CHAPTER FORTY-ONE

The Role of Functional Metrics in B2B E-Commerce Project Success

Sam Bayer and Vic Tolomei

Introduction

In the winter of 1999, how was a young high-tech Internet startup, with version 1.0 of a new B2B application software product, able to gain enough credibility in the marketplace to attract—and do business with—its targeted Fortune 1000 customers?

The answer was threefold. First of all, the business functionality delivered in version 1.0 had *demonstrated* demand in the marketplace (which is discussed in the next section). This at least opened the doors to interested parties. Second, the client's trust was won by leveraging impeccable early references created by using an implementation methodology worthy of corporations that were orders of magnitude larger. Last, eSell Inc.[1] deployed only very senior and skilled professionals on all its implementations.

This paper describes the methods and techniques developed by eSell Inc., especially as they pertain to the adaptation and adoption of functional metrics in their project-implementation processes.

We start off with a brief description of how functional metrics have been incorporated into the typical project launch

[1]Fictionalized name.

process, with an overview of the major benefits accrued. With success as a backdrop, we describe the atomic parts of the overall program:

- Adaptation of the counting techniques
- Creation of an Excel worksheet to support the counting and estimation process
- A project repository used to calibrate the actual estimates of time, effort, and cost
- The team-based process used to collect and verify project data

We then follow this discussion with examples of how functional metrics are used to support other aspects of the project, including:

- Initial sale of the product and project
- Project staffing
- Project control

Last, we summarize our findings and experiences and pose a final question concerning the importance of key personnel in sustaining an effective metrics program.

B2B E-Commerce Primer

To truly understand the nature of the problem eSell and its pioneer customers had to solve, some background on business-to-business electronic commerce (B2B e-commerce) would be useful.

With eSell's e-commerce suite of products, a medium-size or Fortune 1000 manufacturer or supplier can enable their buyer customers, such as their large distributors and retailers, to purchase their goods directly on the World Wide Web (the Web). These transactions and the underlying business processes are completely integrated into the highly complex back-end enterprise resource planning (ERP) systems of both the seller and buyer. This deep-integration capability provides real-time availability of materials data, promotions, contractually-based pricing, production schedules, shipment methods, payment terms, and other critical information. Wireless (online and offline) operations can be supported.

In the common multi-tiered form of the implementation (sometimes called B2B2B or even B2B2C when the consumer is the end-buyer), multiple suppliers and buyers along the demand chain are involved in a single automated, real-time transaction. System-to-system automated transactions (such as inventory

replenishment) are now created over the free Internet, reducing the need for expensive leased-line-based transport mechanisms such as electronic data interchange (EDI).

With these solutions, a supplier can establish a Web-based private marketplace to which it can attract its buyer partners with competitive advantages such as cost savings, shorter delays, higher accuracy, and ease-of-use during the buy/sell process. These real-time Web-based and wireless transactions replace the costly and error-prone phone calls, faxes, and manual re-keying so prevalent in traditional systems today.

Suppliers save money and time by reducing demand on their customer service departments. The customer's satisfaction is increased with easier, more error-free transactions.

Overall Function Point Counting and Estimation Methodology

After two years of evolution and experience with scores of projects, the following describes a typical project launch scenario that incorporated function point methodologies. Regardless of the project methodology you choose, one of the central deliverables in the project launch sequence is the project plan. Such a plan must include a comprehensive list of planned functionality, an effort and cost estimate to deliver that functionality, and a profile of the project team needed to do the job. The following overall high-level steps are followed to produce this project plan at eSell:

1. Convene a workshop at which the client, the client's business and customer representatives, and eSell services experts are present. Discuss the client's business processes and transactions and what problems exist that lend themselves to Web B2B solutions. Define a set of capabilities, identifying the application's ultimate end-users and detailing application functionality from the end-users' perspective. These fine-grained items of functionality are commonly called ability-to statements, because they all begin with the words "The end-user will have the ability to. . . ." These ability-to statements are documented in a function point estimation (FPE) worksheet.
2. The eSell function point specialist then convenes and runs a function point estimation meeting at which the eSell technical experts on the project review the ability-to statements. The statements are examined for completeness and correctness, and an FPE worksheet is filled out. Each ability-to is sized (in FP), and the effort and thus cost to develop each ability-to is estimated.

3. The eSell project manager reviews the FPE worksheet, the proposed functionality, and its cost estimates with the client. The client can manage budget with trade-offs across the classical three degrees of freedom: functionality for time expended (cost) for resources required. This can be done at a very fine grain, because the FPE and the line-by-line functionality/size/effort mapping allow the client line-item-veto power over each ability-to.
4. When the client and team are satisfied, the project begins with the worksheet documenting the target deliverables, times, and costs for the deployment.

