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Estimating ROI for Spatial Technology within Enterprise Information Systems: a Methodology

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GVM: A Framework for Estimating the Business Value of Geospatial Technology Within Information Systems

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GVM: A Framework for Estimating the Business Value of Geospatial Technology Within Information Systems

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Summary

This paper describes a general framework for identifying and measuring the tangible value of geospatial technology within enterprise information systems on an ongoing basis. The purpose of this framework is to make the business value of geospatial technology visible within an information system. Hence the name: Geospatial Value Measurement (GVM) framework.

GVM's potential benefits include improved workflow, lower cost implementations, selection of appropriate technology alternatives, and more effective use of geospatial technology within enterprise information systems.

This framework is based on three basic premises:.

- The measurable value of a technology is its tangible contribution to an organization's business processes. Therefore, the value of a technology can be measured by the specific change that it makes in the performance metrics for a business process.
- The value of a technology must be measured continuously and those measures used to improve the technology's use. Otherwise, the measurement process is ineffective.
- Effective value measurement is an inseparable part of business operation and management. So, value measurement has to be designed and managed as a part of most business activities. Because of this broad context, the GVM framework traces a path through workflow modeling, information systems design, and business performance monitoring.

GVM extends existing methods for workflow design[1], information systems design[2], and business performance management[3]. GVM will be most effective when it is adapted to complement the workflow design and business management methods already in use within an organization.

GVM is designed around geospatial examples but can be modified to measure the value of any horizontal technology.

Need for Understanding the Business Value of Geospatial Technology

Revolutions begin long before they are officially declared. Since the beginnings of the dotcom collapse, executives have been rethinking how to measure the value of their information technology. They have recognized that new strategies and competitive realities demand tangible returns for IT investments. Now they are deeply engaged in defining and developing those new management methods that identify and evaluate IT performance. At the heart of this revolution lies a pragmatic point of view: IT must produce tangible results that contribute directly to overall business performance. Otherwise IT investments are wasted.

In today's pragmatic business environment, understanding the value derived from IT investments is a strategic imperative. This imperative is increasingly significant for both the geospatial industry and individual organizations that use the technology. From an industry perspective, revenue and growth will be uncertain until customers see a clear, tangible return for their geospatial technology investments. Individual organizations need to understand return on technology investments so they make sound purchase decisions and optimize existing technology. More specifically, an understanding of the business value for a technology helps organizations in these areas:

- Aligning IT capabilities and corporate strategy
- Understanding strategic, operational, and economic value of investments
- Make good choices between competing investments
- Improve the efficiencies of the business processes that IT supports
- In the case of commercial organizations, understanding contributions of technology to revenue growth, profitability, competitiveness
- In the case of governmental organizations, understanding contributions of technology to mandated programs, operational efficiency, and cost recovery.

In the current economic environment, these issues must define IT's context within an organization. IT groups and the business units they serve must be able to confidently and continually demonstrate the return from their technology investments over time.

However, the uncomfortable fact remains that most organizations do an abysmal job of determining the returns on their IT investments. Many investments in geospatial technology undoubtedly create value, but very few organizations can reliably say which investments do or don't, or for what reasons.

Several reasons for this problem are evident. solution providers are reluctant to back up value claims; users do not determine exactly what their technology is supposed to gain; implementations are poorly executed. Most importantly, organizations do not set definite value targets and do not have a mechanism in place to verify progress toward a target. Organizations, therefore, have trouble knowing whether or not they achieve any return for their technology. The result is a "black hole" of IT investment – few people know for sure what they are getting for their money.

Fundamentals of the Business Value of Geospatial Technology

We propose that the business value of geospatial technology rests on five foundation blocks[4].;

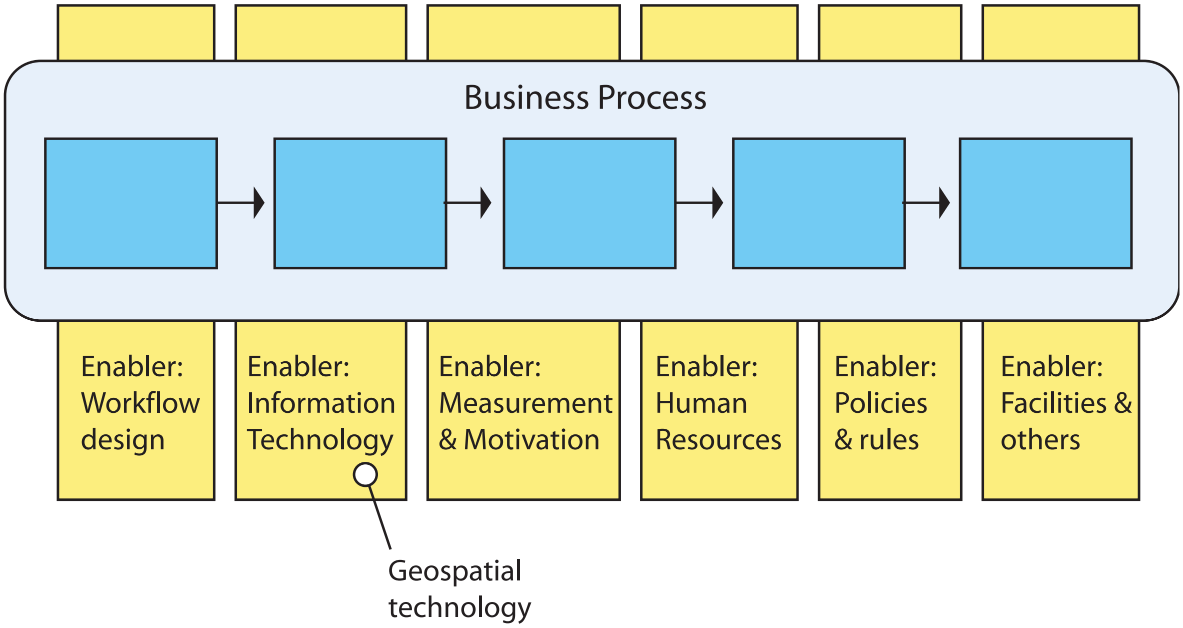
Customers define value. Value is defined by the people who use geospatial technology and those who pay for it. These people are customers whether they are external or internal to your organization. To understand the true value, you have to understand what the technology really does for customers and how they perceive that value. Value has to be defined in the customer's vocabulary. This means learning the language of CFO's who think about return on assets, ROI, and net present value and CEOs who think of value in terms of shareholder returns, process productivity, and customer churn.

