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MBA PROFESSIONAL REPORT

Modeling the Value of Micro Solutions in Air Force Financial Management

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December 2005

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The purpose of this MBA Project was to develop a model that would estimate the value of applying available spreadsheet programming tools to automation opportunities in Air Force Financial Management (FM). Model inputs include Labor Estimates, Labor Rates, and Task Characteristics, while outputs are represented in terms of Return on Investment, Payback Period, and Annual Savings. The boundaries of the model are limited to the Microsoft Excel Visual Basic for Applications (VBA) development environment for the development of short-term (<1 year) automation opportunities of low to moderate complexity (Micro Solutions). First, the project model will be outlined and discussed; including the methodology, assumptions, and the specific mapping of input variables to model outputs. Then the model will be used to analyze six actual field-developed case solutions and project potential value for two currently unrealized solutions. Finally, the project will present recommendations drawn from practical application of the model.

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MODELING THE VALUE OF MICRO SOLUTIONS IN AIR FORCE FINANCIAL MANAGEMENT

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MODELING THE VALUE OF MICRO SOLUTIONS IN AIR FORCE FINANCIAL MANAGEMENT

ABSTRACT

The purpose of this MBA Project was to develop a model that would estimate the value of applying available spreadsheet programming tools to automation opportunities in Air Force Financial Management (FM). Model inputs include Labor Estimates, Labor Rates, and Task Characteristics, while outputs are represented in terms of Return on Investment, Payback Period, and Annual Savings. The boundaries of the model are limited to the Microsoft Excel Visual Basic for Applications (VBA) development environment for the development of short-term (<1 year) automation opportunities of low to moderate complexity (Micro Solutions). First, the project model will be outlined and discussed; including the methodology, assumptions, and the specific mapping of input variables to model outputs. Then the model will be used to analyze six actual field-developed case solutions and project potential value for two currently unrealized solutions. Finally, the project will present recommendations drawn from practical application of the model.

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LIST OF ABBREVIATIONS, ACRONYMS, TERMS

AF	Air Force
AFIT	Air Force Institute of Technology
ALO	Accounting Liaison Office
AP	Accounts Payable
AR	Accounts Receivable
ATF	Automated Tools Forum
CIVPAY_TRANS*	Micro Solution Case Study; intended to translate and analyze Civilian Payroll program data
Community	A large set or subset of like-organizations
COPTRS	Micro Solution Case Study; Cost to Price Translation Software, designed to fill initial operating capability gap in accounts receivable module functionality
COTS	Commercial Off-The-Shelf
Developer	Role of individual who outlines, codes, and debugs software tools in Excel VBA. In the context of this project is likely to have extensive functional experience but limited or no formal training in software development
D04	SBSS Daily Supply Issue Listing
DCPS	Defense Civilian Payroll System
DJMPS	Defense Joint Military Pay System
DJMPS_REJECTS*	Micro Solution Case Study; to facilitate daily translation of Military Pay System posting exceptions
DoD	Department of Defense
DP	Military Personnel
Excel	Microsoft ® Office Excel (2000 – 2003)
FM	Financial Management
FSO	Financial Services Office

Functional	Role of the individual who performs and/or supervises day-to-day tasks in a specific area of expertise; competent to outline solution requirements and certify solution testing
FTE	Full Time Equivalent
Growth Factor	Factor applied to software development estimates to account for unforeseen problems or requirements
GPC_RECON*	Micro Solution Case Study; reconciles expense and funds data in Government Purchase Card (GPC) Program
IOC	Initial Operating Capability
IT	Information Technology
LABOR_RECON*	Micro Solution Case Study; reconciles Government Labor cost accounting vs. pay system data
Micro Solution	Task-specific software tool
MS	Microsoft ®
MSDM	Micro Solution Development Model
NCCA	Navy Center for Cost Analysis
NPS	Naval Postgraduate School
Object Libraries	The functional capabilities of a software application (i.e. Excel) that are made available for use in an object oriented programming environment (i.e. VBA)
ODL_TRAC*	Micro Solution Case Study; facilitates tracking and analysis of Open Document Listing (ODL) records
Organization	Air Force Wing, Squadron, or operating activity
Payback Period	Implementation time required to fully recover costs associated with a solution
ROI	Return on Investment
SBSS_INTERFACE*	Micro Solution Case Study; Standard Base Supply System (SBSS) accounts payable interface
SAF/FM	Secretary of the Air Force for Financial Management

SLOC	Source Lines of Code
Solution	Software tool; automates routines and/or methodology in order to solve problems or streamline operations
Tactical Orientation	Characteristic of a Micro Solution; a software tool where the qualitative benefits outweigh quantitative benefits; directly supports the operational and strategic objectives of an organization or community
Task Orientation	Characteristic of a Micro Solution; a software tool where the quantitative benefits outweigh any qualitative benefits, designed primarily to compress non-value added steps in a task-level process
User	Role of the individual(s) who utilizes a solution in day-to-day operations
USSGL	United States Standard General Ledger
VB	Microsoft ® Visual Basic; an object-oriented programming language used to build Windows ® based applications
VBA	Microsoft ® Visual Basic for Applications; integrates the VB language into individual Office applications (i.e. Excel VBA), allowing the user to create macros or programs which call up host application object libraries

* The 'underscore' format in each of the solution names reflects a developer constraint in Excel_VBA; function names cannot have spaces, so this convention found its way into the name selected for each solution.

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I. INTRODUCTION

A. BACKGROUND

As Air Force Financial Management (FM) Officers, we value the ability to provide near real-time decision-quality information to those we serve. We value flexibility. And, we value the people who do the work and their innovative potential. These values, and the application they find in the Micro Solution development approach, directly support the USAF Transformation Flight Plan's focus on our business processes:

Air Force business processes stem from an industrial age when America faced a security environment that was vastly different in character than the one the Air Force faces today. Although they have been incrementally reformed and modernized over the last 30 years, the underlying philosophy and basic architecture of these processes have not changed-they are labor intensive, they lack agility, flexibility, and speed. Accountability is fragmented and diluted throughout large bureaucracies that must render their collective assent to enable the accomplishment of the most mundane tasks.

The principal goal of business transformation is to fashion fast, flexible, agile, horizontally integrated operational support processes that enable fast, flexible, agile, and lethal combat forces. The key to this goal is focusing on warfighter needs and eliminating the seams that divide Air Force capabilities today. The Air Force envisions a further business environment that provides fast, predictive operational support and response through situationally aware commanders. The secondary goal of business transformation is to achieve increased efficiencies through better, simplified, integrated processes and better support tools. Improved efficiency of business process should deliver the following effects:

- A twenty percent shift in business operations resources (dollars and people) to combat operations and new/modern combat systems

- A working load enabling its people to conduct routine (non-crisis, non-exercise) organizational missions safely within a 40 –to – 50 hour work week.

- A compression of average process cycle times by a factor of four (relative to current established process baseline).

- *The empowerment of personnel and enrichment of job functions.*[1]

These very specific transformation mandates are highly relevant to Financial Management operations. Meaningful analysis in the FM field requires the ability to compile and reconcile data from different systems. Legacy system outputs are notably inflexible, and many analysts are bogged down in tasks related to simply moving data around with little time left for critical thinking. While many 'enterprise-wide' tasks could be automated the expense of formal automation, by means of a contracted agent, is often prohibitive. Even modern COTS-based Financial Software implementations often require temporary solutions to bridge gaps in initial operating capability. While these systematic solutions resolve performance and integration issues, they also drive tremendous process changes – requiring more flexibility and innovation than ever before. FM professionals, not systematic solutions, bring innovation to the fight.

The authors have sixteen years of collective service in the Air Force FM community; including tours in Budget Operations, Financial Services, Cost Analysis, Project Management, and Legacy Systems support. Experience suggests that in many cases, particularly those in which requirements are well understood and solution scope is limited, important 'desktop' development work is within the reach of FM professionals. Unfortunately advanced software application training and support is not a priority in the FM community. The few FM application developers working in the field today are typically self-taught, and their efforts are usually focused on organizationally-unique solutions. FM analysts are generally expected to wait for IT professionals to deliver FM community solutions downstream, meanwhile patching together processes to meet daily requirements.

Excel VBA in the hands of an FM functional expert offers a low-cost, task-precise approach to developing relevant solutions and task automation tools. But when does it make sense? Can the value of this grass-roots development approach be quantified?

[1] USAF Transformation Flight Plan, 6 Jan 2005. Accessed 31 Oct 2005, available from http://www.oft.osd.mil/library/libraryfiles/document_385_2004_USAF_Transformation_Flight_Plan.pdf. Internet.

How attractive is it really? Which projects are most worth doing? The purpose of the Micro Solution Development Model is to address those questions with objective, quantifiable answers.

B. THE MS EXCEL VBA DEVELOPMENT ENVIRONMENT

MS Visual Basic (VB) is an object-oriented programming language used to build Windows-based applications. MS Visual Basic for Applications (VBA) is a powerful software development environment resting on each of the individual Microsoft Office applications (Access VBA, Excel VBA, etc.). Excel VBA differs from Visual Basic in that it is designed to work within the framework of the Excel application's functionality, while retaining the capabilities of the VB language as well. Figure 1 highlights some key features and functions commonly used in Excel VBA development. The VBA language was first included as a standard feature in Excel with version 5 (1994)[2], and comes standard with the current Air Force desktop software package, MS Office 2003.

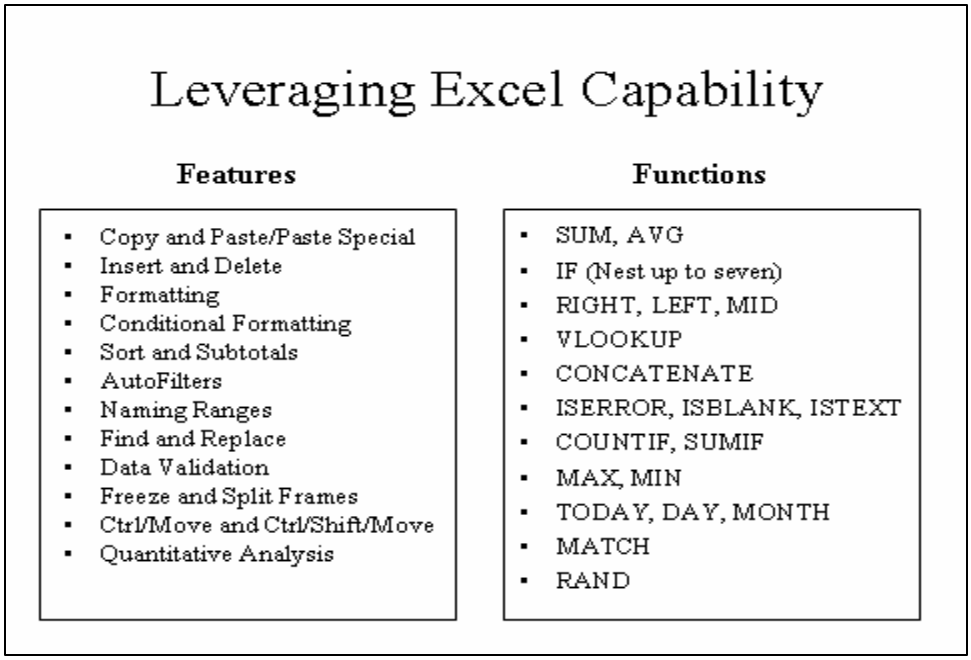

Figure 1. Features and Functions Useful in Excel VBA Development

[2] Walkenbach, John, Excel 2000 Power Programming with VBA. New York: Hungry Minds Inc., 1999.

Excel VBA allows the user to create macros or programs which perform tasks from within the host application. So instead of writing a procedure to sort records, the Excel VBA developer records a macro from Excel environment sorting the records to their requirements using the existing Excel Data/Sort capability (object). Though Excel objects come with constraints (sorting, for example, is limited to three levels), developing automated solutions on top of Excel capabilities jump starts development.

VBA essentially opens programming to a new class of developer. This is the primary advantage Excel VBA offers would-be FM application developers, who generally have years of spreadsheet experience and are well-versed in Excel capabilities. Excel VBA also offers the advantage of being widely available at no additional cost, since it is installed and resides with the Excel application (standard desktop software). Once a solution is developed and tested, it can be easily shared in the form of an Excel workbook. Finally, VBA provides the means to go beyond the capabilities of Excel -- to include writing and securing customized functions, employing decision loops, and automating complex task sequences.

C. DEFINING MICRO SOLUTION DEVELOPMENT

For the purpose of this report, solution opportunities considered 'Micro' in nature will involve automation of tasks involving reconciliation, translation, analysis, or reporting of existing legacy data, or some combination thereof. Though the field cases presented in Section III will vary greatly in complexity, the predictive qualities of the development model are designed to work within a fairly narrow scope of development work (as defined by the model's input variable boundaries). Important characteristics of the Micro Solutions, as presented in this report, are outlined in Figure 2.

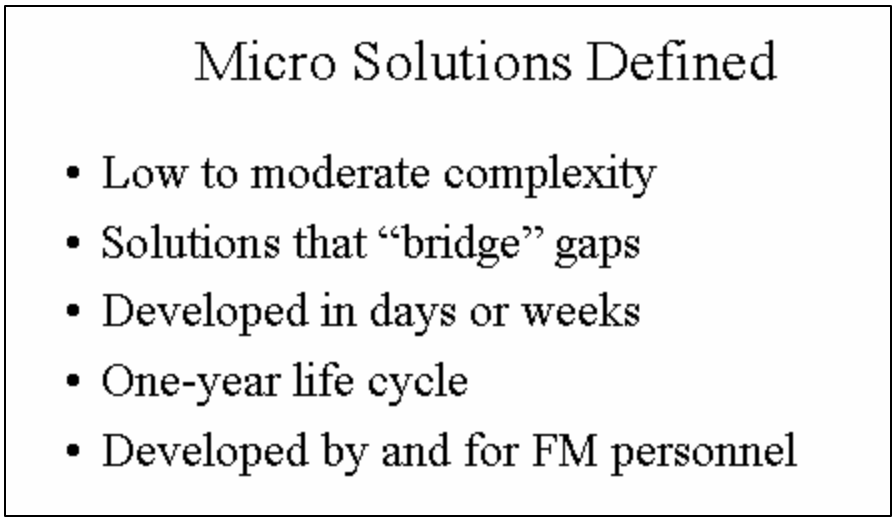

Figure 2. FM Micro Solution Characteristics

Micro Solution candidates are potential development projects of low to moderate complexity. They might be thought of as tactical solutions, since they address procedures and processes at the task level. If two people can't get their arms completely around the solution requirements in 30 minutes or less of discussion, it's not a Micro Solution. Micro Solutions are NOT designed to replace legacy system data or reports; they simply make relevant information available much more quickly. A typical solution will take a few days or weeks to develop, and will reduce a series of tasks that once took minutes or hours into seconds. The development model assumes the solution is perishable, relevant for no more than one year. Micro Solutions are indeed short-term solutions.