Benefits of Function Point Counting and Estimation

It has been said that *one cannot manage what one cannot measure.* eSell's FP-based metrics allow measurement both before the project begins (for cost estimating) and during the project phases (for mid-course corrections and status checks). In the final analysis, without metrics, the delivery organization would have had no rational way of managing the project. For the customer, it was all about limiting their exposure on a "bleeding edge" project.

The key benefits to eSell's customers with this approach include:

- **Birth of the collaborative partnership:** The project launch event with the initial FPE meeting is a microcosm of the entire project. It is a mini-project that has a start, a process, a deliverable (the FPE worksheet and the plan), and an end. Because the client is intimately involved more as a partner, the collaborative nature of the entire project is introduced. Delivering the size/effort/scope plan is a small enough deliverable to be an early and quick success for all. The tone is set, the ice is broken, and ground rules are established for the long-term relationship. We have found that the chance of a successful project is increased if the relationship sought from the outset with the customer is that of a partner—a truly concerned compatriot—and not an arms-length "vendor."
- **Focus on ultimate end-user:** FPE forces the entire team to view the world from their customer's customer perspective (sometimes the customer's customer's customer). The ability-to statements serve to anchor the end-user's voice in the process. Combine this with an implementation methodology that physically engages the end-users, and you can virtually guarantee customer acceptance and satisfaction at go-live. Thus *success* is measured predominantly by end-user adoption, engagement, and satisfaction. A project

that deploys an application that is on time and on budget but is rejected by its ultimate end-users is still a horrific failure.

- **Managing client expectations:** The FPE worksheet is the vehicle by which the client's expectations can be accurately set and then tracked as the project proceeds. This includes both the scope of the functionality and the projected costs. With mid-project re-estimations, the client can manage the size of functional changes and their budgetary ramifications. It gives the customer the project cockpit instrumentation (sufficient metrics) and flight controls (ability to make corrections at a detailed level) necessary to manage and mitigate risk. This is especially apparent with the line-item-veto capability during the FPE process.
- **Better designs:** FPE requires design reviews by disinterested third parties (the FP analysts) who are by necessity senior software architects in eSell's process. This is often done multiple times during the project, each time improving the design.
- **Accurate forecasts of effort:** The project kickoff and FPE process reviews all client business processes with the client experts and the project design team at a very fine grain. The elementary business transactions correspond to FP elementary processes. Because each is sized and the effort estimated, the ramifications of adding, changing, or deleting functionality on budget is readily apparent. Without these metrics, sales and services would have been estimating too low or too high, with the inevitable result of disappointing either the client or eSell management. Customer satisfaction would certainly suffer. This could even have created a situation where liability would be a factor.
- **Credibility:** eSell earns credibility from two perspectives. First, discussions are done at the business problem level, not at the technology feature/function level. The customer's customer's view is represented. Discussing at this level is more difficult but more compelling and effective than the traditional alternatives. Second, the teams fielded are senior experts who clearly inject the voice of experience. This shows especially in the level and quality of the questions asked, including those the client has not even thought about. Ultimately the client is enlightened by the process and ensuing discussions, which include analysis of the issues at the complete systems level. It becomes clear that this team of experts has solved these types of problems before. eSell's customers are being tasked by their Boards of Directors to jump on the Internet business wave. Many of these brick-and-mortar companies have been doing business the same traditional way for decades. To survive, they

must gain enough confidence to become early adopters, but they are faced with the dot-com meltdown of the recent past and its associated marketing hype. Who can they trust? On what claims can they bet their company's future? The credibility earned during the project kickoff and FPE process alleviates many of these concerns.

The rigorous detail, standardized objective analysis, quantitative approach, lack of reliance on "guesstimation" and hand-waving, and line-item veto all gave eSell's customers a feeling of confidence in their ability to manage the project and budget risk and still have a high probability of success.

