A Web Based Wireless Order Management Application

Facilitating the Migration from Professional Center Management to Teleworker Management

David Cohen, Gary Larson and Bill Ware
david@sente.com, gary@sente.com, bill@sente.com
sente Corporation
7209, Briarnoll Dr., Dallas, Texas 75252-6356 USA

Abstract

The Wireless Industry finds itself under significant economic pressures on both margins and revenue. Competition and recent 3G network investments demand new revenues streams. This further increases the pressure on network operators to deploy faster and more cost effective operations support solutions. The ***e****lectronic* ***c****ustomer* ***c****ontact* ***m****anagement system* ***(eccm)*** *application is a software platform that tackles this business challenge at three levels:*

1. It delivers software functionality in the context of baselined operations processes using faster cycle times (e.g., one software release per week or faster),

2. It provides center management the tools required to professionally manage center resources and to facilitate enhancements to the center's process maturity level.

3. It provides the organization the option to selectively deploy a teleworker-based operation that reduces cost, and increases productivity while significantly improving employees' quality of life.

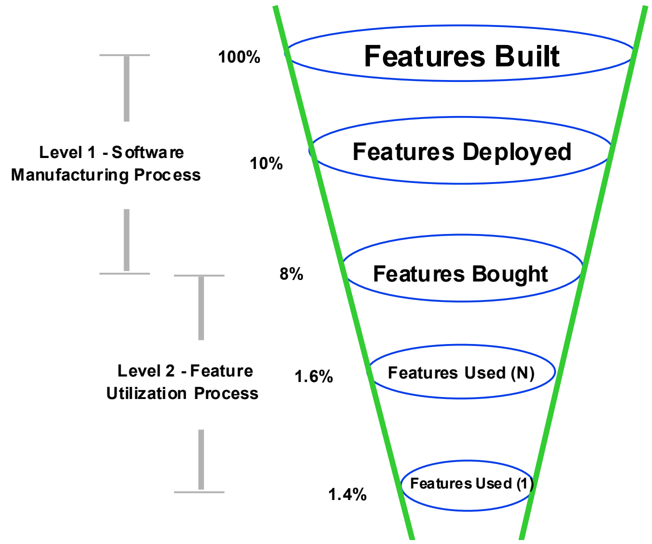
The solution presented was driven by productivity improvements in center operations and not by technology. The eccm application was incrementally expanded to respond to change requests associated with "user visible features" through configuration management. This improved both the robustness and effectiveness of the center operations, providing an attractive Return on Investment (ROI) to the business.

1. Introduction

1.1. Investment in Software Solutions

The *eccm* platform was originally implemented as a system-engineering tool to validate the completeness of requirement specifications [1, 4]. In the late 1980's we recognized a phenomena that we defined as **software pollution™**. During a period of 15 years we examined over 400 hundred projects in sizes from 10-500 person-years per release. In every project evaluated there was a large deviation between the number of lines of code (LOC) developed and tested (e.g., investment) compared with the LOCs deployed in the field (see Figure 1).

Figure 1: Software Pollution Definition



Software pollution is defined as the "scrap" by-product during the software (manufacturing) development process. For example, software pollution at level 10 means that we invested in the development of *ten LOCs* for every *one LOC* in the deployed release. The level of software pollution measured in these programs was in the range of 10-100, in line with the complexity, size and the talent related to each project. In general, larger and more complex projects had higher pollution levels. A similar effect was observed also in feature utilization. No project reviewed had a feature utilization (from all the features deployed) that exceeded 20%. This means that after all the effort, cost and pain to deliver a feature to the users, there is a high probability (e.g., over 80%) that no user will utilize it. The analysis identified four major pollution sources:

1. Incomplete understanding and capture of customer needs in the format of requirements specifications. Requirements must be developed before they can be specified recognizing that the customers' knowledge and

IEEE Computer Society Order Number PR01381
ISBN 0-7695-1381-6 Library of Congress Number 2001095562

business needs continue to evolve during the development process.

2. Traditional system engineering cannot effectively transfer the customer need to the development team. There are several human barriers for information transfer and on the average the features captured by the requirements represent less than 20% of the capabilities included in the deployed product and subsequent service.

3. The development team attempts to implement a system that will support a very large user base in a long single release. Market and customer needs change continuously in response to business needs. Large/long projects are attractive to development organizations because of the less frequent interaction with end-users, but the results show limited relevancy to the business.

4. The development team attempts premature utilization of "bleeding edge" technology ignoring its current level of expertise. Unknowingly, the project turns into a job-training program. The primary objective should be to deliver an effective business solution and not to champion technology evolution. New technology should be introduced in a controlled environment gated by the availability of talent and expertise.