Value is opaque. A significant consequence of value being defined by customers is that it is hard to quantify. To understand value, you need to understand the factors that customers consider in assessing value, and you have to understand the relative importance that they place on each factor. You need to develop robust value models that are calibrated with data continuously collected from customers. Otherwise, your models of value will diverge from your customer's and gradually become irrelevant.

Value is multidimensional. In the past, IT investment decisions were made on the basis of functional value – a product's features and functionality. Today, customers consider two other dimensions as well: economic value – what features and functions are worth in terms of money and productivity; and impact on customers – the ways that IT effects psychological factors like customer satisfaction and loyalty. The point here is that value models have to consider all relevant dimensions including financial, productivity, and customer value.

Information technology is an enabler. Information technology's primary value comes from the results that it enables in business processes. As illustrated in Figure1, geospatial technology is a subset of IT, so it's value often comes from the ways that it enables or enhances other information technologies.

Figure 1
Enablers that support a business process



- Adapted from "Workflow Modeling", Sharp& McDermott, Artech House, 2001, p. 34.

So, IT value measurement must consider the role of IT as an enabler, similar to the many other factors which enable business processes.

Performance metrics reflect the tangible value of IT. The current business environment requires relevant and repeatable value measurements. But, the indirect relationship between IT and business results make direct value measurement difficult. We have found that well-designed performance metrics for a process offer the best tangible indication of the value of the technologies that support the process.

Performance metrics reflect the efficiency of a business process[5]. Even fairly crude metrics provide useful guidance in selecting and using technologies. Well-selected metrics can tell us what we need to change to make a process more effective. Another important reason to collect metrics is to provide a baseline against which to measure the performance of new technologies within a business process. This is crucial – without hard proof, there's no support for the next initiative.

But take care not to go after inappropriate metrics, those that might encourage local optimization at the expense of overall improvement[6]. Using the wrong metrics or using metrics in a way that encourages distortion subverts the metric's usefulness[7].

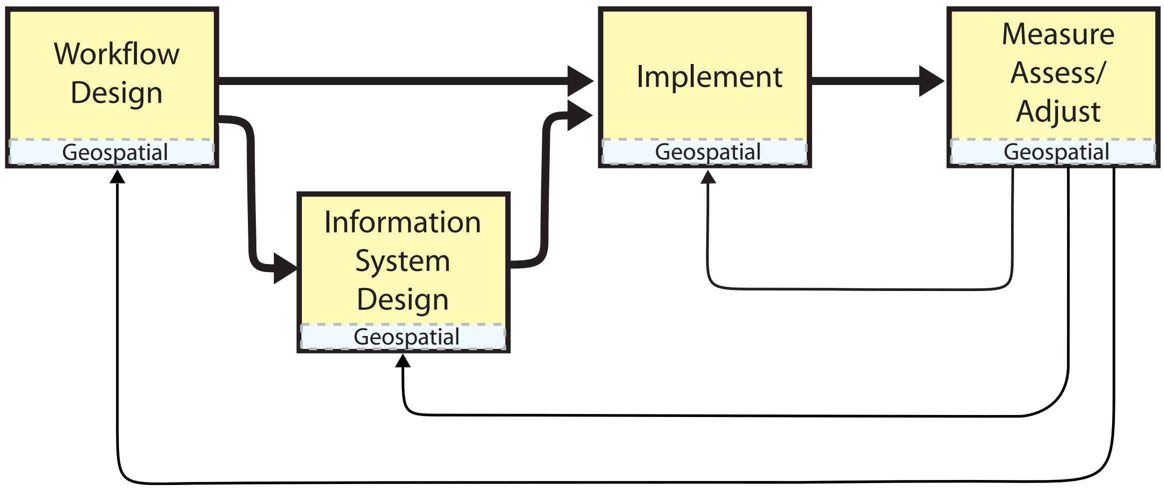
The primary utility of the GVM framework is to identify and assess the impact of geospatial technology on performance of business processes as indicated by performance metrics.

Framework in a nutshell

A framework is a structure for discovering, organizing and presenting ideas or information. They can be as simple as a two by two matrix or complex as a multidimensional structure for systems analysis. Frameworks mange complexity by reducing vague or complex topics to a simpler set of questions. They help users organize work, maintain focus, ensure coverage of germane topics, and provide a format for documenting findings.

As shown in Figure 2, the GVM framework follows the value of geospatial technology through a business process: from workflow design, to information systems design, through continuous business performance monitoring.

Figure 2
General Framework flow



- Source: ISSI, 2003

Steps

This framework is organized into ten steps within four functional groups:

Workflow Design

1) **Identify the business process and the people involved**
2) **Develop process diagram**
3) **Determine performance objectives and metrics**

Information System Design

4) **Identify required geospatial functions and data**
5) **Identify additional uses for required geospatial functions and data (optional)**
6) **Determine specifications for geospatial functions and data**
7) **Assess alternatives for geospatial functions and data**

Implement

8) **Provide input for broader information system design and business management frameworks**

Business Performance Monitoring - Measure, Assess and Adjust

9) **Measure performance and assess the business value of geospatial functions and data**

10) Adjust and act

What the GVM Framework is and isn't

The GVM framework is a general approach for identifying and continuously evaluating the business value of geospatial technology within an information system. This frameworks works because is uses time-tested modeling techniques, guidelines, and steps that make it repeatable and learnable. It is a practical response to the need to identify the specific roles and values of geospatial technology within broader information systems.

