Developing an Energy Information System: Rapid Requirements Analysis

David C. Green
Green Management Services, Inc.
Fort Myers, Florida—dcgreen@dcgreen.com

ABSTRACT

This article describes a simple method of evaluating the importance of specific energy information system (EIS) requirements. This method helps organizations that have identified a need to develop an EIS but can't find the time to define the complex requirements. It is a method intended to speed up the process without sacrificing the quality of the process. Energy management teams typically know a lot about the need for each requirement, but very little about the cost or effort to produce it. On the other hand, information technology (IT) development teams know more about costs and effort than the relevant importance of each of the requirements. Therefore, the conditions are set for confusion, and the likelihood of disagreements is high. Our goal in using this method of requirements definition is to prevent *cost* evaluation from tainting the *need* evaluation of any one of the proposed features of the EIS. This method breaks the requirements definition down into manageable tasks, evaluates the best balance between need and cost for each of the requirement tasks, and then produces a priority of work document to guide the development team.

INTRODUCTION

With any EIS project, one of the purposes of requirements analysis is to translate the needs and goals of the energy management team into a document that the IT development team understands and can use to produce a cost estimate for the project. Requirements for an EIS, which

may be more complex than many other software development projects, involve data collection (sometimes from remote locations), conversion formulas, input forms, and reports for a wide variety of data. [1] In addition, utility data have unique characteristics. Meters produce the data in a wide variety of units of measurement and at many different intervals. The energy management team understands these complexities very well. IT development teams, however, often don't understand utility data well. Furthermore, the roles of the energy management team and the IT development team are quite different. The energy management team defines what the proposed application should do and how they want to use the application to do those things. The IT development team provides the tools to do it. But first, they need to work together to take advantage of both their strengths to work through the complex requirements of an EIS project.

EIS requirements fall into several categories. This may be one reason why the requirements analysis task is so difficult. There are collection tasks, input forms, reporting tasks, graphing, security issues, and configuration requirements, among others. The EIS must collect data from meters automatically or through input forms. The characteristics of the data vary from meter to meter so each meter must have a unique configuration description in the EIS. The EIS uses this configuration to collect and report data for each meter. This configuration description might include the interval at which the data are collected (minute, hour, day, or month). Varying collection intervals sometimes present a problem to EIS processing tasks, so they need to be part of the system configuration as well. Input forms have to validate data and make sure only certain users can change certain data at certain times. Security features may link users to input screens based on the time period or on which data are changed. The system will likely prevent users from changing previous month or year values. This is necessary to insure the ability to reproduce reports from the past exactly as they appeared at the time. Conversion formulas allow utility data to be presented in units other than those used to measure the utility data at the meters.

Utility data have unique characteristics that make the requirements for an EIS complex. First, the EIS usually collects utility data on an hourly basis, if not more often. This creates a huge amount of data. Systems collect data from many different locations and report it on different levels. The data can come from many types of utilities and are collected in a variety of units of measure. They may need to be divided

into groups for reporting purposes. Looking at the utility usage for different "groups" is a reasonable expectation. The electric consumption of one building can be just as helpful as the consumption for a whole complex of buildings. It might also be necessary to combine data from several meters and report it as a single data point or fractionalize data from one meter and report them as more than one data point.

Utility data are usually date specific and require trending over time to be useful. Systems record all data with a time stamp. Hourly data for specific days and daily data spread over the period of a month provide the most meaningful reports and graphs. Comparisons to other data, such as outside temperature, are also helpful. Sometimes averaging data or summing it for each utility is required. Systems can average data or sum it together over periods of time. Data can also be summed by combining meters at various locations. These conditions obviously require the energy management team to be deeply involved in the EIS development. [2]

The energy management team understands the energy-related processes such as cost allocation, converting units of measurement, and tracking meter reading schedules, to name only a few, that currently aid them in doing business. It also understands how the complex requirements mentioned above fit into those processes. So it knows the priorities, formulas, problems, and plans for improvements, and the potential benefits of an EIS. It knows which tasks must absolutely be done and how to collect, input, and store the data to produce the reports it needs. It works around the problems that come up from day to day, such as missing data or changes in price. It maintains formulas to calculate the desired results. It keeps track of adjustments when needed. The energy management team needs to express these requirements to the IT development team in a clear and concise manner. It needs to specify tasks that are measurable and easily determined as being complete or incomplete.

