HUMAN CENTRED DESIGN FOR ENTERPRISE AR APPLICATIONS
THREESIXTY, is a London-based consultancy specialising in user experience for immersive technologies.

We use research and an understanding of human interactions with technology to make VR / AR experiences intuitive and productive.
Agenda

1. What’s human-centred design
2. Why it’s important
3. Run through the process with example use case
4. Exercise: Prototype evaluation with a user
5. Iterating workflow designs based on user feedback
User Centred Design
Human-centred design

01. Understand & specify the user context
02. Specify user needs
03. Produce design solutions
04. Evaluate the designs
05. Product that works for users

Iterate as many times as necessary
Human centred design: Performance & safety

01. Understand & specify the user context
02. Specify user needs
03. Conduct risk assessment
04. Produce design solutions
05. Evaluate the designs
06. Product that works safely for users

Iterate as many times as necessary
New use error identified

IEC 62366 (2015)
All UK government digital services must follow a user centred design process.

It is also being applied to internal software and systems, where it’s believed that significant cost savings from technology can only be realised if the software is aligned to the way work is done.
Why is UCD important?
Proven benefits of UCD

**Less development costs**
- Less development waste
- Reduced post launch fixes

**Faster transition**
- Lower training costs
- Lower support costs
- Higher adoption & lower churn

**Improved workforce performance**
- Improved worker satisfaction
- Increased productivity and efficiency
- Reduced errors
- Improved quality of outcomes
- Improved safety
ROI case studies

User adoption undermines IT projects

“Out of IT projects that fail, 70% do so due to lack of user adoption”

Forrester Research (2008)

Reduced support costs

“90% reduction in support costs from usability improvement”

Strategic data consulting special report (2009)
ROI case studies

Improved KPIs

“83% average increase in KPIs due to following a UCD process

Jakob Nielsen (2008)

Improved employee performance

“300% increased productivity, 55% reduced training time from ERP redesign


Nielsen Norman Group

Deloitte.
Poor UX impacts adoption of new technology

“Just as in the last survey, respondents said that user experience was the top obstacle for mass adoption of both AR and VR.

2018 Augmented & Virtual Reality Survey, Perkins Coie
Find your ROI

There are multitudes of variables and decisions when designing an AR solution.
Find your ROI

UCD is about finding the optimal design solution for a given set of objectives and KPIs.
Let’s go through the process
First, here’s a use case
Pipe Corp has industrial technicians working on water and gas piping.

Work across multiple sites, depending on operations and needs of the enterprise.

Need to open and close valves in time critical scenarios to maximise system output and minimise delays and downtime.

Human error is a common issue and can be costly or even dangerous, depending on which valves are incorrectly operated and which moment.
Let’s consider this use case: Closing a valve
Closing a valve

- Going to the correct area or site location
- Identify the correct valve
- Perform the correct valve operation (open or close)
- Confirm the status change
For this example, Pipe Corp want to develop an AR solution to help improve **efficiency** and reduce **human error**.
THEIR TARGET KPI

Percentage of valve operations completed within **10** minutes

Currently **15%**
Let’s go through the steps
STEP 1

Understand your users
That means understand their workflows and tasks
Task Analysis

Task analysis for: Close pressure valve

MAN STEPS
1. Select next task
2. Go to location
3. Identify correct valve

USER SATISFACTION (DURATION)

DETAILED STEPS
1.1 Valve test fail
1.2 Valve test fail
1.3 Valve pass test
2.1 Check valve location
2.2 Walk to location
2.3 Confirms location correct
3.1 Look at valve
3.2 Find its reference code
3.3 Check code against valve description
3.4 Turn off code matches

SUB-TASKS
3.3.1 See they don’t
3.3.2 Look for another code

RISK ANALYSIS
Techniques may start a new cycle above
Techniques taken on 3.1

USER PAIN POINTS
Techniques need to close the valve in a timely manner
Users need to complete the task in the correct order

OPPORTUNITIES
Administer and verify tasks can be delayed slightly
Indicate recommendation for mandatory task based on expected timing
Leverage best based on reaction to recommendation
Leverage best practice based on quality of location