In a recent set of articles Boehm et al [2, 3, 5] make a similar observation. Their analysis shows that over 50% of the projects terminated before completion were caused by requirement specifications that failed to capture accurately what the business needed (e.g., incomplete requirements, lack of user involvement, changing requirements, absence of need, unrealistic expectations). The second dominant cause (in over 40% of the projects) was the insufficient availability of *relevant* management and technical talent (e.g., lack of executive support, lack of resources, lack of planning, lack if IT management, technology illiteracy).

The *eccm* platform has evolved over the last four years into an effective *software pollution fighter*. The web-based technology allowed significant expansion of the capabilities to include user interfaces, process definitions, business-rules and management-reports [8]. Incrementally, the platform was expanded to handle most "user visible" feature changes through configuration management. *Cost effective product enhancements are possible as newly acquired insight procured.* This is not practical or even possible when the cycle times are 4-6 months or longer, and the cost of each release is millions of dollars [6, 7].

The second benefit of this faster cycle time is the ability to *detect earlier* issues that are somehow missed and were not included in the project plan. These surprises that show up late in every program are key contributors to deployment delays and cost overruns [8, 9, 10, 11].

The platform, using standard Microsoft technology (e.g., W2000, W2000 SQL Server, IIS), allows scalability to support limited deployment (e.g., 100s of users) to validate the robustness of the solution (e.g., usability, productivity, system operations) while in use. This proved to be an attractive approach to start immediately harvesting the productivity benefits of a solution while the IT organization develops a certified solution that meets the unique architectural guidelines of the corporation [14]. This guarantees that upon deployment, the IT provided solution will be relevant to the business. The *eccm* platform continues to be used effectively in the validation of the requirement specifications.

The development of this software platform would not have been possible in a traditional software development organization because industrial engineering has shown repeatedly that it is unnatural (e.g., impossible) to expect a development organization to adopt an approach or a technology that reduces the demand for its services [15]. The ROI for software projects will improve only when the development team is required to deliver *measurable business benefits rather than. software features.*

1.2. Wireless Center Operations (WCO)

The Wireless Center is responsible for processing approximately 120,000 orders per year. Each order is for the provisioning of a transmission circuit that will provide interconnection between wireless network elements such as switches and antennas (e.g., AT&T Wireless, Cingular, Nextel, Verizon, etc.). Some orders are for a single trunk circuit while others may include a fiber ring within a city or a state.

In the original operations environment without *eccm*, orders were submitted by over 500 customers using faxes and emails. The center had no effective tracking mechanism for the orders received. It was the responsibility of ~60 Reps and ~50 System Designers (SDs) to process the orders received in the center and issue orders to the network provisioning team responsible for the physical delivery (deployment, testing) of the service. The cycle time for provisioning may be less than a week in case the facilities are in place, or it may take 4-6 months if new facilities are required.

Order processing requires the data entry of each order into a set of legacy systems such as service order systems (SOS) and billing systems (BS). Each system validates the order information for both accuracy and completeness (e.g., telephone numbers, addresses, contract information, etc.). In some cases error processing may require contacting the customer for clarifications ("clarifies") to ensure the accuracy of the data. These "clarifies" were transmitted in the past using telephone calls, faxes and/or emails. Similarly, customers unhappy with the progress in their order processing are provided the option, through "escalations", to increase processing priority.

The limited order tracking capability in the center combined with an ever-increasing number of escalations resulted in a crisis mode of operations with high stress levels and reduced Rep productivity. For example, it would take on the average 2-3 days to receive a response on an order status inquiry. Center management was provided only monthly quality and throughput (summary) reports delivered usually 2-3 weeks after the end of the month. The *eccm* solution was deployed in the wireless center as a management tool in support of the order management processes.

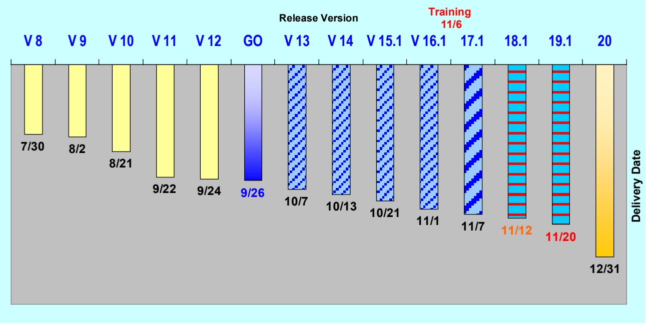
1.3. OMS Characteristics

The *eccm* application has been deployed as an order management system (OMS) in three phases:

1. Order management processes
2. Teleworker mode of operations (reduces Rep/SD cost while improving their quality of life)
3. Flow thru integration (providing an effective solution to order fall-out processing, a byproduct of imperfect automation-software implementation).

This paper focuses on the first phase of the program that included 20 incremental releases over a period of less than five months (see Figure 2).