The IT development team has unique capabilities that the energy management team does not possess. It probably has developed applications similar to the desired EIS. It can develop applications that store, analyze, and present data in a user-friendly manner. It understands the maintenance requirements and all the hardware and software needed for the system. It understands the staffing requirements, strengths and weaknesses of the available personnel, and the amount of effort needed to do the job. Even though it is not necessary to put an *exact*

cost estimate on each task, it should be easy for the IT development team to assign a *relative* cost to each individual task. It will still need to collaborate in some manner with the energy management team to complete the relative cost assessment.

Bringing teams together to work on IT projects has been a problem for some time. Even well-defined systems development life cycle methods have failed to bridge the gap. Statistics show that more than half of large IT projects have significant cost overruns and require constant maintenance. Also, more than half the problems result from poor requirements gathering and functional specification definition. Surveys show that users and developers frequently fail to cooperate and coordinate with each other. Yet organizations continue to attack the problem with more conversation and analysis rather than stepping back and trying alternative approaches. [3]

A case study concerning conversations among analysts and clients during requirements-gathering shows results demonstrating that more conversation may not be the solution. The study showed that brief comments during the discussions were well-informed and pertinent to the topics. However, there was a clear failure to put them all together toward common overall goals. This could be because of frequent topic changes and backtracking during the conversation. Interestingly, the study also shows that most participants gained satisfaction from the conversation based on how well the social interaction went rather than how many goals the group accomplished. [4]

It's clear that bringing two diverse teams together to deal with such complex data could be a challenge, and it is for many organizations. As long as the energy management team can organize the requirements in such a way as to keep the IT development team focused on one task at a time, the whole process becomes a stepwise effort. Merging the strengths of both teams together to produce a development plan in a reasonable amount of time is the goal of rapid requirements analysis.

GOALS OF RAPID REQUIREMENTS ANALYSIS

Rapid requirements analysis provides a way to independently evaluate the tasks required to complete an EIS project yet combine the results of those independent evaluations into a balanced requirements definition and work plan. It seeks to do it in a short period of time so

that those involved maintain interest and find that budgeting is easier. It provides a way for the energy management team to present a clear picture of how important one task is relative to others by establishing a prioritized list of required tasks based on *need*. In other words, for each task required, the team asks the question: "how much is this needed relative to other tasks?" Ultimately, this tells the IT development team which tasks are absolutely required and which tasks are not.

The IT development team then presents a clear picture of how *costly* each task is relative to others independent of the previous evaluation. The team ranks the requirements in some logical order based on cost and effort required to complete the task. Usually the *less costly* tasks get a higher priority, just as the *most needed* tasks got a higher priority. This encourages everyone involved to examine individual tasks in depth, independently of each other. A facilitator can answer questions concerning the details of the tasks or act as a liaison between the teams to clarify the task details. The project manager or a consultant may fill this role. This is a more efficient manner of detailed analysis than conducting meetings with everyone involved since many times the details of any particular task only involve a few people. A later meeting would be a good way to combine the results of their investigations.

A final list of tasks is a combined evaluation of the requirements tasks with the most needed and least costly tasks near the top of the list and the least needed and most costly tasks near the bottom of the list. This list, prioritized by a combined need and cost rating, gives the teams a preliminary look at which tasks may be too costly to include in the project. The final list is the beginning of a detailed requirements document and priority of work that allows the teams to work together more efficiently.

Once the teams have evaluated the requirements list in this manner, they can stay focused on one task at a time and be sure they are working in the correct priority. Evaluating the tasks independently prevents "cross contamination" of results due to the effects of one criterion on the other. For instance, if the teams meet together to discuss one particularly important task and they place a cost estimate on the task at that time, the effect of knowing the cost estimate might be to lower the task's importance to save time and money. In the same manner, tasks that seem less costly might tend to get a rating of higher importance just because they appear to be easy.

This method of independently evaluating tasks using the strengths

of each team and later combining the results of the evaluations into a comprehensive list of requirements thus helps to organize thoughts and processes while the project proceeds. Rapid requirements analysis encourages a well organized and accountable project lifecycle.

CONDUCTING A RAPID REQUIREMENTS ANALYSIS

The following steps illustrate how to conduct a rapid requirements analysis. The project manager may wish to add other tasks to suit an organization's system design rules. However, this framework is a proven method of requirements-gathering. It has worked under the toughest of conditions and shows improvement over conventional methods in concept-to-prototype cycle times.

Step 1: **The energy management team should identify who is involved**.

The team should list everyone involved in the project and what their roles are. A contact list with phone numbers, email addresses, office locations, and a short description of responsibilities is helpful.

