
A Process for Incorporating Heuristic Evaluation into a Software Release

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Abstract

This paper describes a process for incorporating heuristic evaluations into a software product release. The goal of the paper is to provide enough detail and results to other design teams to assist them in developing their own process for this activity.

The process took place over approximately one year. In all, 124 projects were reviewed, involving 1414 web pages, and identifying 5817 defects. Data is not yet available about the exact number of defects fixed, but it is expected to be well over 2000, as described below.

The heuristics used in this process included how well the various pages integrated, how easy it was to accomplish tasks, conformance to style guidelines, and consistency in design, terminology, and layout. Some user testing was done on some of the projects that went through these reviews; the reviews complimented that testing.

Keywords

Design Methods, Process Improvement, Product Design, Usability Research, Usability Testing and Evaluation, User Interface Design

Problem Statement

Although it was a goal to have user experience designers involved in product design throughout the development life cycle, many factors influenced the need for a final evaluation:

- Due to resource constraints, it was not possible to have a designer involved in many design decisions.
- Although there were several user interface style guides available for assisting development team, it was almost impossible for any team to avoid making mistakes in terms of design and consistency in a product as large and complex as Enterprise Manager.
- Design goals/standards changed throughout the project, even after some pages had been designed and implemented.

Therefore the user experience design team decided to conduct exit reviews on the user interface, to assure consistency and high quality in the finished product.

Background

This process was implemented by the Enterprise Manager User Experience (EMUX) team, while working on Oracle Enterprise Manager, version 10g Release 2. Enterprise Manager is Oracle's system management tool for the majority of its server products. It is a thin-client tool, deployed as a J2EE application running on Oracle's Application Server product, and using a back-end data repository. [5] It is an administration tool that consists of approximately 3,000 web pages. The target audience is technical users responsible for the administration of server products, such as databases

application servers, email servers, and others. The development organization (including developers, product managers, technical writers, quality assurance engineers, and, of course, user experience designers), totaled just over 500. The product was initially built in 1996, and has undergone three major rewrites. Development of the 10g Release 2 version of the product began in 2003, and it is scheduled for release in late 2005. Some of the reviews took place as early as the summer of 2004, with the majority of them being completed between November 2004 and May 2005.

The user interface is based on Oracle's Browser Look and Feel (BLAF) [1]. In addition, the Enterprise Manager Style Guide (EMSG) builds on BLAF to provide more detailed guidelines specifically for Enterprise Manager. BLAF and the EMSG provide the basis for "adherence to standards" measures used in the reviews.

Enterprise Manager is available in many countries, so the interface is translated from English into many different languages. Every text string visible to the user has to be sent out for translation, and received back for testing well before release.

The design team (EMUX) initially consisted of 2 designers, grew to 3 early on (May 2003), grew to 9 at its peak, and ended with 7. Some team members had formal training in HCI; others had many years of experience with user interfaces and significant "on-the-job" training. Some were junior, joining the team just after completed their college degrees. The most experienced team members each had close to 20 years of experience in the field.

The concept of UI “exit reviews” was introduced first in the Oracle Application Server 9i release in 2000. The reviews were requested by the vice president in charge of that release to evaluate the state of the UI. Its value as a measure of the quality of the UI was recognized in that release, causing the reviews to be extended to more coverage within Enterprise Manager in each release leading up to the one described in this paper.

Design Process Administration

User experience designers were involved in the design of many of the projects in the release. However, due to the large number of projects (over 120) and the relatively small design staff (between 2 and 9), the projects were prioritized by the senior management team into High, Medium, and Low. This prioritization determined the amount of time the designers spent on the project: high priority projects had a lot of involvement; low priority projects only had occasional input. In addition, some development teams never involved designers at all. In those cases, unfortunately, the first look the designer had at the project was the exit review.

Projects were tracked in a system built on Drupal, an open-source content management system. [4] Projects were “Open” when active design work was ongoing, “Waiting for Exit Review” when the UI was code complete, back to “Open” if there were open issues resulting from the exit review, then “Closed” when the exit review was complete and no more design work was underway.

A primary designer was assigned to each project, and higher priority projects often had a second or third designer assisting.