Let us now examine the component parts of this function point estimation program, as adapted and adopted at eSell. The following sections detail eSell's actual implementation of these atomic parts, listed here:

- Extensions to the International Function Point Users Group (IFPUG) Counting Practices Manual 4.1 or CPM 4.1
- The FPE worksheet
- The productivity database repository
- The processes used

Extensions to IFPUG CPM 4.1

To seamlessly integrate FP into the Web development/deployment fabric, eSell has extended and adapted standard IFPUG counting practices found in the CPM 4.1. This was necessary to accommodate some of the differences that Web-enabled business application development creates over traditional mainframe or client-server software projects. Following are examples:

- Web-application graphical user interfaces (GUIs) are somewhat different, affecting External Input/External Output/External Query (EI/EO/EQ) measurement. Logical business transactions often require multiple physical Web screens with embedded navigation. The challenge is to identify the elementary process as distinct from the highly user-friendly GUI-oriented implementation.
- Web GUIs are built dynamically. Their layout, data fields, and even cosmetics are determined at run time as a function of system and end-user factors. Thus the number of data element types (DETs) and file type references (FTRs) for a particular EI/EO/EQ changes as the online transaction progresses or between online transactions. This had to be accommodated.

- Web-based transactions typically require more master detail or drill-down displays; this is especially challenging when one is defining differences between *physical* and *logical* functionality. Web GUIs use drop-down boxes or combo boxes, often populated by complex dynamic queries (EQ). The ratio of EQ to EI/EO is typically higher than in a traditional mainframe or client/server application.
- Web-based applications are typically embedded in a multi-tier architecture, often requiring as many as four or five tiers. These tiers could be composed of actual end-users or other back-end systems. The issue of exactly where the *application boundary* lies in such a complex topology is challenging.
- E-commerce systems integrate with ERP systems. These multi-million-dollar systems are highly complex, configurable, and also programmable. During the Web deployment, the ERP systems must be customized and reconfigured. Thus, identification of the FP Boundary is a non-trivial task. Data stores (ILF) may exist not only in the Web application but also in the ERP system. ERP programmable components (business objects, remote function calls, and the like) are counted as data stores (ILF/EIF), since their primary intent is to manage ERP business data.
- Web-based applications are highly interactive, requiring real-time access to multiple disparate back-end systems. This may include direct access to back-end databases or indirect access to these data stores by way of business logic in intervening application servers. Complexity is added to determining exactly what are the ILF/EIF files and what are simply EI/EO system-to-system pairs.
- In B2B (ERP-integrated e-commerce, in particular), Web-based applications are developed by project teams with disparate though complementary skill sets, such as
  - Project management
  - Java development
  - ERP language development
  - ERP system functional expertise
  - System administration
  - Network administration
  - Graphics art, page layout, human factors expertise

This adds challenges to the process of gathering productivity data (for example, function points per staff-month) for the team and for the individual roles on the team.

Over the two years eSell has been doing project sizing and estimation, they have accumulated a productivity and size historical database. This productivity database (PDB) plays a crucial role in predicting future results based on past projects. With this data, eSell has performed almost 100 project-sizing and effort/cost estimations and scores of full-application-sizing FP counts.

This work has yielded some startling results:

- Due to eSell's rapid application development (RAD)[2] project approach and recurrent FP process, the RAD-oriented development environment, the reliance on object-oriented design and tools, and other critical factors, the product development and deployment productivities showed marked improvement over industry-standard norms. For example, the conventional wisdom indicates that a respectable average team productivity is approximately 8 to 10 FP per staff-month. However, in our PDB, we have found a range of 14 to 74 FP per staff-month with an average of about 25 FP/SM. This is an overall improvement factor of over 700 percent peak-to-peak and an improvement of 250 percent on average. Is this because our teams are smarter? No. It is because rapid application development (RAD) and function point analysis (FPA) prevent the teams from spending inordinate amounts of precious and costly project time building functionality that will ultimately be rejected by the ultimate end-user—and thus not productive.
- eSell's measurements have shown a high degree of accuracy in the estimations, sometimes achieving ±2 percent error rates in resultant staff-day figures. Is this because we have a better measurement staff? No. It is because we estimate at a very fine grain (the ability-to) and measure and correct at that fine grain. Accuracy must improve.

The Function Point Counting and Estimation Repository

eSell has been gathering a key repository, the PDB, containing project size, effort, and duration data since the measurement program was born. Today, two years later, the repository includes a wealth of data for almost 200 instances of function point counts and project estimates. For each implementation project, or for each

[2]Bayer, Sam and Jim Highsmith, "RADical Software Development," *American Programmer* (June 1994).

product development project, the following types of data can be found in the repository:

- Project name
- Project contract information (if an implementation project)
- FP counter specialist name
- Project actual total size (FP)
- Project actual total effort (SM, SD)
- Project actual average productivity (FP/SM)
- Project actual duration (in calendar months)
- Various productivity factors for the project
  - Programming language used
  - Degree of back-end system integration
  - Level of reusability
  - Overall project risk
  - Project team makeup (was it mostly experienced or junior members, were implementation partners or client resources involved, and so on)
  - Miscellaneous extenuating circumstances (for example, this was the first time this back-end system was integrated)
- Project team members' names, their roles on the team, their levels of experience as it relates to these roles, and the actual effort (SM) expended by each (by role, not by person)
- Current project status

When we began to estimate our first project two years ago, however, none of the above data existed. The key missing component, the "yeast" for the new loaf of bread, was productivity data. With that, we could continue until we had enough actual data of our own. How did we bootstrap this process so we could begin to gather the data? We did so by taking advantage of two readily available sources of information.