LINK
KEY POINT

We need to understand the work from the worker’s experience of doing it, not from corporate manuals of how it should be done.
STEP 2

Capture user needs and requirements

Capture and document the user needs and requirements to feed into the AR solution design process.
<table>
<thead>
<tr>
<th>Pain point</th>
<th>Metric</th>
<th>User need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technician accidentally opens a valve</td>
<td>% of cases with incorrect valve operation</td>
<td>Technician needs to be able to easily see the</td>
</tr>
<tr>
<td>a valve instead of closing as it was</td>
<td>11%</td>
<td>status a valve: open or closed.</td>
</tr>
<tr>
<td>already closed</td>
<td></td>
<td>Linked to step 3.5</td>
</tr>
</tbody>
</table>
## User requirements logs

<table>
<thead>
<tr>
<th>Ref</th>
<th>Task step</th>
<th>Sub step</th>
<th>User type</th>
<th>Requirement</th>
<th>Potential solution</th>
<th>Headline stats</th>
<th>Technician satisfaction</th>
<th>Target KPI</th>
<th>Known performance issues</th>
<th>Priority</th>
<th>Tech feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.0</td>
<td>Select next task</td>
<td>1.1 Technician</td>
<td>Needs to see list of available tasks that are allocated to them</td>
<td>Available task list feature from AR device menu</td>
<td>20% technician time wasted</td>
<td>-2</td>
<td>Improve productivity of technicians: No. of tasks completed, No. valves opened within 10 minute targets</td>
<td>Today around 20% of a technician's time is spent returning to the office to pick up their next task.</td>
<td>1</td>
<td>✔</td>
</tr>
<tr>
<td>2</td>
<td>1.0</td>
<td>Select next task</td>
<td>1.2 Technician, 1.3</td>
<td>Needs to understand which task is top priority to start next</td>
<td>Usually indicate top priority task selected by supervisor or system. Ability for supervisor to block other tasks until top one is completed.</td>
<td>14 hrs/week delays</td>
<td>4.2</td>
<td>Reduce inefficiencies due to suboptimal task ordering: No. of tasks completed, No. valves opened within 10 minute targets, Delay duration waiting for dependent tasks to be completed</td>
<td>We've estimates that there are 14 hours of delay a week caused by tasks being performed in suboptimal order, causing delays and bottlenecks.</td>
<td>2</td>
<td>✔</td>
</tr>
<tr>
<td>3</td>
<td>1.0</td>
<td>Select next task</td>
<td>1.1 Technician</td>
<td>Need to be able to access new tasks without needing to always return to office, particularly as next task might be near to where they already are</td>
<td>Available task list feature from AR device menu</td>
<td>20% technician time wasted</td>
<td>-2</td>
<td>Improve productivity of technicians: No. of tasks completed, No. valves opened within 10 minute targets, Time spent in between tasks (travelling and time spent in office)</td>
<td>Today around 20% of a technician's time is spent returning to the office to pick up their next task.</td>
<td>1</td>
<td>✔</td>
</tr>
<tr>
<td>4</td>
<td>1.0</td>
<td>Select next task</td>
<td>1.2 Supervisor</td>
<td>Needs to be able to set priorities and dependencies for tasks in the task list</td>
<td>Admin mode for task list where supervisor can set next task to be done</td>
<td></td>
<td>3</td>
<td>Reduce inefficiencies due to suboptimal task ordering: No. of tasks completed, No. valves opened within 10 minute targets, Delay duration waiting for dependent tasks to be completed</td>
<td></td>
<td>3</td>
<td>✔</td>
</tr>
<tr>
<td>5</td>
<td>1.0</td>
<td>Select next task</td>
<td>1.2 Supervisor</td>
<td>Needs to be able to assign specific tasks to specific technicians</td>
<td>Admin can allocate a task to specific technician</td>
<td>14 hrs/week delays</td>
<td>3</td>
<td>No. of tasks completed, No. valves opened within 10 minute targets</td>
<td>We could reduce the 14 hours a week of delays and inefficiencies by ensuring technicians in close proximity or with specific skills are allocated to particular jobs.</td>
<td>2</td>
<td>✔</td>
</tr>
</tbody>
</table>
## Pain-points = inefficiencies

