HCI NASA Group
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Appendix E
Requirements Evolution

All Iterations of PROPHET Requirements Back to Back

First Iteration of Requirements – March 8, 2007

As we completed our contextual models, we began to tentatively address and list certain design insights and constraints to inform our later process. What follows are a selection of general, nascent ideas gathered from our contextual modeling phase that became the basis for our design and prototyping process.

Durability

The system we recommend must be extremely durable to withstand the physical environment of NASA's construction floors. If the system is portable, such as a handheld or wearable device, it must be able to fall from a height of ten feet without breaking into small pieces. This is because even a small piece, if lodged or hidden within a spacecraft, can become lethal at low gravity.

Through our research, we came across small and handheld devices that can withstand drops and throws. The best example of this was the Symbol handheld device used at UPS. This button-entry device is made of hardened, reinforced plastic and can withstand rough usage.

The challenge of durability exists primarily for portable systems. Wall-mounted and sedentary systems do not need to withstand significant drop tests - it is sufficient that these have no small parts which can break off.

Dark and Confined Spaces

Our system must allow for easy reading and data entry, even in dark and confined spaces. Ground technicians often must crawl into awkward spaces to diagnose problem reports, and if the system is portable it must be just as usable at these times. Backlit screens and glowing buttons could be possible solutions for this.

Difficult and Limited Connectivity

Earlier in the project, our team had considered that using a wireless network could allow handheld devices to use wifi to send and receive data. However, after visiting Kennedy Space Center, it seems that if our system uses wifi it could only be for limited functionality. This is because the space centers are not currently equipped with wifi, partially for security concerns. Also, if a mobile device was dependent on wifi, it would not work outside of construction facilities, for instance at launch sites. Therefore, we must find a crucial balance between multiple redundant measures to provide extra connectivity in various areas.

Enhanced Running Addendum

Often problems arise in the manufacture of spacecraft which are not determined a serious enough problem to delay a launch. However, if this same problem occurs and is ignored on and after launch, it could be indicative of a more serious problem. An example of this was the Space Shuttle Columbia, which exploded due to damage caused to its foam insulation during launch.

For this reason, it could be an important feature of our system to notify when a problem has been unresolved or continues to appear and has not been corrected. This can be used to strengthen the effect of the Running Addendum on the problem reporting process by making it ever harder for a problem to go unaddressed and overlooked.

Photos

During our contextual inquiry stage, we often found that attaching a photo to a problem report can be vital to diagnosing and fixing the problem. Especially when the problem is something small, such as a crack, in a large item such as a rocket, it can be hard to simply describe in words where the problem is located. Several groups at NASA already use photos in problem reporting, and we think this could be a useful addition to our system. A common problem with photos used in problem reporting is that it can be hard to show scale - we hope to address this in our system. Because it may be awkward to integrate a camera directly into the device, allowing the device to easily connect with common existing digital cameras is a possibility.

Typographical Errors

We want our system to prevent typographical errors in problem reporting as much as possible. Typos can both make problem reports incomprehensible and can prevent an appropriate keyword from finding relevant reports. Systems such as predictive text and selection rather than free-entry are possibilities in preventing typos. Because typographical errors are a widely recognized problem at NASA, especially in any sort of serial or part number, finding a way to address them is essential to improving the problem-reporting workflow.

Reliability and Redundancy

A major reason “technology pushers” have a bad reputation at NASA (as we learned in our CIs) is not just simple resistance to new ideas, but because their technology as every bit as suspicious as the technicians consider it, and may threaten the quality of their work. Our design must, wherever possible, integrate itself into the existing workflow of the technicians in such a way that their original system is not only still present, but visibly improved. This will provide extra redundancy as well as satisfy the concerns of the technicians. The older system can then be phased out at the techs’ own discretion.

Second Iteration of Requirements – May 12, 2007

After this round of prototyping, we decided to re-address the idea of what sorts of features our device should have, and sent our rough draft requirements through another round of iteration. We did this to make sure that we stayed on focus and did not get out of scope as we began to iterate designs. Requirements in parentheses indicate ones that are not decided upon and/or still need more data.

Durability/Tetherability

Shattered pieces of equipment or dropped items can cause a huge safety hazard. Our device must be very hard to break, and not have loose parts that could be dropped in a

work place. It may be necessary to make the device hard to drop (eg attached to the wrist), but at the very least it should be very durable.

(Dark Spaces)

This requirement is still pending sufficient data, but it may be the case that techs need to use the device in dark spaces. This would require the device to have certain features, such as possibly a light, or a well-lit screen.