1. **Industry averages:** In 1999, overall productivity for industries that were close to eSell's was in the range of 8 to 12 FP/SM. We knew that with RAD techniques, RAD tools, and higher-than-usual levels of reuse, we could assume a higher rate to start. So we started with 20–25 FP/SM.
2. **Product development:** In 1999, we had developed several products that gave us an opportunity to obtain some actual data. We did a full function point count on the released applications and went back to internal development

team time sheets to capture effort and duration data. From that, actual productivity for this handful of projects was obtained. Ironically, it simply validated our 20–25 FP/SM extrapolation of the industry averages.

For the first few project estimations, then, we used a productivity of 20–25 FP/SM. Note that this single figure was assumed for all ability-to statements for the entire project. This average was an approximation for the various productivities actually achievable when measured on an ability-to basis.

As time wore on, the process evolved and we began to have enough actual data to make the PDB reasonable. We migrated our worksheets and processes to use productivity data from the PDB, and we began to apply different productivities to *each* ability-to, based on predefined (and premeasured) factors.

Ironically, after two years of estimation work, our PDB still shows overall average productivity to be in the range of 25–30 FP/SM—very close to the bootstrapping approximation we used at the outset.

The Function Point Counting and Estimation Team-based Process

How is this counting and estimation process done? The overall process is in the form of a feedback loop, and looks something like this:

1. At each implementation project kick-off, the end-user ability-to functional requirements are gathered. They are then organized, documented, and listed in a function point estimation (FPE) worksheet. At this point it is time to convene an FP estimation session. The goal is to build and deliver a complete FPE worksheet that has all the ability-to statements and the estimated size, dollar cost, and effort cost for each (see Figure 41-1).

   Attendees for the FPE session include:

- **Project manager:** Represents the client's and the client's end user's perspective of each piece of functionality
- **Senior architect:** Represents the overall technology, interfaces, systems, data models, and capabilities of the existing products and services
- **ERP functional expert:** Represents the overall configuration of the customer's back-end systems and how it maps to our assumptions of what is required to function without customization
- **Senior FPE specialist/architect:** Provides the expertise on how to do the estimate, serves as design reviewer, and drives the FPE process

Project: Order Management					*PM:* Adriane Foster					*FP Counter:* Vic Tolomei				*Contract#:* 28322
Customer: Laramie Oil					*Architect:* Marji Zehnder					*ERP:* SAP R/3 4.6B				*Date:* April 30, 2001
ID *1*	**Functional Requirement** *"The end user will have the ability to"* *2*	**EI FPC** *3*	**EO FPC** *4*	**EQ FPC** *5*	**ILF FPC** *6*	**EIF FPC** *7*	**Total Est. Function Points** *8*	**Technology** *W=HTML/DB C=HTML/DB+COM A=HTML/DB+COM +R/3* *9*	**Degree of Reuse** *N=New Devel R=Customize* *10*	**Risk** *L=Low M=Med. H=High* *11*	**Estimated Productivity** *(Function Points per Staff-Month)* *12*	**Estimated Effort** *(Staff-Months)* *13*	**Estimated Effort** *(Staff-Days)* *14*	**Risk Elements, Comments, Reminders, Assumptions** *15*
…	…													…
18	**Create Sales Order Transaction, Shopping Cart Display -** Customize Create Order Shopping Cart to display all surcharges at sales order header level (i.e. freight and delivery charges)	6	0	0	25	0	*31*	A	R	M	*33.3*	*0.9*	*20*	**EI:** Modification of highly complex External Input Shopping Cart. **ILF:** Change to average complexity SAP R/3 Remote Function Calls or RFCs SalesDocCreate & Simulate (single logical ILF). **ILF:** Change to highly complex Shopping Cart Database (ILF). **Technology:** "A" (ERP Backend). **Reuse:** No new code required (high levels of Reuse). **Risk:** Medium risk due to ERP system freight management interfaces. **Assumptions:** It is assumed that customer must define all surcharges to be displayed on the Web. Mirror text for surcharges from the invoice. Change to cart at header level.
…	…													…
Total and Averages:							***302***				***24.2***	***12.5***	***276***	