GVM is not a quick, once-and-for-all recipe for justifying purchase decisions or selecting vendors. Nor is GVM a finished product. We hope users will experiment with GVM and modify it to fit their own situations. When the framework produces useful results for users, then it is, for that user, a finished product.

Framework Description

Step 0: Fit the GVM framework to your own design and management processes.

In the sections below, we describe the basic steps involved in identifying the business value of geospatial technology. The end result is a continuous flow of information about the effectiveness of geospatial technology within your organization. This framework simply organizes and slightly reorients the information normally produced in the design and management of workflows and the information systems that support them. Therefore, Step 0 involves thinking through the ways that your current design and management methods produce information about business value and business performance. If those methods are adequate, you can implement GVM straightaway. Otherwise, you may want to use GVM as a blueprint for improving your existing methods.

Please keep in mind that GVM, like any measurement process, is iterative – it improves with use and thoughtful adjustment.

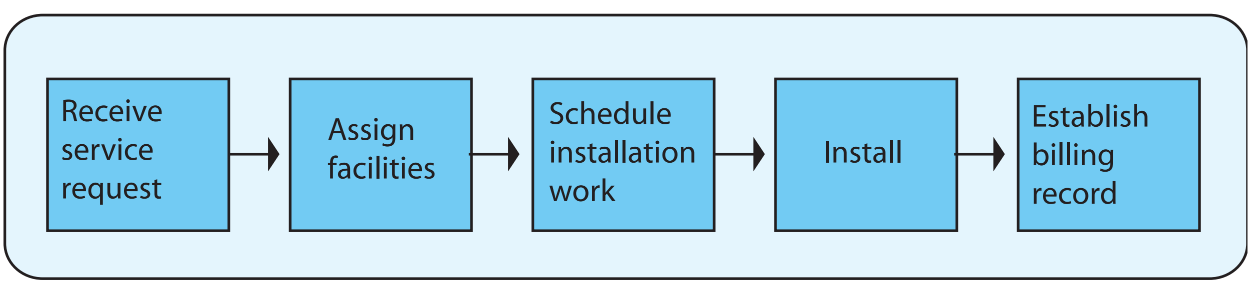
Steps 1: Identify the business process and the people involved.

The value of geospatial technology comes from the ways that it supports a business process. So, the GVM process must begin with a clear picture of the business process(es) that involve geospatial technology. Defining the business process is the most critical element in the GVM framework. Without a clear, accurate definition of the process, its scope, and the people involved, GVM will fail.

In developing and testing GVM, we used the process definition methodology detailed in "Workflow Modeling: Tools for Process Improvement and Application Development" by Sharp and McDermott. (See the endnotes for a complete citation).

There are many other methodologies for defining business processes and as long as they fit an organization's needs they will work for the purposes of GVM. As shown in Figure 3 the key result needed for GVM is a clear picture of the tasks and people involved in a process.

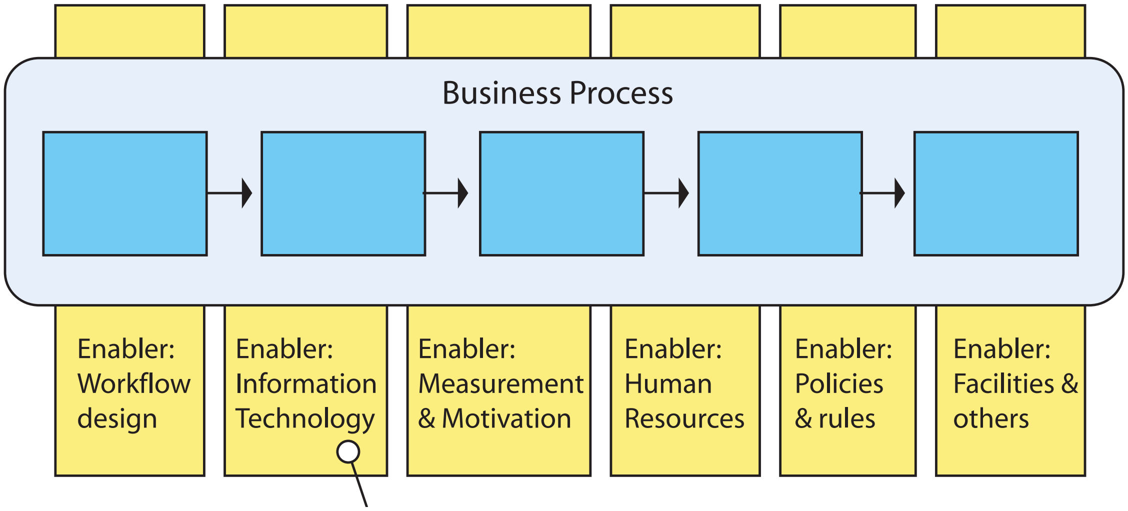
Figure 3
Typical business process: Install phone service



• Source: ISSI, 2003

As illustrated in Figure 4, several functional groups may be involved in the process. It is important to identify and involve all the stakeholders in this workflow[8].