Schedule

The review process started on some early projects in July of 2004, and then there was a brief lull as the remainder of the teams completed their user interface development. Reviews started up again around September of 2004. The bulk of the reviews were done between November of 2004 and May of 2005.

Reviews were scheduled after the user interfaces were deemed code complete by the development team. This was driven by the functional freeze date, which was June 2004 for early projects, November 30, 2004 for some of the projects, and January 30, 2004 for the remainder. Most reviews were completed before “showstopper” mode in May of 2005, when only critical bugs could be fixed.

Another schedule influencer was translation deadlines: the reviews needed to be completed well before the last delivery for translation from English to other languages, since many of the problems found related to terminology or other text on the screen. The final translation date was July of 2005; all reviews were completed before this deadline.

Time in Reviews

In addition to product readiness and release schedules, the review schedule was driven by the capacity of the EMUX team conducting the reviews. The time each review took was largely dependent on two factors: the design skill of the development team, and the amount

of influence by the designers during the design and development phases. High skill levels or high designer interaction led to reviews that could average about 10 pages per hour. The slowest reviews, often where the designers were seeing the project for the first time, or the development team had little skill in design, averaged about 3 pages per hour.

The overall average was not scientifically calculated, but a cursory evaluation by the designers led to agreement that it was about 5 pages per hour. If we had had to review all 3000 pages, that would have been about 600 hours of reviews. Given that the goal was to have at least 2 designers in each review meeting, that number would have doubled, to 1200 person-hours. In addition, each review was followed by a brief session for prioritizing the defects, and then some time in dealing with uploading page images and sending follow-up emails. With the design team engaged in other activities, this time commitment was just not feasible, so we adjusted our expectations.

First we narrowed the scope to just reviewing any new or changed pages. Then we used an algorithm to determine the amount of time spent reviewing any project, as follows:

- High priority projects (which hopefully had had a lot of design attention already): Up to 6 hours in reviews, but more could be negotiated if deemed necessary. Some high priority projects got 10-15 hours of review because they were particularly critical.
- Medium priority projects: No more than 4 hours in reviews.

- Low priority projects (which probably had had little design attention at this point): No more than 2 hours in reviews.

For the projects where we knew we wouldn't be able to review all pages, the development managers prioritized their pages using the following criteria:

- Pages that were particularly key to the success of the project
- Pages that were thought to be particularly difficult from a user experience point of view
- Pages that were similar to other pages, so the review input could be extrapolated by the development team to the other similar pages without us having to actually review those pages.

A total of 124 separate projects were reviewed, involving 1414 pages; 5817 defects were identified. (Unfortunately, statistics were not available regarding the actual time spent in reviews; we will be tracking this more closely in future releases.)

Bug Handling

After the initial development phase, all product defects, not just UI defects, were tracked using a bug database. This is a fairly standard approach in development [2,11]. Tracking of incoming rates were used to determine the health of the product as it approaches release. Fix rates and total net bugs were tracked closely as the product neared release; those numbers drove developers' work. In addition, outstanding bug counts were tracked against the severity of bugs, which are rated from P1 (customer unable to get their work

done with a released product) to P4 (minor defect; no effect on ability to complete a task).

Because of the importance of the bug database in driving development work, we requested management buy-in early on to be able to treat user experience defects the same as any other product defects. There was a lot of resistance from the development managers to doing this. Some of the arguments were based on the assumption that there would be a lot of bugs generated, and the development teams didn't want to deal with the overhead and reporting issues associated with more bugs. But underlying this was the basic belief that user experience bugs weren't as important as other product defects. It was only because the vice president of the department was a strong advocate, and recognized that unless the bugs got into the bug database they wouldn't be dealt with seriously, that we were able to prevail. Even when it was decided that we would use the bug database, there were arguments that perhaps we should only submit the highest priority bugs (P2 bugs, as described below, or maybe just P2 and P3). In the end we decided to submit all bugs. **This explicit support from a senior manager on the project was critical to our success in this area.**

In support of this, it was critical that we agree on the bug severity (prioritization), since higher priority bugs are handled in a more serious and rigorous manner.

Since, by definition, none of the projects being reviewed were released to customers, we only used P2-P4. We created a lengthy document that was widely circulated before the reviews started, listing many types of defects by severity. The designers used this as a reference in assigning severities to the defects after

each review. Having such a document, in addition to providing a shared understanding with the development teams, assured that we would have uniform policies for assigning severities.