Probably the most important difference between the development discussed in this report, and more traditional approaches to application development, is the person doing the work. The Micro Solution approach actually allows for the FM professional (who is likely to have far more functional experience than software development experience) to take the role of the developer. FM professionals already understand the analytical requirements, the business rules, and the best way to present the information. FM professionals probably understand the detailed steps needed to make solutions work in

the Excel environment. But, of course, they need training and on-going support initially to become proficient in the VBA development environment. More specific assumptions about roles and process are discussed in Section II.

D. PROJECT METHODOLOGY

The Micro Solution Development Model is central to the project because it attempts to properly consider the most important aspects of the development scenario, synthesizing the variables and assigning an objective value to the work. So, before any observations or conclusions are drawn, the model itself will be thoroughly outlined and explained. The fundamental 'input' variables (Development Costs and Savings Factors) are discussed, then calculation of the outputs (ROI, Payback Period, and Savings) are explained in some detail. With this foundation in place the methodology used to derive the software development Growth Factor is mapped, including application of Unit Learning Curve Theory and treatment of additional input variables. The Growth Factor is used in the model to account for unforeseen problems or requirements by burdening labor estimates (by degree) before output values are calculated.

The project then applies the Micro Solution Development Model to six field-developed solutions, to assess value in retrospect and draw conclusions. Captain O'Hare was involved directly or indirectly in the development of these case solutions – therefore, model input data for each case is therefore based on first-hand knowledge of actual resources required to complete the work. Captain Krott, a Financial Services Officer (FSO) with experience employing the community solutions presented, offers a 'field customer' perspective. The presentation and analysis of each case thus includes both quantitative and qualitative aspects; the model inputs and outputs, of course, as well as a brief discussion of the important factors driving development and the results experienced in operations.

Next the project will apply the Micro Solution Development Model to two potential development cases. The input variables and Growth Factor considerations for each case are presented and discussed. Analysis of the model outputs will include some

what-if scenarios to shed light on sensitive inputs and to draw conclusions about the profitability, in terms of ROI and Payback Period, of the Micro Solution development approach in a broader sense.

Finally, the project will present specific recommendations consistent with the conclusions drawn from application of the model. This professional report makes extensive use of Figures, actually screen snapshots of the model itself under various conditions, to aid in the illustration of report content. A copy of the Micro Solution Development Model in the form of an Excel workbook (file:ExcelVBA_Model.xls), is provided as an attachment to this report.

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II. THE MICRO SOLUTION DEVELOPMENT MODEL

A. MODEL METHODOLOGY

The Micro Solution Development Model (MSDM), as shown in Figure 3, is assembled and run from an Excel workbook, and is divided into the following: Inputs; including Development Cost Factors, Savings Factors, Characteristics, and Outputs; Return on Investment, Payback Period, and Savings. Regions are outlined and assigned distinct colors for ease of reference throughout the report.

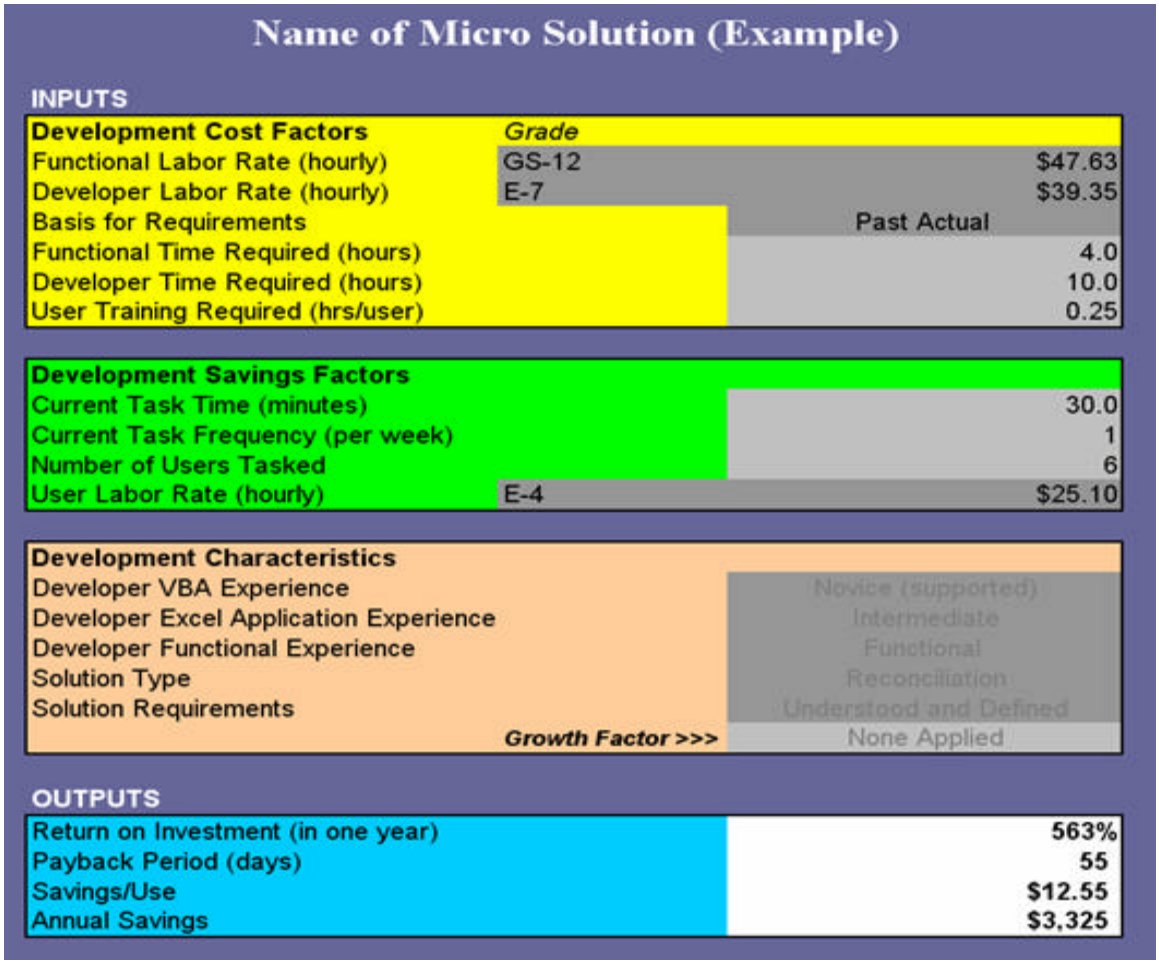

Figure 3. Micro Solution Development Model

The user of the model enters the proposed solution development data into the grey colored fields, paying strict attention to the unit basis for entry of each variable. Note the distinction between light and dark grey areas. The dark grey areas are variables that must be selected from a list of drop-down menu options (the drop-down arrow appears when the appropriate cell in the worksheet is selected). Drop-down lists are used in the model to: 1) provide a standard hourly rate lookup for the labor rate fields, based on grade selection; 2) select the Basis for Requirements; and 3) limit selection criteria in the Development Characteristics region and thus bound the development context. The model simply updates the output values based on current input criteria.

B. ASSUMPTIONS

Achieving a level of reasonable objectivity was a primary consideration in construction of the Micro Solution Development Model. Still, along the way the authors realized they would need to make a number of assumptions about the development situation being evaluated. In order to provide the best possible understanding of the outputs presented by the model, the most important of these assumptions are discussed in the following paragraphs.

1. Horizon

It was decided early on that the model would be used to evaluate short-term solutions, that is, solutions with an assumed field life of no more than one year. Though many of the FM Micro Solutions deployed in the field have remained relevant for years, the model was limited to a single year for several reasons. First, the solutions are designed to be effective interim tools, not to replace or offset the need for systematic solutions (though they may be useful in identifying future requirements). Second, the operational FM environment where these solutions are developed and fielded is increasingly subject to change. And third, using a one year time frame adds an element of conservatism to the model while emphasizing the agile nature of Micro Solutions.

2. Solution Runtime

Because Excel VBA executes even complex task sequences (100+ Excel commands) against thousands of records in seconds, the model assumes the solution runtime to be zero. This is not actually correct, since it may take a few moments to open the solution file, initiate the task routine, perhaps select file(s) for input, etc. But given our purpose to determine the first order value of Micro Solution development in a given situation, with a reasonable level of objectivity, these few seconds were considered immaterial.

3. Roles

The model assumes that the development work is primarily accomplished by a two-person team of FM professionals; the Developer and the Functional. Though others may be involved indirectly, these two take responsibility for understanding the requirements and delivering a quality solution. The Micro Solution development context assumes these two individuals are willing participants, understand their roles, work together well, are relatively tech-savvy, have a desire to learn, and will be provided the time and space needed to see the development effort through.

The Developer would be specifically responsible for outlining the project, handling all the coding and debugging work in the VBA environment, and ensuring the solution is "sturdy" enough for everyday use. In the context of this project the Developer is likely to have functional experience and must have a strong background in Excel, but may have no formal training in software development processes and applications. The Functional, usually in a position to supervise the task being automated, must understand the task(s) well enough to communicate the requirements, validate the business rules, and ensure comprehensive testing of the solution in the operational context.

4. Requirements Definition Process

Another important assumption involves the requirements definition process, which is assumed to be brief and informal. This is where Micro Solution development has a clear advantage over other development approaches, since both team members

should have a clear understanding of what is required. Still documentation is important in this early stage, if for no other reason than to express what the solution will and will not do. The basic process involves the Developer and Functional, a white board and some working markers, and a quiet place (computers are a distraction at this point). Basically, if the principals involved can't map the entire solution out on a whiteboard in thirty minutes or less it's not a Micro Solution candidate. However -- if the proposed solution can be mapped from start-to-finish, and the Developer is comfortable with the Excel and Excel VBA capabilities that will be necessary, the map becomes the basis for estimating time (labor) required.

5. Training and Support Concept

Perhaps the most important assumption has to do with the level of training and support afforded the novice Developer, training and support that is very limited in actual practice. The context of Micro Solution development assumes the Developer has taken the opportunity to attend an entry level Excel VBA training course. At a minimum this course would enable the novice Developer to 1) become comfortable with the functions and capabilities of the VBA environment, 2) become proficient in leveraging key Excel features and functions (as presented in Figure 1), and 3) become familiar with extended VBA features relevant to Micro Solution development. The model also assumes the novice Developer has direct access, via email and phone, to an experienced VBA Developer in the field who can assist them in designing the project initially and help them overcome challenges while working toward completion of their first project.

C. INPUT VARIABLES

1. Labor Rates

The model requires labor rates for the Functional, Developer, and User roles in order to compute development costs and savings. The model utilizes a lookup function to pull the appropriate hourly rate, as described in the following, once the grade for each role is selected from the drop down menu provided.

Military labor costs are based on published DoD Military Personnel Composite Standard Pay and Reimbursement Rates, Department of the Air Force, FY2005, and an assumed work year of 2,080 hours[3]. The Annual DoD Composite Rates must be used when determining cost of military personnel in management studies. These are the same fully burdened rates that would be used to bill other DoD agencies for services, and they include; average basic pay plus retired pay accrual, medical health care accrual, basic allowance for housing, basic allowance for subsistence, incentive and special pay, permanent change of station expenses, and miscellaneous pay.

The best Civilian Personnel Pay Tables available at the publishing of this report were FY2005 tables; therefore FY2005 rates were used as a basis for both military and civilian hourly costs. Civilian Personnel Pay Rates are derived from Salary Table 2005-SF, assuming locality Pay for the SAN JOSE-SAN FRANCISCO-OAKLAND, CA (NPS local) area[4]. Hourly rates, based on applicable Grade at Step 05 (mid-tier Step), are then burdened with an additional 28.1% to account for Civilian Personnel fringe benefits that would be chargeable to other DoD components[5].

2. Other Development Cost Factors

The Basis for Requirements field is used to indicate use of the model in either evaluating completed projects (Past Actual), as shown in Figure 3, or to estimate future work (Future Estimate). When Past Actual is selected as the Basis for Requirements the growth factor displays None Applied. When Future Estimate is selected the Development Characteristics are activated and the growth factor is used to burden the work estimates (both Developer and Functional) appropriately.

The Time Required (hours) entries for the Developer and Functional personnel are critical in determining the model's outcome. Thus, every effort should be made to

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[3] Office of the Under Secretary of Defense (Comptroller). Accessed 31 Oct 2005, available from http://www.dod.mil/comptroller/rates/fy2005/2005_k.pdf. Internet.

[4] Civilian Personnel Pay Rate Table, 2005. Accessed 31 Oct 2005, available from http://www.opm.gov/oca/05tables/indexGS.asp. Internet.

[5] Civilian Personnel Fringe Benefit, Fiscal Year 2005. Accessed 31 Oct 2005, available from http://www.dod.mil/comptroller/rates/fy2005/2005_d.pdf. Internet.

ensure these numbers are as grounded as possible. The requirements 'map', discussed earlier, should be used to break the solution into functional blocks for estimating purposes and the 'Novice' Developer should seek assistance before making an estimate determination. The Functional hours required will consist primarily of developmental and operational testing, usually easier to estimate than Development work. The User Training is simply an estimate of the time required to familiarize EACH functional user with the completed solution.