Figure 4
Groups involved in a business process



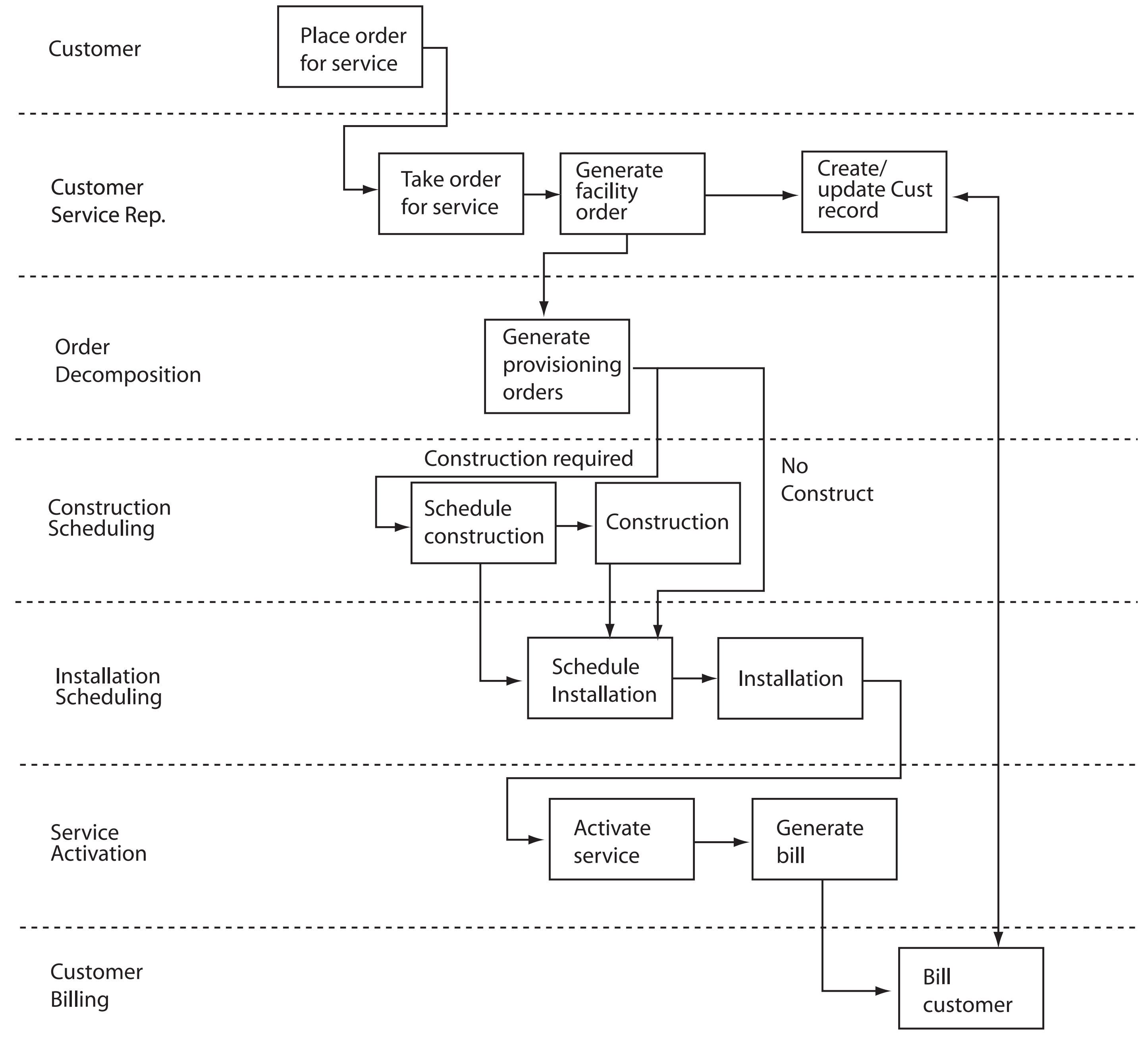
• Adapted from "Workflow Modeling", Sharp& McDermott, Artech House, 2001, p. 66.

Step 2: Develop a process diagram.

Once the business process is defined and the people involved are identified, we need to develop a picture of the information flows within the process. The most common method is to develop a process workflow model.

Process workflow models, as illustrated in Figure 5, are know by many names, but because of their appearance they are commonly referred to as "swimlane diagrams".[9] A swimming pool might be divided lengthwise into lanes for swimming laps. Just as each swimmer is expected to stay in his or her lane, each actor in a process has his or her own lane. A box represents a task or step in the process and is placed in the lane of the responsible actor. Arrows connecting the boxes indicate the sequence and flow of the steps.

Figure 5
Typical process diagram



• Source: ISSI, 2003

Swimlane diagrams have become popular because they highlight the relevant variables – who, what, and when – in a simple notation that requires little or no training to understand. Because they specifically show the actors who are involved in the process, a higher level of involvement and buy-in is likely.

In workflow modeling, swimlane diagrams show an entire business process from beginning to end and are used to both understand the as-is workflow and to design the to-be workflow. They can show a process at any level from a high view down to one showing each individual task. These diagrams also ensure these discussions are grounded in fact, because they depict what really happens or what is actually proposed. This is crucial, because in practice virtually no one ever understands a complete business process or even has a fully accurate understanding of their neighborhood in the process. All of this supports assessment – we can map, measure, and interpret, before and after implementation.