Some examples of the defects, by severity:

P2 Bugs: Some Examples

- UI just didn't work, giving unpredictable or incorrect results, or losing data
- Major accessibility issues, including missing labels, non-standard abbreviations, using only color to distinguish UI elements, etc.
- Serious performance issues
- Most users would need assistance to complete the task
- Context completely lost during workflow
- Typos

P3 Bugs: Some Examples

- Many users would need assistance to complete the task
- Hard to understand concepts
- Incorrect page header or breadcrumbs, or other context-based confusion
- Grammatical errors
- Missing time zone in time display

P4 Bugs: Some Examples

- Layout issues that will help improve usability (including incorrect use of hint text, tips, etc.)
- Incorrect browser window title

- White space issues (too much/too little)
- Minor terminology improvements/corrections
- Incorrect capitalization

Bugs submitted, by priority, were as follows:

P2	580
P3	2410
P4	2827
TOTAL	5817

Two modifications to the bug process were made during the review period, based on specific requests from some development teams. First, we decided to allow a "grace period" if a development team wanted it. This was a time between when the review was held and when the bugs were actually submitted to the bug database. Development managers with many small bugs wanted this because they could use that time to fix bugs and not deal with the administrative overhead of so many bugs in the bug database; only bugs left open at the end of the grace period were submitted to the bug database. Grace periods were typically a week.

The second modification was to combine P4 bugs that were on the same page. Since many P4 bugs were cosmetic, such as small alignment defects, often it made sense for many of them on a page to be fixed at the same time. We therefore decided to combine all P4 bugs on a page into one bug in the bug database, recording the number of separate defects each represented so we could track that number.

Process Details

Early in the release cycle, we published guidelines for preparing for and conducting exit reviews. These provide an outline of the whole review process, summarized here:

Before Scheduling the Review

- State of the project: The user interface code was required to be complete.
- Pre-evaluation: The development team was required to complete the self-check list. (See Figure 1) This contained 14 separate "most common mistakes" which the team was asked to correct before the review, to save time.
- Pages: The development team provided a count of the pages to be reviewed, as discussed above. This was needed to determine the amount of time the designers could expect to spend on the review, and to determine a strategy for the review based on the time limitations described above.
- Text review: Every project was required to have all on-screen text reviewed by a technical writer. (That was the goal: due to lack of writer resources, it didn't always happen.) Although not required, it was requested that this review happen prior to the exit review, as it would save time in the review if we were not correcting grammar and spelling mistakes.

Scheduling the Review

- Length of the meeting: Most of the review meetings were 2 hours, although some were shorter for smaller projects. A few went longer, but we found that after 2 hours everyone was tired and the meeting wasn't as effective. If additional time was needed, additional meetings were scheduled.
- Who should attend: Obviously the primary designer assigned to the project attended and ran the meeting. For high priority projects we tried to have at least one other designer also attend, since the literature supports the fact that problems will go undetected with too few reviewers. [8] Only the primary designer attended reviews for low priority projects. (The only exception to this was when new designers joined the team; they often attended review sessions as a training exercise.) At the very least, the primary developer(s) for a project attended, and hopefully other developers and perhaps the development manager. Other recommended attendees were the technical writer and the product manager.

The Review Meeting

- Running product: The development team was responsible for having the product up and running.
- Evaluation Process: Reviews were done in interactive meetings, with everyone looking at the working product and commenting. We walked through every page, top-to-bottom, and all drill-downs. Everyone spoke as they saw issues. The majority of comments came from the designers, but others also contributed. In order to avoid

needing follow-up meetings, usually specific solutions to defects were generated right in the meeting if this could be done without taking too much time from the review; any defects identified without clear solutions were noted as "issues", dealt with after the meeting, and submitted as bugs later. (Projects remained Open in Drupal until these issues were resolved.) Each entry was recorded in a separate line in a table in the review notes. A designer captured the issues (See Figure 2), freeing the development team to concentrate on the actual defects and solutions.