3. Other Savings Factors

The Development savings factors center around the characteristics of the current task, since the idea of the Micro Solution is to eliminate any manual steps required in the current process. Again, the model output and subsequent analysis are largely dependent on the data provided in this section and every effort should be made to ensure the accuracy of the data. For example the Current Task Time should be provided by a User who actually performs the task day-to-day, based on timing of an actual task sequence using current procedures. If the solution is being considered as a community solution candidate, then the task time should be adjusted to normalize at a typical task time in a typical organization.

The Current Task Frequency indicates the number of times per week the current task *should be performed* in operations. Note that in some cases this may differ from the frequency at which the task *is currently being performed*, especially if the task time makes frequent performance prohibitive. The Number of Users Tasked is the number of users tasked per organization times the number of organizations assumed to benefit from the solution. This assumption has a great potential to color the analysis, as we will explore in the case studies presented in this report, so conservatism is important. For example, before assuming all the Resource Advisors in a Wing will benefit from a solution one must ensure the solution is; 1) relevant to their duties, 2) widely available, 3) sponsored by FM leadership, and 4) supported with training and follow-up. The same concerns must be addressed from a broader perspective before assuming a solution will benefit users across the Air Force FM community.

Finally, it should be noted that the User role, as defined by the model, is not meant to designate a particular person. Instead, the grade selected for "User Labor Rate" should be representative of those typically tasked with performing the activities facilitated by the solution.

D. MODEL OUPUTS

1. Return on Investment

In the world of business Return on Investment (ROI) is used to determine whether a proposed investment is wise, and how well it will repay the investor. It is calculated as the ratio of the amount gained (taken as positive) or lost (taken as negative), relative to the basis of investment. The Micro Solution Development Model uses ROI to determine if a proposed project is a *wise investment of time*. This concept of optimum resource utilization is the driving measure of the model, though labor inputs are quantified in labor dollars to accommodate the ROI calculation.

For the purpose of this model the amount gained (or lost) is the savings the solution will provide, in labor dollars, and the basis of investment is the development costs. The ROI calculation in the model uses is based on the arithmetic return approach: ROI = (Annual Savings – (Development + Training Costs)) / (Development + Training Costs). Thus, a positive ROI means the solution would be profitable within one year. An ROI of 100% means that the savings in the course of a year are twice the cost of development and training. An ROI of 1,000% translates to savings of ten times the cost of development over the course of a year.

However, because DoD decision makers tend to think in terms of *available resources*, as opposed to *return on resources*, the ROI measure presents difficulties. Comparing one potential development project to another is straightforward using the model, but what about comparing the ROI results presented in the model with other pressing tasks? And when competing work MUST be done, what is the 'tipping point' for committing valuable resources to a development project? What about a potentially 'high-leverage' solution (exceptionally high ROI) in which the benefit falls largely

outside the decision-maker's organization, as in the case of a community solution? Clearly difficult questions such as these must be addressed if the Air Force is to achieve a four-fold compression in average business process cycle times.

2. Payback Period

The Payback Period is the length of time required to recover the initial investment or, in the case of our model, how many days it takes for a developed solution to pay for itself once it's fielded (development, testing, and training complete). The idea, again, is to provide the decision maker with a meaningful way to understand the value of potential development work. The Payback Period calculation in the model is as follows: Payback Period = (Development + Training Costs) / (Daily Savings).

This measure already has an established precedence in the Air Force; the Fast Payback Capital Investment Program (FASCAP)[6], which has been using the Payback Period as a watermark for operations-level investments since 1991. The program encourages organizations to compete for funds to finance capital investments in facilities and equipment, and will only consider investments where the Payback Period is less than two years. Using the same approach at the task level the Micro Solution Development Model is designed to identify development work where the Payback Period is as short as possible, often less than 90 days.

3. Savings

Since ROI and Payback Period are rather abstract units of measure, we decided it best to include Savings as a model output. Savings/Use is simply the amount saved (User Labor Rate * Current Task Time) with each run of the solution once it has been fielded, and *after development costs have been fully recovered*. The Annual Savings output, by contrast, accounts for the development costs: Annual Savings = Annual Savings - (Development + Training Costs).

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[6] Air Force Policy Directive 38-3, Nov 1998. Accessed 31 Oct 2005, available from http://www.e-publishing.af.mil/pubfiles/af/38/afpd38-3/afpd38-3.pdf. Internet.

In the end, the Savings metric probably does the best job of presenting a business case for Micro Solution development, though the dollar amounts suggested are not actually a reduction in disbursements. The Savings amounts are instead are a monetary measure of the labor saved by implementation of the solution, so they too are a measure of time.

E. ESTIMATING FUTURE DEVELOPMENT TIME AND COSTS

Because software projects, large and small, tend to overrun planned schedules and budgets the authors felt is was necessary to include a software development growth factor to burden estimates for specific vulnerabilities in Developer Experience and Solution Requirements. At the same time, field experience developing solutions illustrates the benefits of learning curve theory as well; realized through such elements as in increasing familiarity with the development application, mastery of debugger functionality, and code reuse. This section of the report breaks down the components of the growth factor, explaining how Development vulnerabilities and Learning Curve Theory are integrated in the applied growth factor.

1. Additional Input Variables

a. Developer Characteristics

Because the Developer analyzes the development work to be done, outlines the work, and then carries out the development work, their experience is central to determining the potential value of the Excel VBA approach for future work. The Micro Solution Development Model considers three facets of the Developer's experience; their experience using the Excel application, their experience in the Excel VBA environment, and their experience in the functional (task) area being considered for automation. The degree of experience indicated for each area is assigned a numeric value, the higher the better, and then the numbers are multiplied together to arrive at a Developer Experience Factor (possible values 1 through 36). This Developer Experience Factor basically determines how far down the appropriate learning curve the model travels to arrive at the growth factor.

b. Solution Characteristics

Solution Characteristic variables are included in the model to focus on the work being considered, capturing two key elements; the overall complexity of the solution being attempted (based on proposed functionality), and the degree to which the work requirements are defined and understood by the development team. The options available for input from the drop-down boxes reflect the range of characteristics that essentially define Micro Solution development. The input selections are then considered in a pair-wise matrix, as discussed in the following paragraphs, to determine which learning curve is the best fit in determining the growth factor.

2. Growth Factor Calculation

a. Boundary Assumptions

In order to calculate a software development Growth Factor within the context of Developer Experience and Learning Curve Theory it was necessary to make two boundary assumptions; 1) maximum or 'worst case' growth factor, known in Learning Curve theory as the first unit cost or T1, and 2) the range of learning curve slopes relevant to the Micro Solution development environment. We utilized a Software Growth Experience study conducted by the Navy Center for Cost Analysis (NCCA) as a baseline for setting our boundary assumptions[7]. The study considered Source Lines of Code (SLOC) growth in sixteen program-level DoD weapon system software development projects as shown in Table 1.

[7] The Software Development Estimating Handbook, Phase One, "Risk Analysis", NCCA, 1998.

DATA SOURCE	MISSION PURPOSE	ESTIMATED SLOC*	ACTUAL SLOC*	GROWTH FACTOR
AF Space Projects:	C²	618,000	709,000	1.15
	C²	23,599	25,814	1.09
	C²	14,000	70,143	5.01
	Testing	41,800	46,303	1.11
	Software Tools	45,000	45,000	1.00
	C²	39,294	119,400	3.04
	C²	22,000	30,000	1.36
	Signal Processing	15,500	26,513	1.71
	C²	100,000	122,000	1.22
	Mission Planning	532,000	877,129	1.65
Navy Projects:	C²	206,650	394,309	1.91
	C²	74,000	82,930	1.12
	C²	213,800	261,800	1.22
	C²	153,000	185,000	1.21
	C²	83,900	108,850	1.30
	C²	1,246,272	1,272,200	1.02

Table 1. Software Growth Experience Study, NCCA, 1998

These projects obviously represent a range of work far outside the scope considered in the MSDM; it's safe to assume the projects in Table 1 were far more complex, and the software developers doing the work both trained and experienced. But the *nature of the work* is very much like the work being proposed in the MSDM; translating requirements into robust, precise instruction sets in a largely abstract environment that rewards both scientific and creative methodology. So, in developing the Growth Factor calculation we applied two measures from the NCCA study in a broad sense; the maximum theoretical growth factor (5.01) and the mean growth factor (1.63).

b. Application of Learning Curve to Develop Growth Factor

The Federal Aviation Administration Acquisition System Toolset (FAST) Pricing Handbook provides a good background on the fundamental concepts of learning curve theory, cited below[8]:

The Learning Curve was adapted from the historical observation that individuals who perform repetitive tasks exhibit an improvement in performance as the

[8] Federal Aviation Administration Acquisition System Toolset, "Pricing Handbook", Section 18.1. Accessed 31 Oct 2005, available from http://fast.faa.gov/pricing. Internet.

task is repeated a number of times. Empirical studies of this phenomenon (Wright, T.P.; Asher, H.; and Boston Consulting Group) yield three conclusions on which the current theory is based:

- *The time required to perform a task decreases as the task is repeated,*
- *The amount of improvement decreases as more units are produced, and*
- *The rate of improvement has sufficient consistency to allow its use as a prediction tool*

Consistency in improvement has been found to exist in the form of a constant percentage reduction in time required over successively doubled quantities of units produced. The constant percentage by which the costs of doubled quantities decrease is called the rate of learning. The slope of the learning curve is 100 minus the rate of learning. For example, if the hours between doubled quantities are reduced by 20% (rate of learning); it would be described as a curve with an 80% slope.

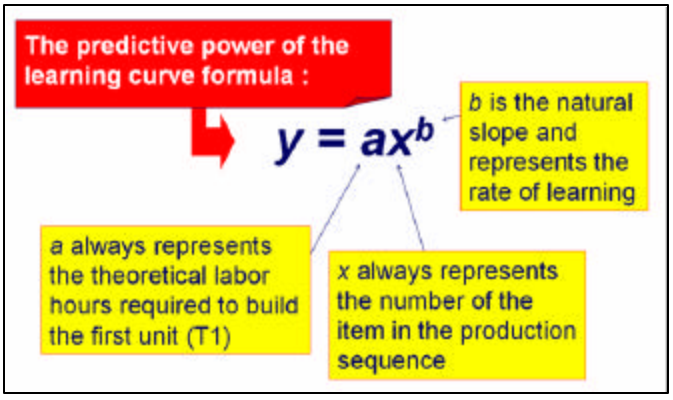

Figure 4. Learning Curve Formula[9]

The formula for calculating the learning curve is presented in Figure 4, and an example of an 80% learning curve is shown in Figure 5. When a learning rate can

[9] Society of Cost Estimating and Analysis, "All About Learning Curves". Accessed 31 Oct 2005, available from www.sceaonline.net/files. Internet.

be assumed, predictions can be made about the costs and time required in production for the nth unit (or lot of units). The learning curve has traditionally been used to estimate manufacturing costs, but it can also be used to estimate costs (or cost factors) of any other repetitive process. Specifically, learning curve estimation techniques are "*most suitable for estimating the reduction in cost resulting from labor and other efficiencies that come with repetition of a process. The repetitive process can involve hands-on labor or mental exercises and can range from simple to complex.*"[10]

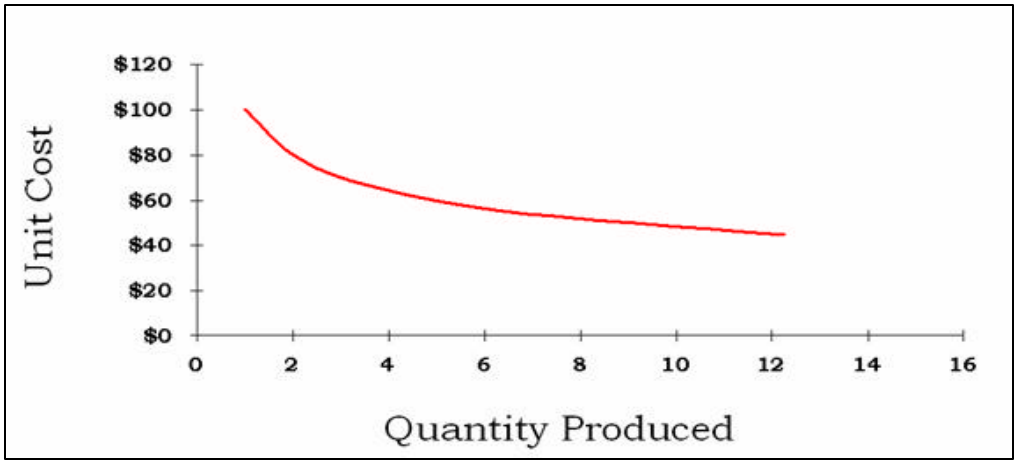

Figure 5. Learning Curve Theory

In the Micro Solution Development Model we apply learning curve theory to establish the development growth factor; an attempt to account for the learning that takes place when a functional with limited programming background initially enters the realm of Micro application development. Normally, the likely rate of learning for a particular industry or project is based on historical data. For example, the average learning rate for the aircraft industry is 85%, though rates may vary significantly down in the job shops, and the shipbuilding industry experiences rates between 80-85%. But since the elements of Micro Solution development are somewhat unique we selected a range of probable learning rates by using comparative guidelines.

[10] Federal Aviation Administration Acquisition System Toolset, "Pricing Handbook", Section 18.1. Accessed 31 Oct 2005, available from http://fast.faa.gov/pricing. Internet.

Same Manufacturing operations that are fully automated tend to have slopes of 100%, or a value very close to that (no learning can happen), while operations that involve a great deal of human activity (manual or cognitive) tend to have slopes in the vicinity of 70% (maximum learning can happen). Because the software development process is highly cognitive, and because inexperienced crews tend to have higher learning rates than experienced crews in industry studies[11], we selected a range of learning rates from 75% to 80% for calculating the growth factor, as shown in Figure 6.

