

Results of Tablet Computer Field Entry Pilot Tests

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Pacific States Marine Fisheries Commission

THANKS!

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- Brian Jonasson, ODFW

Origin of this work

2012. BPA interested in tablet computers.

– Potential **positives**

- **MORE** convenient than clipboard
- **Efficient data acquisition**
- **Improved data quality**
- **Speed data sharing**

Origin of this work

2012. BPA interested in tablet computers.

– Potential **negatives**

- **LESS** convenient than clipboard
- Significant data loss possible
- Slow data entry
- Cost : benefit ratio may be high

Our questions

2012. BPA interested in tablet computers.

- Can we automate target database updates?**
- Can it be easy?**

METHODS

What we tested: the forest

- **4 tablet computers**

- **2 Apple iPads**

- **1 standard size**
 - **1 “mini”**
 - **Both in ruggedized / waterproof case**



- **2 Android**

- **Neither in a case**
 - **One natively rugged and waterproof**
 - **One waterproof, not rugged**
 - **Both roughly the size of standard iPad**



- **All waterproof**



What we tested: the trees

Sony Xperia 1



- Google Android OS
- GPS
- Camera
- Feather-weight, thin
- Waterproof
- Big screen
- Not rugged



Bad Elf BE-GPS-2200

Panasonic Toughpad FZ-A1



- Google Android OS
- Rugged and waterproof construction
- GPS
- Camera
- Heavy, bulky
- Pricy

Apple iPad 4



- Apple iOS
- In optional rugged and waterproof case
- Camera
- Heavy, bulky

Apple iPad Mini 2



- Apple iOS
- In optional rugged and waterproof case
- Camera
- Light, small
- Small screen



Anker Astro ES external battery & 14W solar recharger

We ...

- **researched ways to minimize development and maintenance costs.**
 - **Hardware is relatively inexpensive**
 - **Chose “Fulcrum” mobile data collection platform**
 - **www.fulcrumapp.com; spatialnetworks.com**
 - › Potential for small team to rapidly deploy & manage multiple data systems
 - **One of many options**

We ...

- **recruited fisheries workers to test during real field work.**
- **created a data entry system for each project.**
- **created a data delivery system for each project.**
 - **Directly into Access**
 - **Downloading spreadsheets is also available. IDFG chose that method. Cut/paste.**

We ...

- had the fisheries workers test the several hardware options.
 - created questionnaires regarding:
 - Hardware
 - User interface
 - Usability
 - Durability
 - Reliability
 - Data delivery
-
- The diagram consists of three green rectangular boxes. The leftmost box contains a list of questionnaire topics. A large green arrow points from the middle box to the leftmost box. The middle box contains text about real-world experiences. The rightmost box contains text about system development evaluation.

Real-world experiences tell if the technology is helpful, neutral, or a detriment.

We evaluated the systems development side

RESULTS

Fulcrum Apps Capabilities

- **Various data types**
- **Parent-child relationships**
- **Read-only fields**
- **Hidden fields**
- **Calculated fields**
- **QC and interface functions**

Fulcrum Apps Capabilities

- **But not:**
 - **Wide variety of controls (programming sense)**
 - **Event-driven programming**
 - **No convenient development environment to test updates before deployment**
 - **OS other than Android or iOS (i.e., Windows)**
- **Tablet computer limitations**
 - **Touchscreen is convenient but**

Our experience programming

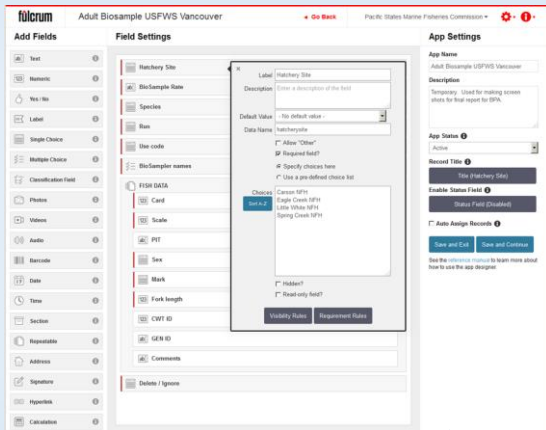
Design and create forms
~ 8 hours / form

Create back end database
in SQL Server at PSMFC
~ 4 hours

Code to fetch data
from Fulcrum server
~ 4 hours

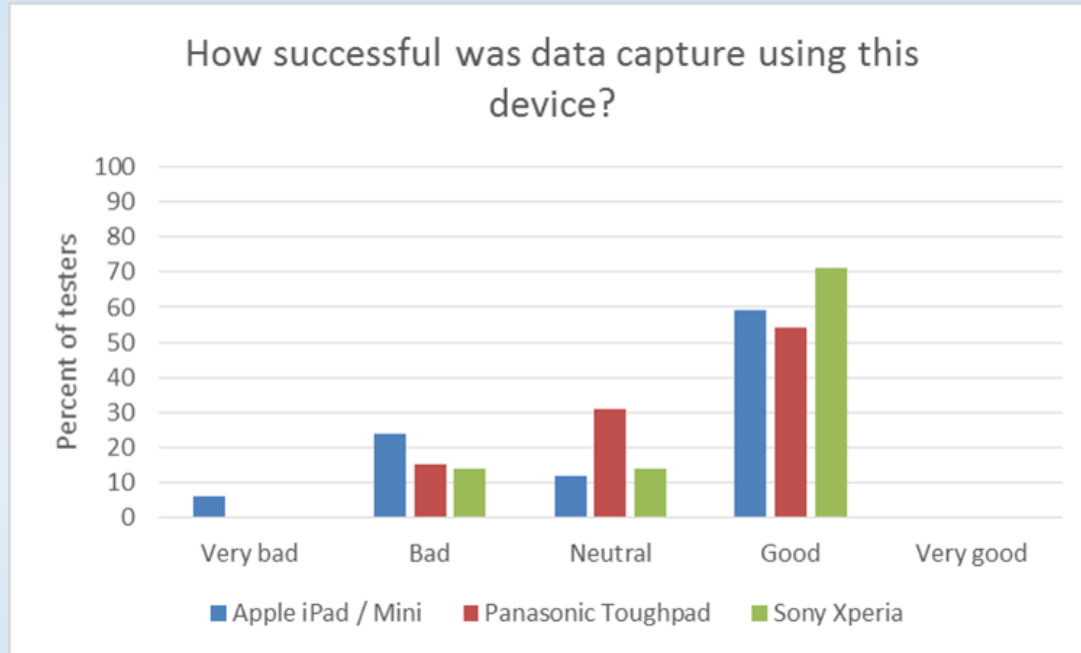
MS Access VBA code to let
end user call web service
and fetch data
~ 8 hours

Code for web service to
send data to end user
~ 8 hours



Oh,
that's a
big table!

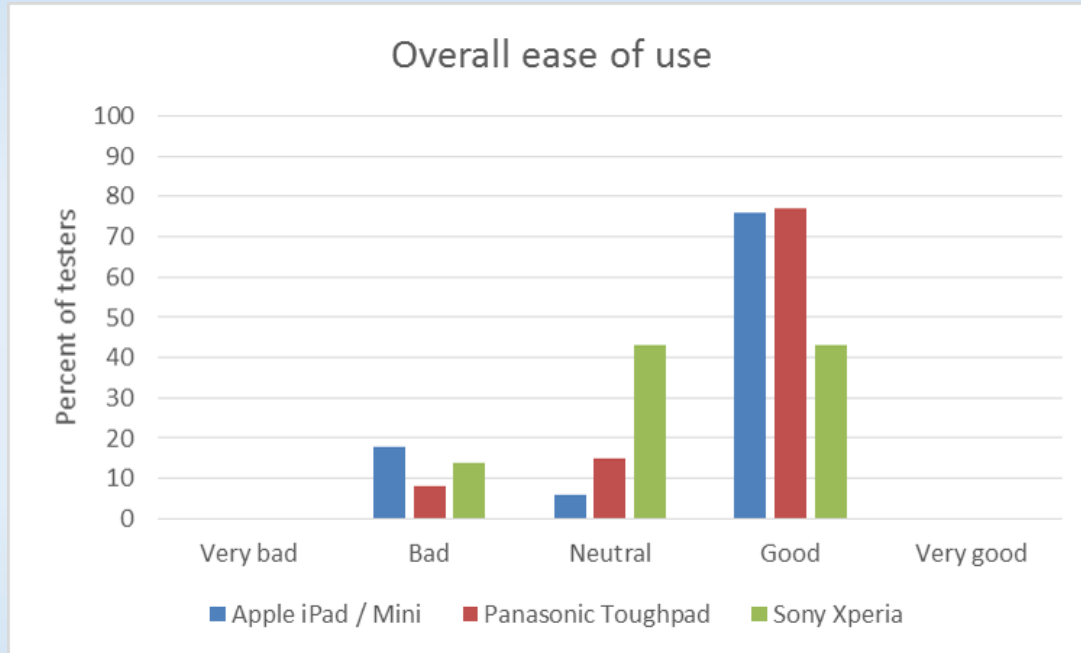
Users' experience: questionnaire results