Figure 2: eccm Software Releases



The application includes the following OMS processes:

User processes:

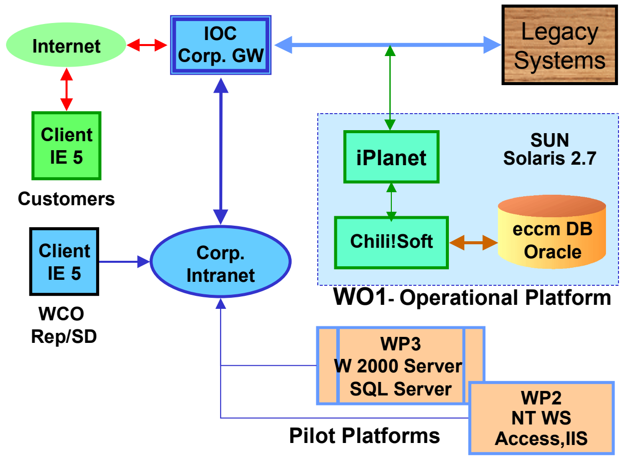
New Order Processing, Supplemental Order Processing, Disconnect Order Processing, Clarify Processing, Escalation Processing and Productivity Management Processing.

Operations Processes: Software Defect Processing, Database Backup and Recovery Processing, Disaster Recovery Processing, New Feature Processing and Change Management Processing.

The *eccm* architecture includes two pilot platforms and one operations platform (see Figure 3).

The pilot platforms WP2 and WP3 are used for requirements validation and limited deployment (Reps and SDs) respectively. The operation platform is used for order processing by customers, Reps and SDs. Reps/SDs have access to both operation and pilot platforms according to their responsibilities. For example, a small group of twenty Reps/SDs may participate in the validation process of a *new product* (e.g., BRs, processes) while using the operation platform **WO1** for normal order processing. Web access is supported through the Corporate Intranet (e.g., internal users such as Reps/SDs, sales teams) or the Internet (customers).

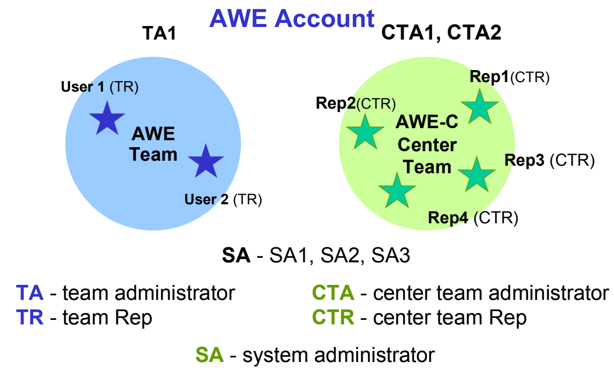
Figure 3: Wide Deployment Architecture



The users associated with a customer account are restricted access to only their own orders. WCO management has the flexibility to load balance resources within the center allowing Reps/SDs access according to their assignments. Each account includes two teams (Figure 4) one associated with the customer users and second associated with the center Reps.

Each team can be assigned one or more administrators, allowing local autonomy for account management. The team administrators (TAs) maintain their team's user profiles. For application management one or more system administrators (SAs) are available to deal with system operations (e.g., database backup and recovery, session tracking, ad-hoc report creation etc.). Once a SA creates an account, (including the related teams and TAs), all other account management is implemented at the team TA and CTA levels.

Figure 4: Account Configuration



We have reviewed several competitive product offerings by Siebel (ISS eSales), Nortel (Clarify OMS - formerly Architel) and Lucent (Kenan Systems Arbor) [19]. Both Clarify and ISS allow Internet based access. All three products allow changes in BRs and provide users order status information. Process changes are addressed as a product configuration feature, reflecting limited understanding of the center operations process-flows. They all require significant system integration activities that exceed significantly the product license fees.

A review of over 20 projects in these areas showed that cycle times were in the 4-12 months range and cost was 15-35 person-years per release. All projects followed the standard IT paradigm using incomplete requirements resulting in several costly and late releases.

1.3.1. New Order Processing and Example

The customer creates a new order. It is a data entry function that requires a significant amount of knowledge about the circuit to be provisioned. The data entry function can be suspended at any point in time and resumed later using the saved order data. The system keeps track of *all* changes in the life of the order. This trace database is an important element in the production of the management reports. At any point in time the user may verify the accuracy and completeness of the order according to the business rules specified for this particular product.