<table>
<thead>
<tr>
<th>Step</th>
<th>Step name</th>
<th>Painpoint</th>
<th>Severity</th>
<th>Solution</th>
<th>KPI</th>
<th>AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>View task list</td>
<td>Currently workers need to find their supervisor or return to office to report completed tasks and pick up new tasks</td>
<td>M</td>
<td>AR will remove the need to return to base each time</td>
<td>20% time saved</td>
<td>✅</td>
</tr>
<tr>
<td>2.1</td>
<td>Check valve location</td>
<td>Technicians need to check site maps or request a guide to take them to the correct location. A lot of time is lost.</td>
<td>M</td>
<td>AR should eventually replace maps, but not in V1. Technician still need to know where they are going, but system can provide feedback they are in correct location once they arrive.</td>
<td>45 mins a day saved</td>
<td>✅</td>
</tr>
<tr>
<td>3.1</td>
<td>Look at valve</td>
<td>Many installations have numerous similar valves, and identifying the correct one can take some time</td>
<td>H</td>
<td>AR should allow technician to quickly differentiate correct and incorrect valve by looking at the valve code</td>
<td>More valves opened within target time 97 hrs a week of delays reduced 21 Type 8 critical incidents avoided each month</td>
<td>✅</td>
</tr>
<tr>
<td>3.3</td>
<td>Check code against task instruction</td>
<td>Technicians today need to write down or remember the ID of the valve or other references. They may need to carry paper or refer to a hand held device</td>
<td>M</td>
<td>AR overlays will solve this issue as the ID of the valve will be displayed and automatically checked against the task instructions</td>
<td>21 Type 8 critical incidents avoided each month</td>
<td>✅</td>
</tr>
<tr>
<td>3.2</td>
<td>Find valve reference code</td>
<td>Today, reference codes get worn down quickly and can be hard to read.</td>
<td>H</td>
<td>AR solution will mean these codes are obsolete. However we need to ensure the valve markets do not get worn down or that the system can recognise a valve accurately without the need for markers</td>
<td>Reduce valve identification time to below 17 mins</td>
<td>✅</td>
</tr>
<tr>
<td>3.2</td>
<td>Find valve reference code</td>
<td>Once the correct valve is identified, it's easy to lose track or get mixed up. Technicians tie ribbons or otherwise mark them.</td>
<td>H</td>
<td>This can potentially still happen, however it's suggested that once the correct valve is identified the AR overlay is persistent, guiding the user back to it if they need to turn away briefly</td>
<td>Reduce valve identification time to below 17 mins</td>
<td>✅</td>
</tr>
</tbody>
</table>
## Include risk assessment