Confined Spaces

The device cannot be bulky. It must be small, maneuverable, and allow the user to continue to work on a WAD with as few interruptions for the device as possible. Additionally, the device must support confined finger/stylus motions so that it can be used in a combined space.

Sterile spaces

Our device cannot cause problems with sterile spaces. This means that if it is dropped or otherwise broken, that it will not cause small pieces to end up in the work area. Additionally, the device cannot build up dust, hair, or other small particles.

Difficult or limited connectivity

WiFi is not used on the tech floor, according to CI data. Our device cannot rely on such technology for device-to-device communication or tech-to-engineer communication. We also cannot rely on use of the internet.

Integration

It is not our goal to significantly change the work flow. We believe that too big a shift in work flow will have deleterious effects on user acceptance. As such, we want to build a device that takes what the user already knows to do and simply makes it easier or faster.

Photos

CI data showed that techs use photos and notes to make problem reports easier to understand for quality and engineers. It also showed that the cameras that are currently provided are too bulky and have many unused functions. Users indicated that they would prefer smaller digital cameras, like those sold commercially to the average consumer. Any photo functionality included on the device must be of appropriately high resolution, balanced with a manageable file size for quick transfer between users.

(Video and Audio Media)

There is no evidence that technicians presently use video to clarify PRs, but there is evidence that they call engineers and leave voice mails. This leads us to believe that audio notation may be an interesting direction to go in. However, we would like to get more data before making this a requirement.

Facilitate Searchability

The device should, to the extent possible, constantly update a searchable database of WADs and/or PRs and annotations. Slowly phasing out inconsistent work flows and paper systems is part of our goal, and doing this in a way that allows documents to be searched for easy reference is ideal.

Increased Satisfaction of Techs

The final prototype needs to be something that most technicians will want to use and continue to use. It has to sell itself well, be easy to integrate into the current workflow, and continue to be useful to both novice and experienced technicians. It should be noted that satisfaction of secondary users, such as supervisors or engineers, is a secondary goal to increasing efficiency in the technician work flow.

Increased Accuracy

A problem that came up often in the models had to do with consistency and accuracy in text entry. These problems ranged from mistakes as simple as typos to incorrectly entering part numbers and naming the same part two different things on two different reports. It is an important requirement of our system that it force the user to enter data consistently and accurately as much as possible to resolve these issues.

Increased Efficiency for Techs

The device must demonstrably affect technician workflow in a positive way. That is, there should be a measurable difference in time spent on task and saved as a result of using our device.

Battery Life

The device needs to be able to last as long as an engineer's shift (on average 8 hours), and should be able to be used at all times it is not docked.

Reasonable Cost

The system must not be expensive enough to implement such that the cost outweighs the savings in efficiency and safety.

Feasible Technology

The design should be able to be implemented with existing, modern technology, or at the least technology that is likely to be available in the next year or so.

Third Iteration & Refinements – June 5 & July 5, 2007

The next section is dedicated to our most major iteration of requirements, in which a wide variety of different needs were addressed. The requirements were slightly reinterpreted after our first round of user testing, in which we decided to scrap several requirements and prioritized demonstration of the others. The majority of the document was created for the third iteration; the decisions of the refinement process are displayed in the rightmost column. If this column is blank, no reinterpretation of the third iteration was made.

Req #	Req Name	Req Description	Req Category	Sev	StDev	Priority	Justification	Tradeoffs, Workarounds, & Criticality Notes	Refinements
1	Inline user Notes	The problem reporting form should allow for inline user notes.	annotation	1		High	PRACA requirement	Easy to implement, part of PRACA requirements, supports annotation model	Implement
2	Informal Notes	Problem reports will allow for the user to enter informal notes in the PR for co-workers to read or as a personal memos.	annotation			High	PRACA requirement	PRACA requirement	Implement
3	WAD Annotation	WADs should be annotatable on the device. These annotations do not permanently change the WAD, only on the individual device for an individual user. Annotations by different users will be different to show who annotated what. Annotations can be shared or hidden.	annotation			Optional (For NASA)	Similar behavior observed at KSC	Outside of scope of summer project.	Out of scope
4	Automatic Information	The device will need to auto-fill certain PR fields that are obvious to the system and a waste of the user's time to enter. These include the date and time, location, the owner of the report, and any other information the system does not need user input for.	autofill	2	1.225	High	Time-consuming lack of autofill observed in BNS	Easy to implement, saves time	Fake; must be consistent with user test script
5	Check for Redundant Reports	If a report appears to be redundant, the system will allow the user to see the redundant report and decide if there are different. Probably will be handled by the PRACA.	autofill	3.2	1.643	Low	Repeat reports in OPF, Arcjet repeats	Difficult to implement, not entirely useful. PRACA system will likely handle this.	Recommend
6	Repeat Report Recognition	The system should notice when a user is filling in a report that is similar to an old one and allow the option of auto-filling data fields. It will do this, for example, when a part number and a title are the same.	autofill	2.8	1.483	Medium	Repeat reports in OPF	Saves a lot of time and allows all-in-one submission in situ with device. Implementation could be difficult. Could make use of predictive search.	Recommend
7	Auto-fill	WAP should automatically fill in location information on PR	autofill	1.6	0.548	High	Saves time	Easy to implement	