Step 2: **The energy management team should list all primary and secondary tasks that the EIS must perform to completely replace the existing processes and accomplish the desired new processes.**

A mission statement can help qualify which tasks the project absolutely needs to accomplish its goals. If tasks are categorized, they can be grouped together based on their dependence on one another. The team should list the tasks as clear and concise descriptions, but not so detailed as to make them cumbersome to read and comprehend rapidly. Detailed analysis of the task later can clarify any questions that arise. An ID number will help keep track of individual tasks since the list may be quite large. See Figure 1 below for an example of how to list tasks.

Step 3: **The energy management team and the IT development team must agree on criteria for evaluating the requirement tasks and a rating scheme for the criteria.**

ID	CATEGORY	TASK
2	Electric	Maintain List of Utility account numbers
4	Electric	Maintain Electric Billing Days
5	Fuel	Generator gasoline
9	General	A security plan describing all security issues and procedures.
12	General	Data will be reported at various levels: by year, month, day, hour.
15	Network Access	Specific input screens will require security login procedures.
17	Square Footage	By Facility
18	Weather	Degree days
19	General	Data will be stored at various levels: by year, month, day, hour.
20	General	Data collected automatically will be available for reporting on an daily basis.
21	General	Graphs will be an image allowing them to be copied and pasted to other applications.
22	General	Distribution list
23	Distribution	Email notification of change to persons on distribution list.
24	Email Subscription	Maintain list of Name, email address, Report URL, Frequency of delivery
25	Email Subscription	Email link to reports according to email subscriptions on a daily basis.
26	General	Graphs will allow for multiple data sets, combined line and bar graphs and auxiliary data on the right axis.
27	General	Graphs will allow for any specified data set as the auxiliary data on the right axis.

Figure 1. Task List

It's likely the criteria will be "need" and "cost." Either team can add other criteria as desired. However, the more criteria, the more difficult and time-consuming the analysis becomes. Our examples will assume *need* and *cost* are the two criteria. The rating scheme determines how tasks compare to each other. For instance, the most common method is to assign the most needed tasks a lower number and the least needed tasks a higher number. Or, in other words, "lowest is best." The same method can apply to cost evaluations. The tasks with the lowest cost will have a low value assignment and tasks with a high cost will have a high cost value assignment.

Step 4: **The energy management team independently evaluates the tasks based on *need*, and at the same time, the IT development team independently evaluates the same tasks based on *cost*.** The EM team puts a value in the "NEED" column associated with each task that represents its *need* relative to the other tasks, while the IT team fills in the "COST" column, ranking the tasks according to *relative cost* and not trying to estimate an exact cost for each task. Each team should assign values in large increments, at least one hundred units apart, so that other tasks will fit between them later. The EM team can add new tasks that are required to complete other tasks but only if their *need* value is inherited from tasks that require the new task. These additional required tasks should be few in number and only added if the task enhances the EIS. Any other tasks required to complete the listed tasks should be part of the cost and effort involved in completing that task. Figures 2 and 4 show independent evaluations of tasks based on need and cost respectively.

Step 5: **The results of the two teams' work are combined**.
The project manager merges the task evaluation values together by adding the *need* values to the *cost* values as a "TOTAL" column. The project manager then sorts the list by "TOTAL" and calls a meeting to discuss the results. It could be that some tasks are not in the appropriate position in the list. Adjusting the *need* and *cost* values in the list produces a new prioritized list. This "adjusting" is repeated until the teams agree on a final requirements task list. Figure 4 shows the "NEED" and "COST" columns summed together as "TOTAL," and then sorted by "TOTAL."

Step 6: **The final analysis is performed**.
Once the teams agree on a final task list, the IT development team can draw a line, or lines, in the list and assign project costs to the tasks above or between the lines. This list becomes the basis for a detailed requirements document, cost estimate, and priority of work.

ID	CATEGORY	TASK	NEED
2	Electric	Maintain List of Utility account numbers	100
4	Electric	Maintain Electric Billing Days	100
5	Fuel	Generator gasoline	100
12	General	Data will be reported at various levels: by year, month, day, hour.	100
9	General	A security plan describing all security issues and procedures.	100
15	Network Access	Specific input screens will require security login procedures.	100
17	Square Footage	By Facility	150
18	Weather	Degree days	150
19	General	Data will be stored at various levels: by year, month, day, hour.	200
20	General	Data collected automatically will be available for reporting on an daily basis.	200
21	General	Graphs will be an image allowing them to be copied and pasted to other applications.	350
23	Distribution	Email notification of change to persons on distribution list.	400
22	General	Distribution list	400
24	Email Subscription	Maintain list of Name, email address, Report URL, Frequency of delivery	600
25	Email Subscription	Email link to reports according to email subscriptions on a daily basis.	600
26	General	Graphs will allow for multiple data sets, combined line and bar graphs and auxiliary data on the right axis.	600
27	General	Graphs will allow for any specified data set as the auxiliary data on the right axis.	600