Figure 41-1: Function point estimation worksheet excerpt

2. For each ability-to, the FPE team discusses the architectural, business, logical, and software implications of the function and agrees to and documents the following:

- Estimated functional size in FP of the ability-to requirement (EI/EO/EQ/ILF/EIF) based on the transactional and data functionality and complexity involved
- Various productivity enhancement and reduction factors expected for that piece of the development, such as
  - Type of technology involved
  - Amount of back-end integration required
  - Degree of reuse that can be leveraged
  - Team's subjective impression of overall risk and comfort level, based on the assumptions documented
  - Team make-up (experience, seniority, internal versus partner, and so on)
  - Customer team involvement
- Of equal importance, a detailed summary of the risk factors, assumptions, design considerations, architectural notes, open issues, and other comments related to this ability-to—including work expected to be done by the customer

3. The worksheet takes this data and automatically calculates the following estimates for this ability-to:

- Estimated size (FP)
- Estimated average productivity (FP/staff-month)
- Estimated effort (staff-months and staff-days)

The worksheet automatically maintains the following estimated project totals:

- Estimated total project size (FP)
- Estimated average project productivity (FP/SM)
- Estimated total project effort (SM, SD)

4. The customer reviews the FPE worksheet with the eSell project manager. The list of end-user functionality is validated as correct and complete. The assumptions are also adjusted and accepted. Based on dollar, resource, and time budgets, the customer then exercises line-item-veto privileges on any ability-to. For functionalities either removed or deferred, only *that* ability-to's size/effort estimate is removed from the total project plan. Sometimes, these changes warrant another FPE session to adjust the estimates.
5. Development begins to the first incremental milestone.

6. The first focus group meets soon after. During this meeting, the actual ultimate end-users are invited. The first agreed-on block of functionality is delivered, demonstrated, and reviewed by this extended project team. Change requests are captured. The ability-to list is updated, and another FPE session is held to re-compute the size and effort based on the agreed-on prioritized changes. Steps 1–6 iterate until the application goes into production.
7. At the end of this project's deployment and after the application is successfully in live production, an FP counting session is convened, with approximately the same makeup as the FPE session in step 1. This team examines the live application (previously estimated) and does a full application count. Each transaction, screen, data element, data store, field, and such is examined in accordance with standard CPM rules (as extended by eSell). Actual time sheets from the project team by role are accumulated. Data is obtained for *actual* size (FP), effort (SM), average productivity (FP/SM), and various other productivity factors. (Review the earlier description of the PDB.)
8. All data is placed in the PDB to increase the "reality" of future FPEs.
9. Repeat from step 1.

Function Point Estimation Worksheet Example Segment

A segment of an actual FPE worksheet (created in Excel) is included in Figure 41-1 as an illustration of the FPE process described. Each line on the worksheet is a functional requirement from the end-user perspective, in the form of an ability-to with all associated size and effort estimates attached.

Column 1: A numeric ID is assigned for reference purposes.

Column 2: The new or customized functionality (ability-to) is articulated by the Specialist.

Columns 3-7: The FP Specialist enters the function point size (estimate) for the EI/EO/EQ/ILF/EIF associated with the new or modified functionality.

Column 8: The worksheet calculates the FP total for that ability-to, indicating the estimated total **size** of the ability-to (31 FP in this example).

Now project team productivity for this ability-to is estimated.

Column 9: The FP Specialist enters the type of technology and degree of back-end integration used to implement this function. Currently there are three choices (W, C, A) in increasing complexity and thus decreasing productivity.

Column 10: The FP Specialist enters the level of reuse expected to implement this function. Currently there are two choices (R and N) in decreasing reuse and thus decreasing productivity.

Column 11: The FP Specialist enters the overall subjective risk associated with all known (and forecast unknown) factors involved with this function. Currently there are three choices (L, M, H) for increasing risk and thus decreasing productivity.

The worksheet uses these three factors to look up in the historical productivity database what productivity was achieved in the past for work of that profile.

Column 12: The estimated productivity for this individual ability-to is calculated by the worksheet and placed in Column 12. Here it is 33.3 FP/SM for the combination of the three productivity factors chosen (A-R-M).

Columns 13 and 14: The worksheet uses simple arithmetic and computes the estimated effort in staff-months (SM) and staff-days (SD) for Columns 13 and 14, respectively. Here this is 0.9 SM and 20 SD.

Column 15: Finally, the FP Specialist logs all the changes, risk elements, assumptions, notes, reminders, and other miscellaneous information that would be relevant to justify and document the estimate, for the customer to validate or for the design team to use.