8	Date and Time	Device should keep track of Date and Time and auto-fill into PR	autofill	1.6	0.548	High	Save time by auto-filling fields	Easy to implement	Implement
9	Time Zone	The system will display the current time zone next to the date and time	autofill			High	NASA bases in multiple time zones	Easy to implement	Implement
10	Base station	The device should dock into a base station where a tech can decide to finish or edit a problem report	base	1	0	Critical	Text entry is much easier on a desktop/laptop/tablet than it is on a handheld; fits current KSC workflow	This means that software will have to be written or at least mocked up for the base station.	On the table, if infeasible fake it
11	Auto-sync with Base	When the device is plugged into the base station, all unsubmitted problem reports will be pulled up onto the screen. This will make for a seamless transition between mobile and docked usage, and prevent the user from forgetting a report that they did not finish.	base	1.3	0.5	Critical	OPF technicians lose or misfile data upon returning with camera containing digital photos to desktop environment to file problem reports	Using the server, reasonably easy to implement	Recommend
12	Choice of place of submission	A problem report can be originated, entered, and submitted on either the device or the docking station	base	1.8	1.304	Critical	If it is an easy submission, it can be done right from the soutce of the problem, saving a walk and therefore time.	We'd need to go through the details of how it's submitted on the device. Will we have to mock up the PRACA system to make the desktop app?	Recommend
13	Desktop or Web App	An application needs to be developed that runs on a computer to interface with the device	base	2.4	1.949	Critical	Required for seamless transition from handheld to desktop	Will we have to mock up PRACA for this?	Recommend
14	Cell Capacity	The device needs two-way communiation capability. This includes but is not limited to cell phone capability.	comm	2.8	2.049	High	Engineers had trouble finding techs; technicians may need to communicate while at the site of a problem to be fixed	Easy to WoZ or implement on something that's already a phone	Recommend

15	Messaging	The device will be able to send a message to a specific person, in the form of text, picture, and incomplete PR, or other media.	comm	2.6	1.342	High	Informal problem reports in the form of memos, pictures, voice recordings, etc	Easy to WoZ or implement on something that's already a phone	Fake for testing, then implement
16	Email PRs	PRs should be able to be forwarded, replied to, like an email. It may be sent in a message as an attachment	comm	2.8	1.643	Medium	Multiple people may see and edit a problem report before it becomes formally submitted; senior techs tutor junior on problems	WoZ	Fake for testing, then implement
17	Headset/Headphones	The device should have an optional headset or headphones for hands free talking and easier use in loud environments	comm	4	0.707	Low	Allows technicians to talk while using two hands to fix a problem, or allows them to talk while looking at a document on the screen; needs validation		
18	Engineer feedback	The device should support engineers giving feedback to technicians on problem reports to prevent inconsequential reports	comm	2.8	1.708	Low	Engineers frequently annoyed and disrupted by inconsequential and superficial problem reports	Easy workaround using cell phone capabilities. Specially adding engineer feedback might not be necessary	
19	Grouped Data Elements	Data elements shall be grouped conceptually.	data elements			Critical	PRACA requirement, interface design principle	Easy to do, and essential for smooth data entry.	Implement
20	Other Option	Selection lists should have an other option. When selected, this option brings up a small text box for further explanation.	data elements			Critical	PRACA requirement	PRACA requirement, easy to implement	Implement
21	Multiple Instances of a Data Element	The interface must have an "Add" button that allows the reporter to add multiple instances of a single data element.	data elements			High	PRACA requirement	PRACA requirement, easy to implement, however screen real estate may quickly become an issue	Implement