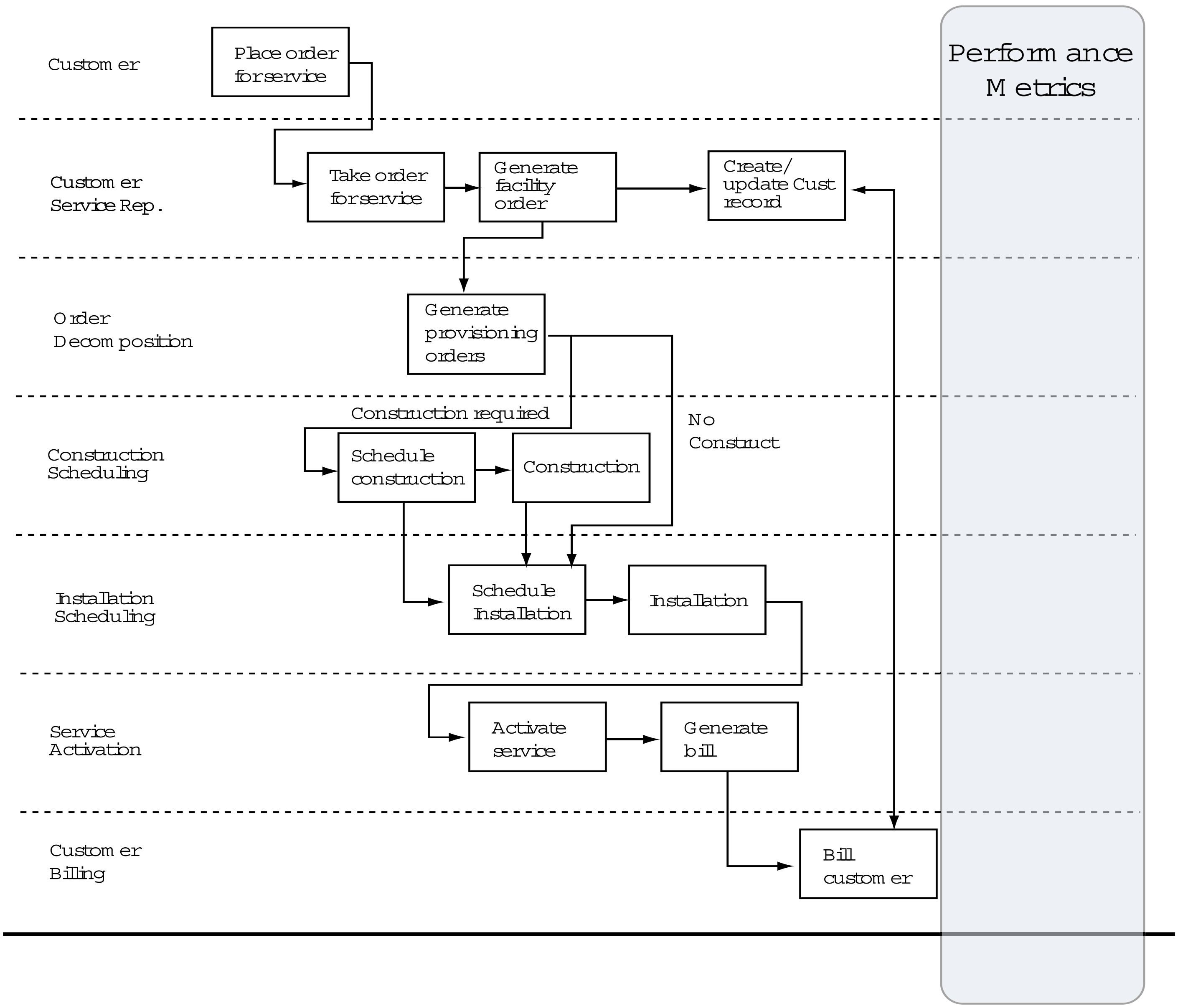
Because swimlane diagrams are so simple and intuitively understood, it is easy to become bogged down in detail. For the purposes of the GVM framework, swimlane diagrams should be only detailed enough to identify performance metrics and general geospatial requirements.

Step 3: Set performance metrics.

Now for each logical set of tasks identify the key performance indicators. These are the ways by which the process is measured[10],[11]. As shown in Figure 6, these metrics can be displayed on the horizontal axis of your swimlane diagrams.