- **Generally positive to neutral**
- **Zero “Very good”**

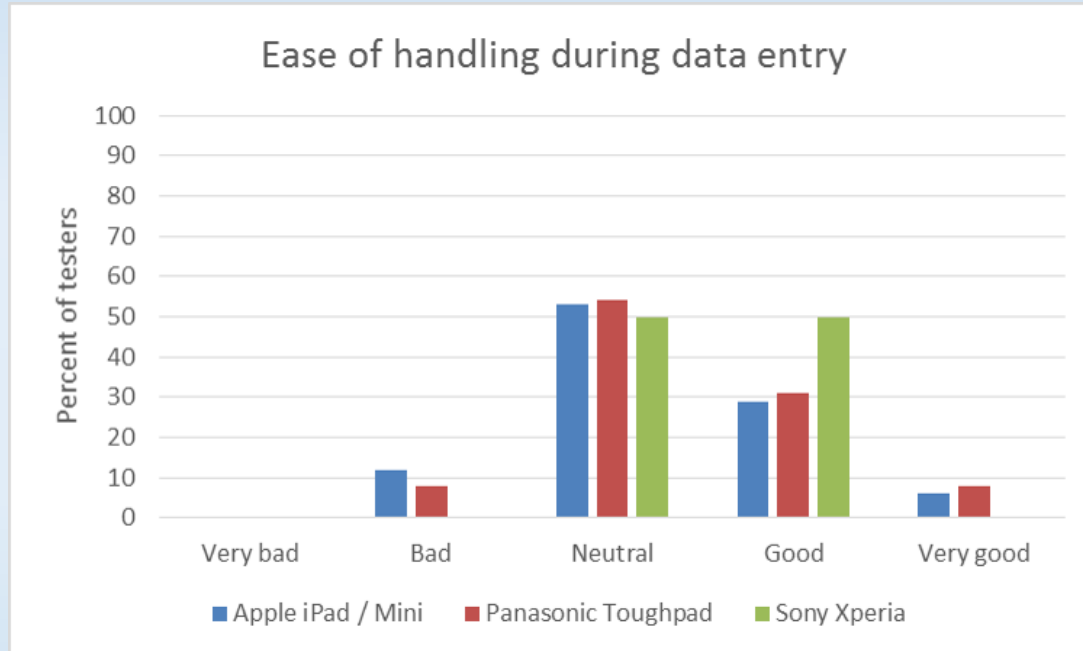


Users' experience



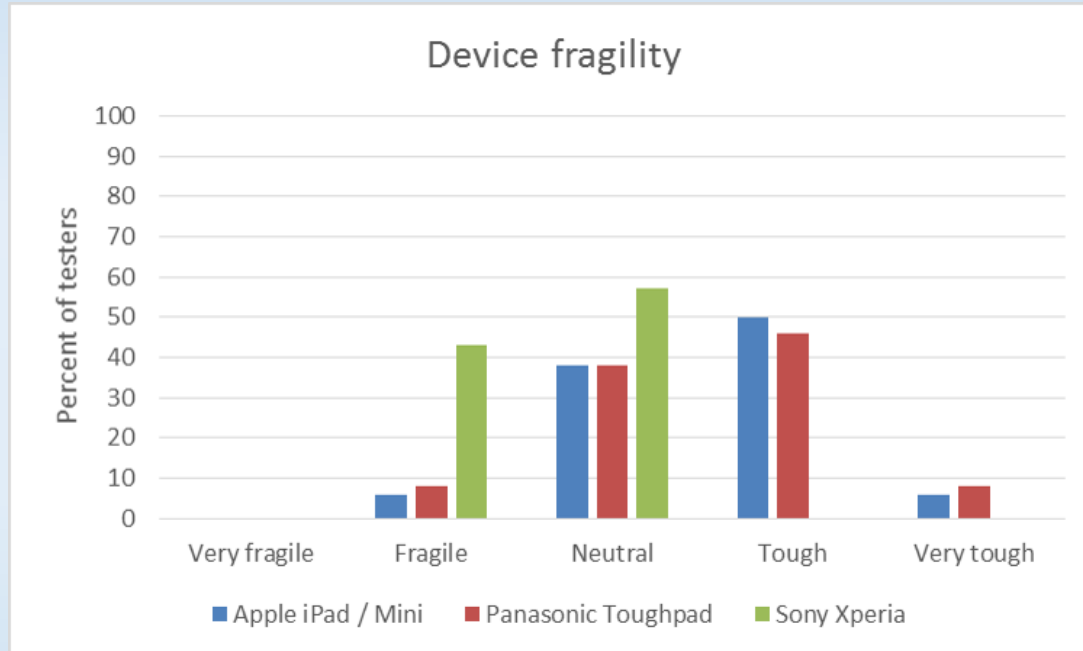
- **90% said was easy**

Users' experience



- **Trouble holding all day.**
- **Xperia's weight and slimness helped**

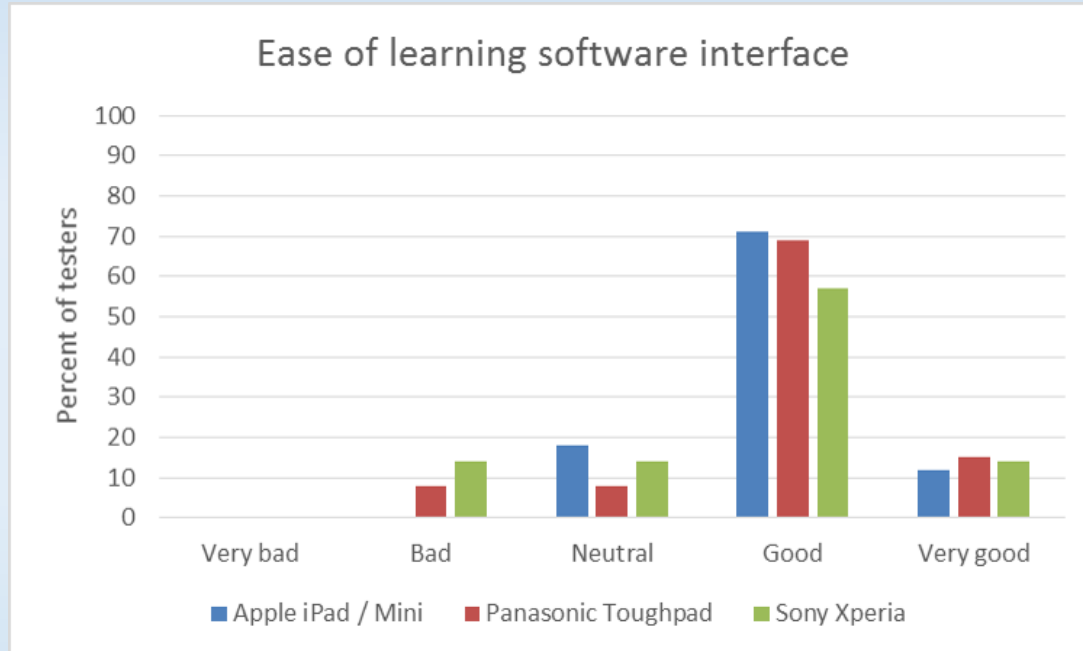
Users' experience



- **Xperia's lack of rugged construction made testers nervous**
- **Nobody actually had trouble with it.**