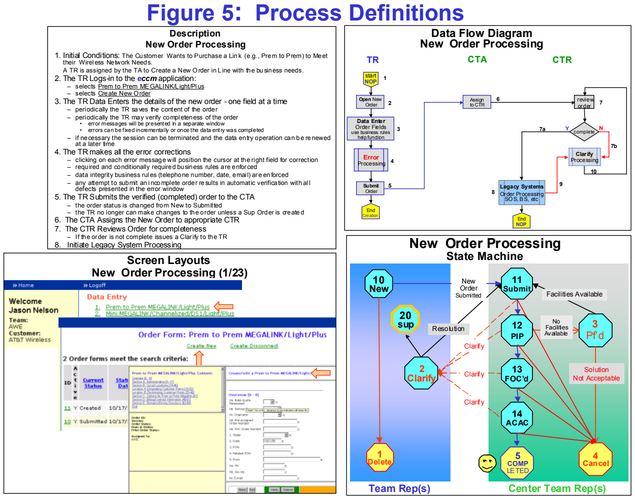
Once the order has been completed (some products include over 120 fields and almost 200 business rules) the customer can submit the order to the center. Verify processing was integrated into the submit function; *an order cannot be submitted by the customer unless it has been verified for completeness and accuracy.* Customers today may contact their account SDs/Reps for assistance through a telephone call, email, inquiry, and/or instant messaging.

The *submission of an order* automatically transfers responsibility from the customer team to the center team, and specifically to the center team administrator (CTA). The *CTA assigns* the new order to a particular Rep/SD in his team according to expertise, availability, workload and/or urgency. Both activities are tracked by the system. The Rep evaluates the order and if it is complete, legacy system orders are issued.

The new order process was defined in four different presentation methods *to guarantee* user understanding: Text Description, Data Flow Diagram, State Machine Diagram, and Incremental "screen shots" (see Figure 5).

Section 2 introduces an improved IT paradigm using validated requirements to drive the implementation process. Validation capabilities of the current *eccm* application are detailed in five major areas. Section 3 provides a summary of the key contributions and identifies future research areas.

Figure 5: Process Definitions



Description
New Order Processing

1. Initial Conditions: The Customer Wants to Purchase a Link (e.g., Prem to Prem) to Meet their Wireless Network Needs.
   A TR is assigned by the TA to Create a New Order in Line with the business needs.
2. The TR Logs-in to the ***eccm*** application:
   - selects Prem to Prem MEGALINK/Light/Plus
   - selects Create New Order
3. The TR Data Enters the details of the new order - one field at a time
   - periodically the TR saves the content of the order
   - periodically the TR may verify completeness of the order
     - error messages will be presented in a separate window
     - errors can be fixed incrementally or once the data entry was completed
   - if necessary the session can be terminated and the data entry operation can be renewed at a later time
4. The TR makes all the error corrections
   - clicking on each error message will position the cursor at the right field for correction
   - required and conditionally required business rules are enforced
   - data integrity business rules (telephone number, date, email) are enforced
   - any attempt to submit an incomplete order results in automatic verification with all defects presented in the error window
5. The TR Submits the verified (completed) order to the CTA
   - the order status is changed from New to Submitted
   - the TR no longer can make changes to the order unless a Sup Order is created
6. The CTA Assigns the New Order to appropriate CTR
7. The CTR Reviews Order for completeness
   - If the order is not complete issues a Clarify to the TR
8. Initiate Legacy System Processing

Screen Layouts
New Order Processing (1/23)

Data Entry
1. Prem to Prem MEGALINK/Light/Plus
2. Mini MEGALINK/Channelized/DS1/Light/Plus

Welcome Jason Nelson
Team: AWE
Customer: AT&T Wireless

Order Form: Prem to Prem MEGALINK/Light/Plus

2 Order forms meet the search criteria:

ID	Active	Current Status	Stat Dat
11	Y	Created	10/17/
10	Y	Submitted	10/17/

2. A New IT-Paradigm Using Validated Requirements

All development programs in IT organizations are driven by requirement specifications. All funding, schedule and delivery commitments are predicated on a requirements document that is *always* created under significant time pressure by an ad hoc group of people assembled for this particular task. The specifications and the associated release plan are always a major barrier to further activities such as budget approvals and the start of development. This paradigm has not changed in the software industry for over forty years [3, 6] despite a poor track record of delivering solutions with a good ROI. A key element of this paradigm requires that the business unit take ownership for the specifications delivery (mapping business and operations needs into software features). ***The development team is measured strictly by the timely delivery of the requirements-specified software features and NOT by the effectiveness of the solution.*** The problems detected after deployment require further enhancements to make the solution usable. In practice this means that it will cost more, it will be delivered later and the solution will be partial at best. *In essence this economic model rewards the internal development organization with additional development resources while it continues to deliver limited/no return on the investment.* Even in cases in which a systems integrator (SI) (e.g., Accenture, Cap Gemini, EDS, IBM and SAIC) is contracted for the delivery of the requirements, the outcome turns out to be very similar. The standard SI review process transfers responsibility for requirements correctness to the sponsor. The customer is trapped into a software investment using a faulty process. This explains why technical organizations are not motivated to improve the systems engineering process, while the center is disillusioned due to software solutions that make limited/no contribution to staff productivity. Repeatedly, manual processes have to be deployed to meet the business needs creating a major recruiting and training challenge in the centers. *Under the current IT paradigm it is not possible to deliver cost effective center solutions independently of the resources invested* [15].