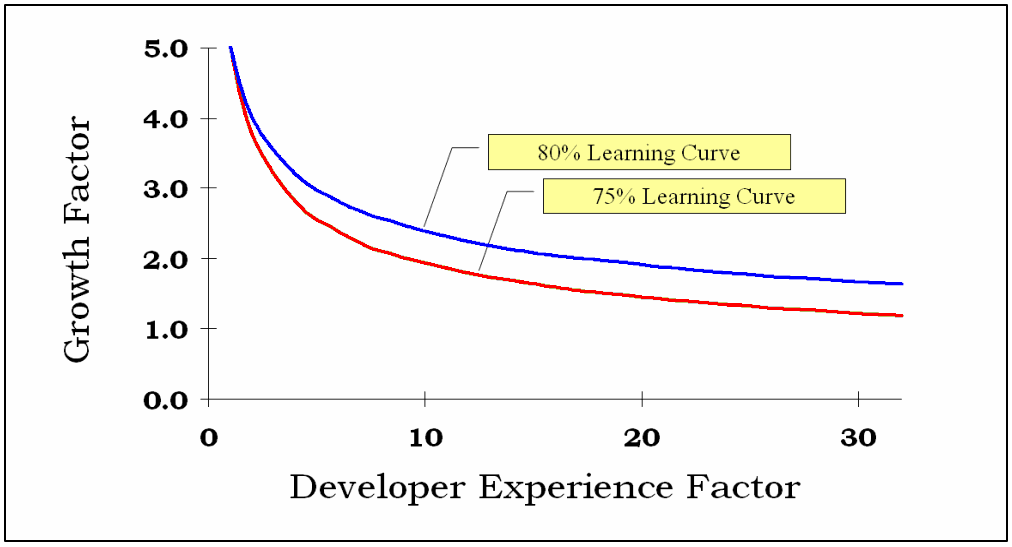

Figure 6. Unit Learning Curve Theory As Applied (MSDM)

To ensure we were on the right track with our learning curve assumptions, we cross-checked the typical Micro Solution development scenario against the NCCA analysis. Figure 7 depicts both the variable inputs and calculated Growth Factor in the typical Micro Solution scenario (where the Developer-based Experience Factor = 18 and the Solution-based Learning Curve = 76%). The Growth Factor applied by the MSDM (1.60) is reasonably close to the mean observed in the NCCA study (1.63).

[11] Society of Cost Estimating and Analysis, "All About Learning Curves". Accessed 31 Oct 2005, available from www.sceaonline.net/files. Internet.

Development Characteristics	
Developer VBA Experience	Projects < 3
Developer Excel Application Experience	Advanced
Developer Functional Experience	Functional
Solution Type	Any Two
Solution Requirements	Understood and Defined
Growth Factor >>>	1.5953

Figure 7. Typical Development Characteristics and Growth Factor

There is no empirical foundation for the growth factor. However, we evaluated each possible combination of characteristics and compared the resulting factor for each scenario to ensure internal consistency. Based on our experience the factors make sense. The average developer, as described in the report, will experience 50-60% growth from first stage planning to completion of the project. The best possible project will experience growth in the range of 15%, also supported by our experiences. The worst case scenario of 500% growth makes sense if you consider the relative inexperience of the novice developer, both in estimating and performing the development work. Certainly this is an area where the learning curve is steep, made possible by Excel application knowledge, code reuse, and first-hand knowledge of the requirements. Calculation of the growth factor is fully disclosed in Figure 8.

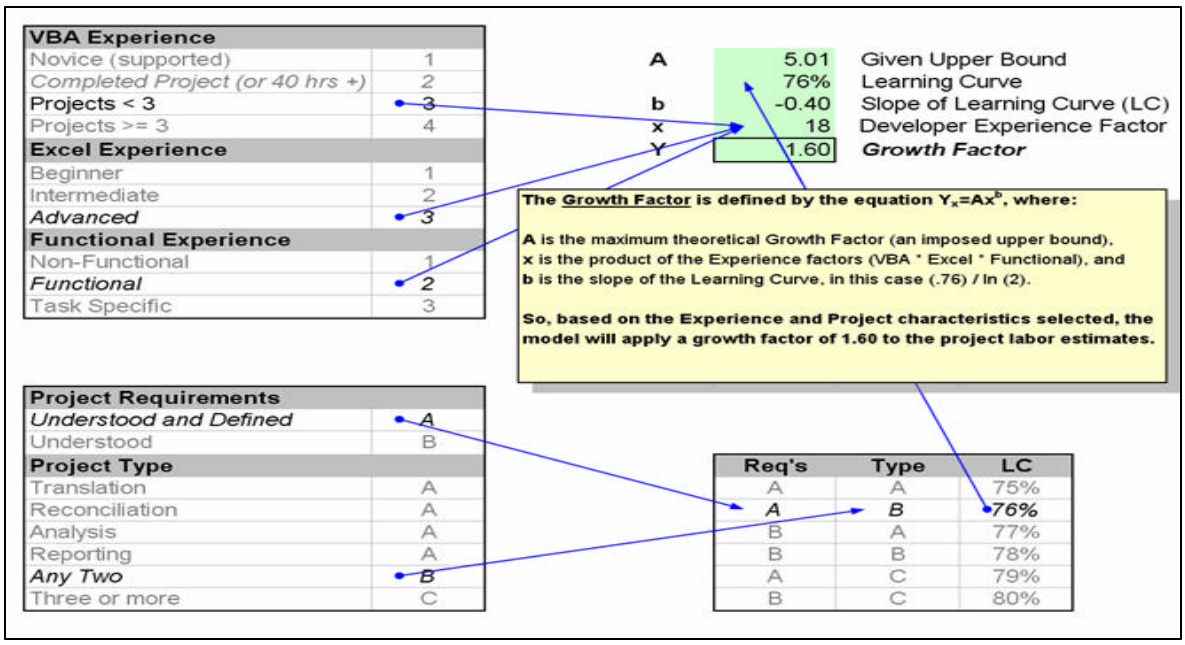

Figure 8. Mapping Development Characteristics to Growth Factor

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III. MICRO SOLUTION DEVELOPMENT CASE STUDIES

A. FIELDED FM SOLUTIONS

This Section of the report turns the corner. With the Micro Solution Development Model in place we now turn to practical application of the model, beginning with six fielded FM Micro Solutions. Captain O'Hare was involved directly or indirectly in the development of each of the fielded solution, while Captain Krott validated the savings factors represented in the model and offers a qualitative 'field customer' perspective.

1. Case#1 (GPC_RECON)

The Government Purchase Card Reconciliation is a classic Micro Solution; it was developed by FM personnel in just a few hours, automates a routine of low complexity, and achieves a remarkable ROI. In order to provide a flavor of the kind of processes the typical Micro Solution addresses we've included in this case a brief demonstration of the functionality of the GPC_RECON solution (Figure 9.).

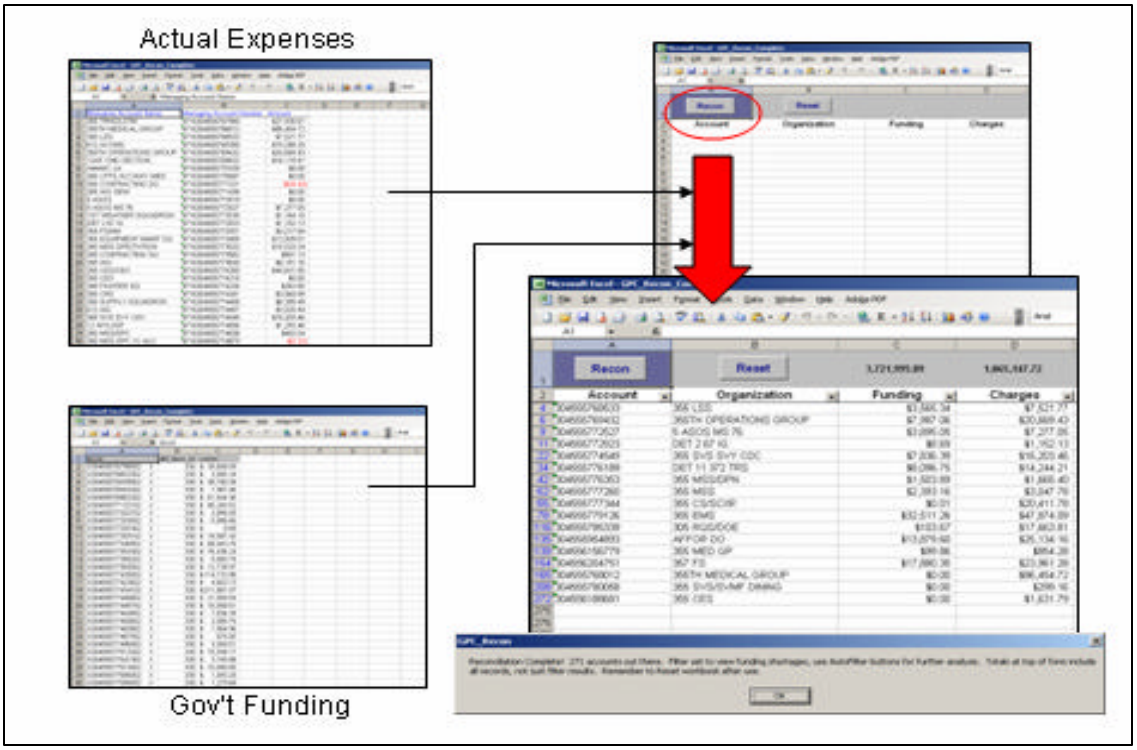


Figure 9. Typical Micro Solution Functionality (GPC_RECON)

The GPC_RECON solution was developed to assist the Accounting Liaison Office (ALO) with reconciliation of Government funding and actual expenditures as they relate to the Government Purchase Card program. In the upper left hand corner of Figure 9 is data set from the US Bank website, reporting current actual expenditures for each card. In the lower left is shown the funding applied to each card, records that must be pulled from the Air Force General Accounting and Finance System (GAFS). The upper right depicts the GPC_RECON tool workbook. The user of the tool loads the current data into the corresponding worksheets and then clicks the Recon button (circled). In seconds the tool reconciles the two data sets matching funding with expenses for each account (card), then drops the data into the output worksheet where it is sorted and filtered to display only the overextended accounts. Hundreds of accounts are reduced down to the few that warrant attention.

Now we'll use the Micro Solution Development Model to evaluate the solution in retrospect. The actual development scenario for GPC_RECON, using an organizational benefit perspective, is represented in Figure 10. Reviewing the inputs to the model we find; the task under the previous method took two hours (cutting and pasting data to properly match the 300 accounts) and was required twice weekly, the task was performed by only one person in the ALO office, and the development time was only four hours with 90 minutes allotted for requirements development and testing. The Development Characteristics are shown for informational purposes, since no growth factor is applied ("Past Actual").

The model gives the GPC_RECON high marks, with a ROI of 1,744% and Payback Period of only twenty days. From a qualitative aspect, the speed and accuracy provided by the solution enables the analyst to more effectively manage the Government Purchase Card program (several hundred accounts at an operational Wing). As opposed to spending hour's simply moving data around in an effort to get meaningful information, the analyst can take immediate action on meaningful information. In the GPC program this means stronger management controls, more likely detection of fraudulent charges, and better expenditure management since there is now time to analyze account activity on a daily basis. These qualitative benefits are not addressed in the model's output.

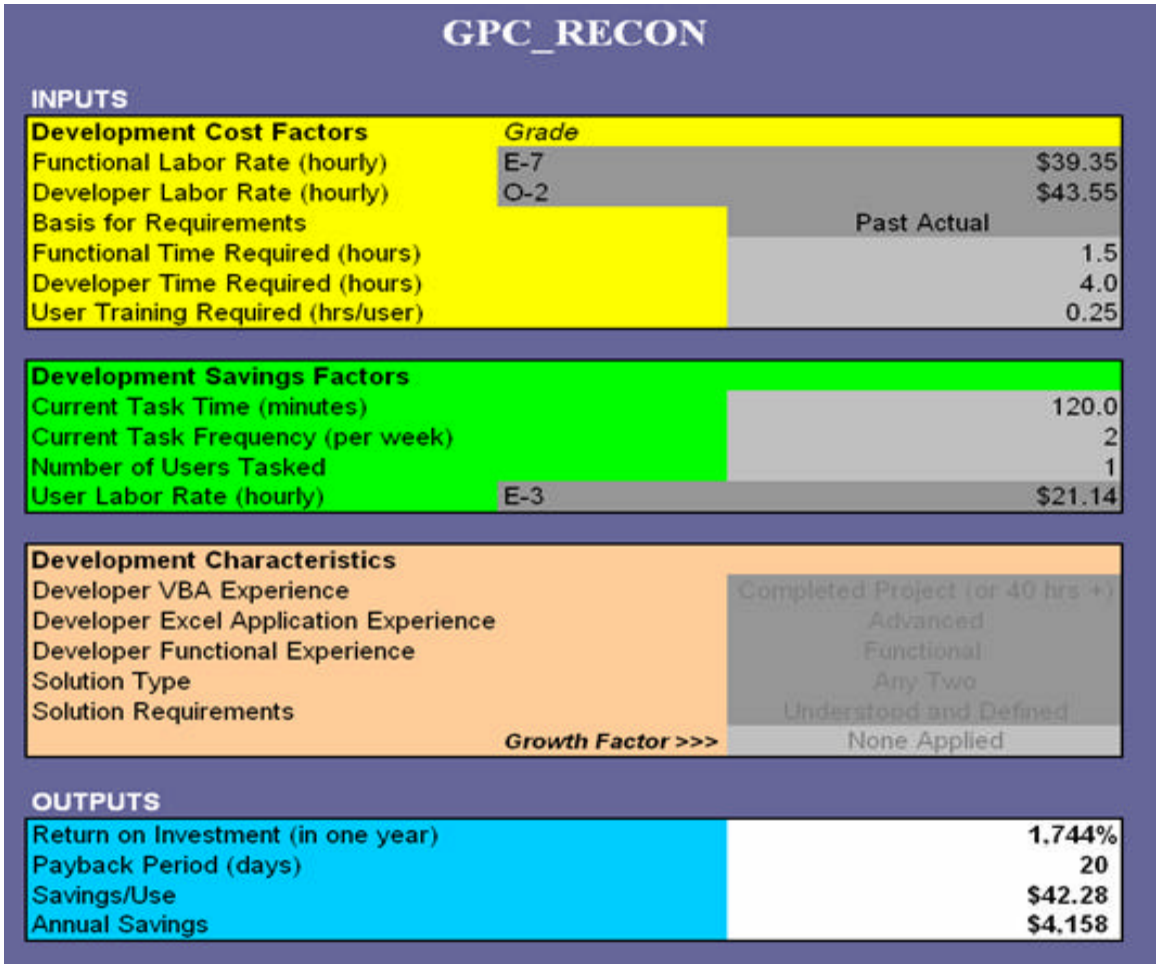


Figure 10. GPC_RECON (Organizational Benefit)

As we'll see throughout these cases, the assumptions made to arrive at an input for Number of Users Tasked drives the output. In Figure 10 the model is presented under the assumption the solution benefits only the organization that developed it. In practice many Micro Solutions, including GPC_RECON and the others presented in this section, could and have been used in many organizations within the Air Force FM community since our legacy systems, tracking, and reporting requirements are largely standardized from one operation to the next. In Figure 11 the model is presented under the assumption that the model is available and put into use across the FM community.