Users' experience

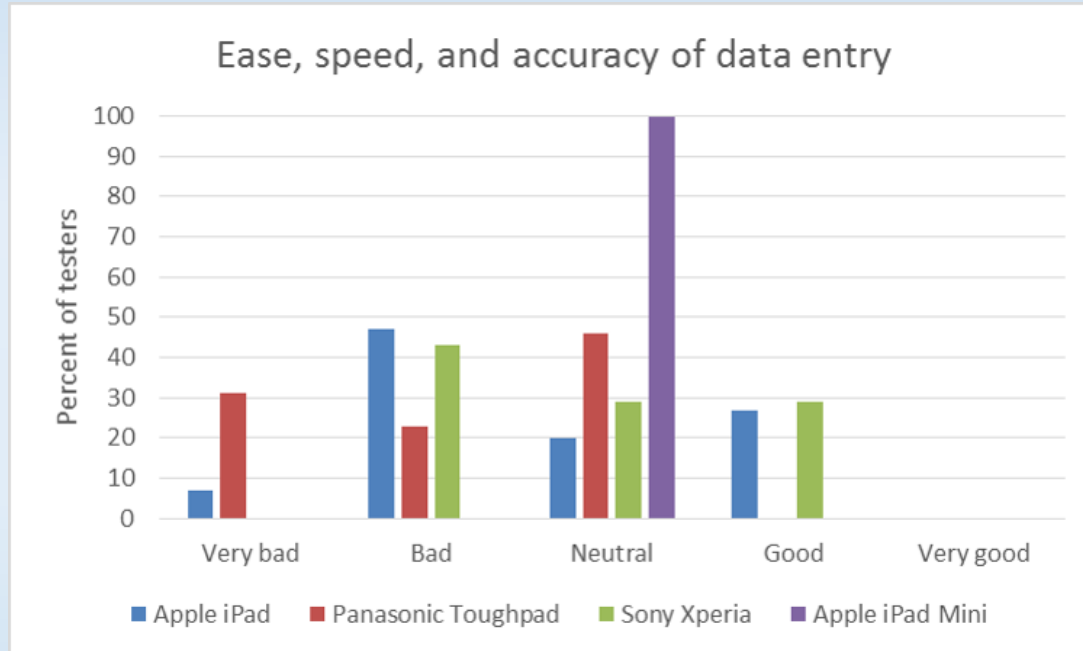


- **Few bad reactions**

- We did emulate their existing systems / data sheets

- Parent / child tables easy, but not elegant

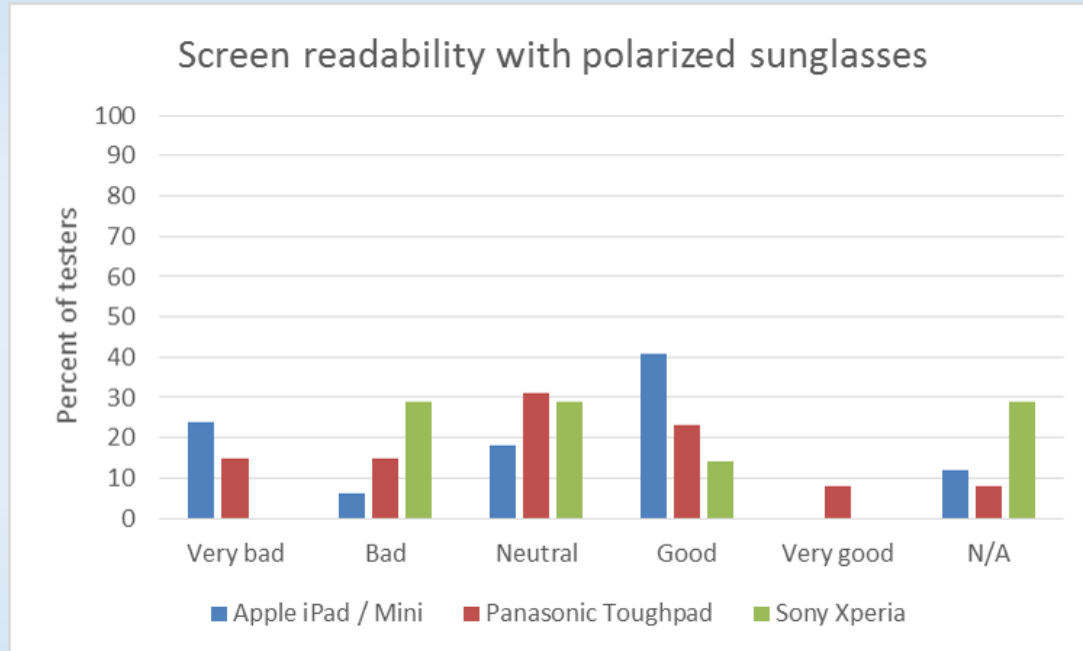
Users' experience: **KEY QUESTION**



- **Zero “Very good”, few “Good”**
- **Data entry tedious and inefficient**
- **Finding previously-entered record was difficult and slow**

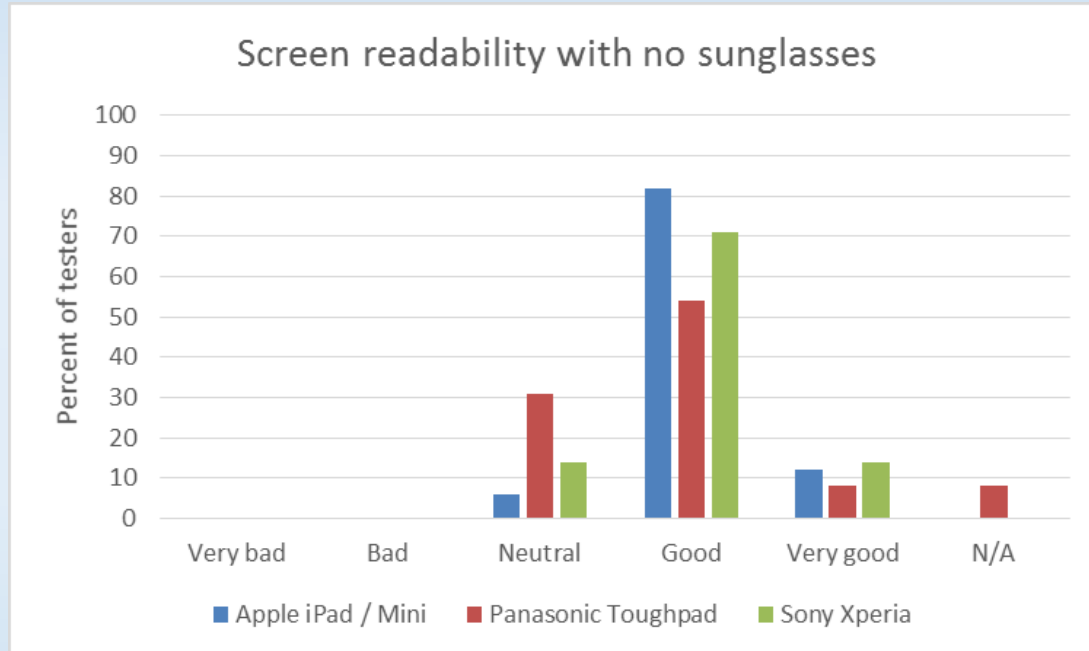


Users' experience



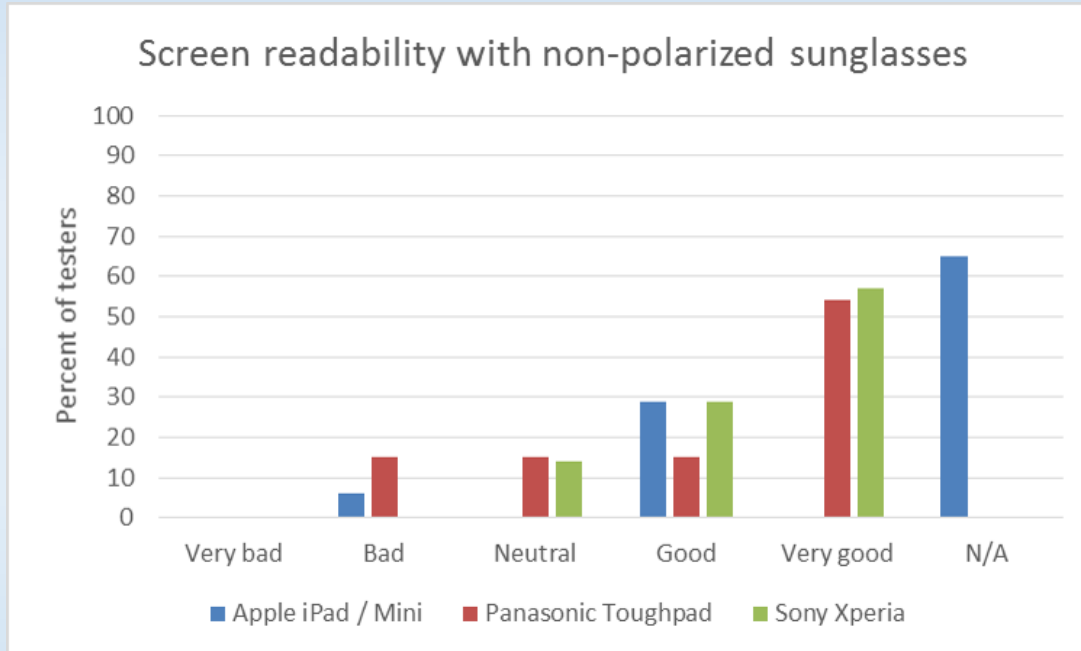
- **Significantly worse than without sunglasses**
- **Some units had polarized screens, which prevented holding unit in one direction while wearing polarized glasses.**

Users' experience



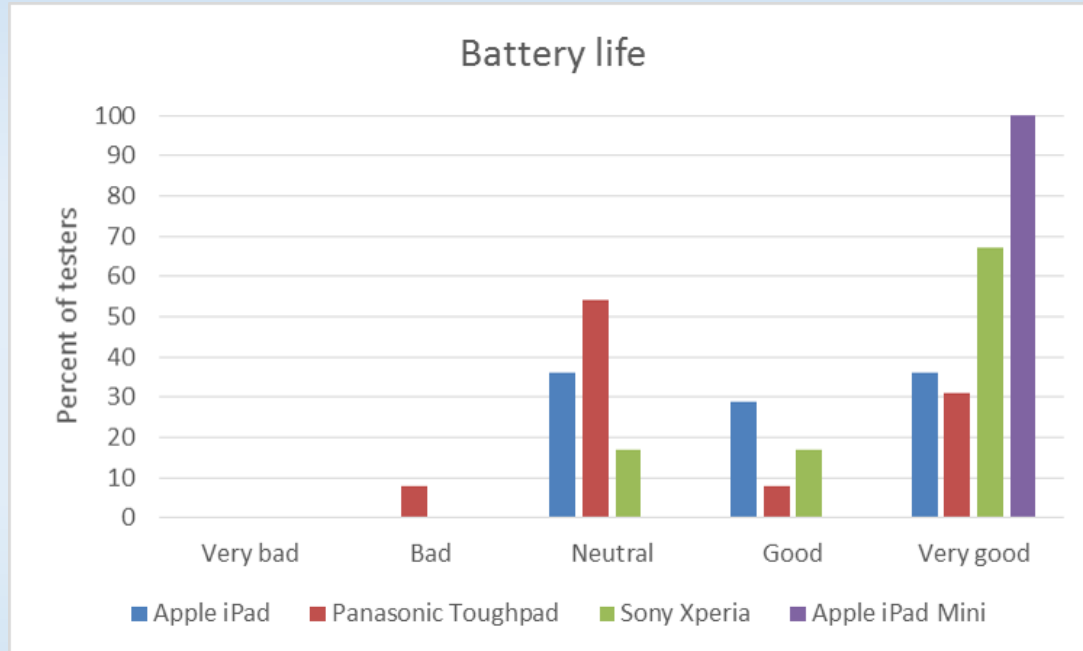
- 70% said “Good” or “Very good”
- Toughpad got lowest rating