The *eccm* program employs an enhanced IT paradigm that uses validated requirements to tackle this ROI challenge.

2.1. Eccm Capabilities in Support of Requirements Validation

The platform supports the validation of business rules, the software usability, the operational processes, management reports and the robustness of the solution upon deployment. Most enhancements that are related to "user visible" functionality are carried out by the systems engineering team using configuration management (CM) capabilities. eccm provides an environment in which users are delivered ***clearly defined and measurable benefits*** instead of ***software features*** [12, 13].

2.1.1. Architecture

The architecture guarantees that all validated functionality is tested for robustness and that it delivers the productivity objectives specified. The two pilot platforms (see Figure 3) are used for validating both the requirements and the solution benefits. This eliminates most center disruptions in operations caused by a new release. For example, each two-hour outage in a 100-person center results in a productivity loss of 1-2 Reps per year. The loss grows if overtime is necessary to make up for the outage loss. Added penalties occur when a new software feature is "dumped" in the lap of the users and the center team has to develop an operational process around it. This is the reason that some feature deployments (e.g., automated flow thru) have caused a temporary reduction in center productivity.

Each *eccm* release is validated internally with 20-25 users using the WP2 NT WS platform; only when the solution delivers the expected results, is it deployed to the rest of the internal organization (e.g., 100 users). Only after the performance results scaled successfully within the internal organization, do we incrementally make the functionality available to the large number of external customers. *The center staff is responsible for change management and for controlling the pace and scope of deployment.* The *eccm* software caused no service disruptions during the first year.

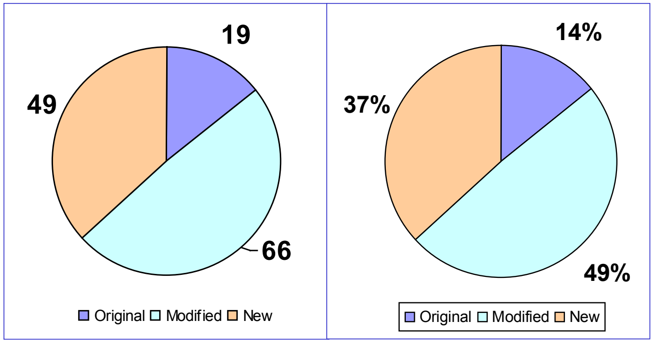
The WP3 W2000 pilot platform is used for limited deployment of the application for up to 120 users. This allows newly developed features to be validated for their productivity benefit while continuing to refine processes and user interfaces. By the time features were deployed for wide customer use on the SUN Solaris platform we experienced few surprises. The typical delay in making software available on the operations (SUN) platform is 4-5 weeks [14]. The delay is driven more by the change management process than by the software port functionality. So far we have not been able to replicate the daily/weekly cycle-time experienced with the pilot platforms in the operations platform environment.

2.1.2. Business Rules (BRs)

Business rules validation turned out to be a surprisingly difficult challenge. Initially BRs were provided to the development team in a textual description form. Once implemented in software we discovered that no previously processed order could pass verification. This was due to incorrect and missing information in the BR descriptions.

The rules have been maintained by a team of experts and were considered accurate and complete (the rules were posted on the company web site with the related customer order form). It took *five* software releases to validate the correctness of the BRs. Enhancements in the platform reduced the cycle time for BR validation from a week to 1-2 hours. Figure 6 shows the pollution level experienced in validating the business rules.

Figure 6: Prem to Prem MEGALINK BRs Validation



Only 19 of the BRs were used as is; 66 of the rules were modified and 49 new rules had to be added as part of the validation process. The process has proven that BRs cannot be validated effectively through standard reviews of the textual descriptions.

The BR knowledge is made available to the users as a standard product related report. The BR's textual description was also integrated with the browser's standard help feature. The user has direct access to this knowledge base just by positioning the mouse pointer over a selected field. This turned out to be one of *the most valuable aspects of the application* during order creation or verification. It also proved to be an effective "safety net" to the training program. The BR knowledge base can be updated based on users' feedback without any service interruption. Several users were able to create and submit orders given just a brief 10 minutes introduction to the application (without training).

2.1.3. User Interface

Users access the *eccm* application through industry standard browsers (e.g., IE 5, NN 4.7). The training of a Rep prior to *eccm* deployment in the complete WCO operations took over 6 months. Three success criteria were identified for the design in this area:

1) User training should take a day or less including hands on use of the software capabilities.