Figure 2. Independent Evaluation by Need

CONCLUSION

EIS project requirements analysis is never going to be easy. As more and more technological innovations work their way into the energy management arena, it will only become more complex. As responsibilities grow and time becomes more and more valuable, it will be more difficult to get large groups of people to work together on such complex projects. This may be one reason why outsourcing is so popular these days. This may also explain why energy information systems have been slow to prevail. Yet the advantages of EIS projects continue to multiply rapidly. Political, environmental, and weather trends, among others, affect our energy consumption and cost. For the most part, these factors are uncontrollable. Monitoring consumption regularly is the most productive way to cut costs. This justifies an effort to streamline the

ID	CATEGORY	TASK	COST
2	Electric	Maintain List of Utility account numbers	100
4	Electric	Maintain Electric Billing Days	100
22	General	Distribution list	100
9	General	A security plan describing all security issues and procedures.	100
17	Square Footage	By Facility	100
18	Weather	Degree days	100
5	Fuel	Generator gasoline	200
21	General	Graphs will be an image allowing them to be copied and pasted to other applications.	300
12	General	Data will be reported at various levels: by year, month, day, hour.	400
19	General	Data will be stored at various levels: by year, month, day, hour.	400
20	General	Data collected automatically will be available for reporting on an daily basis.	400
15	Network Access	Specific input screens will require security login procedures.	400
23	Distribution	Email notification of change to persons on distribution list.	500
24	Email Subscription	Maintain list of Name, email address, Report URL, Frequency of delivery	500
25	Email Subscription	Email link to reports according to email subscriptions on a daily basis.	500
26	General	Graphs will allow for multiple data sets, combined line and bar graphs and auxiliary data on the right axis.	600
27	General	Graphs will allow for any specified data set as the auxiliary data on the right axis.	600

Figure 3. Independent Evaluation by Cost

requirements-gathering process and help produce energy information systems specific to the needs of an organization.

This rapid requirements analysis method attempts to bridge the gap between two diverse professional teams in an effort to take advantage of each of their respective strengths toward developing an EIS. It avoids the well-known pitfalls of large lengthy meetings hammering out details of an EIS project without losing the detailed analysis needed to get the job done. It combines needs and costs of tasks so that the tasks can be compared and prioritized more effectively. It brings everything together into a well-organized document that reflects the goals and capabilities of both teams.

As with any other idea, this method is open to adaptation. Subcategories assigned to each task may be helpful. Also, the project manager may want to add a reference column to keep track of data or other information for each task. However, the project manager should

ID	CATEGORY	TASK	NEED	COST	TOTAL
2	Electric	Maintain List of Utility account numbers	100	100	200
4	Electric	Maintain Electric Billing Days	100	100	200
9	General	A security plan describing all security issues and procedures.	100	100	200
17	Square Footage	By Facility	150	100	250
18	Weather	Degree days	150	100	250
5	Fuel	Generator gasoline	100	200	300
12	General	Data will be reported at various levels: by year, month, day, hour.	100	400	500
22	General	Distribution list	400	100	500
15	Network Access	Specific input screens will require security login procedures.	100	400	500
19	General	Data will be stored at various levels: by year, month, day, hour.	200	400	600
20	General	Data collected automatically will be available for reporting on an daily basis.	200	400	600
21	General	Graphs will be an image allowing them to be copied and pasted to other applications.	350	300	650
23	Distribution	Email notification of change to persons on distribution list.	400	500	900
24	Email Subscription	Maintain list of Name, email address, Report URL, Frequency of delivery	600	500	1100
25	Email Subscription	Email link to reports according to email subscriptions on a daily basis.	600	500	1100
26	General	Graphs will allow for multiple data sets, combined line and bar graphs and auxiliary data on the right axis.	600	600	1200
		Graphs will allow for any specified data set as the auxiliary data on			

Figure 4. Merge Evaluations

be careful to avoid over-complicating the process, since simplicity is one of its virtues. A demonstration of using rapid requirements analysis is available at *http://www.utilityreporting.com/rra.*

Acknowledgments

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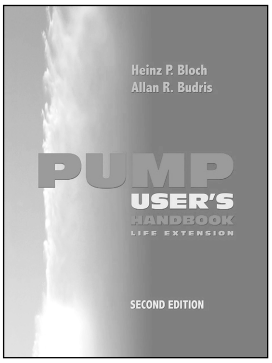