22	Basic Text Formatting	Within free text fields, user should have the option to use basic text formatting (E.g., italics, underline, bold, etc)	data elements			Low	PRACA Requirement	PRs can get done without it.	Scrapped
23	Invalid Input	If a free text field or some other widget somehow allows invalid input, notify the user right away of which field is invalid.	data elements			Critical	Visibility of system status heuristic	Accuracy is essential, this is easy to implement	Recommend
24	On-Site Information Gathering	The device should encourage the user to gather as much data as possible in situ	efficiency	2.2	0.837	Medium	Common problem observed at airport is rapid mental loss of data on way to base station	Non-functional	
25	Constraint Propogation	Narrow down the possiblities of all remaining fields based on which fields have already been entered.	efficiency	1.8	0.837	High	Constraining field entry reduces errors and reduces time to select the correct option	Increases accuracy, saves time, constraint propogation not particularly difficult to implement	Fake
26	Incomplete Search	Allow for search of incomplete part #'s, including wild cards.	efficiency	3	1.414	Medium	Minimizes text entry, saving time; PRACA requirement	Somewhat difficult to implement on a large data set	Simulate
27	Efficiency	Problem reporting should be faster with the device than without the device	efficiency	1.8	1.304	Critical	Cost/Benefit, usability goal		
28	Engineer PR	Engineers can originate a problem report from their computer that can be retrieved on the device. Part of PRACA.	engineers	2.4	1.949	High	Observed KSC engineers reporting problems. Assumption is that the reports were filed from their desktops.	Bounce to server, pick up on device. Will be hard or impossible to push it to the device, however.	
29	Communication with Engineers and Quality	Information from the device should be able to be directly sent to the screens of engineers and quality to reduce lag	engineers	2.6	1.14	High	Models showed breakdowns where there was considerable lag between floor workers and engineers.	Easy to implement via server	

30	Alternate Versions	A version of the device application should be built for the blackberry, so that engineers who own one may use the application on their own mobile device	engineers	###	#####	Optional	Engineers may not want to carry the device. Additionally, a version for blackberries that they already have will prevent NASA from having to purchase extra devices	Depending on outcome of Dryden project and possibly for NASA down the road	Fake; slideshow on an iPhone
31	Desktop buyoff	Engineers can buy off on PRs made on the device from their desktop. Part of PRACA	engineers	1.2	0.447	High	Current engineer workflow is to read problem reports at their desk; part of PRACA	Get PRs via server, use PRACA interface to sign off on it	
32	Image recognition	The device should use camera input to confirm text input (e.g., part #'s, etc)	error reduction	3.3	1.528	Optional	Error reduction	Very difficult to implement, out of scope for summer project.	
33	Error rate	The device should reduce the number and severity of errors in problem reporting	error reduction	1.8	1.095	Critical	Typographical errors are a widely known and reviled problem at NASA	Non-functional	
34	Standardization of Fields	Menus instead of text entry where available, required fields, to reduce ambiguity in problem reports	error reduction	###	#####	Critical	Reduce errors and ambiguity	Interface elements	
35	Rich Media	The device should be able to capture rich media in situ to give context and clarification to a problem report	media	2.2	2.168	Critical	Vague problem reports requiring engineers to come to floor are an observed problem; current practice at NASA, airport		On the table until feasibility checked
36	Field Associated Attachments	Every attachment should be associated with a field, there should no longer be general attachments.	media	3	0	High	Vague picture attachments are an observed problem	Almost all will default to the description field.	Scrapped

37	Commented Attachments	Attachments must have comments associated with them as well for clarity.	media	3	1.414	Medium	Vague picture attachments are an observed problem	Will be easy to do, but not particularly urgent because the PR should be loaded with comments. This may not even be necessary	Implement
38	Recordings shareable	All recordings must be able to be shared soon after they are made	media	3.4	1.673		Makes problem resolution faster by getting information where it needs to go faster		On the table
39	John Madden	Voice recordings should be able to be recorded over a photograph with simultaneous stylus input	media	4.8	0.5	Optional	Helps for clarity in annotation	Very difficult to implement, out of scope for summer project. For NASA after summer	Recommend to be researched
40	Sound Recordings	The device should be able to take voice recordings	media	2.8	1.304	High	Faster than text entry. Techs may use for quick reminders to themselves for when they finalize and submit the report later	Should be implementable, supported in data	On the table
41	Videos	Device should be able to create videos	media	2.4	0.894	Low	Tech can use to show to someone else for clarity	Not supported in data	On the table
42	Photograph Scale	Photographs taken by the device need to show scale. It should be clear right away how large elements of the picture are.	media	2.2	1.304	Critical	Engineers sometimes have to leave their desks to check on problems because they are unable to discern the size of a crack or other damage	Highly supported in data, could be hard to implement however	On the table
43	Camera Flexibility	Camera should be able to fit into small, dark, awkward spaces	media	1.6	0.548	High	Problems may be in small, dark, awkward spaces	May or may not be possible	