2) The application must support the baselining of user capabilities through measurements collected while processing a standard set of test scenarios.

3) New computer literate users must be able to use the application without training, exposed only to a limited introduction to the application (e.g., 15 minutes).

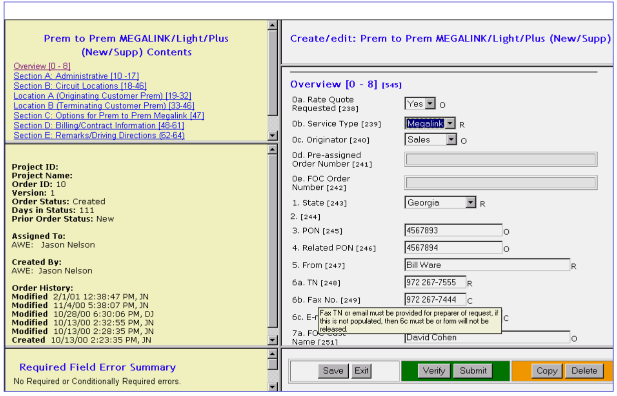
All three of these objectives have been met.

The following user features made this possible:

a. The BR knowledge base was turned into an effective "help" capability using the standard browser feature (used to create and correct orders); the effort invested in the maintenance of this information was significant with an exceptional benefit to the users.

b. The system maintains a complete trace of *all order* content and status changes; each trace record identifies the initiator of the action as well as the date and a time stamp. This database is accessible on line to all authorized users of an account *providing process transparency* (see Figure 7).

Figure 7: Data Entry User Interface



Prem to Prem MEGALINK/Light/Plus (New/Supp) Contents

- Overview [0 - 8]
- Section A: Administrative [10 -17]
- Section B: Circuit Locations [18-46]
- Location A (Originating Customer Prem) [19-32]
- Location B (Terminating Customer Prem) [33-46]
- Section C: Options for Prem to Prem Megalink [47]
- Section D: Billing/Contract Information [48-61]
- Section E: Remarks/Driving Directions (62-64)

Project ID:
Project Name:
Order ID: 10
Version: 1
Order Status: Created
Days in Status: 111
Prior Order Status: New

Assigned To:
AWE: Jason Nelson

Created By:
AWE: Jason Nelson

Order History:
Modified 2/1/01 12:38:47 PM, JN
Modified 11/4/00 5:38:07 PM, JN
Modified 10/28/00 6:30:06 PM, DJ
Modified 10/13/00 2:32:55 PM, JN
Modified 10/13/00 2:28:35 PM, JN
Created 10/13/00 2:23:35 PM, JN

Required Field Error Summary
No Required or Conditionally Required errors.

Create/edit: Prem to Prem MEGALINK/Light/Plus (New/Supp)

Overview [0 - 8] [545]

0a. Rate Quote Requested [238]	Yes	O
0b. Service Type [239]	Megalink	R
0c. Originator [240]	Sales	O
0d. Pre-assigned Order Number [241]		
0e. FOC Order Number [242]		
1. State [243]	Georgia	R
2. [244]		
3. PON [245]	4567893	O
4. Related PON [246]	4567894	O
5. From [247]	Bill Ware	R
6a. TN [248]	972 267-7555	R
6b. Fax No. [249]	972 267-7444	C
6c. E-m		C
7a. FOC Cust Name [251]	David Cohen	O

Fax TN or email must be provided for preparer of request, if this is not populated, then 6c must be or form will not be released.

c. The user interface has a *table driven* configuration to select which subset of the order fields (approximately 10% of the total number of fields) will be visible when displaying an active order list. This allows *immediate* refinement of the user interface if needed in the future.

d. The user interface includes a powerful two dimensional sort capability. First, any subset of the order fields can be "equipped" with a sort option (the selection is table driven and bound by the display area). So far 12 fields were configured with this option. Second, a column sort is provided for all visible fields that could benefit from such a capability. The combination of these two sort capabilities creates a powerful *ad hoc report generator* without any query processing expertise. This eliminated the need for technical staff in support of this function. Because of the difficulty experienced by some of the users in dealing with boolean logic, we included three standard sort configurations to handle standard operations functions. They display the Rep's workload by urgency (default), by time interval in a state and by completion during the last 30 days.

e. The user interface has an effective representation of verification errors. All verification errors are captured as a list of active links in a "red background" error frame. Each link includes a numeric identifier of the field that failed the business rule verification. Clicking on any error link positions the cursor at the field to be corrected. Holding the cursor on the field's name provides the user the related BR guideline. Once the correction is made, a verify action will immediately remove this link from the active error list.