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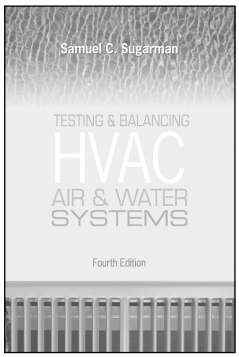

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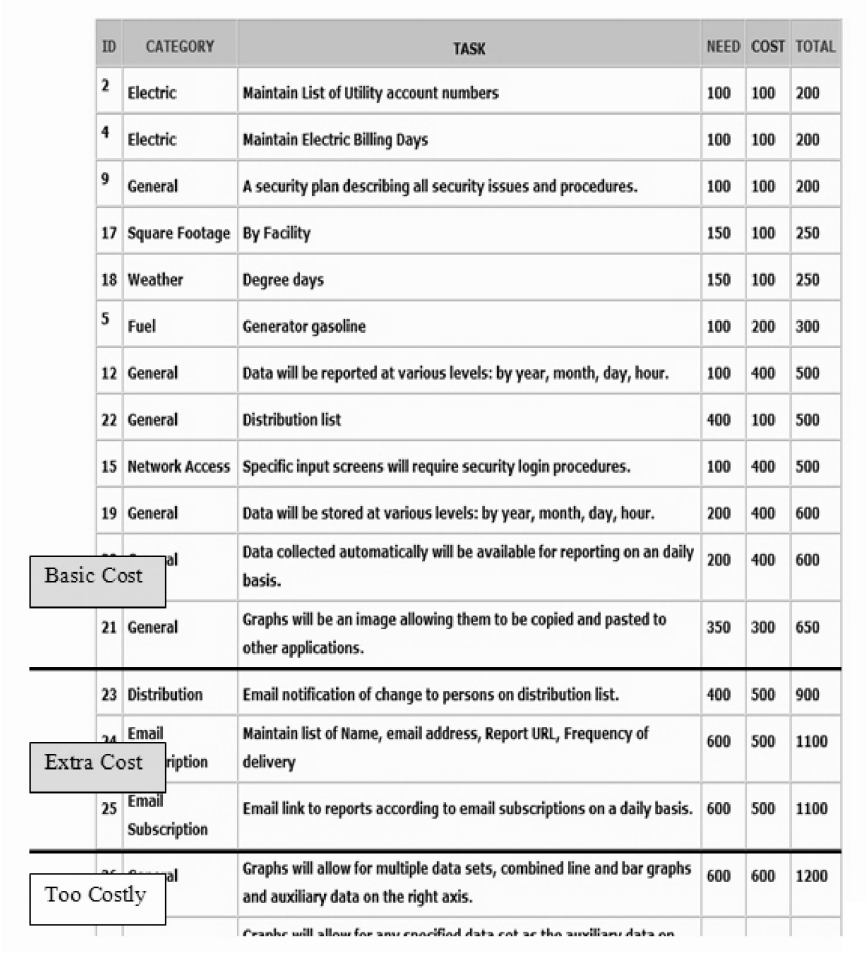

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2	Electric	Maintain List of Utility account numbers	100	100	200
4	Electric	Maintain Electric Billing Days	100	100	200
9	General	A security plan describing all security issues and procedures.	100	100	200
17	Square Footage	By Facility	150	100	250
18	Weather	Degree days	150	100	250
5	Fuel	Generator gasoline	100	200	300
12	General	Data will be reported at various levels: by year, month, day, hour.	100	400	500
22	General	Distribution list	400	100	500
15	Network Access	Specific input screens will require security login procedures.	100	400	500
19	General	Data will be stored at various levels: by year, month, day, hour.	200	400	600
	al	Data collected automatically will be available for reporting on an daily basis.	200	400	600
21	General	Graphs will be an image allowing them to be copied and pasted to other applications.	350	300	650
23	Distribution	Email notification of change to persons on distribution list.	400	500	900
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Figure 5. Cost Lines

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ABOUT THE AUTHOR

David C. Green has combined experience in intranet/internet technology and database projects and has developed programming for energy information systems. David has been the president of his own consulting company, Green Management Services, Inc., since 1994. He has a Bachelor of Science degree in chemistry and a Master of Arts degree in computer science. David is also a lieutenant colonel in the Illinois Army National Guard and has 21 years of military service. David has successfully completed major projects for The ABB Group, Cummins Engine Company, ECI Telematics, M.A.R.C. of the Professionals, Walt Disney World and The Illinois Army National Guard. (dcgreen@dcgreen.com)