The evaluation criteria used in the reviews came from the following sources:

- Oracle's Browser Look-and-Feel (BLAF) guidelines [1]
- Enterprise Manager Style Guide (EMSG)
- Established UI heuristics, such as general understandability, use of jargon, intuitive flow, etc.. Many well known techniques were applied. [3,6,7,9,10]
- Product knowledge about the usefulness and understandability of the project's system model.
- Prioritization: At the end of the meeting, the designers who participated in the review prioritized all of the defects. We found it was important not to wait too long after the meeting to do this because it was easy to forget exactly what the issue was. The development team was instructed not to change the priorities without first consulting with

the designer. The count of defects by priority was recorded in the review notes.

- Screen captures: We captured images of the pages as each visited in the review. The image files were linked to from the review notes, so each defect or other entry had an image accompanying it. This was found to be critical in going back later and analyzing or discussing the entry.
- Page Counting: There were some issues with page counting. For example:
 - If choosing a different radio button in a group caused part of the page below it to change, is this one page or multiple pages? We generally chose to count this as one page.
 - If one logical page has subtabs separating parts of the page (see Figure 4), is this one page or multiple pages? We generally chose to count those as multiple pages.
 - Do separate confirmation pages (see Figure 5) and progress pages (see Figure 6) count as a separate page? We decided yes.
 - Some defects were found on many pages in a project. For example, if a team generally used the wrong time format on one of their pages, they often used the wrong time format on all pages. We would recognize this and mark the page on which the defect was found as "All", assuming it was really one bug that would be fixed across the pages rather than submitting separate bugs for this defect on each page.

After the Review

- Bug submittal: All bugs were submitted with special coding to identify them as bugs found in an exit review. The primary designer assigned to the project was identified in the bug as the person to contact with any questions about the bug.
- Managing the bugs: As with any other bugs, the development team was responsible for closing bugs when they were fixed. The QA department verified all fixed bugs of any kind.
- Dealing with issues: As described above, sometimes there were unresolved issues in the review meeting. The project was kept in the Open status in Drupal until these were resolved. If the resolution was that there was a new bug to be submitted, the designer submitted the bug.
- Finishing incomplete reviews: Based on the above criteria, it was possible that a designer would not review some pages in a project. In this case, it was strongly recommended that the development team continue independently with reviews in the same fashion, using each other and product managers, quality assurance (QA) engineers, and technical writers as additional sets of eyes. While this might not have found the same number of issues as if there had been a designer present, it was likely to find issues that might not otherwise have been discovered.
- Text review: If a technical writer hadn't yet reviewed the text, it was recommended that this be done as soon as possible.

The design team was responsible for getting the bugs submitted. Unfortunately this was a manual process, so we hired a data-entry contractor to do the work. During the peak of the reviews this often resulted in a backlog, and of course there were some errors in data entry because human beings are not infallible.

Tracking Status

In order to encourage and evaluate progress towards getting bugs fixed, we agreed on "exit criteria", the limits set for bug counts with which we would ship the product, based on the number of pages:

- No more than 1 P2 bug per 5 pages
- No more than 1 P3 bug per 2 pages

For this release there was no P4 bug limit. This was initially done because before we started combining P4 bugs on each page, there was no way to do this count in any automated fashion, and doing it manually was not an option. Since then we found a way to track the numbers automatically, so P4 bug limits will probably be added in a future release. It is expected that the criteria will limit P4 bugs to 8 or 10 per page; the exact number has yet to be determined.

Given the expectation of meeting these bug limits, this would result in no more than $1414/5=282$ P2 bugs and $1414/2=707$ P3 bugs remaining at release time. This means that at least $(580-282)+(2410-707)=2001$ bugs can be expected to be fixed. In fact the numbers will undoubtedly be much higher because a large number of P4 bugs could also be fixed because they are generally easy.

Reporting on progress is done using a scorecard, one per project area. (See Figure 3) The scorecard contents were generated automatically from the bug database. (A small user-centered design process was spawned for the scorecards, tailoring them exactly to the needs of the intended audience, senior managers.)