When all ability-to items are analyzed, the worksheet calculates (at the bottom) the total function point size estimate (302 FP), the average productivity (24.2 FP/SM), and the total effort from which contractual costs are computed (12.5 SM, 276 SD).

Other Applications

We have examined in detail how the four components of the eSell functional measurement program (CPM extensions, FPE worksheet, PDB, and process) are used in the most common application—namely to perform size, effort, and cost estimates at project kick-off to produce a realistic project plan. The following sections examine some of the other ways these techniques are being used during the sales cycle to improve eSell's traction with its customer base. These are

- Pre-sales: The make versus buy decision
- Post-sales: Project staffing
- During implementation: Project control

Pre-Sales: The Make versus Buy Decision

Do not conclude at this point that the measurement and estimation process provides value only in the post-sales or implementation phases of projects. It is also a key component of the pre-sales environment. Here is a case in point.

When a corporate e-commerce initiative is established, the prudent response of the customer's executive management is to determine whether the solution should be built in-house (make) or purchased from an outside supplier such as eSell (buy). Most IT organizations instinctively look at these projects as make opportunities in which they can learn new technologies and keep their staff busy and productive. From a corporate perspective, however, developing these applications from scratch may not be the most fiscally responsible decision. More often than not, the custom development projects incur large hidden costs: learning curves for new technologies, the team's not knowing what it does not know, inability to manage scope creep, ongoing maintenance and support, and so on. These discoveries can be costly in time, effort, and competitive advantage.

With FP techniques, eSell formulated a *quantitative* analysis to estimate the cost of making product functionality in-house that was equivalent to what they could buy off the shelf. This showed clearly that buy's advantages far outweighed make's. This Make vs. Buy analysis became a formal sales tool. The analysis (described here) was trivial arithmetically but powerful in its objectivity and quantitative perspective.

1. A third-party-validated FP application count was done on each off-the-shelf (buy) product to obtain its exact functional **Size** in FP. In this example, the size of the complete product offering was counted as **3200 FP**.
2. Industry-standard **Productivity** numbers (FP/Staff-Month or FP/SM) were obtained from various databases, and the average was used. In this example, the average was **10.0 FP/SM**, the median between the identified extremes of 8.0 and 12.0.
3. Estimates of **Effort** (SM) were calculated, using the above two sets of figures, to show approximately how much time it would take an industry-standard project team to deploy the equivalent functionality (**Effort = Size / Productivity**). In this example, Effort was calculated at **320 SM** or **26.7 Staff-Years** (**SY**).
4. Industry-standard **Loaded Labor Rates** ($/SY) for comparable high-tech industries were obtained. These were estimated at **$150,000/SY** (per employee per year).
5. Estimates of labor-only **Make Cost** ($) were calculated by using the effort estimates and the loaded labor rates (**Make Cost = Effort * Loaded Labor Rates**). This was computed at **$4M**.

6. This labor-only cost compared quite unfavorably with the (buy) license fees of the already-released software products (in this case, **Buy Cost approximately $1M**). This factor of almost 4x was a clear and objective argument that, in this case, *buy* was a better value than *make.* Note: the $4M make cost did not, of course, include large, subtle hidden costs such as opportunity loss, time delay, and support and maintenance costs, relegating the *make* alternative to even lower attractiveness.

eSell's customers found this compelling. They might not have agreed with the exact numbers used, but they found the analysis and argument valid.

Post-Sales: Project Staffing

Another useful application of the FP sizing and estimation process is used in the post-sales time frame. Here the methodology helps the team managers (eSell's and the client's) better determine what skill sets and domain expertise (team roles) must be represented on the project team to have a successful project and how much their time will be impacted. Again, the PDB plays a central role, as follows:

After project kickoff and the FP estimation process, the project managers have an idea of the functional requirements, their size, and the effort required to implement them. In the FPE worksheet, they also have documentation of the productivity factors affecting each ability-to, including the technologies involved. The PDB contains accurate, actual historical data, including the team make-up for each past project. The project manager can cross-reference the estimate data of the new project with historical data in the PDB by finding one or more past projects that best match the new one. Previous efforts by role are used to determine the percentage contribution to the entire project by each role.

For example, for some projects, the Project Manager's contribution absorbs 20 percent of the overall project budget. The Java Developer contingent (this is Web, after all) is 35 percent, the ERP Developer 15 percent, and so on. From this historical data, staffing projections can be done for eSell, partner, and client resources based on role. The appropriate resource with the needed expertise for the required time can be allocated to the team in each case.