<table>
<thead>
<tr>
<th>Step</th>
<th>Step name</th>
<th>Risk</th>
<th>Risk level</th>
<th>Solution</th>
<th>Fixed by AR</th>
<th>Introduced by AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>Identify next task</td>
<td>Technicians may pick a sub-optimal task to do next. Incorrect task sequence can cause delays</td>
<td>H</td>
<td>Admin feature for supervisor allows prioritisation of critical tasks. Technicians see priority tasks and can even be locked into selecting them.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>Select next task</td>
<td>Technicians take on tasks that have incomplete dependencies. This can cause risks if they are not alerted</td>
<td>M</td>
<td>Supervisor can send alerts to all technicians working on tasks with incomplete dependencies. Technicians would see a message that they should hold off and not complete their task until further notification. This could be baked into admin features, where the supervisor blocks tasks from progressing if there is a danger.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Walk to location</td>
<td>Technicians have been known to go to an incorrect location or stop to work on the wrong installation. High risk.</td>
<td>H</td>
<td>Require technicians to scan and confirm location marker before they can continue with the task. The next task step is not displayed until location is verified as correct. The system checks against task details (which must specify the location) and provides the AR user with feedback.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Look for valve</td>
<td>AR could create a risk by reducing user's situational awareness of hazards, obscuring their vision or distracting them.</td>
<td>unknown</td>
<td>UI design needs to minimise obstructed view. Safety alarms need to appear in the AR screen if triggered. Include safety warnings for tasks with safety risks Inform user when approaching hazardous zones.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>reference code</td>
<td>Working on the wrong valve in an uncontrolled and unplanned way can have disastrous consequences</td>
<td>H</td>
<td>Technician needs to scan valve marker and confirm it's the correct valve before they can continue. The supervisor needs to ensure the correct valve information is entered into the task details.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.6</td>
<td>Confirm status OPEN</td>
<td>Today, this is assessed by the technician inspecting it. Errors are common and can cause damage to the system</td>
<td>M</td>
<td>The AR solution will display the latest known status of the valve based on sensor readings.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>3.6</td>
<td>Confirm status OPEN</td>
<td>We currently experience an up to 30 sec delay on status change updates so there is a risk the status shown is expired</td>
<td>M</td>
<td>Users should be prompted to wait 30 seconds to check status is valid.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1.2</td>
<td>Find valve code details page</td>
<td>This step is very involving and technicians lose situational awareness and are at risk to unexpected events</td>
<td>M</td>
<td>This risk is solved by the AR as technicians no longer need to spend time looking through technical manuals on site.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>4.3</td>
<td>Perform action to CLOSE</td>
<td>Performing the opposite or incorrect action can in certain circumstances cause a critical risk or system damage</td>
<td>H</td>
<td>The AR will overlay the correct information, reducing user error and therefore reducing the risks associated with this step.</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>
STEP 3

Design based on data and insights

Create a workflow design based on the data you’ve gathered during your research and that supports your KPIs
Design for performance

Requirement:
Needs to be able to find the correct valve quickly.

CLOSE operation needs to be completed within \textbf{10 min} window.

Current Satisfaction: \textcolor{red}{-4.9}/5

Current Business KPIs: \textcolor{red}{17 \text{ mins}}

Overlay all feedback and instructions
Providing all task related information and valve operation instructions with the AR solution, \textbf{should eliminate reliance of manuals} and significantly reduce time to identify and confirm the correct valve.

Overlay all feedback and instructions
Providing all task related information and valve operation instructions with the AR solution, \textbf{should eliminate reliance of manuals} and significantly reduce time to identify and confirm the correct valve.
Design for performance

 Requirement (Correct valve):
 Technician needs to know if a specific valve is the correct one for the task or not.

 Technician needs to be 100% certain which is the correct one.

 Current Satisfaction: -4.9 /5

 Current Business KPIs:
 21 Type 8 critical incidents a month
 97 hrs /month of delays

 Indicate correct valve after scanning
 Automatic detection and display of valve ID, along with explicit feedback whether a given valve matches task instruction should eliminate the majority of Type 8 errors.

 Confirming correct location should further eliminate errors and reduce wasted time.
Design for performance

Key task info always visible at a glance.

Valve ID shown on scan. Users will not trust system to auto match, so we need to show it.

Current status of valve always shown to avoid errors

Access instructions for closing valve. Note this green bar serves as a positive confirmation that it’s the target valve.

Target KPIs

16 mins mean time to ID correct valve

21 monthly type 8 critical errors

11% incidence of incorrect operation

16 mins mean time to ID correct valve
## Storyboard

### 1.0 Select next task
- User can scan any valve to view contextual information, even if no active task.
- Valve info box reveals valve ID and latest status and sensor information about the valve as an overlay.
- User says [VIEW TASKS] to open the task menu.
- Available tasks allocated to user are shown along with status.
- User selects a task and instructions. They say [start task mode] and let the system know the task is underway.

### 2.0 Audio feedback
- Audio feedback when valve scanned and recognised.
- Audio feedback voice command recognised and actioned. Negative audio feedback if command not recognised.
- Audio feedback task selected or any voice command received and actioned.