Figure 6

Process metrics by functional group

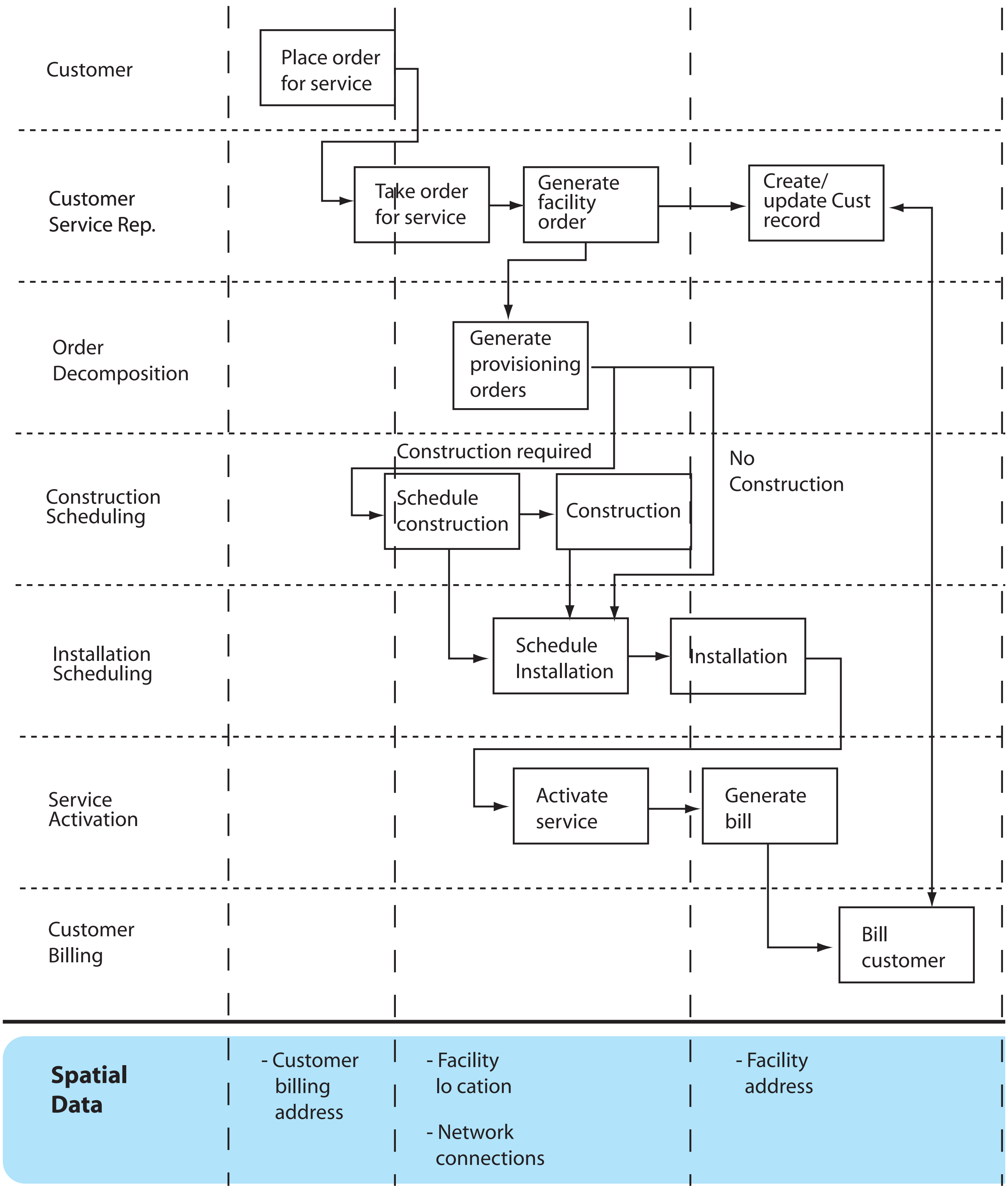


• Source: ISSI, 2003

Step 4: Identify geospatial functionality and data requirements.

After developing a clear picture of the business process and performance metrics, we are at the point of identifying geospatial requirements. As shown in Figure 7, you simply list the geospatial functionality and data required for each set of tasks on the swimlane diagram's vertical axis[12].

Figure 7
Geospatial functionality and data by activity

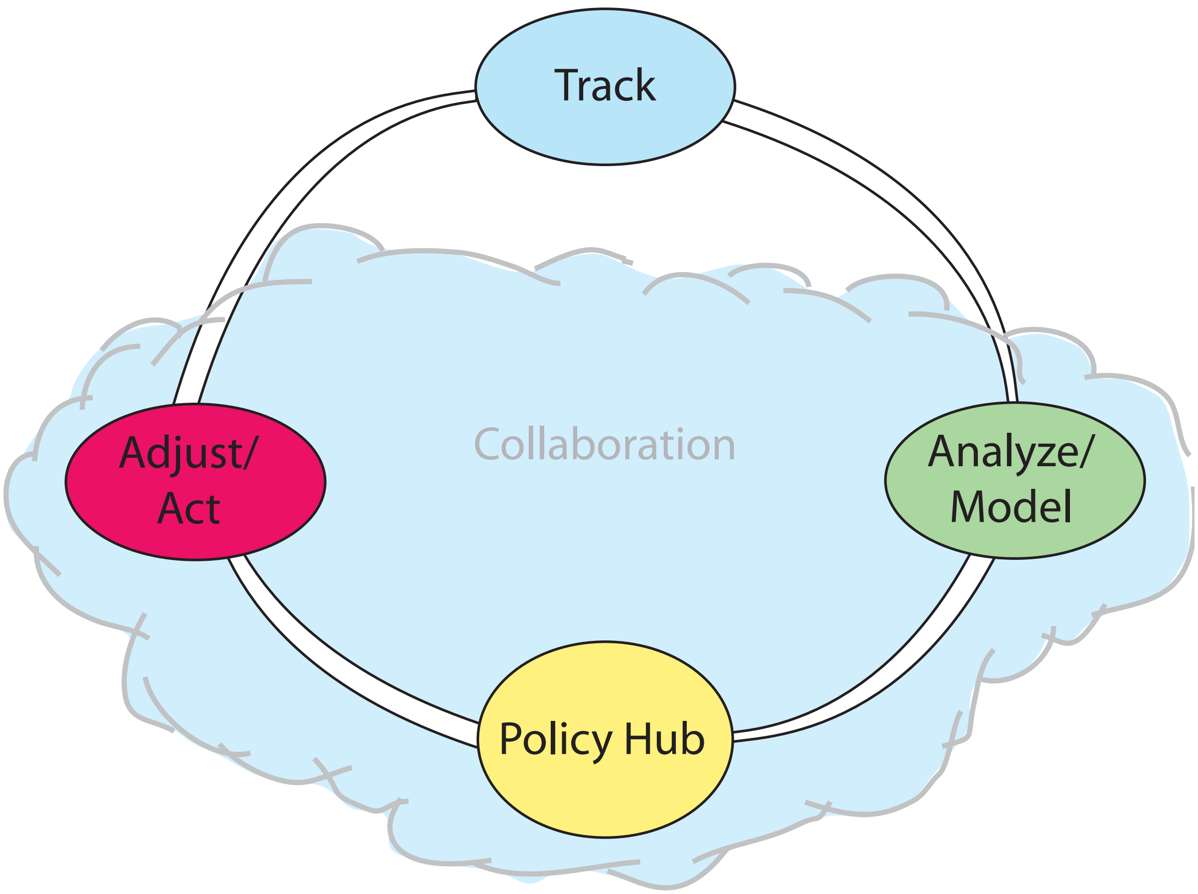


• Source: ISSI, 2003

Step 5: Identify additional uses (optional).

As shown in Figure 8, a business process involves four distinct activities. Collaboration among the participants helps the process move effectively. Geospatial technology and data is often an important part of all of these activities. In your organization you will likely find that the geospatial resources used in one process will be quite useful in others. In this step, you can identify the other processes and applications that use the geospatial resources involved in the process you are studying.