The following are the key configuration management features supported by *eccm* (the systems engineering staff was the primary user of these features to implement changes without coding):

1. Create a new product and related form.

2. The order form can be partitioned into meaningful logical parts with effective navigation-links.

3. Data fields can be classified as Required, Conditionally Required (it is required if the condition is "true") or Optional; field names can be modified as needed. Each data field can be assigned integrity constraints and/or BRs.

4. Modify a variety of system parameters (e.g., time out parameter of an inactive session - 30 minutes; time interval used in active/inactive order reports - 30 days).

2.1.4. Operational Processes

The operational processes have a dominant influence on the organization's productivity. They define the organization's internal and external interfaces. Each one of these interfaces represents a handoff between organizations and/or people, a *potential cause for delay and/or confusion*. Therefore, the *eccm* application allows monitoring of operations processes both before and after deployment. High priority was given to process definition because they are also used to *verify completeness* of the functional requirements.

Most organizations rush into software development, and attempt to develop operational processes around this functionality later. This is caused either by the lack of relevant expertise during the requirement specification phase or by the anxiety of the team to start development.

The center staff usually does not participate in this phase of the program because they are too busy fighting fires; *their participation would also disrupt the harmony of a* *technology-driven program that is designed to eliminate their job function through automation.*

A typical project is missing about 30-40% of the needed requirement specifications if the baselined operations processes were not available. This is the primary reason that requirement specification documents rarely include throughput and quality objectives (these objectives can be defined only in the context of operations processes).

There are three major challenges in process definition. First, each operational process definition represents a major intellectual challenge for the project participants; it requires unique visualization characteristics that are not widely available. The second challenge is associated with the perception that management wants to maintain on how the work gets done in the center. Usually this is not consistent with the actual mode of operations. The third challenge has to do with human nature; the center staff will attempt to recreate the *current mode of operation using* ***the new*** *application*. Under normal circumstances this guarantees to reduce center productivity; at the same time it is difficult for the center staff to re-engineer effectively the current operational processes around software capabilities that are not fully understood.

Table-driven state machines control the operational processes. Most process changes (e.g., create new states, or make changes in the state transition matrix) can be implemented through CM updates.

2.1.5. Center Management Reports

The WCO is partitioned into 12 teams; each team is assigned a supervisor that has the role of center team administrator (CTA). Each team includes 10-14 Reps. Accounts are assigned to teams trying to load balance the center load across the teams. The CTA assigns each order to a specific Rep. It is also the CTA's responsibility to reassign orders between Reps if a particular Rep is absent or in over-load condition.

Periodically, changes in the business may result in an account transfer from one team to another to further balance the workload. Because of the unpredictable nature of the order work-load, a Rep from one team may be assigned temporarily to assist another team for a period of time or to process a block of orders.

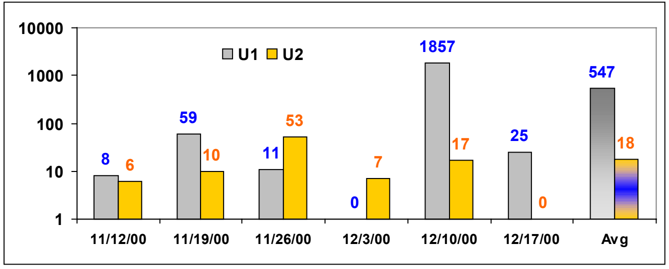
On the average a Rep processes approximately 1500 orders per year (orders have a large variance in complexity). Given the average 1822 working hours per Rep per year, it means that on the average it takes the Rep 1.26 hours to process an order. Differences across product types combined with differences in Rep experience results in major variance in Rep throughput within a team during a day. Variations of 1:20 in performance are not unusual.

In this fluid environment it is critical to track accurately the contribution of each Rep or team. The trace database maintained by the *eccm* application contains a detailed record of all the content and status changes of an order. It also contains a trace of the all users' session activities. The management reports created using this database provide detailed insight into the effectiveness of center operations at different levels (e.g., user, team, administrator and customer). Within an account, all reports are available to all users creating an effective management tool. Anomalies are clearly identified and special studies can be conducted to understand the history of a particular order or the effectiveness of a specific Rep.

Users are able to submit a new order within 5-10 minutes taking advantage of the order copy-function that was developed primarily as a development tool. They discovered that a new order can be created more effectively by making a copy of a completed order and making a few required changes (orders from the same account naturally have a large number of fields in common). Once a few users established this standard of excellence, the center relayed this insight to all other users through advisories. Within two months, all customers were performing according to this new performance standard (see Figure 8).

Management reports are provided to track orders, clarifies, escalations, user sessions, business rules and process state transition rules. Similarly, there are throughput and quality reports at the user, team and the center levels.