### 3.0 Identify correct valve
- User scans valves at location to find the correct one.
- In task mode the info box is simplified to just what is needed. The user can access the instructions at any point.

### 4.0 CLOSE valve
- The overlay will show the user how to perform the CLOSE operation on the specific valve.
- An animation shows how the valve needs to be turned.
- Upon completion the user can run a status check to see if the valve status is CLOSED.

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### KPI target

- % valve operations completed within 10 mins
- Currently only 15%
STEP 4

Prototype early and test with users

Create a prototype that can be changed and iterated at a low cost. Then test it with users as many times as you need.
Quick and low effort. Hard to get a sense of space and proportions
UI mock-ups

Still very flexible and low cost. Images can usually be uploaded onto the device.
Interactive prototypes

High effort

Can be code-based
(Unity/Unreal/Vuforia/WebXR, Procedure platforms)

Quality and accuracy of the user feedback
KEY POINT

Only include enough detail in the prototype to evaluate if the design solves the problem
Usability evaluation

We want to know if users can actually do the specific things that are critical to the applications success.

**ISO definition of usability**

The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.
## Design goal
- Operate wrong valve error
- Time to ID correct valve
- Wrong operation (valve already closed)
- Wrong operation (turn wrong way)

## Prototype scenario
- Scenario with multiple valves, one is correct. Info in UI to differentiate.
- Scenario where correct valve status is CLOSED
- Scenario with valve that can turn 2 ways (e.g. half open) Show overlay guide.

## Desired behaviour in testing
- User ignores wrong valves. Only proceeds on correct one.
- User stops and does not operate valve
- User turns valve the correct way

## Metrics recorded
- Error rate
- Time to find correct valve
- Error rate
- Error rate

## Ultimate objective
- 17 mins
- 21 errors/month
- 97 hrs delay
- -4.4 sat score
- 11% incidence
- 11% incidence
Let’s quickly do a LIVE test

Volunteer user: “Please show me how you would complete the next task in your task list.”

Everyone else: Record your observations!
STEP 4

Record your findings
<table>
<thead>
<tr>
<th>Ref</th>
<th>Category</th>
<th>Area</th>
<th>Description</th>
<th>Comments and solutions</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV1</td>
<td>2.0 Go to location</td>
<td>Missing feature</td>
<td>Technicians indicated they really need the location checking feature included with the valve. They report frequent re-orienting to the wrong area and at times may even try to operate the wrong valve. The issue is that technicians work across a number of sites, some of which are quite large. They do not know the area and valve names off by heart so they need to figure out where they are going. This slows down their task efficiency, particularly if they go to the wrong location. Another issue is that many of the installations, pipes, and related tasks vary similar, and there is a lack of data input information.</td>
<td>There are no fixed values in 1.1.1.1.1 valves where there are many valves. It’s hard to keep count which ones are checked and which are not. Some technician bases are not as automated as others. This can make the task less efficient and frustrate the technician. It also increases the risk that they operate the incorrect valve.</td>
<td>Need a permanent marking cover to indicate incorrect valves that have been removed.</td>
</tr>
<tr>
<td>CV2</td>
<td>3.1 Identify correct valve</td>
<td>2.3.1 Valves don’t match</td>
<td>These valves have been identified by the technician. They need to see the valve again, some of which are old, and re-check the valves.</td>
<td>Technicians need the correct valve to be locked and persistent. When the valve matches the task, it also reduces the risk of the task being incorrectly completed.</td>
<td>HIGH</td>
</tr>
<tr>
<td>CV3</td>
<td>3.1 Identify correct valve</td>
<td>3.4 Confirm code matches</td>
<td>Some technicians indicate the status indicator for a valve command is not present and say “OPEN.” Others are confused as to whether the valve is currently to be CLOSED. It’s not clear if the status is the same as the valve.</td>
<td>When the valve is correctly configured after a few attempts, technicians believe the task has been matched. A different visual design should be applied that is less button like. - Don’t use a button shape - Don’t use a NAV-related command (e.g. ‘OPEN’); - Add the label ‘Status’ next to it. - Consider a switch that shows OPEN/CLOSED with closed/paused displayed.</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>CV4</td>
<td>3.1 Identify correct valve</td>
<td>3.1 Lock at a valve</td>
<td>The task is to immediately see pressure information. The key task is to easily identify the correct valve.</td>
<td>No other information just states the FOV.</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>CV5</td>
<td>3.1 Identify correct valve</td>
<td>3.3 Check against FOV</td>
<td>The task is to be able to view live on a screen the valve.</td>
<td>A visual cursor and a timer showing the scan attempt can help improve the user experience until the valve scan is complete. This feedback helps user understand what the system is doing.</td>
<td>HIGH</td>
</tr>
<tr>
<td>CV6</td>
<td>3.1 Identify correct valve</td>
<td>3.3 Check against FOV</td>
<td>The task is to be able to view live on a screen the valve.</td>
<td></td>
<td>MEDIUM</td>
</tr>
<tr>
<td>CV7</td>
<td>3.1 Identify correct valve</td>
<td>3.3 Check against FOV</td>
<td>The task is to be able to view live on a screen the valve.</td>
<td></td>
<td>MEDIUM</td>
</tr>
<tr>
<td>CV8</td>
<td>3.1 Identify correct valve</td>
<td>3.3 Check against FOV</td>
<td>The task is to be able to view live on a screen the valve.</td>
<td></td>
<td>MEDIUM</td>
</tr>
<tr>
<td>CV9</td>
<td>3.1 Identify correct valve</td>
<td>3.3 Check against FOV</td>
<td>The task is to be able to view live on a screen the valve.</td>
<td></td>
<td>HIGH</td>
</tr>
</tbody>
</table>
## Findings log