During Implementation: Project Control

The final application of functional metrics at eSell is in the area of project control and monitoring during implementation. A measurement process that takes the accuracy of its data seriously also recognizes that accuracy can be achieved only with

constant monitoring, *re*measuring, and iterative corrections. The project sizing and estimation process described earlier is done at project launch. At that point, there is only an approximation ("educated guess") of what functionality might be required. The sizing estimate for each of those ability-to statements will be fairly accurate (given a good understanding of the function). But even the effort estimate will be somewhat suspect since (a) the predicted productivity factors that influence the timing can only be guessed, (b) inaccuracies exist in the assumptions and risk assessments, and (c) functionality and understanding will mature during the project.

As explained earlier, these inaccuracies are constantly under scrutiny and being corrected, because the final, live project application is FP counted for actual size, and the actual productivity is computed from time-sheet data. But this corrective process is too late for the project itself. Monitoring must be done *during* the project at key milestones to check progress against the estimate, and then the estimate itself is refined.

Therefore, a pivotal process is used in eSell's project methodology: the Focus Group. At short intervals (typically 3–4 weeks), the project team is convened *along with the client's customer representatives*—the ultimate end-users. The development product to date is demonstrated for the team, and another pass is made at required functionality. Feedback from the client and their end-users at this point is vital to the success of the final deployment. The list of ability-to statements is revisited. Existing ones (from launch or earlier Focus Groups) are validated, rejected, or postponed, and some new ability-to statements are discovered. These changes dictate the need to recalculate the original sizing and effort estimate.

Another FPE meeting is convened on the revised set of ability-to statements, and a new size and effort estimate is obtained. A supplemental worksheet is used (one outside the scope of this paper) that enables the project team to *re*-estimate the new size, effort, and budgetary costs. New information such as the following is taken into account:

- Some work is already completed and delivered and thus paid for.
- Some work estimated but not started or completed has now been rejected (a cost savings).
- Some new, unexpected work has been added to the mix.

In fact, some analysis reveals nine combinations of ability-to statements, in two dimensions of 3×3. These are Original Work Delivered, Original Undelivered, and New Work versus Approved, Rejected, and Deferred (by the client or end-user). The re-estimation worksheet provides a revised effort and cost

estimate for the remaining work. The client can then apply the same line-item-veto process to the revised ability-to statements to assure the remaining costs fit the dollar, resource, and time budgets.

Thus, the fine-grained project-progress monitoring is facilitated by the FP estimation (and re-estimation).

Internal Challenges at eSell

In any complex development organization, establishing such a pervasive software measurement program is a challenge. Many technical, organizational, cultural, and political obstacles had to be overcome at eSell before the benefits described earlier could be realized. Here are some of them:

- Early understanding of the potential benefits of FP sizing/estimation was insufficient when compared with the perceived cost and effort to build the measurement program.
- No software measurement methodology was in place, making the learning curve quite steep.
- No historical data was available, so industry-standard data was used until enough experience was obtained and more Web/eSell-specific data was gathered.
- Function point counting (FPC) practices that did not quite fit Web application development methodologies and RAD project methodologies all had to be adapted without losing sight of the IFPUG CPM "spirit" (principles and intent).
- Sizing for product development and estimation for project implementation services required completely different techniques and data models.

Going forward, there is much potential for other departments across eSell to leverage the benefits of the FPE process. The following departments have started, but none to as deep a level of adoption as the successful Implementation Services organization.

- *Implementation Services:* eSell's deployment teams have wholly adopted FP analysis. All project managers and architects are trained and use these techniques daily. This allows more accurate estimation and management of resource allocation, cost forecasting, productivity tracking, scheduling, and other vital planning tasks.

- *Product Development:* eSell's product development teams also use FP estimation techniques to size products already built and estimate the resources and time required to build new products or enhancements. There is room for growth here.
- *Product Management:* eSell's product management teams use our unique FP estimation capability to get a more accurate picture of what product features are in the highest demand in the customer base. Because we gather functional requirements from the end-user's point of view, we get a unique insight into where the product road map needs to be directed. We can also forecast the costs of new or enhanced functionality.
- *Sales:* eSell's Sales organization actually sells FP expertise and methodologies as an important component of their technology product and services package. They believe this FP-based component is of high value and a key differentiator in the marketplace. The standardization and objectivity of the approach, the focus on the ultimate end-user, and the fine-grained control the client has on project cost serve together as a risk management vehicle and a client confidence-builder for eSell's solution and relationship. For example, the Make vs. Buy tool is now commonly used in the field.
- *Training:* The eSell Academy teaches RAD and FP principles to its employees and implementation partners through formal classes. In fact, some of eSell's customers are so sold on the benefits of FPC/FPE analysis that they have either sent their project managers and development managers to eSell's project sizing and estimation classes or have retained eSell to bring the FPC/FPE class onsite to their facility.