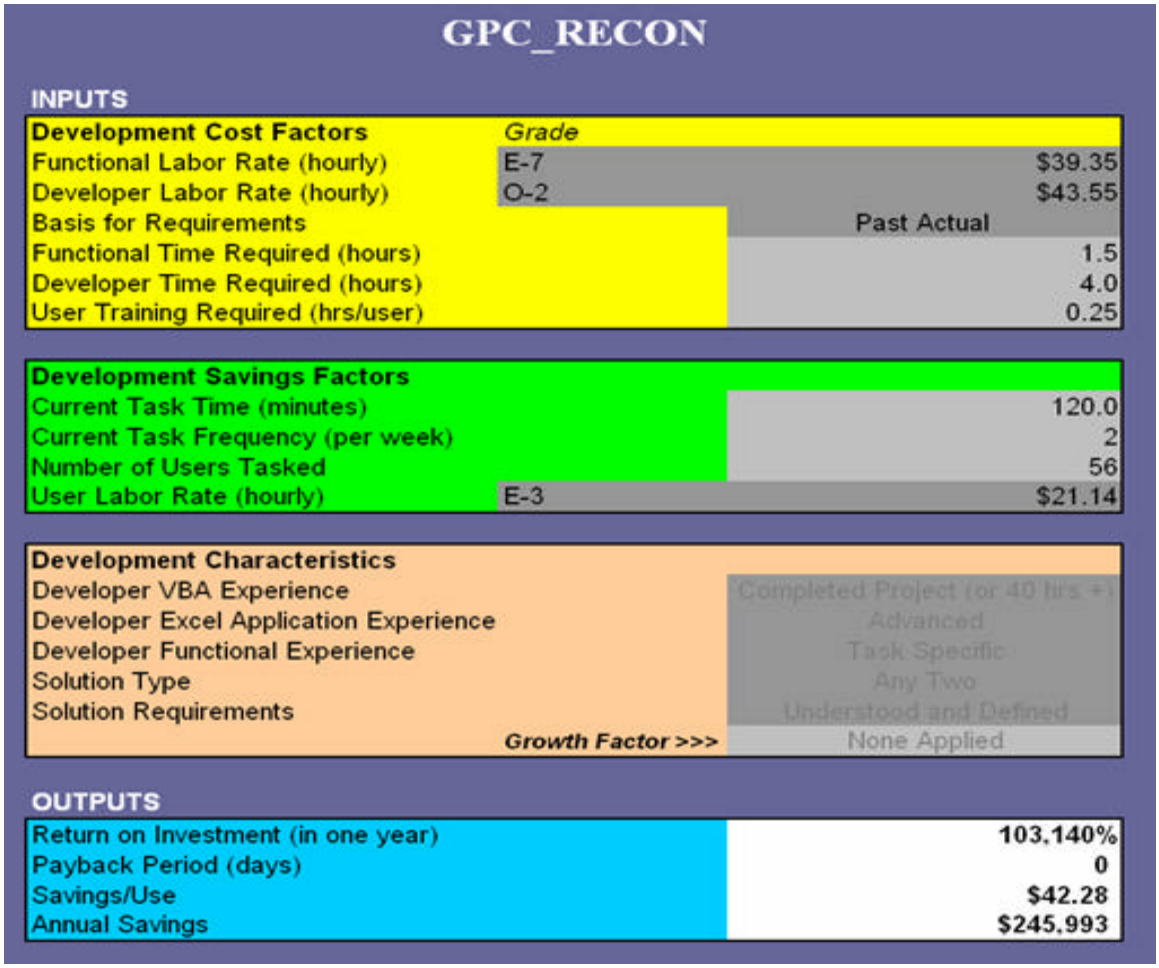


Figure 11. GPC_RECON (Community Benefit)

The FM Community, for all of our MSDM calculations, is defined as the 74 Major Air Force installations[12], with an assumed community penetration of 75%, for a total of 56 Wing organizations. The community assumption also suggests the Task Time Required entry is a typical task time required at a typical Wing (though in fact the number of records and situational factors throughout the year may vary greatly). Note the dramatic increase in benefit potential when available and supported in the community; this solution has the potential to save 11,636 hours annually, or $245,993. The next two solutions are presented under the Community Benefits assumption as well, since they too have a foothold in common system outputs and procedures.

[12] Airman Magazine, January 2005.

2. Case#2 (TRAVEL_MERGE)

The TRAVEL_MERGE solution was developed by a novice FM Developer to assist the Accounting Liaison Office (ALO) with management of the Open Travel Order Listing (G00), which lists all current open travel documents in the Wing organization. The G00 is a standard tool for managing the Wing travel program but unfortunately does not include the name or organization for the reported open travel documents. TRAVEL_MERGE integrates the G00 listing with a current DP listing then looks up the respective name and organization for each document based on the Social Security Number. The model evaluation of the TRAVEL_MERGE solution is shown in Figure 12, using the community benefits approach. Again, substantial leverage is achieved under the community benefit assumption, freeing 4,805 hours annually at a savings of $120,593.

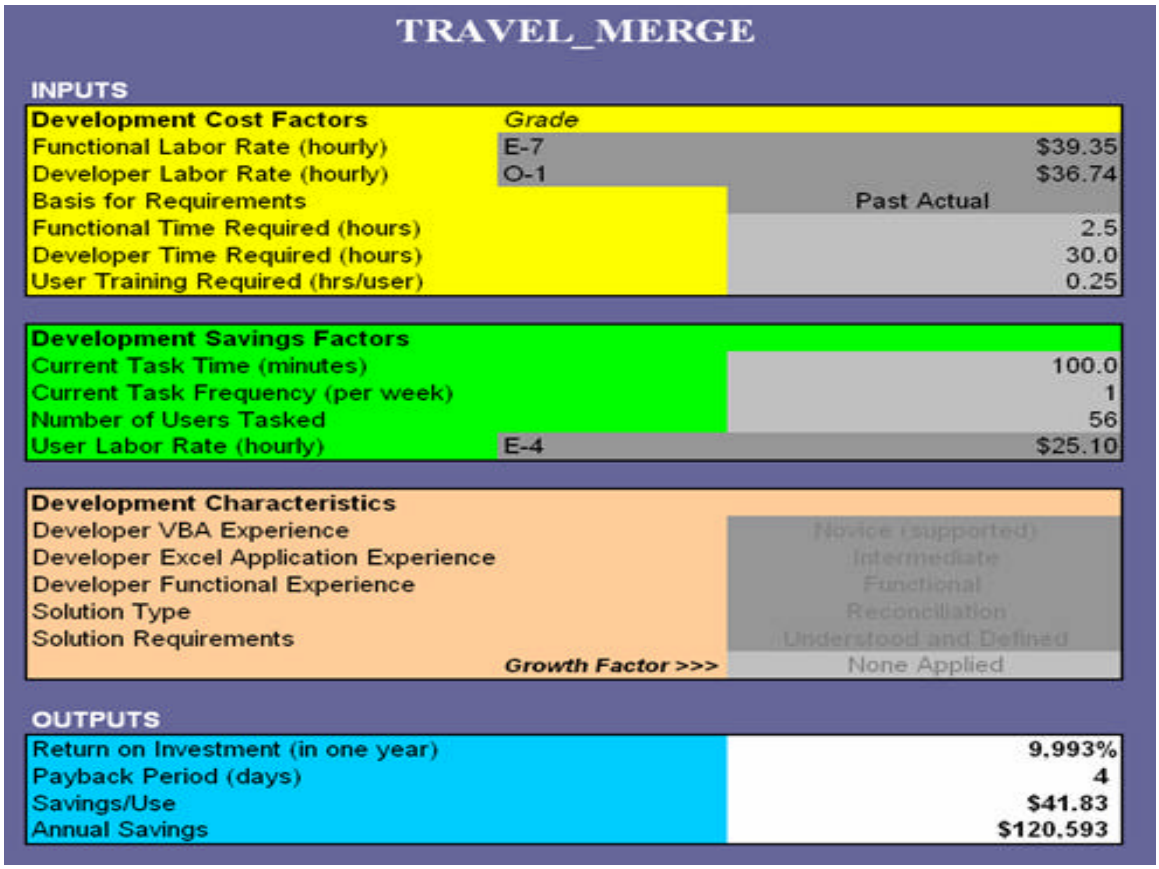


Figure 12. TRAVEL_MERGE (Community Benefit)

From a qualitative aspect the capabilities of this solution enable the Accounting Liaison Office to more effectively manage open travel orders. Under the pre-solution process the G00 listing, often several hundred documents (travel orders), must be bumped against the DP listing manually. This process is time-consuming enough to push it outside the scope of on going day-to-day management and analysis in many organizations. The TRAVEL_MERGE solution places the listing under a consistent, methodical management control process and enables the ALO to keep the listing clear instead of scrubbing month's worth of documents at the end of an accounting period. Simply put, this solution inspires proactive management.

3. CASE#3 (ODL_TRAC)

The ODL_TRAC solution was developed by an experienced FM Developer to assist Resource Advisors and Budget Analysts across the FM community with the task of managing open obligation documents. It was designed to be a community solution from inception. The solution works off inputs from one of two AF reporting programs, reconciling the current Open Document Listing file (a snapshot in time of outstanding obligation document records) with a previous file and returning in a single worksheet view a synopsis of the changes that has taken place. The solution offers a status for each document (NEW, DROP, CHANGED, or UNCHANGED) along with a summary of the relevant financial activity for each document. The same file can be used repeatedly, allowing the analyst to keep a record or remarks for each document.

Most Resource Advisors are charged with managing dozens, or hundreds, of open obligation documents simultaneously. This is normally accomplished manually, either by printing out listings for side-by-side comparison, or by dropping the report files into Excel so the analyst can sort records and make notes to aid in tracking activity. Each week the process is repeated, and analysts often resort to copying and pasting notes *after* reconciling the two listings. OR, due to the time required to manage the documents the resource analyst resorts to management by exception, working documents after problems arise or in a last ditch effort to free obligation authority ("scrubbing the books").

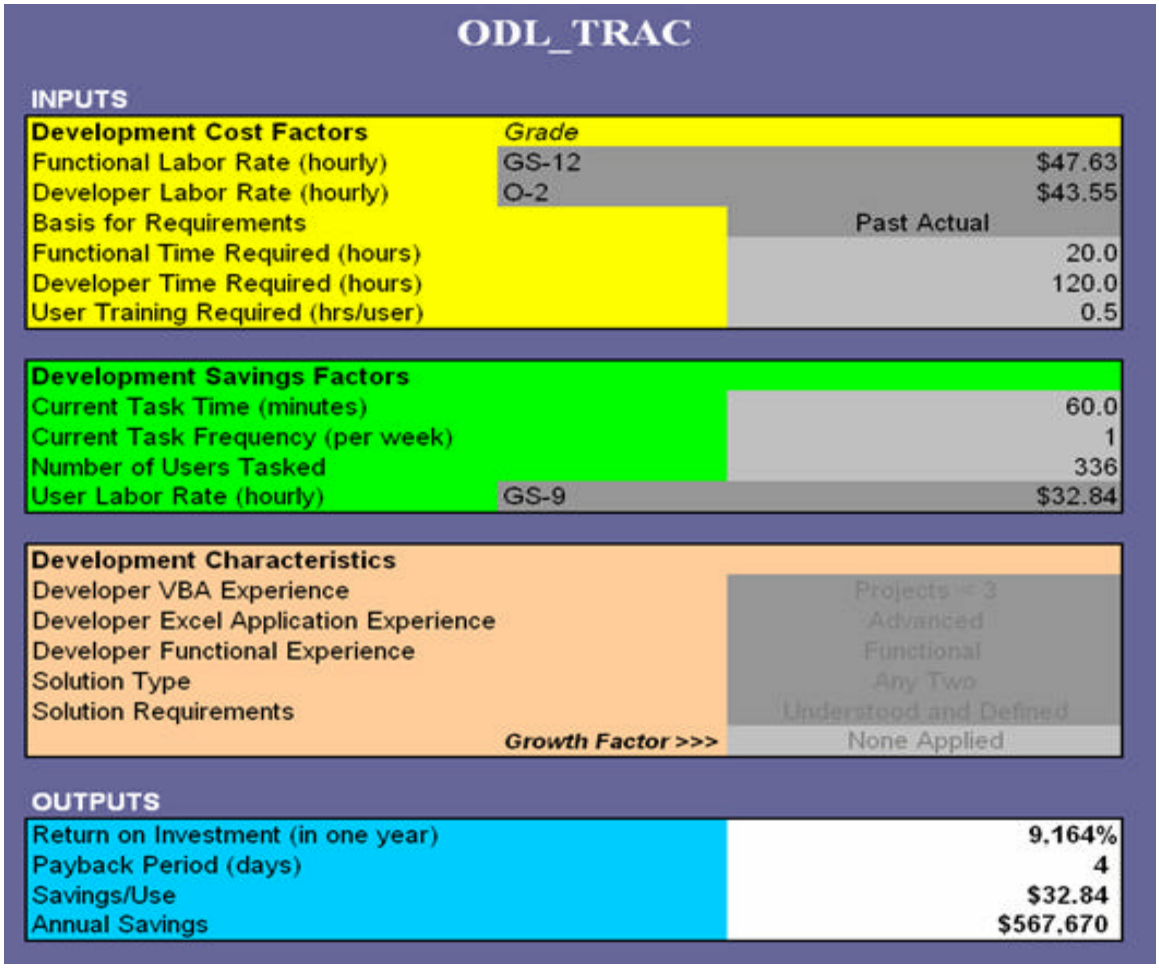


Figure 13. ODL_TRAC (Community Benefit)

From a qualitative perspective ODL_TRAC provides a document management tool that encourages effective tracking of document activity. This means more time can be devoted to analyzing the program and resolving problems, providing for a more accurate view of actual obligations incurred on a routine basis. This solution was a great deal more complex, consuming considerable resource in development. Current Task Time is based on a typical reconciliation process in a typical Group-Level organization. The Number of Users Tasked is based on the number of Group Resource Advisors in a typical Wing (Operations Group, Maintenance Group, Mission Support Group, Wing Staff, Medical Group, and the ALO) times the number of Wings considered in our Community penetration assumption (75% of Active Duty Wings), or 6 X 56 = 336. This

is a conservative estimate, since it does not include others who might benefit from the solution; Guard and Reserve units, Headquarters personnel, and Resource Advisors and analysts below the Group level.