<table>
<thead>
<tr>
<th>Ref</th>
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</tr>
</thead>
<tbody>
<tr>
<td>CV1</td>
<td>2.0 Go to location</td>
<td>Missing feature</td>
<td>Technicians indicated they really need the location checking feature included asap. They report frequent navigating to the wrong area and at times may even try to operate the wrong valve. The issue is that technicians work across a number of sites, some of which are quite large. They do not know the area and valve names by heart so they need to figure out where they are going. Due to this issue, they may not have a clear understanding of the location codes. This slows down their task efficiency, particularly if they go to the wrong location. Another issue is that many of the installations, pipes, and valves look very similar, and there is also a degree of staff turnover.</td>
<td>There needs to be a way for technicians to check if the location they have gone to is correct or not. There needs to be a way for supervisors to add specific location codes to the task. Ideally there should be some guide or map or wayfinding system to guide the user to take the most efficient and safe route.</td>
<td>Unmet need</td>
</tr>
<tr>
<td>CV2</td>
<td>3.0 Identify correct valve</td>
<td>3.3.1 Valves don't match</td>
<td>Technicians often end up re-scanning the same valves in scannable areas where there are many valves. It's hard to keep track of which ones are checked and which are not. Some technicians use the same area as a look. This can make the task less efficient and frustrates the technician. It also increases the risk that they operate the incorrect valve.</td>
<td>There needs to be a persistent overlay marker to indicate incorrect valves that have been scanned.</td>
<td>HIGH</td>
</tr>
<tr>
<td>CV3</td>
<td>3.0 Identify correct valve</td>
<td>3.4 Confirm code matches</td>
<td>Once the correct valve has been identified the technicians may lock away or move around and lose track of the correct valve. They sometimes tag the valve with a code as a reminder. They need to re-scan the valves again, losing time.</td>
<td>Technicians want the correct valve to be locked and persistent. When the valve matches the task it should receive 'locked' status, until the user switches off task mode.</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>CV4</td>
<td>3.0 Identify correct valve</td>
<td>3.5 Check current status</td>
<td>Some technicians mistake the status indicator for a voice command prompt and say 'OPEN'. Others are confused as they expect the command to be 'CLOSE'. It's not clear if it's the status or the available action.</td>
<td>Users will likely learn the correct meaning after a few attempts, however to reduce training time a different visual design should be applied that is less button like.</td>
<td>MEDIUM</td>
</tr>
</tbody>
</table>
## Findings log