Users' experience



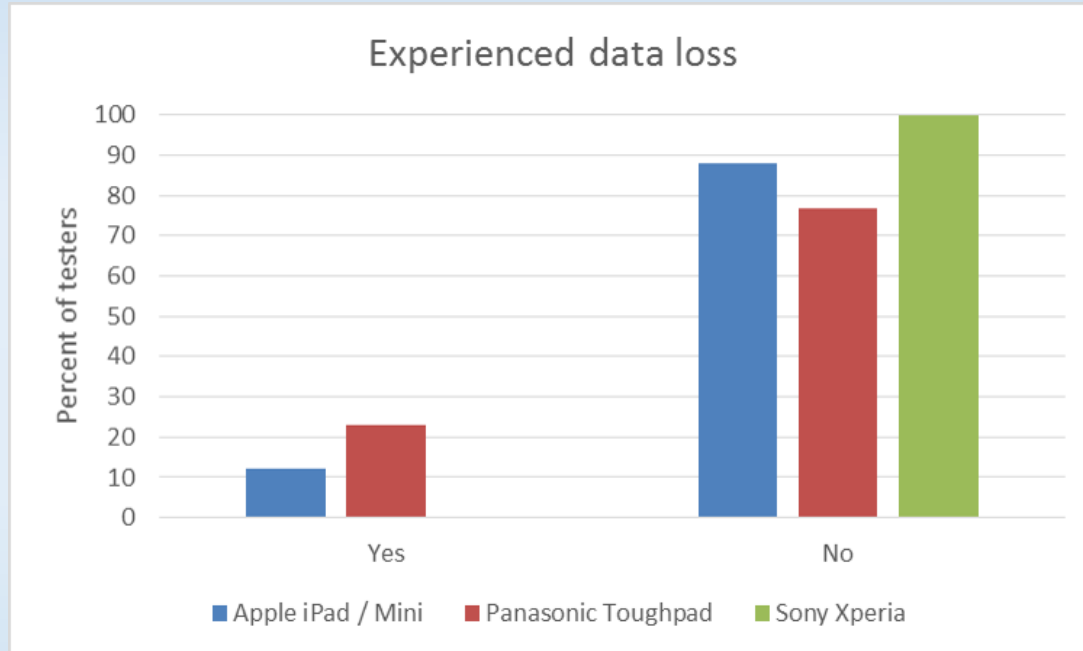
- **This seemed best to most people**

Users' experience



- Few problems encountered
- iPad Mini and Sony Xperia stood out

Users' experience: **KEY QUESTION**



- **10% of iPad users**

- **Causes**

- 85°F caused shutdowns
- Operator error

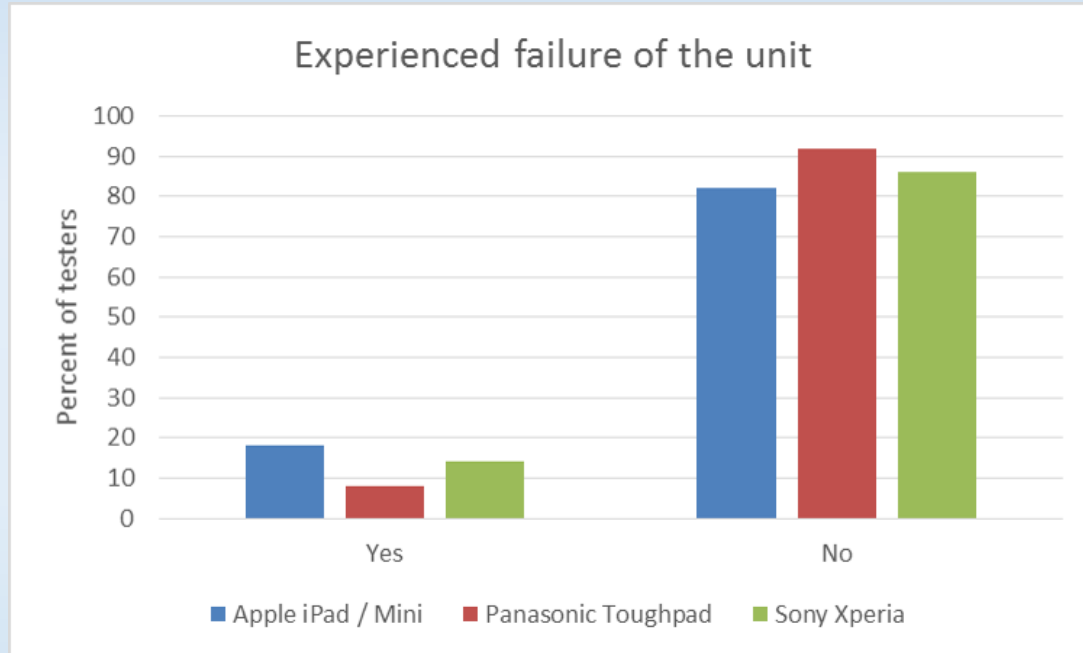
- **20% of Toughpad users**

- **Causes**

- Operator error
- Slowness of data entry
- Data not syncing with server correctly

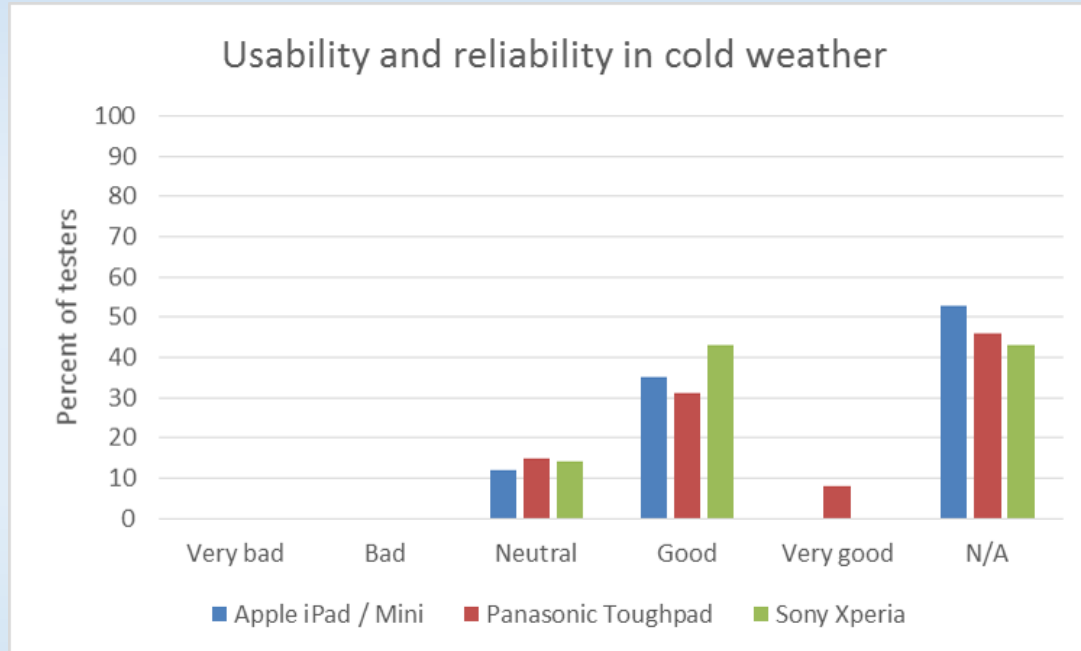


Users' experience: **KEY QUESTION**



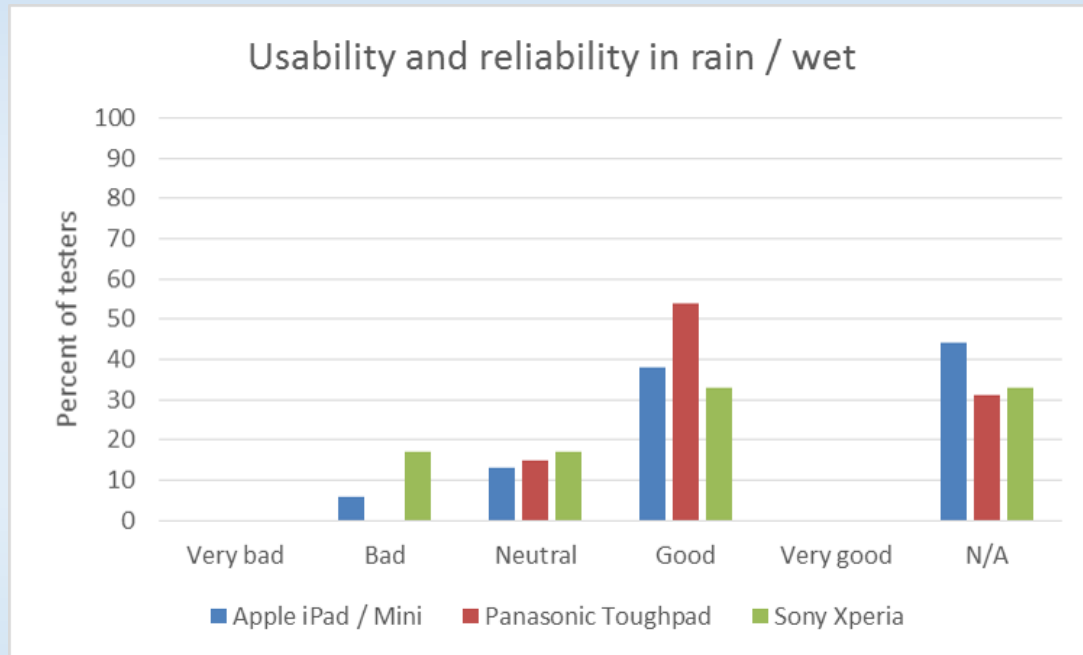
- **18% of iPad users**
 - Causes
 - 85°F caused shutdowns
- **0% of Toughpad users**
 - (Reported incorrectly by tester)