44	Image Resolution	The camera needs to be moderate to high resolution (Both in terms of pixel resolution and lens quality)	media	###	#####	Critical	Pictures must be at least high-resolution enough to be useful. Blurry images will waste storage space without sufficient benefit to justify	Must be at least good enough to be useful	
45	Flash	Camera must have a flash	media	1.6	0.894	Critical	Some areas in which techs will be working will be dark.	Must be at least good enough to be useful	Recommend
46	PRs unecessary for photography	An image can be taken even if a new problem report is not open	media	1.8	0.5	Medium	The photograph could be used to open a report later, or could be sent to a coworker as an informal report.	The PR application may be the only thing on the device	
47	Text Captioning	The device should allow technicians to instantly caption phots at the time of creation to avoid forgetting	media	2	1	High	Vague picture attachments are an observed problem	Not difficult to develop, will prevent forgetting	Implement
48	Attachment Default Field	If not specifically attached to a field, an attachment will default to the description field	media	2.5	1.732	High	Vague picture attachments are an observed problem	A default is necessary here	Scrapped (in association with requirement #36)
49	Photograph Annotation	User should be able to annotate photographs on the device directly	media	2.8	0.837	High	Vague picture attachments are an observed problem	Assuming we can get to a stylus API, is possible to implement, highly supported by data	Recommend
50	Collaboration in Problem Reports	The device should allow for screen sharing between users for collaboration on problem reports. Part of PRACA.	misc	4	1.732	Optional	PRACA requirement	PRACA requirement, so we don't really have to worry about implementing it	Recommend to be researched
51	Drafting	PR can be saved as a draft or complete before being actually submitted, but only on the device.	misc	###	#####	Medium	Problem reports go through multiple iterations/edits before being submitted	May not be necessary if we're sending it to the server right away. Might be helpful for network outages	

52	Stylus Text Entry	The device should recognize stylus text entry	misc	4	1.826	Low	Alternative to qwerty and t9	Other options for text entry exist, and this may be quite difficult to develop	
53	Management Using the Device	Managers should be able to use the device, not just technicians, engineers, and quality employees	misc	2.5	1.732	Medium	Managers expect access to entire site; as at KSC	They have a log-in, so they should be able to use it easily	
54	Log-in	There should be some way to log in with a password for the device. One team member logging in logs in all PRESENT members of his/her entire team	log-in	1	0	Critical	Allows engineers to know which tech is on which team working on which project, and which ones are in that day for contact reasons. Additionally, logging in allows the device to store who is using the device and auto-fill fields	Makes tech finding possible. We can make it interface with a quick and dirty shift schedule pretty easily as well	Fake
55	PRs Online	All PRs should be online as soon as they are submitted. Part of PRACA.	misc	1.6	0.548	Critical	If they are online ASAP, techs working on related WADs can be notified of reports or updates that may affect their work	part of PRACA	
56	PRACA Consistency	To a reasonable extent, the screens of the device interface should look similar to the screens of the current PRACA interface	misc	2.2	1.304	Medium	Consistency and Standards heuristic	Should not be too difficult, and we should not limit interaction to it. However, submission should have a look and feel similar to that on the console	
57	One device per team	The device will be given to one member of each team, and should be designed to reflect this	log-in	2	1.414	Critical			
58	Benefit Analysis	The device should provide a benefit in time, money, convenience, and/or safety that meets or exceeds the cost of implementing it	misc	1	0	Critical	NASA should not lose money or efficiency by implementing our device		

59	NASA-wide deployment	The device should be designed such that it can be deployed to any and all NASA facilities and be useful at all of them	misc	1.4	0.894	Critical	Project scope		
60	Warn of Loss of Info	If user has not committed changes and tries to leave the application, the system should warn him or her that he/she has unsaved information they may lose.	misc			High		Should be pretty easy and not used unless there is no connectivity, Must check for connectivity and check to see if all data has been saved	
61	Undo/Redo	Allow for undo and redo of actions in filling out a report	misc			High		Necessary for error prevention. Probably won't have to deal with it, and is a PRACA requirement	
62	System Status Notification	Any process that takes longer than 5 seconds must update the user with a status display	misc			High			
63	Notification of changing data elements	The system notifies users of when a data element in a problem report they are actively working on is changed. This notification should be displayed on the handheld.	notification data elements			High		Just keep track of when the form itself is edited	Recommend to be researched
64	Feasible	The device should be able to be built using current technology	physical	1.8	1.095	Critical	Project scope		
65	Reasonable Cost	Device should be built using materials that will allow it to be produced at a reasonable cost	physical	1.6	0.548	Critical	It is more likely to be implemented if it is easier/cheaper to implement		
66	Available Form Factor	The device should be built on a platform that is not too hard to find	physical	1.8	0.837	Critical	It is more likely to be implemented if it is easier/cheaper to implement		