| Severity analysis | Severity | User Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|-------------------|----------|-------------|---|---|---|---|---|---|---|---|---|-----|-----|-----|-----|-----|-----|-----|-----|
| combined          | 7.7      | 3           | 3 | 1.7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| HIGH              | 7.3      | 3           | 3 | 1.3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| MEDIUM            | 4.8      | 2           | 2 | 0.8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| MEDIUM            | 5.0      | 1           | 1 | 3.0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| MEDIUM            | 5.7      | 3           | 1 | 1.7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| HIGH              | 7.3      | 3           | 3 | 1.3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
Key issues selected for V2

1. Technicians need support to confirm **correct location** to avoid wasted time
2. Need to indicate **when camera has commenced scanning** as users turn away if no visible feedback
3. Once correct valve identified, users often **turn the head away from the target** and lose the information
4. Status feedback isn’t clear. It needs to be further differentiated from the appearance of voice command prompts.
5. After closing, need to explicitly prompt users to wait **30 seconds** for status change
STEP 4

Iterate the design
Examples of design changes

Problem
Users often turn the head away from the target and lose the information

Design solution
When in task mode, the card is locked so that it’s always visible to the user
Examples of design changes

Problem
Need to explicitly prompt users to wait up to 30 seconds for status change.

Design solution
Added a timer to help user track time and take action if there’s no feedback after 30 seconds.
STEP 4

Measure post-launch

Continue to measure your KPIs during a pilot and post launch
### Output

![Graph showing output over ten days]

### Quality

<table>
<thead>
<tr>
<th>Error 1</th>
<th>Error 2</th>
<th>QA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1%↑</td>
<td>5.2%↑</td>
<td>95%↑</td>
</tr>
<tr>
<td>(4.3%)</td>
<td>(6.1%)</td>
<td>(91%)</td>
</tr>
</tbody>
</table>

### Desirability

<table>
<thead>
<tr>
<th>Adoption</th>
<th>Satisfaction</th>
<th>FLOW rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>90%↓</td>
<td>87%↑</td>
<td>62%↑</td>
</tr>
</tbody>
</table>
### Output

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 5</th>
<th>Day 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>20</td>
<td>20p</td>
</tr>
</tbody>
</table>

### Quality

#### Errors

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 5</th>
<th>Day 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR</td>
<td>6.2%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Current</td>
<td>10.0%</td>
<td>6.5%</td>
</tr>
</tbody>
</table>

#### QA pass

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 5</th>
<th>Day 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>Current</td>
<td>82%</td>
<td>90%</td>
</tr>
</tbody>
</table>

### Satisfaction

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 5</th>
<th>Day 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR</td>
<td>80%</td>
<td>85%</td>
</tr>
<tr>
<td>Current</td>
<td>90%</td>
<td>90%</td>
</tr>
</tbody>
</table>
Three EU directives stress that medical devices meet certain essential human factors and safety requirements. It states:

“Reducing, as far as possible, the risk of use error due to the ergonomic features of the device and the environment* in which the device is intended to be used.”

* This includes hardware, software, labelling and other user interface features (including video, mobile apps, etc)
ROI case studies

Improves productivity, conversions and other KPIs

“Every dollar invested in ease of use returns $10 to $100

Cost-Justifying Usability, Clare-Marie Karat, Ph.D. from IBM

Reduced support costs

“90% reduction in support costs from usability improvement

Strategic data consulting special report (2009)
"Out of IT projects that fail, 70% do so due to lack of user adoption"

Forrester Research (2008)

"72% of businesses cite effective user adoption as key"

TSIA (2009) Realizing Value in Enterprise Software
ROI case studies

**Improved KPIs**

“83% average increase in KPIs due to following a UCD process

Jakob Nielsen (2008)

**Improved employee performance**

“300% increased productivity, 55% reduced training time from ERP redesign