Users' experience



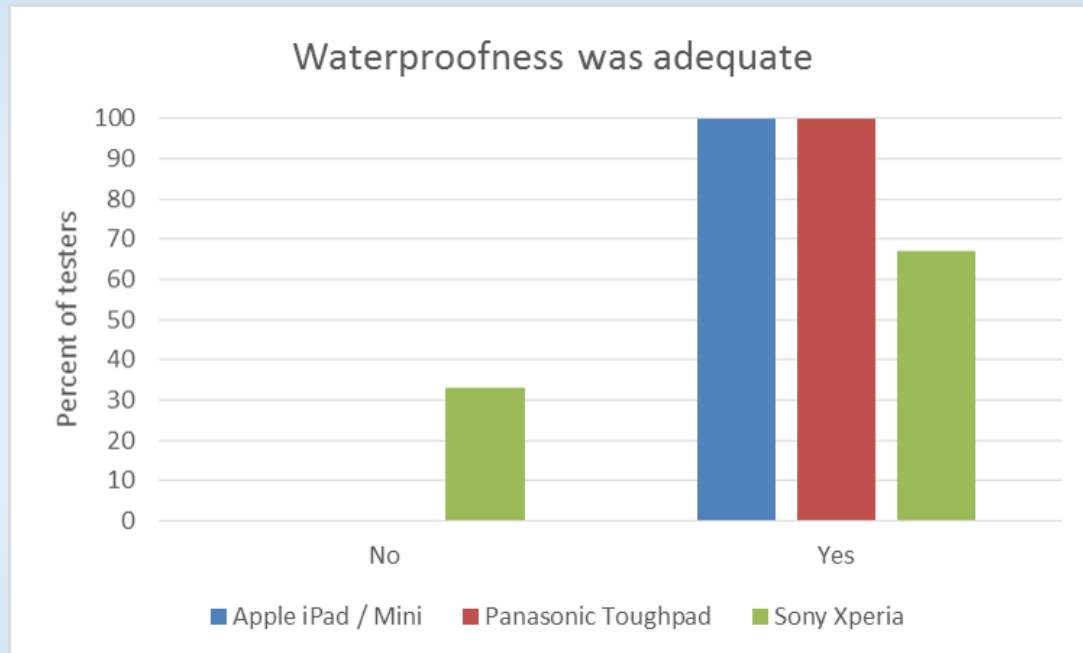
- **No problems encountered**
- **Widespread use of smartphones confirms this**

Users' experience



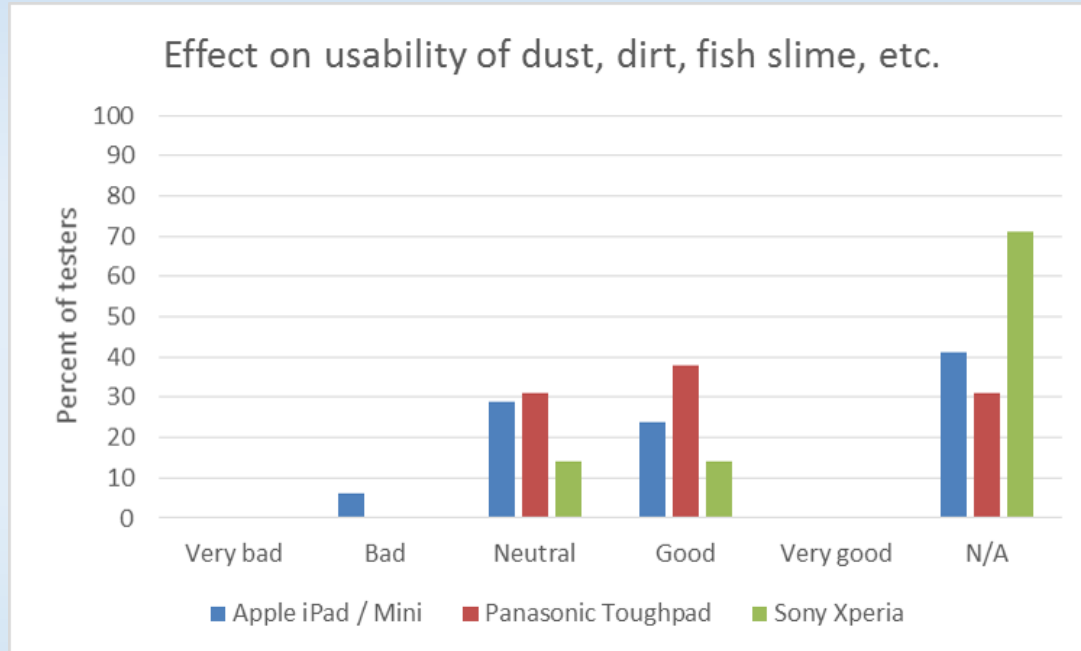
- **Little difficulty encountered**
- **Xperia had most trouble**

Users' experience



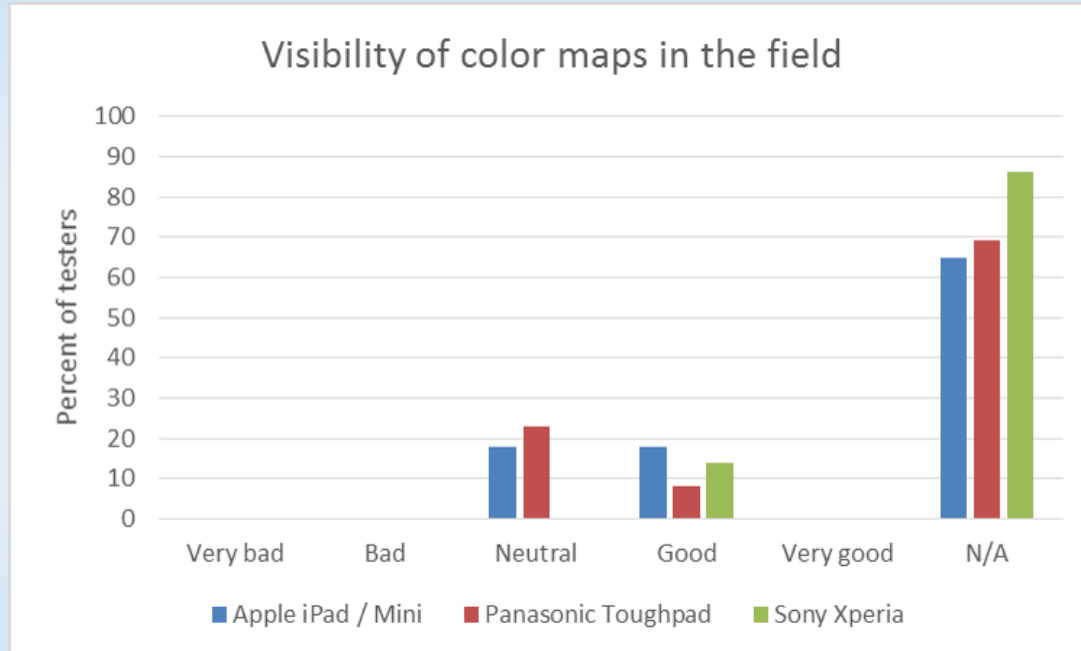
- iPads in rugged / waterproof cases were fine
- Toughpads were fine
- Xperia was waterproof but made testers nervous

Users' experience

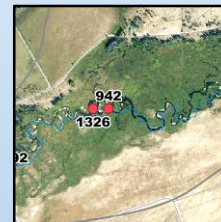


- **Impurities on the screen did not cause problems**

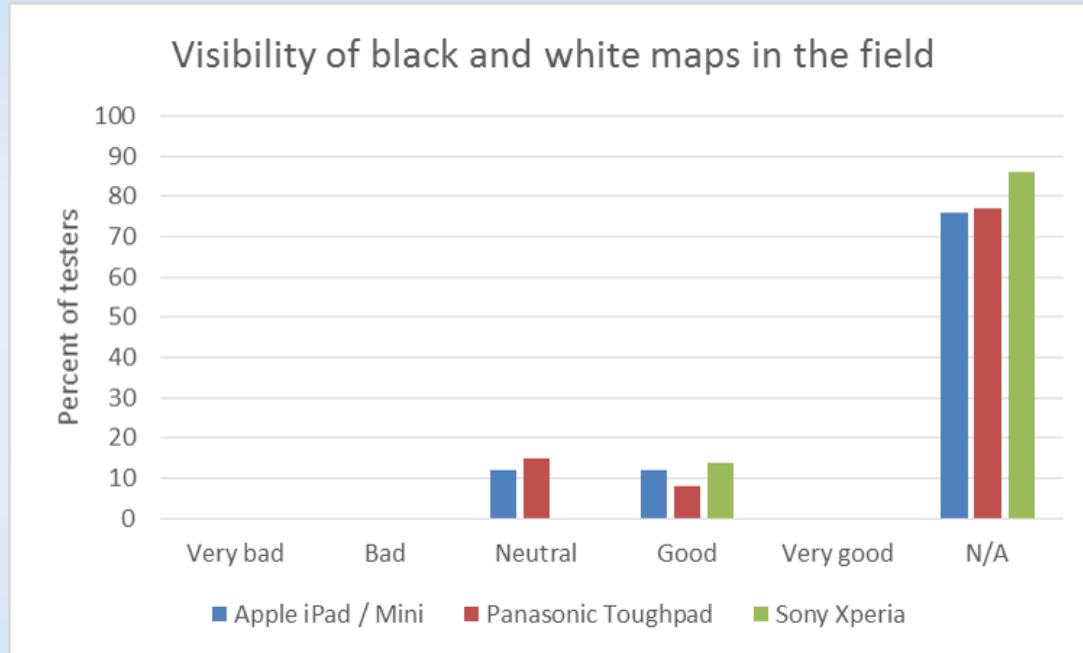
Users' experience



- **Few used**
- **Color maps visible and useful**
- **Generally used to find sampling sites, and to add new sites**