From the quantitative perspective the MSDM evaluation of ODL_TRAC, under the assumptions discussed, is truly remarkable. As shown in Figure 13, the ODL_TRAC solution posts a ROI of 9,164%, and has the potential to save $567,670 annually, freeing 17,286 labor hours annually. This Micro Solution, developed and fielded in February 2003, is still relevant and used today across the Air Force.

4. CASE#4 (COPTRS)

The COPTRS solution was developed by a novice FM Developer as a stop-gap measure to correct an Initial Operating Capability (IOC) deficiency in the Accounts Receivable module of a newly fielded system. Specifically, the Accounts Receivable module had a faulty design, billing reimbursable work orders based on estimated resources instead of actual resources. Three months into the IOC Fiscal Year the responsible organization had billed only $3M in a program that averaged $100M annually. The Comptroller summoned auditors from the Headquarters agency and a functional team was assembled to correct the deficiency.

The COPTRS solution was developed in response to this crisis. Once the functional team had agreed on a solution a means of translating actual resources against the appropriate cost rates (more than 50 rates and six customer types) for each project for each month was sought. In addition, billings already released had to be evaluated and business rules applied to determine corrective action, if any, to apply. COPTRS allowed the billing analyst to import an actual resources data file, translating the cost rates into a customer-specific price, and providing an electronic file output for use downstream in the Accounts receivable module. The development work and testing took place over a four month period and was intensive. Once fielded this organization/situation-specific solution was utilized to reconcile, calculate, certify, and post more than $102M in receivables.

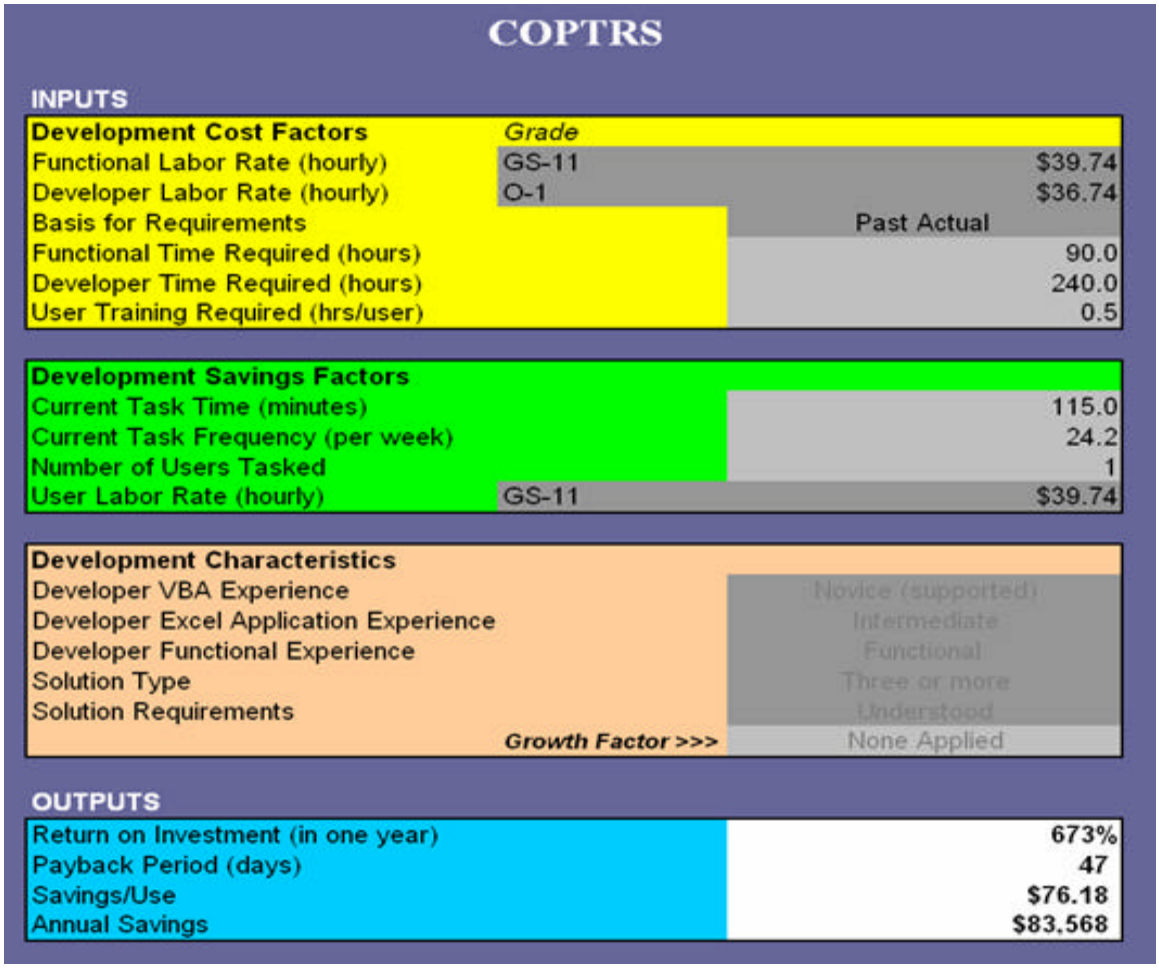


Figure 14. COPTRS (Organizational Benefit)

The task was defined in this scenario as the processing of one project invoice for a single month. Current task time was the time that would have been required to prepare an auditable invoice under the best of circumstances without automation. The current task frequency represents the average number of invoices that had to be run in a single week (approximately 105 projects monthly). This solution demonstrates the agility, flexibility, and range of capabilities available in the Excel VBA environment. Though the ROI, Payback, and Annual Savings are not as remarkable as the previous cases, this solution clearly pays for itself (Figure 14). The qualitative aspects provided were the driving factor behind this solution; billing records were restored, processes for dealing

with discrepancies were standardized to the satisfaction of the independent auditors, and time was provided for a systematic solution to be developed.

5. CASE#5 (SBSS_INTERFACE)

The SBSS_INTERFACE solution was developed by an experienced FM Developer to automate the steps required in processing raw invoice (expense) data from the SBSS into the Accounts Payable module of a newly implemented COTS Financial Management System. This solution served as a smart interface, since the COTS product had no front-end edits and no interface was funded in the original implementation. The alternative to automating this routine was to manually convert hundreds of SBSS records weekly from the D04 listing format into an approved cost accounting framework based on the United States Standard General Ledger (USSGL). Once records were converted, the work order number had to be validated (cross-referenced), and then the invoice was ready to hand-type into the COTS 28-field Accounts Payable Entry Log. This procedure involved nearly one Full Time Equivalent, and was considered a material weakness.

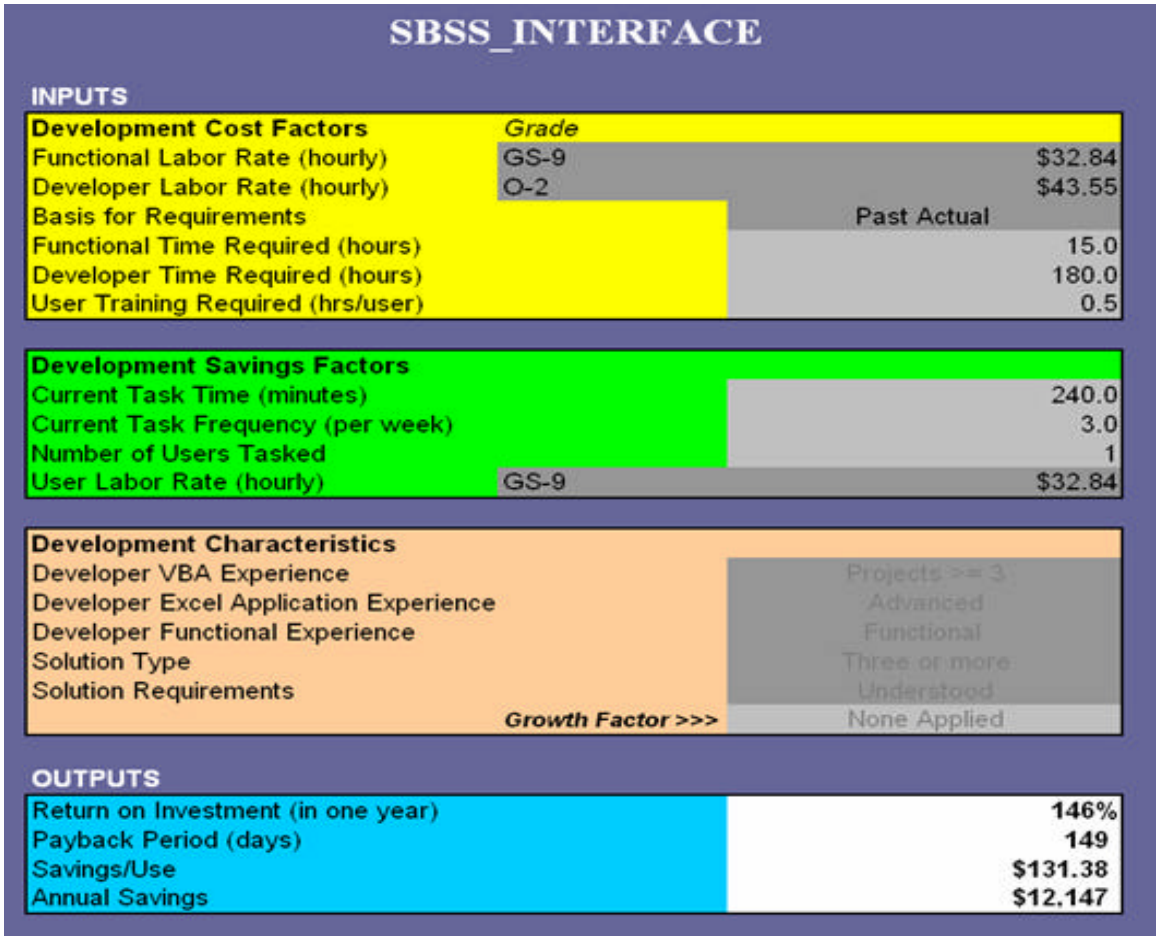


Figure 15. SBSS_INTERFACE (Organizational Benefit)

The SBSS_INTERFACE solution provided an electronic, secure means to quickly convert legacy data, according to a standard set of business rules. The 'spreadsheet' approach to the interface also provided a step for the analyst to review data by exception before entry processing, including an automated query against the production system to validate work order numbers. Finally, output files were created to facilitate electronic loading of invoice records into the COTS AP module. Like the previous case, the SBSS_INTERFACE solution benefited a single process in a single organization. And, like the previous case, the qualitative benefits were considered to be of far greater importance to the management team than development cost considerations. Still, Figure 15 makes it clear this project was profitable; development costs were recovered in less than six months and 370 labor hours were freed annually. This solution is still in use

three years after development; it serves as an offset to the cost of formally developing an interface, while meeting audit requirements.

6. CASE#6 (LABOR_RECON)

The LABOR_RECON solution was developed by a novice FM Developer to facilitate the reconciliation of pay records between the organization's cost accounting system and the Defense Civilian Payroll System (DCPS). Besides compressing the task time for reconciliation, this project served as a "teeth-cutting" exercise for the novice Developer. Normally the data in DCPS is more reliable, but any discrepancies between the two systems (i.e. Pay Grade/Step, Work Center) could cause errors in Work Center cost rates. The old method of reconciling these two systems was to simply print reports from each and manually work through the records to sort discrepancies. This task was so cumbersome that often the discrepancies were worked on an exception basis, once a problem became apparent. By pivoting on the Social Security Number the LABOR_RECON solution was able to reconcile the two payroll files in seconds, grouping potential discrepancies by type and providing a summary report that was immediately actionable. However, as shown in Figure 16, this solution did not pay for itself in a quantitative sense; achieving a – 9% ROI and Payback Period of more than 365 days. An objective analysis of this project might lead us to invest development resources elsewhere.