Lessons Learned

The following observations were found regarding these reviews:

Positives

- There is general agreement in the organization that the reviews resulted in significant improvements in the quality of the user interface.
- The scorecards were presented to vice presidents in the development organization at release status meetings, adding legitimacy to user experience being an integral part of release quality decisions.
- Although the design team produced the scorecards, the release management team eventually took over "enforcement", pushing teams to turn their yellow and red bubbles to green. This "mainstreaming" of the reviews resulting in significantly more user experience bugs being fixed.
- Having the reviews be interactive meetings helped the design team learn more about the product and the motivation behind many of the development team's design decisions. It also provided an opportunity for the development team to learn about good UI design principles directly from the designers. Additionally, having an interactive discussion versus long e-mail trails for answering

questions was much more efficient. (In previous releases the reviews had been less interactive and we saw this phenomenon, prompting the change for this release.)

- Development managers at Oracle have significant control over their product content and priorities. As such, giving them discretion over which pages should be reviewed and in what order improved their buy-in to the process.
- Having a small number of designers see a large number of pages helped the design team acquire broader knowledge about the product.
- Sometimes, in addition to the primary designer assigned to a project, a designer would join a review meeting who had not seen the project before. This actually turned out to work well because this designer could provide a fresh look at the interface, providing a different and often beneficial perspective.

Issues

- Although there was no objective data collected to support this, it was generally agreed amongst the designers that when either designers had early involvement with development teams, and/or development teams had significant expertise in the area of user experience, reviews were more efficient, sometimes covering as much as two or three times as much material in the same amount of time as reviews of other projects. In addition, the severity of the defects found seemed to be lower overall.

- The best reviews, in terms of depth and breadth of feedback, came from designers who were familiar with the project. Some development managers didn't involve designers early on in the project so no designer had product knowledge before the exit review. In addition, there was some design personnel turnover during the release, so sometimes designers who did exit reviews were not the designers who worked with the team early on in the release. This led to fewer issues being found, and those issues being more cosmetic than structural.
- Having the bug submitting and reporting process be primarily manual was very high cost and error-prone. Work is underway to develop a tool for exit reviews, which would automatically submit and track bugs from the reviews.

The following future process improvements were recommended as a result of this process:

- Create an automated tool for entering defects and submitting bugs, as described above.
- Better tracking of the correlation between early designer involvement and development team design expertise versus exit review results.
- Better tracking of "coverage" numbers: what percentage of each project area was actually reviewed?
- Better tracking of total time spent in reviews.
- Institute and track exit criteria for P4 bugs.

- More early intervention by designers.
- More user experience training within development teams.

Conclusion

The exit review process proved to be a valuable part of the overall user experience design process used for Enterprise Manager 10g release 2. It supplemented having designers work with the development teams early in the design process, as well as the small amount of formative and evaluative usability testing done on the project.

This process appears to be especially useful if it is generally agreed that there have been insufficient resources applied during the design and development process. There is no substitute for early intervention, but when faced with a situation where it has been lacking, this process can help assure the product doesn't ship with significant usability problems.

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Illustrations

Self-Checklist for UI Exit Review


Last Updated: March 22, 2005

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General Description

Use this checklist to verify your application's UI compliance with the [BLAF guidelines](#) and this style guide. Once you are confident that your product is reasonably within the guidelines, contact the EMUX team to set up a review. (ID is based on vertical order of page layout)

Interaction and Usage Specifications



ID	Checkpoint	Description	Visual Example
1	Window Title	The window title should contain the text that's in the page header in addition to the application name and login name. ie, Oracle Enterprise Manager (login name) - Page Header - Browser Name	Window Title
2	Breadcrumbs	Each time you drill down, add a level to the breadcrumbs. Each one should exactly match the page heading of that page. The last item should be the heading of the page you're currently looking at. (Note that starting in UIX 2.2.7, the last breadcrumb element will not be displayed.)	Breadcrumbs
3	Message box	<p>Message Box appears between the breadcrumb and the page header.</p> <p>If you wrap the <uix:messageBox> tag inside a <uix:messages> tag, it doesn't matter where you define your messageBox tags in your jsp. They'll always show up at the very top of the page, where they're supposed to. "</p> <p>Message box title should always be Confirmation, Information, Warning, or Error, and should contain the appropriate icon.</p>	Error
4	Page Heading	In most cases, the name of the link from the previous page should exactly match the title of the page.	Page Heading
5	Page-level Buttons	Use Cancel and OK to permanently accept changes and then navigating off the page (back to the calling page); use Revert and Apply to accept changes but stay on the page. In EM we rarely use Revert and Apply.	OK vs Apply