Figure 8
Closed loop business process



• Source: Adapted from Policy Hubs: Linking Analytic and Operational Applications, Henry Morris, IDC, 2002[13]

Table 1 illustrates one option for identifying applications that use geospatial functionality. If you decide to embark on this step, you should evaluate each new process and activity just like your initial process.

Table 1

Other applications using geospatial technology

	Related Operational/ Analytic Applications							
Geospatial Functionality	Inventory Tracking	Workforce Analytics	Materials Management And Logistics Analytics	Demand Planning Analytics	Pricing Analytics	Procurement Analytics	Risk Management Analytics	Other Operations/ Production Analytic Applications
Geocoding		X	X	X			X	X
Location determination	X		X					X
Routing		X	X	X		X		
Spatial query	X	X	X	X	X	X	X	X
Desire line modeling	X			X	X			X
Thematic mapping	X	X	X	X	X	X	X	X

- Source: ISSI, 2003

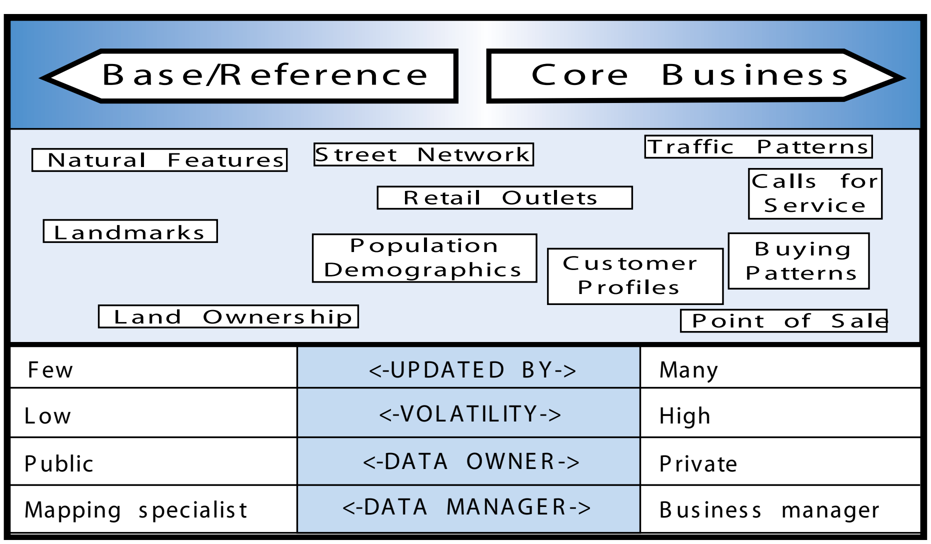
Approach this step with caution. While repeated use of the same technology can certainly improve ROI, it's easy to expand the measurement effort beyond achievability.

Step 6: Determine specifications for geospatial functionality and data.

This step is familiar to many geospatial professionals. Here we specify the functionality, accuracy, immediacy, scale, and the other relevant characteristics of geospatial technology and data. Most organizations with geospatial experience have their own methods for developing these specifications. Figure 9 illustrates a general specification for selected data elements.

Figure 9

Geospatial data characteristics



• Source: ISSI, 2003

Once you've developed the specifications for the required geospatial functionality, you can evaluate the alternatives for getting those resources. Table 2 illustrates the general headings for an analysis of alternatives.

Table 2
Analysis of alternatives for required geospatial functionality and data

Metric	Required Capability	Current Capability	Alternatives	Change in Metric	Change in Costs

• Source: ISSI, 2003

Step 7: Estimate geospatial contributions to performance metrics.

At this point, you've developed a clear picture of a business process, appropriate performance metrics, and the geospatial resources needed to support the business process. As illustrated in Table 3, you can now estimate the contribution of each geospatial function or data set to performance metrics.

Table 3
Geospatial contribution to performance metrics

	Geospatial Function						
Performance Metric	Determine asset location (RFID)	Automate asset location data entry (RFID)	Track asset location continuously (RFID)	Generate pallet load orders in near real time (RFID)	Generate optimum routes	Integrate all location data into transaction database	Incorporate location data into reporting and analysis applications
Improve warehouse inventory throughput times by 80%	X	X	X	X		X	X
Produce on-demand inventory status for dispatch center	X	X	X			X	X
Decrease load/unload mistakes to 1 per 150 trailers dispatched			X	X			X
Generate State permits for all routes					X	X	X

- Source: ISSI, 2003

Because geospatial or any other technology is a process enabler, the relationship between the technology and the performance metric are somewhat indirect. In this example, we've indicated a simple yes-or-no relationship. You may use a slightly more quantitative high-medium-low rating. Or you may estimate the actual cost and benefits in terms of financial, productivity, and customer value.

Please keep in mind that crude measures of the right thing are better than precise measures of the wrong thing. Also simplemeasures done well are more useful than elaborate measures done poorly.

Step 8: Design and implement.

At this point, all the data you've developed in this process becomes input to your information system design and business management systems. For this research, we used Rational's modeling system[14] and the Balanced Scorecard[15]. These are certainly useful and time-tested methods, but not the only options. In Step 0, you fit this framework to the design and management methods familiar to you - those are your best options.

Step 9: Measure results.

