core of each of the models all contain invention, development, maturity, and support / retirement stages. The context in which each of these models has been developed along with their similarities and differences needs further analysis.

The Technology Life Cycle model is evident in the evolution of most technologies that have been introduced. For example, the first practical fountain pen was patented by Lewis Waterman in 1884. Many instruments designed to carry their own ink supply where invented earlier, but they were prone to leaks and spills which made them difficult to market. Using the Kurzweil Technology Life Cycle Model, the fountain pen went through a precursor stage, which was the quill pen, and then the invention and development stages between 1702 and 1884 when writing instruments which could carry their own ink were being developed [16]. After 1884, the fountain pen became a practical writing instrument as it reached maturity and the general market. As the market grew, numerous pretenders began to market their versions of the fountain pen after this time. Then in 1930, Laszlo Brio invented the first ballpoint pen [17]. He noticed that the ink used in newspaper printing dried quickly and did not smear, so he created a pen which used this ink. As the ballpoint pen reached the maturity stage, the fountain pen began the obsolescence stage for it was no longer a practical writing instrument given the emergence of the ballpoint pen. The fountain pen then reached the antiquity stage and was no longer marketed. This example can be applied to every technology that has emerged over the years. We will use the life cycle technology model to analyze those technologies that have been introduced which can extend the life of legacy systems.

Research Problem

Executives are continually confronted with the challenge of extending a legacy system which has not reached functional obsolescence, but where components of the system have reached technical obsolescence. By functional obsolescence, we mean the system no longer provides the functionality that it was designed for. Technical obsolescence means the system cannot perform the function because it is running on obsolete or unsupported hardware or software. Numerous papers have been published on methods used to extend the life of legacy systems, but few have reviewed the use of internet inventions in the extension of legacy systems.

With the continued emergence of new internet inventions, the technology life cycle of a legacy system can often be extended for a far greater time period than previously anticipated. Internet and web technologies include, but are not limited by, web services, XML, Web Distributed Data Exchange (WDDX), and Wireless Application Protocol (WAP). To evaluate the potential of extending legacy systems using internet inventions, we will analyze the evolution of legacy systems for financial transactions in the banking industry and for manufacturing execution in the mass production arena. The phases of the technology life cycle will be used to provide the context for the various types of legacy systems. In this analysis, we will classify the legacy systems into categories based on the type of system or a system's amenability to the addition of internet components/interfaces. We will also attempt to develop a common framework for extending legacy systems that can be used by executives faced with legacy system problems. We will also analyze the context, type, etc. of internet inventions used in the extension of legacy systems. It might be possible, for example, to say that certain types of legacy systems, or certain types of internet inventions, have more potential than others in extending the life of legacy systems. We anticipate that such an analysis will result in a framework or model that tabulates such types with their expected years of legacy-system extension.

Possible TLC Hypotheses

In light of the Technology Life Cycle and the extension of legacy systems through the implementation of internet inventions, the following hypotheses will be investigated:

(1) The time period from invention to acceptance for internet inventions is decreasing.
(2) Legacy systems are being extended through the addition of internet interfaces.
(3) The time interval from invention to acceptance for internet inventions is shorter than for non-internet inventions.
(4) Legacy systems can be classified into categories based upon the type of system or the system's amenability to the addition of internet components and interfaces.

Relevance and Significance

There is little quantified research in analyzing the impact that internet inventions have had on extending the life of legacy systems. This study will develop a framework (or model) as described above, to guide the systems manager on ways to extend a legacy system's life to postpone technical obsolescence and possibly predict the number of years a particular type of system could be extended.

Research Plan

(1) Review and compare the different technology life cycle models with emphasis on the context in which the models were developed.
(2) Research legacy systems and how internet inventions have resulted in the extended life of the legacy system. Gather detailed data on companies that have extended the life of their legacy components by implementing web technologies.
(3) Categorize the company by industry with respect to the web technology that was implemented for extending the life of the legacy system and analyze any trends within that industry.
(4) Develop a framework for extending the life of common legacy systems.
(5) In considering internet web components, develop a criteria to determine the times for the different technology life cycle phases.
(6) Perform statistical analysis on the data to verify the hypotheses.

Preliminary Data Collection

Table 3 contains a preliminary summary of those companies that have extended the life of their legacy systems through mainframe upgrades or the use of internet components.