Figure 1: Excerpt from Self-Check List

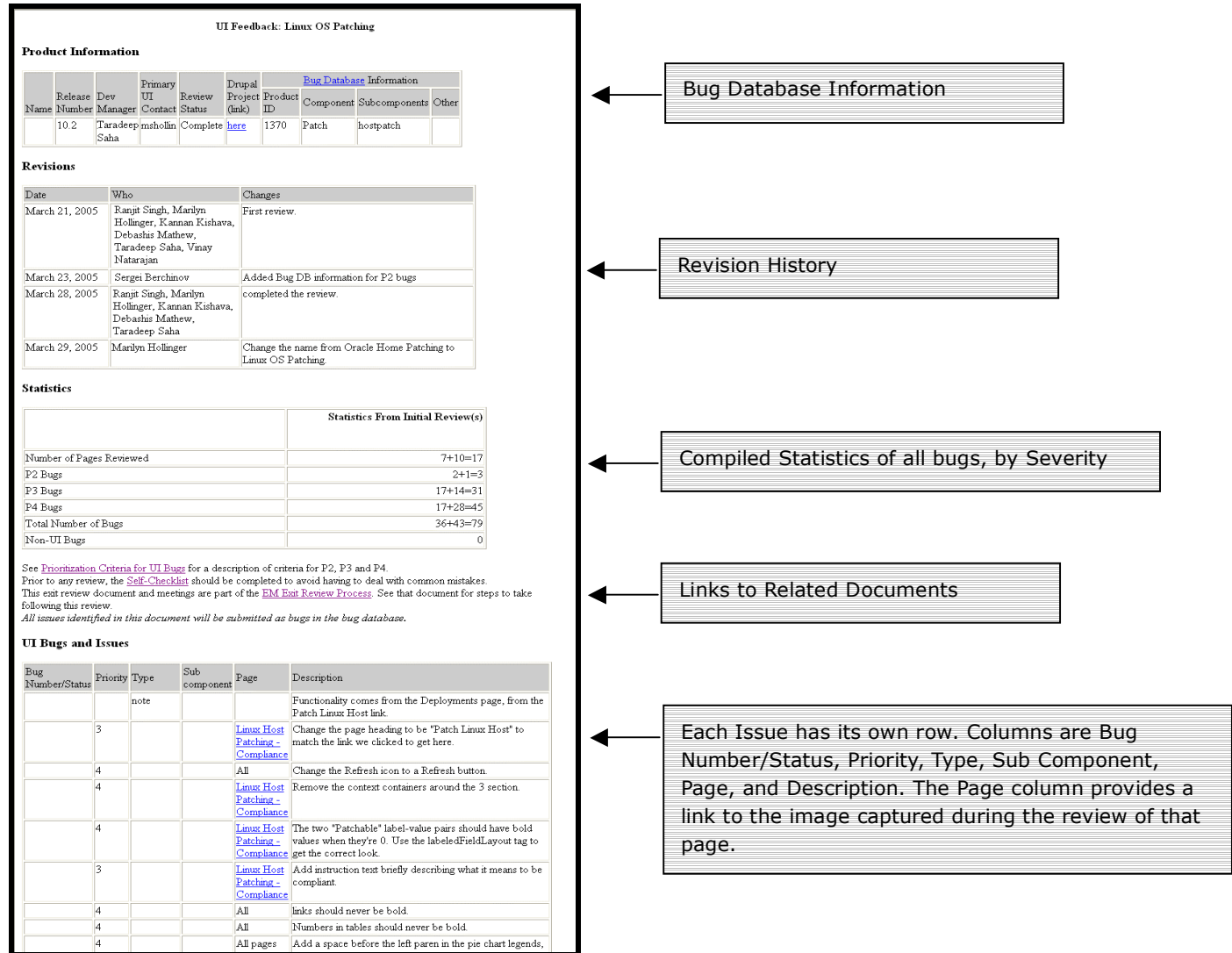









Figure 2: Sample Exit Review Notes

ORACLE Enterprise Manager 10g
Grid Control

[Contact](#)

UI Review Scorecard

For a description of icons used, go to [icon legend](#)