67	Look and feel	The device should look and feel industrial. It should not be a flashy consumer product.	physical	2	0.707	High	NASA cultural restrictions preclude non-utilitarian "feel" to tools		
68	Hardening	Device should be drop tested and hardened for durability	physical	1	0	Critical	NASA requirements forbid fragmentation; tools on workfloor will be battered		
69	Tethering	Device should be tethered or holstered to prevent dropping **and provide freedom of both hands**	physical	2.4	1.14	High	The technician may want to work on something with both hands without putting down the device or passing it to someone else. Additionally, if the device is not sufficiently hardened, it is a requirement that it at least be tethered to prevent dropping and breaking.		
70	Screen Backlighting	The screen must be backlit for awkward spaces in a cavity	physical	2.2	1.304	High	Technicians may be in tight, dark spaces and backlighting the screen makes it possible to use in those situations		
71	Non-glare screen	Screen should be designed so as to reduce glare on bright days	physical	2.2	0.837	High	During a launch, there may be considerable glare off of a reflective screen, making use more difficult		

72	Dealing with gloves	Form factor must be able to be manipulated while wearing light gloves such as those worn by some technicians	physical	1.6	1.342	High	Work-gloves are used in heavy mechanical work; plastic gloves are used in light clean-room work		
73	Battery Life	The battery should be able to last a 12-hour shift without replacement, and be replaceable by a backup if a shift for some reason extends beyond that timeframe	physical	1.2	0.447	Critical	Disruption during shift to replace device will lower efficiency, cause annoyance. Additionally, the battery running out during a shift could also cause data loss, which in some cases means a lot of wasted time.		Recommend
74	Stylus	The device should be able to take stylus input	physical	2.3	0.957	Medium	Supports annotation	Tasks will be designed such that stylus input is not necessary, but the option should be available	Implement to not be dependent on stylus for tech or quality.
75	Camera Look and Feel	The camera should look, feel, and behave in a way that is reminiscent of a real camera	physical	3.4	1.517		Familiar "feel" to device interaction will result in less alienation than a new technological gadget interaction		
76	Hard Buttons	Device should use hard buttons for at least some features. It should not be entirely touch screen.	physical	2.8	1.643	Meidum	Hard buttons have higher affordance		
77	Touchscreen	The device should have a touchscreen	physical	1.8	0.837	High	Touchscreens allow easier annotation using a stylus or fingernail.		
78	Text Entry	The device should support text entry	physical	1.2	0.447	Critical	Problem reports composed significantly of text		

79	QWERTY Keypad	The device should have a QWERTY keypad	physical	2.2	0.837	Medium	QWERTY keypad vastly more efficient than any other text entry for the average user	Other options for text entry exist	
80	Bar Code reader	The device should have a barcode reader	physical	3.2	0.837	Optional	Documents relevant to work steps often have bar codes. There is also talk of parts and tools having scannable bar codes for easy data entry as well.	Out of scope for summer	Recommend
81	Mobility	The device should be completely mobile, so a technician may take it to wherever they are working	physical	1.2	0.447	Critical	Project scope		
82	Size/Weight	The device should be small and light enough to go into awkward spaces with the technician	physical	2	1.225	High	Quality person in OPF spoke of having to cram himself into tight spaces to work as a young tech		
83	Compact Usability	The device should be able to be used using compact hand motions and arm motions in case of cramped conditions	physical	2.2	1.304	Low	Quality person in OPF spoke of having to cram himself into tight spaces to work as a young tech	One per team, so the technician in the cramped space may be able to work around by relaying info to a partner	
84	Electronic Approval	People other than the reporter should be able to electronicaly sign/stamp/buy off on a report directly on the device	quality	2.4	1.14	High	It will save time if an engineer or quality tech has the option of approving a report right on the device		
85	Annotatable Diagrams 2	User should be able to annotate engineering diagrams, design documents, and others	related docs	2.6	1.517	High	Technicians were obvserved annotating such documents on hard copy at KSC	Can be done with or without stylus input.	On the table