Company	Industry	Mainframe Legacy System	Legacy Extension Activity	Year
Owens and Miner [10]	Medical Supplies	Mainframe Applications	Web Services	2002
Ascension Health Systems[11]	Healthcare	Mainframe	Citrix, Winframe, EUI, CA	2001
Mutual of Omaha[12]	Insurance	Mainframe	IBM, .NET, SOA, Java	2006
PMA Reinsurance Management [13]	Insurance	Wang Cobol legacy system (1980's program named SOLAR)	Wrap Cobol applications as EJB or ActiveX. Use MERANT's Direct Data connect ODBC drivers	2001
Marriott International [14]	Hotel	Mainframe based SAP for general ledger and account systems	PeopleSoft on Unix	2000
Tower Records [15]	Record Sales	Mainframe Cobol	Accubench Cobol development tool from Accucorp Inc.	2005
Northrup Grumman Corp. Ship Systems Unit [15]	Defense	Cobol and Fortran on a mainframe	Mainframe SAP	2005
DaimlerChrysler Services Americas [15]	Automobile	Mainframe Cobol	Outsource to India	2005
Roadway Express Inc. [16]	Transportation	IBM mainframe apps. (Computer Corp. of America's Model 204 using IBM OS/390)	Janus Web Server	2002

Table 3. Approaches to extending the life of legacy systems

Data Analysis

In collecting data on legacy system extension, it was anticipated that the majority of legacy system extension methods would be based upon wrappers and the use of web services. In reviewing the sample data in Table 3, however, it is evident that there are many different techniques that have been used in extending the life of legacy systems. Given the vast amount of COBOL programs that are still in existence, many companies have focused on extending the life of the applications which use COBOL.

Conclusions

With the stability of many legacy system applications and the increasing number of technologies to support functionality and user access through the internet, more companies are using a diverse number of techniques to extend their legacy system life. It is believed that certain industries will pursue the use of similar technologies to extend the life of their legacy systems. This may be the case given that businesses within a certain industry use similar applications or that similar businesses hire consultants with expertise in their industry and deploy those technologies which the consultant has experience.

Future Work

As listed in the research plan section, the future work entails gathering more data on how companies in different industries have extended the life of their legacy systems. This data will then be used to develop a model to establish which legacy system is most amenable to a specific internet component for legacy system extension.

References

[1] Abernathy, W.J. and Utterback, J.M., “Patterns of Technology Innovation,” Technology Review, vol. 80, June/July 1978, pp. 40-47.
[2] Ansoff, H.I. and Stewart, J.M., “Strategies for a Technology-based Business,” Harvard Business Review, vol. 45, pp. 71-83.
[3] Baker, John H., “The Technology Life Cycle,” Best’s Review: Nov 1989-90, 7; ABI/INFORM Global, p. 66.
[4] Kendall, Kenneth E., The Age of Spiritual Machines, (The Penguin Group, New York, New York), 1999.
[5] Kurzweil, Ray, Emerging Information Technologies: Improving Decisions, Cooperation, and Infrastructure, (Sage Publications, Thousand Oaks, California), 1999.
[6] Roberts, Edward B. and Liu, W. Kathy, “Ally or Acquire? How Technology Leaders Decide?” , MIT Sloan Management Review, Fall 2001, vol. 43, no. 1, Fall 2001, pp. 26-34.
[7] Roberts, Edward B. and Liu, W. Kathy, “Ally or Acquire? Case Studies of Compaq and Cisco as Additional Tests of the External Technology Life Cycle Model,” MIT Sloan School of Management Working Paper 4421-03, August 2003.
[8] “Technology Life Cycle Classifications,” The Office of Administration for the State of Pennsylvania, http://www.oit.state.pa.us/oaoit/cwp/view.asp?A=723&Q=194554 &oaoitNav=%7C8305%7C.
[9] Moore, Geoffrey A., Crossing the Chasm, Collins BusinessEssentials: New York, New York, 2002.
[10] Guzman, David, “Business Needs Outpace Technology,” Information Week, Jan. 27, 2003: vol. 924, p. 44.
[11] Sujitparapitaya, S., Janz, B., Wetherbe, J., and Sammett, D.,“Ascension Health Systems: Enterprise User Interface Approach to Organizational Management,“ Proceedings of the 34th Hawaii International Conference on Systems Sciences 2001.
[12] Valentine, Lisa, “Transparent Technology,” Insurance and Technology, May 2006: 31,5, p. 20.
[13] MacSweeney, Greg, “PMA Re Migrates Legacy to the Web,” Insurance and Technology, Oct. 2001: 26, 11, p.24.
[14] Paulson, Linda Dailey, “Making Legacy Assets Work in an Internet World,” IT Pro, May | June 2000, p. 10-15.
[15] Anthes, Gary H., “Love that Legacy,” Computerworld, July 4, 2005, 39, 27, p.27.
[16] Bellis, Mary, “A Brief History of Writing Instruments Part 2: The History of Fountain Pens,” http://inventors.about.com/library/weekly/aa100897.htm.
[17] Bellis, Mary, “A Brief History of Writing Instruments Part 3: The Battle of the Ballpoint Pens,” http://inventors.about.com/library/weekly/aa101697.htm.