Group	Component/ Feature	Live UI Exit Review	Target Release	Comments	Pages Reviewed	#P2 Bugs/ Page	#P3 Bugs/ Page
GridControl	System Dashboard	 1/17/2005	EM10gR2	Completed	7	0.14	0
GridControl	Service Levels	 2/1/2005	EM10gR2	Completed	3	0	0.33
GridControl	EM Patching (Critical Patch Facility)	 5/2/2005	EM10gR2	Complete	6	0.16	0.33
GridControl	GridControl Plug-in for Oracle Applications	 9/9/2005	EM10gR2	Completed	5	0.8	3.4
GridControl	OAM EM integration & Install	 8/24/2004	EM10gR2	Completed	11	0.09	0
GridControl	CSA	 12/3/2004	EM10gR2	Comple			0.5
GridControl	ASLM Detail & Analyze	 12/16/2004	EM10gR2	Completed	11	0.09	0.18

This bubble is red

This bubble is yellow

Figure 3: Sample Scorecard

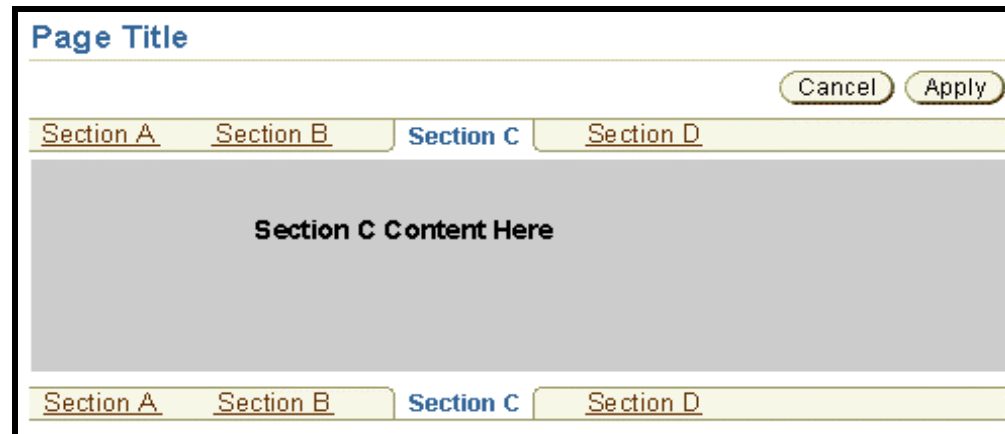


Figure 4: Page Containing Subtabs

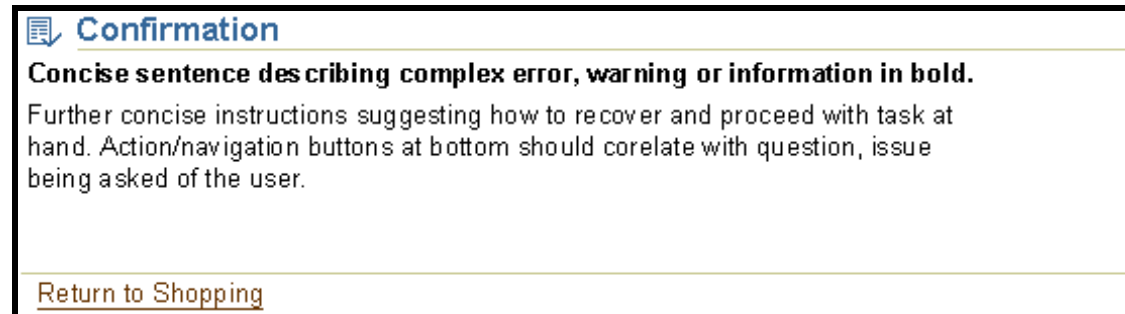




Figure 5: Confirmation Page

 **Processing: [Name of Process]**

Concise sentence describing processing here. Cancel

Further concise information about the processing occurring during the download. Bla, bla, bla, bla, bla, bla, bla, bla, bla, bla, bla, bla, bla, bla, bla. Bla, bla, bla, bla, bla, bla, bla, bla, bla, bla, bla, bla, bla, bla, bla



5 of 10 files searched.

Figure 6: Processing Page