86	Provide for Templates	Users need to be able to make templates of commonly used problem reports to save time when addressing the same problem over and over. These templates are not necessarily created on the device but are viewable on the device and may be passed between devices.	related docs	1.8	0.837	High	A user may be able to save time by re-using certain information from an old report	Will not be very hard.	
87	Show Related PRs	Make related and linked PRs available when filling out a PR.	related docs	3	1.155	High	A user may be able to save time by re-using certain information from an old report	Probably pretty easy to link docs, data shows use of old docs	
88	Related PRs	Give user access to related PRs when they are filling out a problem report for context or reference	related docs	2.4	1.14	High	Looking at related PRs can give a technician context and be a good reference for filling in a new report.	Probably pretty easy to link docs, data shows use of old docs	Fake
89	Browsable PRs	Old Problem Reports must be able to be browsed and viewed by the user on the device.	related docs	2.6	1.14	High	A user may be able to save time by re-using certain information from an old report	Probably pretty easy to link docs, data shows use of old docs	Implement
90	Text Searchability 1	Old PRs, design docs, and other related documents must be text searchable to the extent possible	related docs	2.8	1.789	High	Text searchability greatly increases the ease of finding a document, especially in a large repository of data	Can take already written scripts for searching for a database	
91	Text Searchability 2	The PRs produced by the device should promote easy text searchability by future users	related docs	2.2	2.168	Critical	Goal of PRACA is to allow easy reference of old problem reports	Will really have to be done by NASA down the road	
92	Related PRs 2	The user should be able to find PRs related to his current WAD	related docs	2.6	0.894	Optional	A new problem report related to a tool, part, or other aspect of a WAD may affect a technician's work	For NASA in the future	Recommend

93	Part database	Device should hold or provide access to a database of informtion about parts, as there is usually not enough information on the tags	related docs	3	0.707	High	OPF people mentioned lack of information on part tags	Database searching pretty easy. We'll need to build a parts database	Fake
94	Network Printing	Device should be able to access relevant documents and print to nearby network printers to reduce walking back and forth from job site to desk to print	related docs	3	1.225	Optional	ISS and OPF people mentioned "running back and forth" to get documents to the floor	For NASA in the future	Scrapped
95	Accessing Diagrams	User should be able to access engineering and design documents on the device	related docs	3.3	0.957	High	Less walking around if they can access documents on the mobile device	Data supports this feature, will need to build a small database of design docs to test browsability	Fake
96	Update notification	The device should notify users of updates to documents relevant to their task (WAD). This includes WADs they are working on, active PRs from their team, and any other documents they have subscribed to.	related docs	2.6	1.14	Medium	Documents are changed frequently, sometimes while they are being worked on. This occassionally causes a tech to perform an outdated workstep which means it needs to be redone.		Recommend (related to collaboration)
97	Bar Code documents	The bar code reader should be able to load documents onto the device by reading the docs' bar code	related docs	3.4	1.673	Optional	Many documents that technicians will want to use have bar codes. Being able to read them onto the device prevents them from having to carry it around with them.	For NASA in the future	On the table

98	Submission Notification	When a PR is submitted, all people associated with it will be notified via their handheld device	related docs	2.2	1.304	High	Documents change often and work that is done with a tool that has a problem reported must be redone, so technicians will want to know about new PRs in case it affects their work		Scrapped
99	Design Viewing	In order to make scanning design documents for useful information less laborious, the device should support zooming, text searching, and other PDF viewing features.	related docs			Medium			Fake
100	Design Documents	Engineering and design documents are generally too large to print on 8.5x11, so the device should be able to scan large documents for quick reference, but not for printing	related docs			Medium			Fake
101	Notification of Filtered Search	When filtering search,notify the user that the search is filtered and by what.	search			High			
102	Field Based Search	The system will allow contextual field-based search	search			High			
103	Updating Search Results	Searches taking more than 5 seconds will show current results and add to them as they are found	search			High			
104	Search Cancellation	Allow the user to cancel a search before it has completed	search			Medium		If we can't cancel, put a short cap on it	
105	Search Results	Search results should have additional information with them.	search			Medium		Can WoZ if necessary, but this shouldn't be too hard	
106	Predictive Search	The system should present the user with common search terms when they are entering a search.	search			Medium	Reduces text entry on common tasks.		
107	Search	Narrow search results based on entered data. For example, only return serial #'s that can correspond with an already entered part #.	search			High		Just make it part of the query	