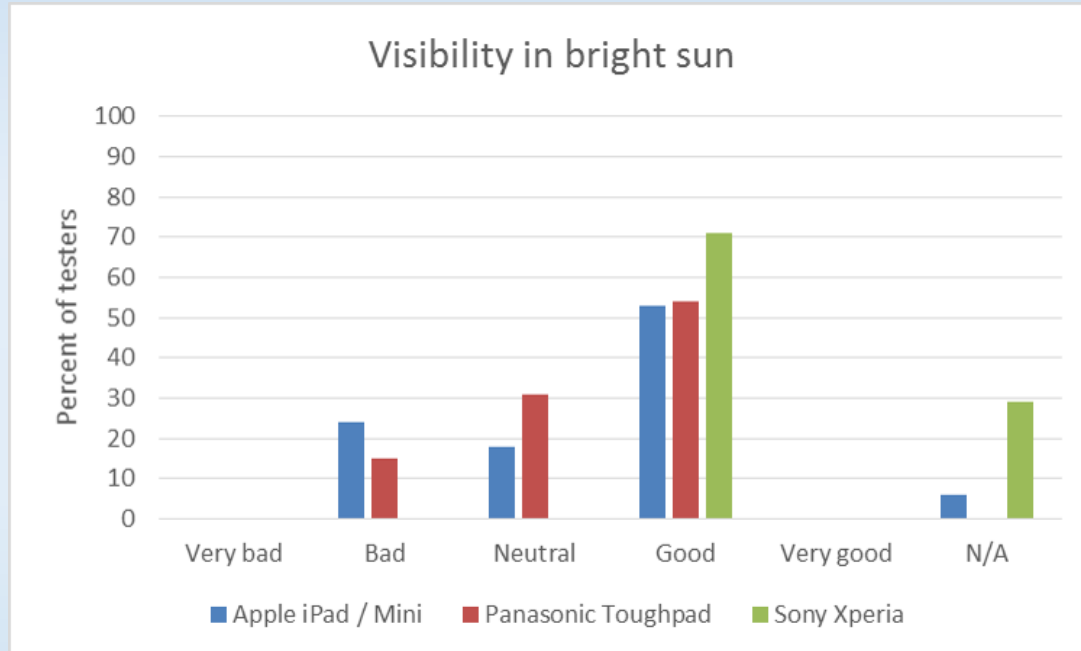


Users' experience



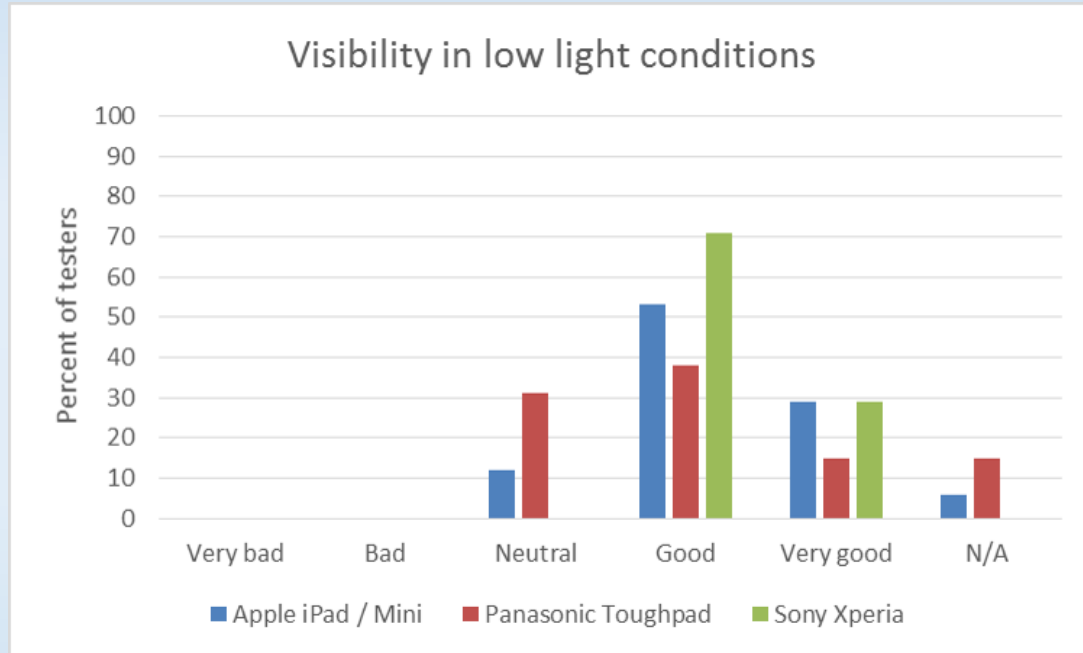
- **Few used**
- **B&W maps visible and useful**

Users' experience



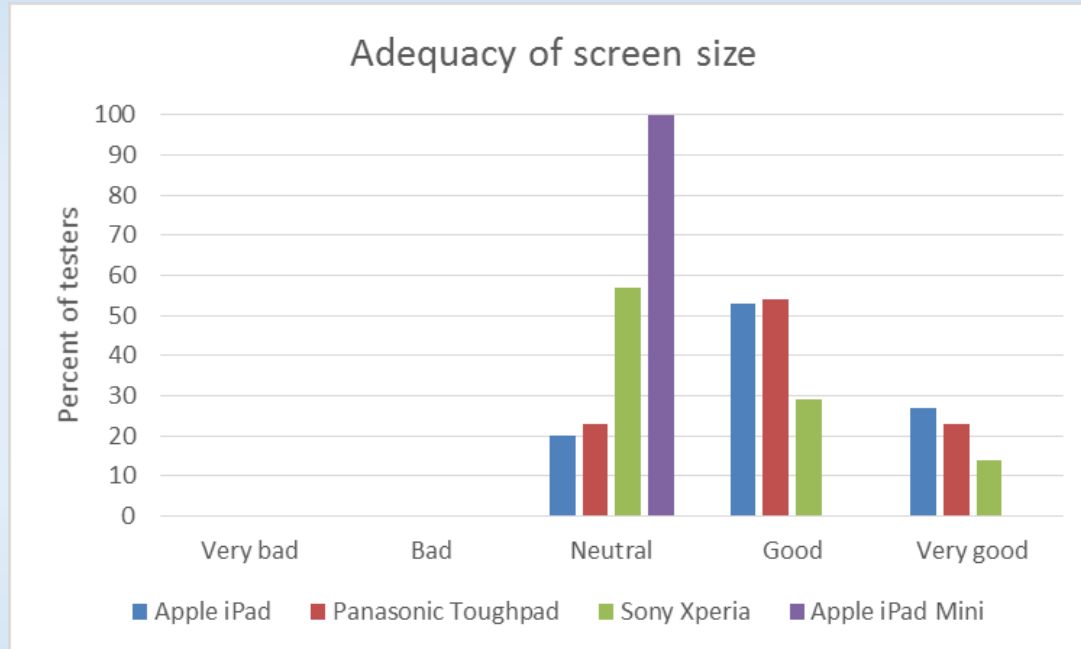
- **Generally good**
- **Xperia scored 100%**
- **iPads scored lowest**
– **25% said “bad”**

Users' experience



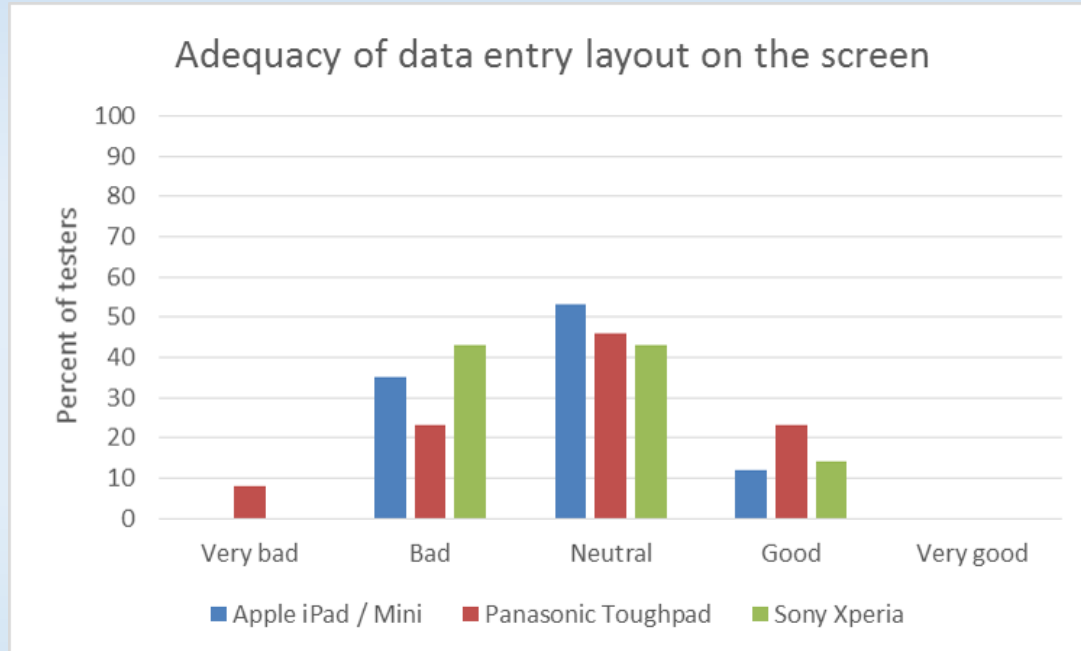
- **All testers satisfied with all units**

Users' experience



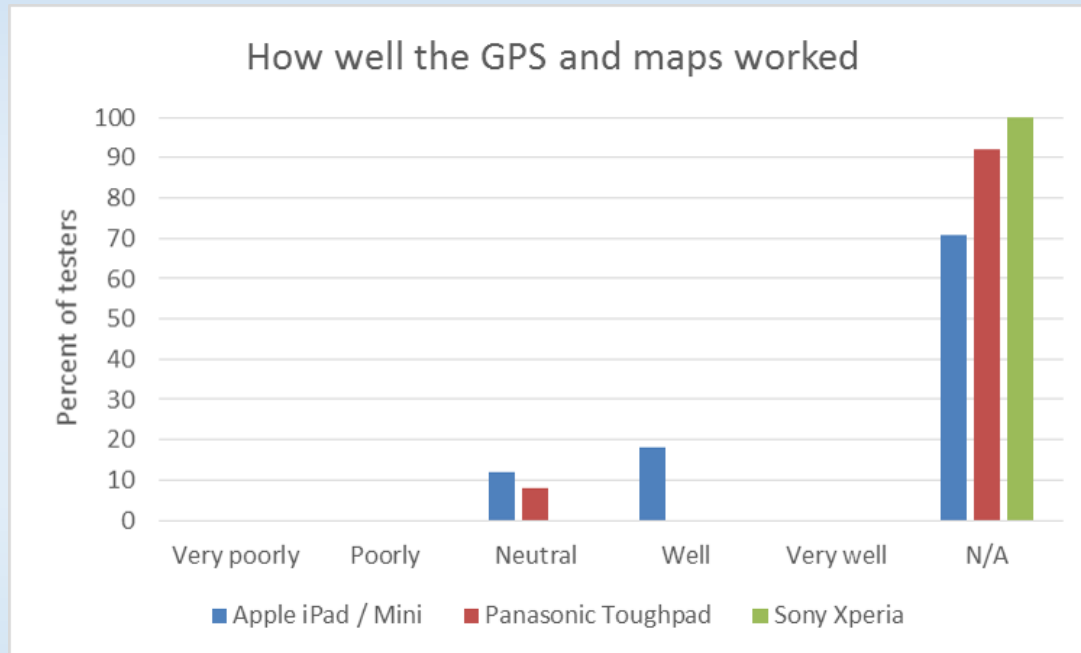
- All testers satisfied with all units
- iPad Mini had lowest ranking, but still 100% above “bad”