Figure 8: Average Create to Submit Interval (minutes)



The application currently supports about 150 standard reports. Based on the expertise we acquired, an average time to create a new reports is about four hours; iterative validation with the users results in new reports ready to be deployed in the field within 2-3 calendar days. Getting feedback from key users is the gating factor for new report deployment.

3. Conclusions

eccm proved to be an effective platform to:

1. Eliminate software bottlenecks in the delivery of business solutions*, shifting the challenge from software development to change management.* Currently, software releases are deployed monthly because of our limited ability to distribute changes effectively to a large number of physically distributed users while the development team continues to operate on weekly cycles.

2. Improve delivery of complete solutions to center users; the solutions were delivered faster, cheaper and met user and management expectations. The cost of a software release has been reduced by at least two orders of magnitude compared to similar projects. The weekly cycle time is on the average 10-20 times faster than on similar projects.

3. Enhance productivity at both the individual and team levels using a rich set of throughput, quality and analysis reports. The new operational environment allowed the creation of performance standards for transactions, users, teams and the center as a whole. The solution delivered productivity improvements with an ROI of less than 18 months and a significant competitive advantage in the market place.

4. Successfully deploy teleworker-based operations by facilitating the validation of related processes, the home communications infrastructure, and the guidelines for center staff participation in such a hybrid operation.

Future papers will present the benefits of a hybrid teleworker operation that reduces the cost of a Rep by 15% -30% per year, while improving both productivity and quality of life [16, 17]. The environmental benefits are widely known (e.g., 100,000 telecommuters per year could eliminate 2,613 tons of pollution and save $78Billions per year in wasted time and burning fuel) [18]. The teleworker solution was possible as a result of the performance standards established in the center [17]. Each teleworker was provided a telecommunications infrastructure including a PC, a DSL based remote access desktop and an integrated single number service [16].

Acknowledgments

We gratefully acknowledge Dee Freeman Butler, David MacFarlane, Doug McDougal, Brigitte Nix, *Tiffany Ray*, Elina Rodriguez, and Jackie Stephenson for their timely support and guidance during the evolution of this program. This work could not have been completed without the assistance, suggestions and friendly support of the WCO team members Ava, Clare, Dena, Denise, *Janetta,* Jo, and Mark. Special thanks to the sente development team that was always ready to go the "*extra mile*" and deliver solutions "*just in time*" under challenging conditions.

4. References

[1] B.W. Boehm, "A Spiral Model of Software Development and Enhancement," IEEE Computer 21(5) pages 61-72 (1988).

[2] B.W. Boehm, "Software Management," IEEE Computer, September 2000, pages 94-97.

[3] B.W. Boehm, and V. Basili "gaining Intellectual Control of Software Development," IEEE Computer, May 2000, pages 27-33.

[4] B.W. Boehm, "Software Engineering Economics," Chapter 33, Prentice Hall (1981).

[5] B.W. Boehm, and V. Basili "A COTS Based Systems - Top 10 List," IEEE Computer, May 2001, pages 91-93.

[6] R.S. Pressman, "Software Engineering A Practitioner's Approach," 5th Edition, McGraw Hill, 2001.

[7] S. McConnel, "Rapid Development," Microsoft Press, 1996.

[8] M. Lutz, "Software Engineering on Internet Time," IEEE Computer May 2001, page 36.

[9] S. A. Sedigh, A. Ghafoor, and R.A. Paul, "Software Engineering Metrics for COTS Based Systems," IEEE Computer May 2001, pages 44-50.

[10] R. Karpinsky, "Don't Get Nike-ed," Internet Week, March 7, 2001.

[11] M. Wagner, "Oracle Savings Don't Add Up," Internet Week, March 8, 2001.

[12] T. Braun, M. Guenter and I. Khalil, "Management of Quality of Service Enabled VPNs," IEEE Communications Magazine, May 2001, pages 90-99.

[13] D. Cohen, L. Berke, G. Larson, "Role of Interoperability in Business Application Development," ACM SIGMOD, May 1993, pages 487-490.

[14] R. Hellman, "The Future of the OS for Internet Applications," IEEE Computer, May 2000, pp. 12-15.

[15] G. Pour, M. Griss and M. Lutz, "The Push to make Software Engineering Respectable," IEEE Computer, May 2000, pages 35-43.

[16] Teleworker and Telecommuting Web Sites
www.teleworker.nildram.co.uk www.wfh.co.uk/
www.jala.com/ www.esa-goldteam.hypermart.net
www.lakes.com/Mobility yahoo.com/telecommuting

[17] J. Niles, "Managing Telework: Strategies for Managing the Virtual Workforce," John Willey and Sons, 1998.

[18] C. Marx, "Telecommuting Incentives Considered," AP, April 24, 2001.

[19] Competitive Products Web Sites
www.nortelnetworks/solutions/eba/cebus
http://siebel.com/iss/
www.lucent.com/products/solution/