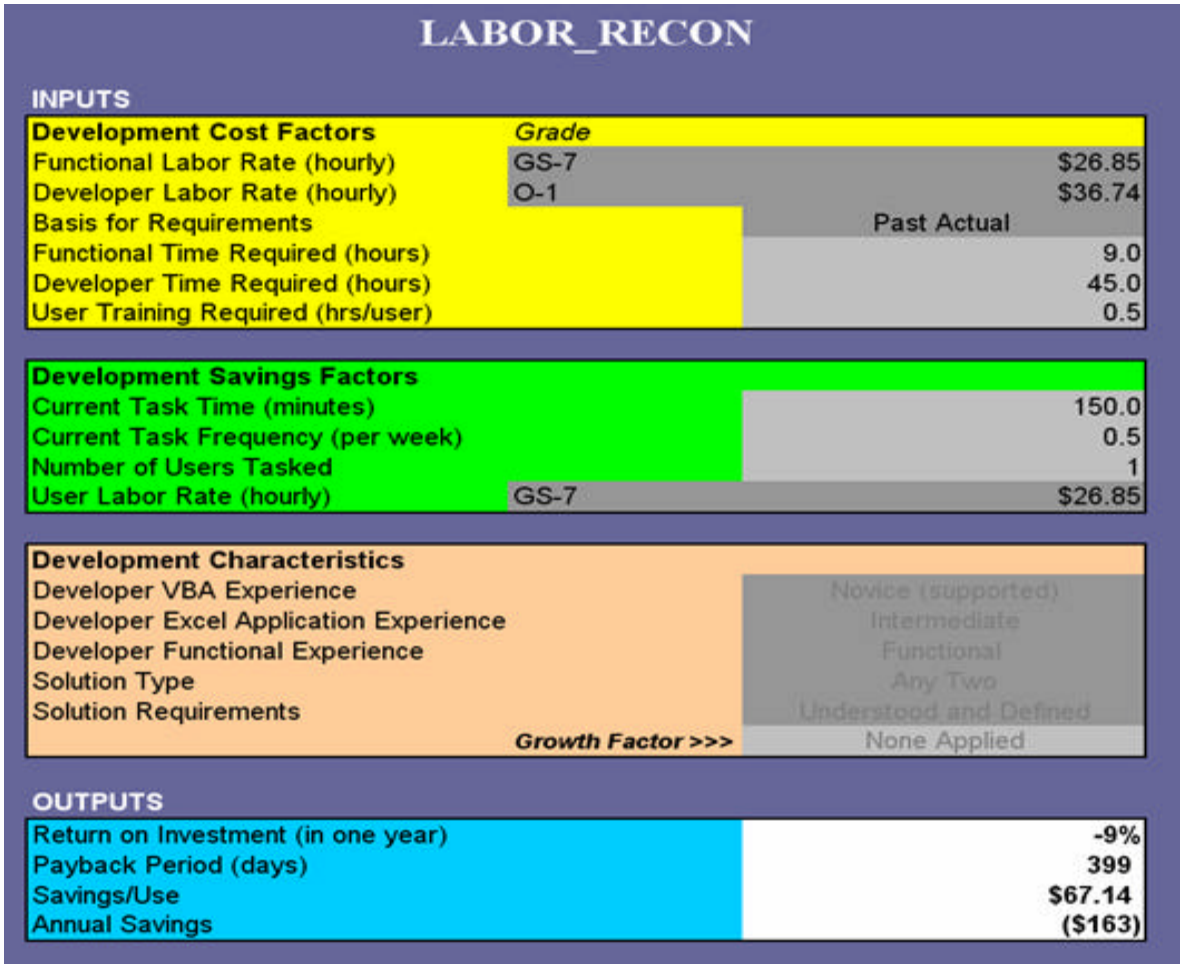


Figure 16. LABOR_RECON (Organizational Benefit)

B. UNFIELDED FM SOLUTIONS

This Section of the report addresses potential FM Micro Solution projects; projects that have a requirements basis and are typical of other opportunities existing today in FM operations. These cases will call upon the predictive capabilities of our model and in so doing will burden the initial work estimates with a growth factor to provide a conservative, perhaps more realistic, appraisal of the solution value potential.

1. CASE#7 (CIVPAY_TRANS)

The CIVPAY_TRANS case is a Micro Solution candidate whose aim is to provide Civilian Payroll Analysts across the Air Force with a more effective means for managing their Wing-level programs. Today Wing-level data files from DCPS,

representing thousands of employees in dozens of Work Centers, are only available in the original paper-report based format; the same used to print on 128-column multi-page listings that once filled listing cabinets in Comptroller offices across the globe. The data cannot be opened in a spreadsheet format using the Excel Text Import Wizard. To get at this data the FM Developer will have to use other Excel VBA capabilities to exploit rule set-based patterns and so untangle the data for presentation in a spreadsheet format. Then, once the data is formatted in a usable format, there are some standard management information requirements that could be satisfied in an Excel VBA driven first-order analysis of the data. The result would be an actionable management report that would largely compress the time required to perform a pay-period Civilian Payroll analysis.

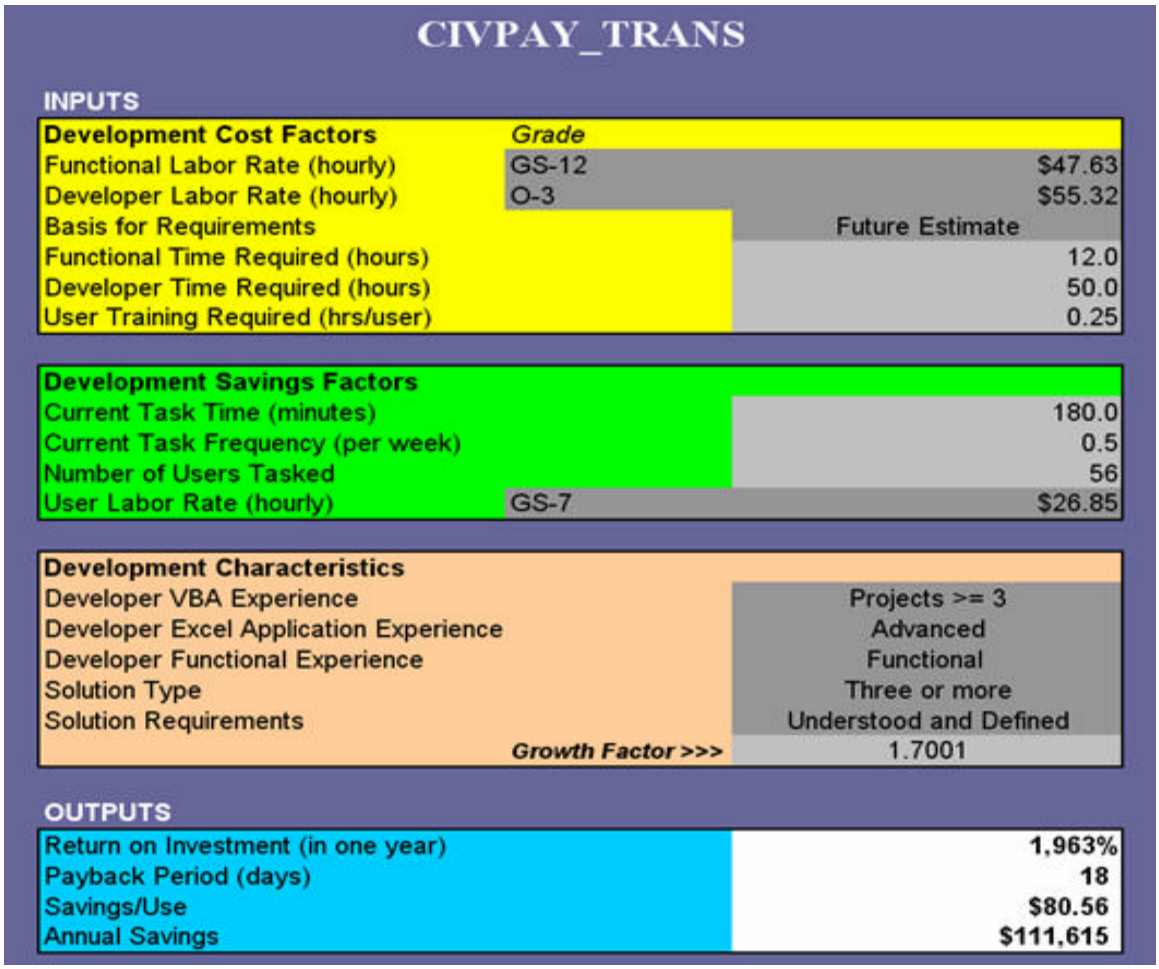


Figure 17. CIVPAY_TRANS (Community Benefit)

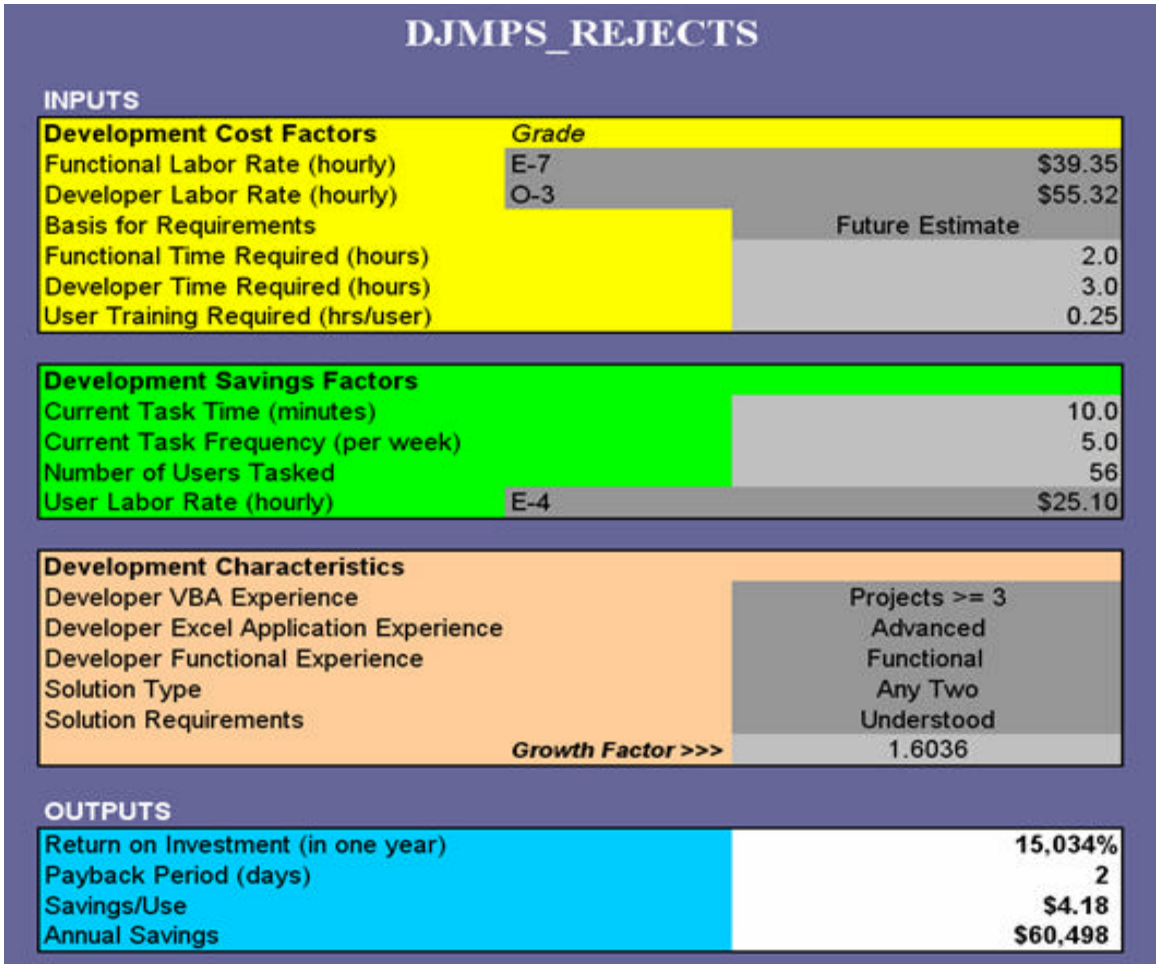
The CIVPAY_TRANS case development potential is shown in Figure 17, based on Development Savings Factors provided by a Wing-level Budget Officer[13]. The Number of Users assumes the Civilian Payroll programs are managed exclusively at the Wing-level; one times the number of Wings considered in our Community penetration assumption (75% of Active Duty Wings), or 1 X 56 = 56. The Development Cost Factors were provided by an Experienced FM Excel VBA Developer after a thorough review of the requirements. The resulting development potential is outstanding, and the indicated Annual Savings corresponds closely with the Community Benefit cases previously discussed. Once fielded, this solution has the potential to recoup Development Costs in the first month, while providing substantial qualitative benefits as well.

2. CASE#8 (DJMPS_REJECTS)

The DJMPS_REJECTS case is a Micro Solution candidate that is aimed at compressing the task time required to pull and analyze the Defense Joint Military Pay System (DJMPS) transaction reject listing. This is a classic example of a straight-forward task that is dependent on an outmoded data source, in this case the DJMPS data which can only be retrieved in a *.dat file format and must be imported and reformatted prior to use. Though the daily process of churning the data takes only a few minutes (10 minutes), the community assumptions makes this a strong candidate for automation. The DJMPS_REJECTS case development potential is shown in Figure 18, based on Development Savings Factors provided by an experienced Financial Services Officer[14]. The Number of Users assumes the program is centrally managed at the Wing level; one times the number of Wings considered in our Community penetration assumption (75% of Active Duty Wings), or 1 X 56 = 56. The Development Cost Factors were provided by an Experienced FM Excel VBA Developer, and include consideration for limited enhancements such as sorting, grouping, and conditional formatting options.

[13] Interview, 24 August 2005. Suzanne Colpitts, GS-12, 62 CPTS/FMA.

[14] Interview, 07 November 2005. MSgt Ian Martinez, 311th DLI/FSO.