Users' experience



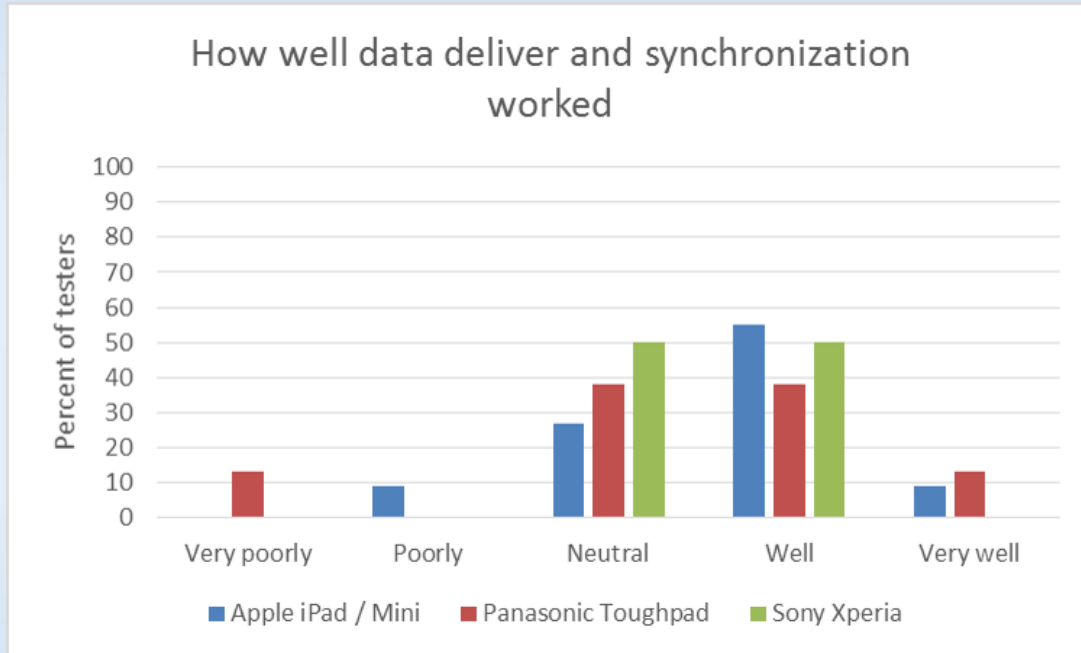
- **Wide range of responses**
- **Most “Neutral” or lower**
- **Layouts dictated by strengths and weaknesses of Fulcrum Apps**

Users' experience



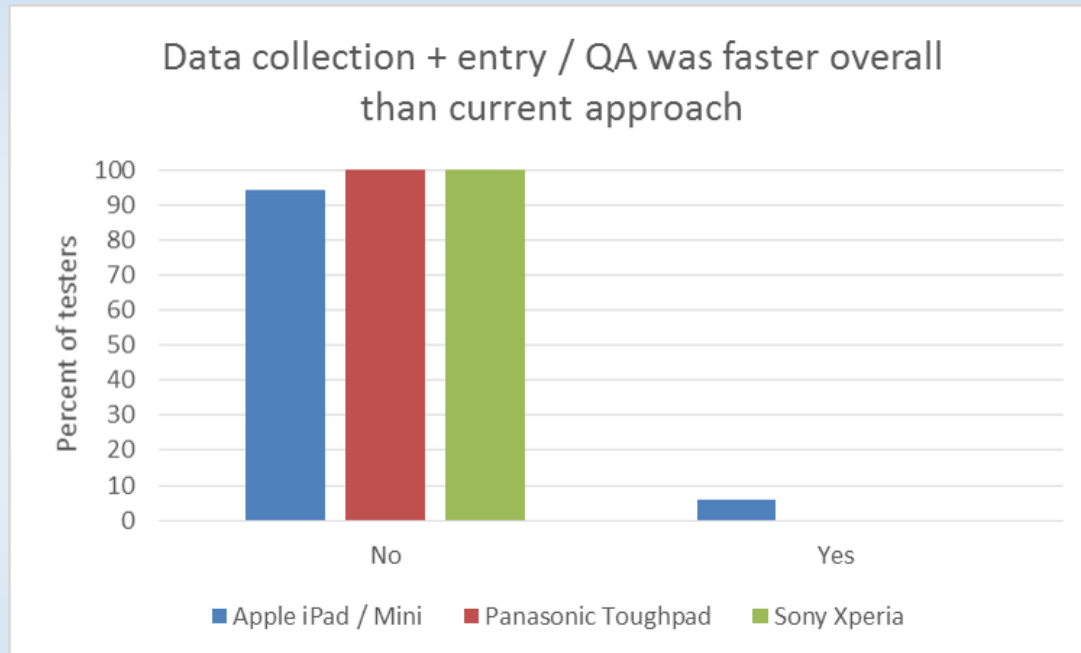
- **Few used GPS with maps**
- **Both integrated and external Bad Elf GPS worked well**
- **Recording x/y on every observation is potentially useful**

Users' experience



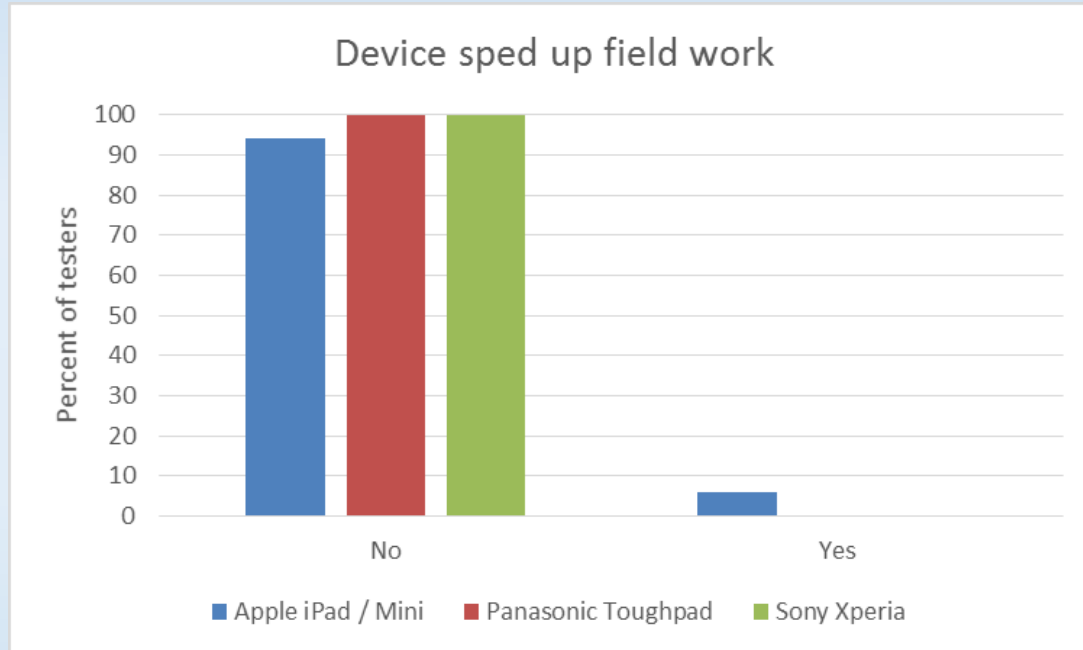
- **Sync from tablet to Fulcrum to us and on to target Access database was smooth in all cases**

Users' experience: **KEY QUESTION**



- **The only person reporting this system as faster than old system was one who had not used the old system.**