108	Tech-Finder Database	An engineer or other supervisor should be able to find and contact a tech, so long as he is still employed and has signed in that day	tech finding	2.4	2.191	High	Engineers have great difficulty tracking down a technician to ask for clarification on a problem		Recommend
109	Tech Information	An engineer or other supervisor at his/her desk should be able to pull up information of the tech who filed a report. To this end, the device must capture relevant information about the person who entered the problem report.	tech finding	3.2	1.924		Currently a requirement of all major NASA problem reporting systems; needed to track down the person who filed a report to look for more information; needed to verify authority to authorize a problem report	Profile already a PRACA requirement, so for NASA to do later	
110	Directory	Users should have a directory of contacts in the device for easy contact	tech finding	3	2.121	Medium	Having contact information readily available reduces time spent looking for someone's information		Fake
111	Log-in and Shift Schedule	The log-in should interface with the groups stored in the user profiles, and additionally with the punch-in system (assume the system knows who showed up to work that day)	tech finding			Optional		We should WoZ this, but NASA should probably do it in the future	Fake
112	User Profile	When an engineer clicks on a user that entered a report, it should bring up their profile. Probably a PRACA requirement	tech finding			High		Already a PRACA requirement	Recommend

113	Highlight changes	If a report has been updated, make the changes prominent so the user is aware of the changes	tracking	2.2	2.168	High	Filing of report is sometimes a back-and-forth communication between tech lead and quality in ISS. Making changes prominent reduces the likelihood that an important one will be overlooked.		Recommend (related to collaboration)
114	PR Tagging	The person who files a problem report, and everyone who modifies it will be tracked by the system	tracking	2.3	2.5	Critical	Currently a requirement of all major NASA problem reporting systems; needed to track down the person who filed a report to look for more information; needed to verify authority to authorize a problem report		Recommend (related to collaboration)
115	Tracking/Threading	Track who edited what as PR is passed around.	tracking	2	2.236	Critical	Currently a requirement of all major NASA problem reporting systems; needed to track down the person who filed a report to look for more information; needed to verify authority to authorize a problem report		Fake

116	PR Tracking	PRs should be able to be tracked by managers in real time	tracking	2.6	1.949	High	USA engineer communicated that it was important for management to be well-informed about the growth of a problem in order to make well-informed management decisions in advance of a launch		Recommend
117	Display Edits	The device should clearly show recent editions to a PR/WAD/Other document	tracking	2.2	2.168	High	If changes are not obvious, they risk being overlooked. Since technicians often use familiar WADs, they may do them from memory unless the interface clearly shows change		
118	Viewing WADs	WADs should be able to be retrieved on the device	wads	4.4	1.14	Optional	Centralizes all technician paperwork on one mobile device	For NASA in the future	Fake (insofar as there is a field for it) and recommend
119	Leveraging WADs	Information related to the current WAD should be browsable and retrievable	wads	4.4	1.14	Optional	Use WAD-specific context for constraint propagation	For NASA in the future	Fake (insofar as there is a field for it) and recommend
120	Team sign-in	The team will log in to the device as one unit	log-in						Recommend
121	Ownership dropdown	The names of the members of the logged in team will be in a dropdown menu in a PR, and the one person who will own the report selects their name from the menu when filing a non conformance.	log-in						Implement

Modularization of the Interface – July 17, 2007

This final interpretation of the requirements was a simple adjustment in scope due to the fine-tuning provided by the visit to Johnson Space Center. Having finally reached a point of familiarity with the interfaces at hand, including a recently-bought iPhone capable of displaying webpages containing Javascript, and confirming at JSC that personnel of different roles rarely met face to face to collaborate on problems, we created a distinct handheld interface for each of the static, mutually-exclusive roles of Technician, Quality person, and Engineer.

These changes complete the evolution of the requirements, and exist as a form of modularization of the refined third iteration requirements to match the three distinct roles.

Technician – Symbol Form Factor, Short Entry Workflow

Short form
No messaging or need for a larger context
Possibility of rich media
Barcode scanning capacity
Just enough entry to summon Quality with an acceptable problem description to expand
Minimum disruption to work
Speedy text and value entry for minimal entry

Quality – Symbol Form Factor, Extended Entry Workflow

Longer form
Automatic provision of online diagnostic questionnaires & forms appropriate to problem
Extensive use of rich media
Barcode scanning capacity
Limited search abilities for use of older PRs as templates
Ability to call for engineer attention for suspected critical situations
Speedy text and value entry for minimal to extended entry

Engineer – iPhone (or Similar) Form Factor, Extended Review & Workflow

Form capable of being accessed from an existing personal handheld of any common type
Expanded search abilities of PR archives
Ability to monitor, review, and analyze PRs
Sufficient capacity to invalidate necessity of travel to the scene of the problem
Speedy text and value entry for minimal to extended entry