If you've gotten this far, Congratulations. You've enabled your design and management systems to produce meaningful cost and benefit data about your geospatial resources. What remains is to plug that data into a familar ROI model. Table 4 illustrates such a model. A free working Excel version of this model is available from the author. (dsonnen@ispatial.com)

Table 4

ROI Analysis Model

Geospatial Technology ROI Worksheet

Annual Increased Revenues & Savings	**Base**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Technology-related benefits						
Cost avoidance						
Cost reduction						
Productivity-related benefits						
Productivity enhancement						
Staff re-deployment						
Workforce reduction						
Other productivity metrics						
Business process enhancements						
Management framework efficiencies						
Core competencies						
Enabling functions						
Customer value enhancements						
Reduced churn						
Customer service						
Other customer-related metrics						
Total	**0**	**0**	**0**	**0**	**0**	**0**
Capital Expenditures	**Initial**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Additional in-house hardware						
Additional in-house software						
Total	**0**	**0**	**0**	**0**	**0**	**0**
Depreciation Schedule	**Initial**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Additional in-house hardware	0	0	0	0	0	0
Additional in-house software	0	0	0	0	0	0
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Expensed Costs	**Initial**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Data (spatial and non-spatial)						
Services (internal)						
Services (external)						
Software licenses/maintenance						
Server purchase/ maintenance						
Storage purchase/ maintenance						
Training (technology and end user)						
Other expensed costs (Specify)						
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Basic Financial Assumptions						
All federal and state taxes	40%					
Discount rate	15%					
Depreciation -- Straight Line (years)	3					
Hardware and software salvage value	10%					
Net Cash Flows	**Initial**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Total benefits	0	0	0	0	0	0
Less: Total Costs	0	0	0	0	0	0
Less: Depreciation	0	0	0	0	0	0
Net profit before tax	0	0	0	0	0	0
Add: Depreciation	0	0	0	0	0	0
Less: Capital Expenditures	0	0	0	0	0	0
Net Cash Flow After Taxes	$0	$0	$0	$0	$0	$0

Financial Analysis	**Results**
5-Year ROI	#NUM!
5-Year NPV using 15% discount rate	$0

Notes:

1) The effective use of this worksheet requires that performance metrics be set and measurec continuously over the period being evaluated.

2) When hardware costs are in excess of $50,000 they are depreciated over three years

3) When software costs are in excess of $50,000 they are depreciated over three years

4) Hardware and software costs less than $50,000 are expensed as incurred

5) Software upgrades are treated as a depreciable assets if greater than $50,000, otherwise they are expensed as incurred.

6) Assume a 220-day working year, 35 hour productive working week.

7) For depreciation, hardware and software salvage value is 10% of initial purchase price after three years.

- Source: ISSI/IDC, 2003

Step 10: Assess geospatial value, adjust and act.

You should step through this measurement process regularly and update your ROI model. Then you will be able to adjust your geospatial resources and investments to best support your own business processes.

Conclusions

This project shows that the process of identifying the business value of geospatial data is non-trivial but achievable.

GVM works well in the test cases we used for this project, but the real world of business is quite different from a research project. As one reviewer put it, “This looks good, but these things always look better on paper”. We encourage readers to experiment with GVM within their own organizations and we invite critical review of these methods.

Acknowledgement

Sun Microsystems funded the research detailed in this paper. We gratefully acknowledge Sun’s ongoing efforts to promote geospatial technology.

Endnotes

[1] For a comprehensive set of workflow modeling tools see, “Workflow Modeling: Tools for Process Improvement and Application Development, Alec Sharp and Patrick McDermott, Artech House, 2001.
[2] For a practical guide to information systems design see, “Software for Use”, Larry Constantine and Lucy Lockwood, Addison Wesley, 1999.
[3] For a comprehensive overview of IT performance measurement methods see, “ The IT Payoff”, Sarv Devaraj and Rajiv Kohli, Prentice Hall, 2002.
[4] For a broader view of the fundamentals of IT business value see, “Fundamentals of Value” Mohanbir Sawhney, CIO Magazine, Jul, 1, 2003. Dr. Sawhney has written extensively on the business value of IT in CIO Magazine and is currently writing a book about customer value.
[5] See the classic HBR article, “ The Balanced Scorecard, Measures that Drive Performance” Robert S. Kapland and David P. Norton, Harvard Business School Press, 1992. This article laid the foundation for the Balanced Scorecard method. Since 1992, Kapland and Norton have produced several well-respected texts that deliniate the Balanced Scorecard method. Kaplan and Norton’s books are a valuable resource for those implementing IT performance measures.
[6] For a useful guide to setting appropriate performance metrics see, “The Basics of Performance Measurement”, Jerry. Harbour, Productivity, Inc. 1997.
[7] For complete coverage of performance-based management see, “The Balanced Scorecard: Translating Strategy into Action, Robert S Kapland and David P. Norton. Harvard Business School Press, 1996.
[8] See, “Workflow Modeling: Tools for Process Improvement and Application Development, Alec Sharp and Patrick McDermott, Artech House, 2001. p97-102.
[9] For a complete discussion of the use of swimlane diagrams in workflow modeling see, “Workflow Modeling: Tools for Process Improvement and Application Development, Alec Sharp and Patrick McDermott, Artech House, 2001, p.137 – 159.
[10] For a detailed method for setting performance metrics for information systems see, “The Business Value of Computers”, Paul A. Strassmann, The Information Economics Press, 1990. Also see Strassman’s continuing work on this subject.
[11] For a detailed methodology for using IT performance metrics to manage an IT organization see, , “The Balanced Scorecard: Translating Strategy into Action, Robert S Kapland and David P. Norton. Harvard Business School Press, 1996.
[12] For a useful overview of the use of geospatial technology for business analytics see, “Geographic Data Mining and Knowledge Discovery, Harvey J. Miller and Jiawei Han, Taylor and Francis, 2001.
[13] See “Policy Hubs: Linking Analytic and Operational Applications”, Henry Morris, Balanced Scorecard Report, #B0007B, 2002. Henry Morris is International Data Corporation’s Group VP for Applications and Information Access. Morris has written extensively on the concept of closed-loop processes and the process of using closed-loop processes to improve ROI for IT. See www.idc.com for Morris’ publications.
[14] “Visual Modeling With Rational Rose and UML”, Terry Quantrani and Grady Booch, Addison Westley, 1998.
[15] See endnote 11.