Summary and Conclusions

"Those who foretell the future lie, even if they tell the truth." —Arabian Proverb

---

eSell Inc. installed a metrics program based on functional metrics to insert predictability—and therefore confidence—into its sales and implementation processes. From that perspective, the program was an unqualified success. After two years of effort to create and refine the tools and techniques required implementing the program, the following observations can be made:

- Customers appreciate the dialog that has to take place to produce an estimate for the project. It gives them a sense of comfort to be explicitly asked to

walk through the project's requirements from *their* customer's perspective and to participate in the process of visualizing how the requirements will be implemented.

- Because customers appreciate the process, the sales organization has embraced it as an integral part of their sales process.
- Because both the sales organization and their prospective customers have embraced the program, the implementation teams do not have to be seen as the "bad guys" when recommending the use of a rational metrics-based process for project estimation and control.
- Consequently, overall implementations have proceeded smoothly and have produced a highly referenceable customer base that can be leveraged for sales to new customers.

As the above referenced Arabian proverb suggests, the authors believe that the value of the estimation process is not in the accuracy of its predications but in the creation of attainable targets in which the customer and their customer are intimately engaged with the project teams. These attainable targets produce the self-fulfilling prophecy of project completion on time and within budget.

Some unexpected lessons were also learned and helped evolve the process. First, the bootstrapping of the measurement process in an organization unaccustomed to such mental models is slow-going and requires constant attention. For the process to be truly adopted and embraced, each group in the organization had to come to its own conclusions about the value of the extra effort, and each had to be "evangelized" separately and on an ongoing basis. The good news is that such adoption, thus hard-won, is strong and somewhat self-sustaining. Second, in practice it was a challenge to keep a balance between overly detailed and overly general ability-to functional descriptions during the estimation process. This required several consistency and normalization checks on the project managers who were generating the first draft of these lists. Third, at times some of the various functionalities described in separate ability-to statements were too related and intertwined to be structured in a completely self-sufficient and independent manner. Thus there were times when customers could not have individual line-item veto. Finally, for the same reason of threads of dependence between ability-to statements, it was a constant challenge not to double-count elementary processes and thus over-inflate the estimates. Avoiding this took attention to detail, practice, a dedicated team, and documented, consistent rules.

Final Questions to Ponder

The journey to an enmeshed and integrated FP process within eSell's sales, services, and development organizations and with its partners and customers was arduous and circuitous. They succeeded only with the support and guiding hands of an executive sponsor, who had the vision and clearly saw the risks and rewards. Also instrumental was a process/technology evangelist with the drive, persistence, and expertise to execute on that vision over the long haul.

But company landscapes change, roles shift, priorities move. Is such a program entrenched sufficiently to survive if the sponsor and evangelist were removed from the equation? Is not any measurement program a young and vibrant plant that needs the constant attention, watering, and nutrients of a few dedicated individuals so it will not die on the vine? Or, is it like the forest, which tolerates the absence of the caretakers because the system is self-contained and self-sufficient? That is a question for which only the passage of time will provide an answer.

Biography

Sam Bayer is currently a principal in the Bayer Consulting Group, a management consultancy focused on helping technology companies realize their desired potential in the marketplace. Sam also holds an adjunct faculty position at Capella University's School of Business.

Sam most recently spent three years at HAHT Commerce, where he was instrumental in reengineering the company's business model from a provider of software development tools to a total solution provider of B2B e-commerce applications and services.

Sam was a founder of Axiom Systems, which became a publicly held corporation providing Laboratory Information Management software and services to testing laboratories in Fortune 500 companies around the world. He has also held various professional and executive positions at IBM, Amdahl, Agfa, and Sapiens.

Academically, Sam earned his B.S. and Ph.D. in chemistry from the University of Florida.

Vic Tolomei is currently a management consultant. For the past five years he was senior director of technology at HAHT Commerce, Inc., in Raleigh, North Carolina, a business-to-business e-commerce product and solution provider.

He has 31 years of professional experience in software product and application architecture, development, and technical management. This includes work with the Web and Internet, client/server, workstation, microcomputer, minicomputer, and mainframe platform architectures from the operating system level through the user interface. During this time he has also been a senior instructor for the University of California for certified programming courses.

He has a B.S. in mathematics and computer science from the University of California at Los Angeles, where he graduated from the Honors College, Summa Cum Laude, Phi Beta Kappa.