DJMPS_REJECTS

INPUTS

Development Cost Factors	*Grade*	
Functional Labor Rate (hourly)	E-7	$39.35
Developer Labor Rate (hourly)	O-3	$55.32
Basis for Requirements		Future Estimate
Functional Time Required (hours)		2.0
Developer Time Required (hours)		3.0
User Training Required (hrs/user)		0.25

Development Savings Factors		
Current Task Time (minutes)		10.0
Current Task Frequency (per week)		5.0
Number of Users Tasked		56
User Labor Rate (hourly)	E-4	$25.10

Development Characteristics	
Developer VBA Experience	Projects >= 3
Developer Excel Application Experience	Advanced
Developer Functional Experience	Functional
Solution Type	Any Two
Solution Requirements	Understood
Growth Factor >>>	1.6036

OUTPUTS

Return on Investment (in one year)	**15,034%**
Payback Period (days)	**2**
Savings/Use	**$4.18**
Annual Savings	**$60,498**

Figure 18. DJMPS_REJECTS (Community Benefit)

Though the MSDM quantitative output represented is notable, with a Payback Period of less than three days, the qualitative potential of this automation candidate are more important. Daily management of the REJECT listing is required at Wing-level to ensure pay records are accurate. The morale impact of inaccurate pay records is hard to value, but is at the heart of Air Force readiness. Recent problems with related personnel system implementations have brought the importance of proactive daily management in this area into focus; Wings that are striving to manage the exception transactions in DJMPS find it a challenging task to keep the listing clear, Wing organizations with no daily management approach are simply reacting to pay problems as they become apparent.

C. ANALYSIS

Because the development projects analyzed in this section represent such a wide range of complexity, orientation, and value, we decided it would be helpful to attempt a segmentation of the solution cases. We wanted to capture a qualitative perspective, as well as the modeled quantitative value, so we assigned a relative value of qualitative benefit. Selection of the measure of qualitative value was based on *the degree to which the solution did, or would, contribute directly to the operational and strategic goals of the organization or community.* Once qualitative measures were assigned, the solutions were mapped into the segmentation matrix as shown in Figure 19. Note the 'blue' data points represent un-fielded solutions.

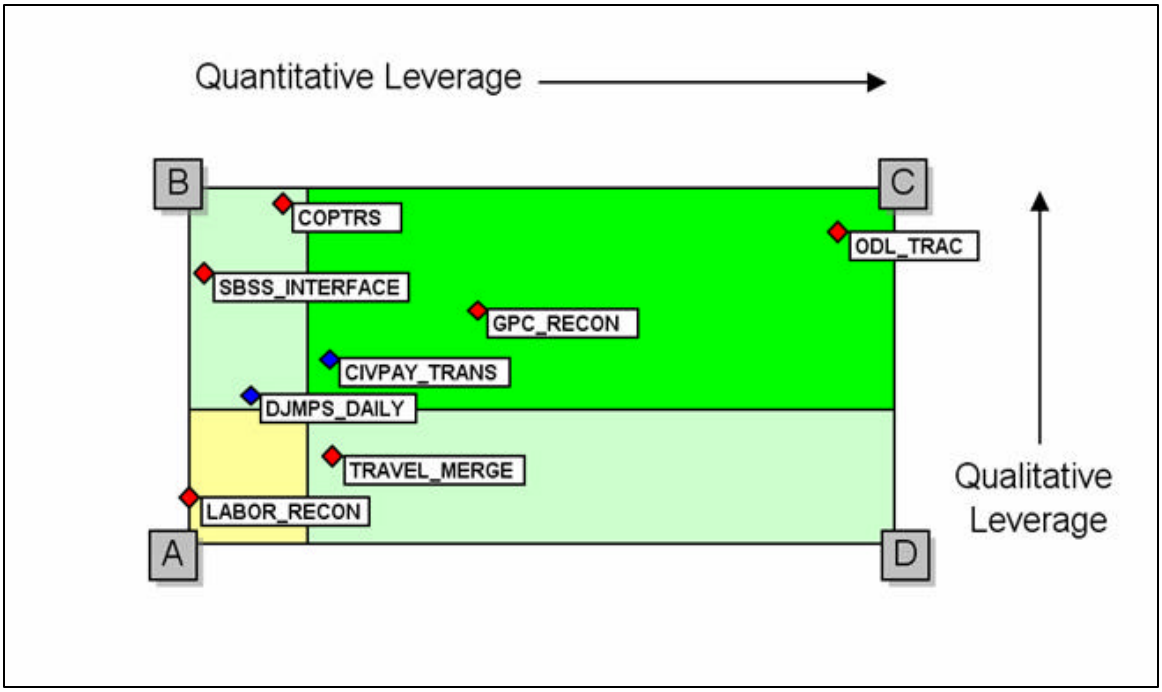


Figure 19. Micro Solution Segmentation Analysis

The data points are segmented into the four quadrants as shown (A-D). Basically, the solutions that mapped into Quadrant A have questionable development value, while the solutions in Quadrant C have outstanding overall development value. Many potential

solutions will fall into Quadrants B and C, where they have the potential to make important contributions. *General* characterizations of each segment follow:

Quadrant A (Task Orientation-Organization Benefit): The only solution that fell into this quadrant was LABOR_RECON, which was taken on primarily as a training project. The solution still provided some benefits once completed, but those benefits are limited to a single duty position. In light of the alternatives, focusing development efforts on such a project is unwise. It should be noted that developers are often focused on solving organization-specific problems.

Quadrant B (Tactical Orientation-Organization Benefit): These solutions are organization specific, but differ from Quadrant A in that they are considered essential from a qualitative perspective. In the case COPTRS and SBSS_INTERFACE, the organizations were unconcerned with the Development Costs of solutions that were moderately complex. These solutions demonstrate the flexibility, power, and agile nature of Excel VBA development work.

Quadrant C (Tactical Orientation-Community Benefit): These solutions are the 'best of the best', providing solid returns on both the qualitative and quantitative fronts. These are the solution development candidates with the greatest potential to streamline operations, yet no one in the FM community has responsibility for development or support of these solutions. As such, implementation of even the best practices and field solutions are not consistently applied in the community.

Quadrant D (Task Orientation-Community Benefit): Solutions in this quadrant have very short development cycles, and are focused on task compression techniques that would benefit front-line workers across a community. Typically these solutions will evolve into tools that provide a degree of automated analytical capability. Like the Quadrant C solutions, there is no one in the community responsible for supporting 'standard' Micro Solutions of this nature.

D. CONCLUSIONS

Great ROI, Savings Potential. Even with the one year time horizon assumption, the Micro Solution Development Model clearly demonstrates a lucrative investment potential. The average Return on Investment values for the cases modeled, disregarding the highest and lowest values, is 6,162% in the first year! The community benefit solutions should be targeted; the five community benefit solution cases had an average Payback Period of only 5.6 days, and a cumulative annual savings of $1,107,000.

Supports Key Business Area Transformation Initiatives. The Micro Solution development approach is transformation in action. Based on the concept of leveraging labor resources and software already available on the desktop, Micro Solutions are the kind of innovations envisioned in the Air Force Transformation Flight Plan, enabling; "*increased efficiencies through better, simplified, integrated processes and better support tools*", "*compression of average process cycle times by a factor of four"*, and "*the empowerment of personnel and enrichment of job functions"*[15].

Micro Solution Development is Within the Reach of FM Professionals. The case studies demonstrate the ingenuity of FM professionals in the field, and the potential to reap big savings from 'small' ideas and 'small', desktop-based solutions. Excel VBA training is the logical next step for our FM personnel. The agility and flexibility offered by Excel VBA, to solve pressing problems or provide seamless interfaces, must be grown ahead of time if we are to meet the challenge of fielding new systems in an uncertain environment.

Field Leadership Awareness. Though the Excel application is used extensively in every field of business operations, the capabilities and extraordinary usefulness of Excel VBA seems poorly understood at the field leadership level. Field leaders should be aware of the precise, practical functionality and ROI potential offered by Excel VBA,

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15 USAF Transformation Flight Plan, 6 Jan 2005. Accessed 31 Oct 2005, available from http://www.oft.osd.mil/library/libraryfiles/document_385_2004_USAF_Transformation_Flight_Plan.pdf. Internet.

especially leaders in the DoD business community. This is an emerging field and should be addressed in DoD educational programs if we are to thrive in an environment of continuing personnel reductions.

Not real money. The annual savings presented in the Micro Solution Development Model for each case do not, as previously noted, equate to an actual reduction in cash disbursements (unless personnel reductions accompany fielding of a particular solution). Instead, the annual savings represent the value of the labor hours saved. The MSDM does not make a case for reducing the number of workers, but rather suggests the degree of waste associated with non-value added tasks. Unfortunately, it's difficult to get support for DoD investments where the benefits don't translate directly into funding or personnel reductions.

Community Penetration is Far Below Potential. The outstanding ROI and annual savings potential offered by the community solution cases presented obviously depend on penetration. The SAF/FM Automated Tools Forum (ATF), hosted on the FM Knowledge Now website, provides a place for users to upload, download, and comment on community solutions, but community penetration is still far below potential. The authors believe the primary reason for poor community penetration of fielded solutions is a lack of marketing and support.

IV. RECOMMENDATIONS

A. FM MICRO SOLUTION DEVELOPMENT AND SUPPORT TEAM

Based on the conclusions presented in this report, the authors recommend establishing an FM Micro Solution Development and Support Team. This Team would be focused on leveraging Micro Solutions from an FM Community perspective. The team would formalize, in a sense, the innovative capacity of the MSDM approach and the most relevant solutions available. Specific functions placed under the responsibility of this team would include:

- **Marketing.** Establishing a presence at functional, command, and community conferences to 'sell' the best practice solutions already available on the Automated Tools Forum, shown in Figure 20. Providing short demonstration-centered workshops at conferences and appropriate 'pipeline' training events.
- **Solution Management.** The team would be responsible for testing FM Micro Solutions before release for utilization across the community.
- **Training.** This team would have the balance of technical skills to needed to provide an FM-focused entry level Excel VBA course. This course would focus on standing up applications quickly by covering commonly used development techniques. The training could be tailored to the need of the students and or situation.
- **Development and Development Support.** The team would have the functional and technical skills available to develop solutions that presented the best return, based on outputs provided from the MSDM. The team could also serve as an informal 'maintenance' agency, refining and building on existing solutions driven by inputs from the field. Finally, the team would provide support services to FM Developers in the field who were engaged in solution development.

B. ADDRESS IN POSTGRADUATE EDUCATION

Another opportunity for realizing value, as modeled in this report, is found in postgraduate education. Specifically, the introduction of advanced Excel application and Excel VBA course offerings at the Air Force Institute of Technology (AFIT) and the Naval Postgraduate School (NPS). These courses would be an excellent addition in business-focused programs, such as Contracting, Logistics, and Financial Management, where use of the Excel application is prevalent. This next-level approach to application training is a great opportunity to equip students with important technical skills, or at a minimum make field leaders aware of Excel VBA potential. The demand for IT skills in the government has expanded outside the traditional functional boundaries as we have become increasingly resource constrained.

Top Ten Business Schools (Ranked by Forbes)	VBA Course	# of IT classes	IT Concentration
Harvard	1	10	No
Columbia	0	0	No
Chicago	0	0	No
Dartmouth	0	0	No
Yale	0	0	No
Penn	2	11	Yes
Stanford	1	12	Yes
UNC	0	2	No
Northwestern	0	1	No
Virginia	0	0	No

Table 2. IT/VBA Emphasis in Top Ten Business Schools (U.S.)

The authors looked at the top MBA programs to see what training they were offering in this area; we evaluated the Information Technology emphasis of the MBA programs in the top ten business schools, as ranked by Forbes Magazine[16]. Among the top programs, five had required courses in information technology, three had VBA elective courses, and two of the programs offered an IT concentration. So what conclusions could be drawn from this? It's an emerging field in the business schools.

[16] Forbes Magazine, September 2003. Accessed on 31 October 2005, available at www.forbes.com/2003/09/24/bschooland.html. Internet.

Many schools are focusing on the managerial level and are placing less emphasis on technology side. Table 2 displays the rankings and characteristics of each program.

Though the academic community, like operations in the field, is clearly divided along functional lines (IT vs. FM), we still see an increasing need for DoD professionals who possess a degree of skill in leveraging common business applications. We're often called on to do more with less, and we must become smart about the way we live within today's infrastructure, today. The MSDM highlights the investment potential of 'grass-roots' solutions, but for solutions to be developed and supported in the field they must be understood and supported by leadership. Offered an Excel VBA course as an elective provides the field leader an opportunity to work through the development process of a small project. Not only would the student gain a better understanding of the Excel application, but such a course would provide a practical basis for developing leaders who will someday lead large-scale system implementation projects.

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LIST OF REFERENCES

Department of Defense [DoD], Office of the Under Secretary of Defense (Comptroller), "Military Pay rates, 2005". Retrieved 31 October 2005 from <http://www.dod.mil/comptroller/rates/fy2005/2005_k.pdf>.

Department of the Air Force [AF], Air Force Policy Directive 38-3, November 1998. Retrieved 31 October 2005 from < http://www.e-publishing.af.mil/pubfiles/af/38/afpd38-3/afpd38-3.pdf.>.

Department of the Air Force [AF], Airmen Magazine, "Major Active Duty Air Force Bases/Overseas Bases". January 2005.

Federal Aviation Administration Acquisition System Toolset, "Pricing Handbook". Retrieved October 31, 2005 from <http://fast.faa.gov/pricing/>.

Navy Center for Cost Analysis, "The Software Development Estimating Handbook", Phase One, Risk Analysis, 1998.

Forbes Magazine. "The Best Business Schools, 2005". Retrieved 31 October 2005 from <www.forbes.com/2003/09/24/bschooland.html >.

Interview, 24 August 2005. Suzanne Colpitts, GS-12, 62 CPTS/FMA.

Interview, 07 November 2005. MSgt Ian Martinez, 311th DLI/FSO.

Department of the Air Force [AF], Office of Force Transformation, "2004 USAF Transformation Flight Plan", January 2005. Retrieved 31 October 2005 from <http://www.oft.osd.mil/library/libraryfiles/document_385_2004_USAF_Transformation_Flight_Plan.pdf>.

Office of Personnel Management [OPM], "Government Civilian Pay Rates, 2005". Retrieved 31 October 2005 from <http://www.opm.gov/oca/05tables/indexGS.asp>.

Society of Cost Estimating and Analysis, "All About Learning Curves." Retrieved 31 October 2005 from <www.sceaonline.net/files/ >.

Walkenbach, John, "Excel 2000 Power Programming with VBA." New York: Hungry Minds Inc., 1999.

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