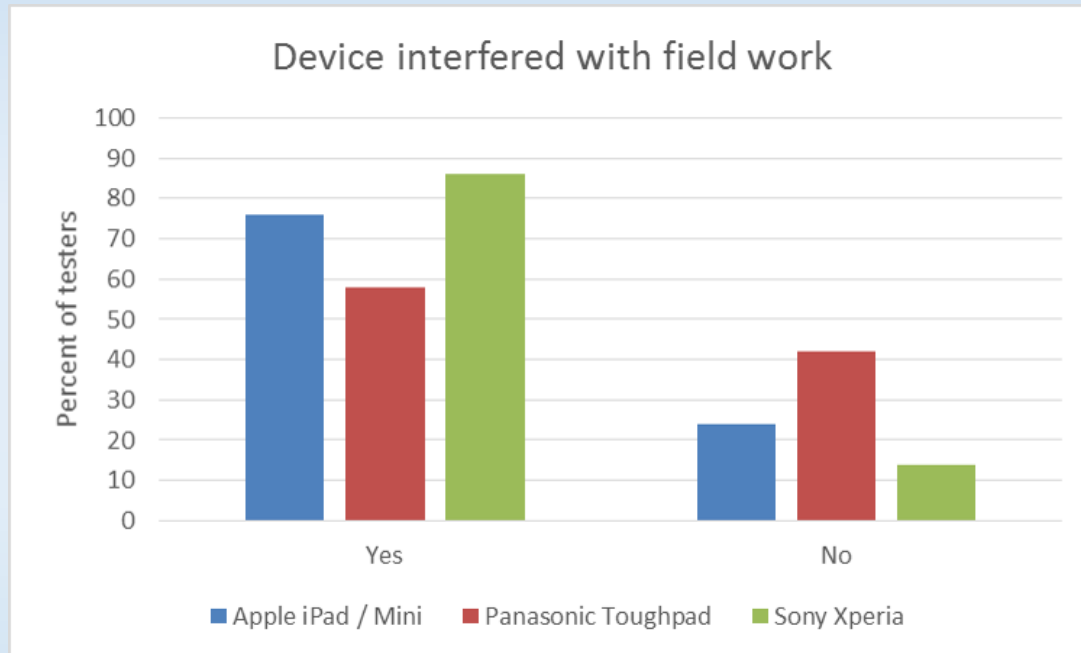
Users' experience



- **The same person was the outlier on this question.**

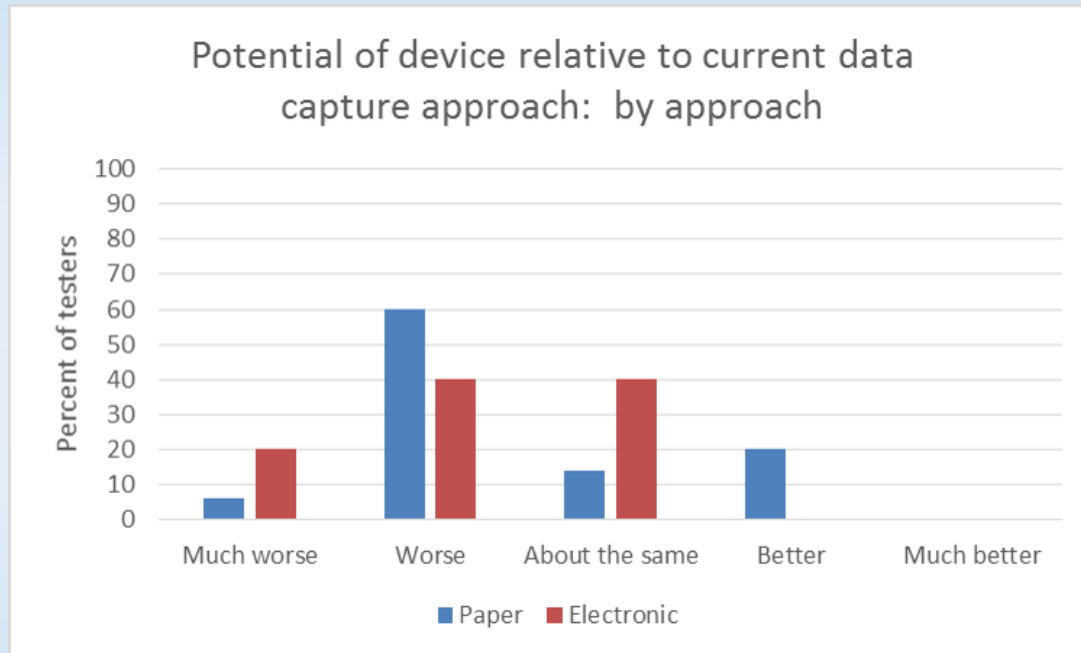


Users' experience: **KEY QUESTION**



- **Most people thought this system actually interfered with field work.**

Users' experience



- **Current paper users were not impressed**
- **Neither were current electronic users**

After our tests we also ...

- **In 2014 gave similar questionnaire to others who had developed their own systems.**
- **52 responses**
- **Compared to our testers**
- **Basic result: people who made their own systems are happier with them**

Other observations

- **Apple iPad / iPad Mini**

- **The good**

- Smoother user interface
 - Mini was most liked tablet

- **The bad**

- Consumer grade
 - Agencies did not allow them on their network.
 - Agencies did not allow purchase of iOS tablets.
 - Low power CPU = performance lags
 - Few peripherals supported



Other observations

- **Panasonic Toughpad**

- **The good**

- Really is tough
 - Comes in a Windows version, which has been used with great success, can be purchased by agencies, and is allowed on agency networks.

- **The bad**

- Heavy
 - Most expensive tablet we tested. Windows version very expensive.
 - Agencies did not allow the Android version on their network.
 - Button pushed not always the one recorded — sensor offset from screen image
 - Low power CPU = performance lags



Other observations

- **Sony Xperia**

- **The good**

- Light, slim, big screen, better interface than Toughpad
 - Fragility seemed not as big a problem as anticipated

- **The bad**

- Agencies did not allow them on their network.
 - Low power CPU = performance lags



Original questions

– Potential positives

- **MORE** convenient than clipboard?

- › Debatable

- **Efficient data acquisition?**

- › No

- **Improved data quality?**

- › Probably

- **Speed data sharing?**

- › Yes. But bigger issue is interference with field work

Original questions

– Potential negatives

➤ **LESS** convenient than clipboard?

› No

➤ Significant data loss possible?

› Yes

➤ Slow data entry?

› Yes

➤ Cost : benefit ratio may be high?

› Matter of scale. Depends on annual volume of data, how long system is used, and by how many people

Original questions

– Can we automate target database updates?

➤ **Yes.**

– Can it be easy?

➤ **Some parts.**

Conclusions

- **Tablet computers can be used for at least some types of field work.**
- **But they do have drawbacks.**
- **Designing an efficient user interface is key.**
- **Fulcrum not as helpful as we hoped.**
- **A Windows-based tablet may be a better choice for multiple reasons.**
- **The next talk by IDFG will show how they applied these lessons and made a better system.**

Questions?



- **Contact Mike Banach or Greg Wilke**
 - mike_banach@psmfc.org, gwilke@psmfc.org
 - 503-595-3100

- **This presentation based on:**
 - **Pacific States Marine Fisheries Commission et al. August 2015. Electronic Field Data Collection Pilot Study. Final Report for Bonneville Power Administration. 97 pages.**
 - [Available from Mike Banach, PSMFC]

End
Fin
Koniec

Unused slides

Data types and conditions

Data type	Crew size	Speed*†
Hatchery adult salmon biological data	Multi-person	Fast
Adult steelhead weir counts and biological data	2 person	Slow
Stream and riparian habitat	3-6 people	Slow
Snorkel counts (fish, amphibians, bivalves)	3-6 people	Fast
Mark-resight: fish marked (hook and line), resighted (snorkel)	3-6 people	Fast
Creel survey fishing pressure counts, fish biological data	1 person	Slow
Boat electrofishing, fish tagging	Multi-person	Very fast
Steelhead spawning ground surveys (redd counts & measurements, dead fish biological data, spawning gravel abundance, incidental observations of other species)	Multi-person	Slow

* How fast data need to be entered for this type of data.

† Two projects not attempted because of obvious data collection speed issues.

Input forms created using Fulcrum Apps



The screenshot shows a mobile application interface for logging in. At the top, there is a status bar with icons for signal, Wi-Fi, 61% battery, and the time 10:21. Below the status bar, there are two input fields: "Email Address" and "Password". A "Login" button is positioned below the password field. The Fulcrum logo, featuring a red triangle above the word "fulcrum" and the tagline "mobile location leverage", is centered on the screen. At the bottom, there is a navigation bar with three icons: a back arrow, a home icon, and a recent apps icon. The "spatial networks" logo with the tagline "location leverage™" is located at the bottom center of the screen.

Example of creating forms

fulcrum Adult Biosample USFWS Vancouver Go Back Pacific States Marine Fisheries Commission

Add Fields

- Text
- Numeric
- Yes / No
- Label
- Single Choice
- Multiple Choice
- Classification Field
- Photos
- Videos
- Audio
- Barcode
- Date
- Time
- Section
- Repeatable
- Address
- Signature
- Hyperlink
- Calculation

Field Settings

- Hatchery Site
- BioSample Rate
- Species
- Run
- Use code
- BioSampler names
- FISH DATA
 - Card
 - Scale
 - PIT
 - Sex
 - Mark
 - Fork length
 - CWT ID
 - GEN ID
 - Comments
- Delete / Ignore

App Settings

App Name
Adult Biosample USFWS Vancouver

Description
Temporary Used for making screen shots for final report for BPA.

App Status
Active

Record Title
Title (Hatchery Site)

Enable Status Field
Status Field (Disabled)

Auto Assign Records

Save and Exit Save and Continue

See the [reference manual](#) to learn more about how to use the app designer.

Example Fulcrum Apps forms

Parent form:
sampling
event

Cancel Adult Biosample USFWS Vancouver Save

Tap to Select Project

Hatchery Site *

BioSample Rate *

Species *

Run *

Use code *

BioSampler names *

FISH DATA
0 items >

Delete / Ignore *

No

Child form:
fish
data

Cancel FISH DATA Save

Card *

Scale *

PIT

Sex *

Mark *

Fork length *

CWT ID

GEN ID

Comments

Special capabilities

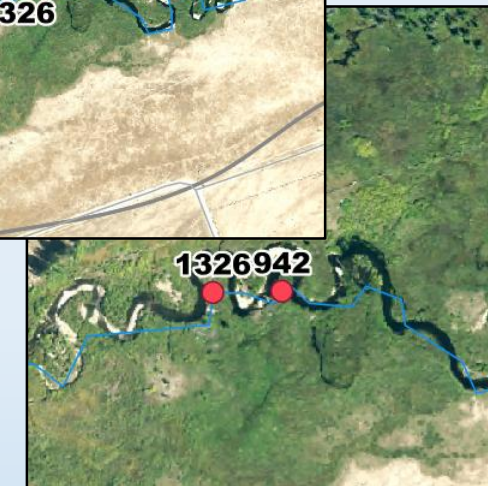
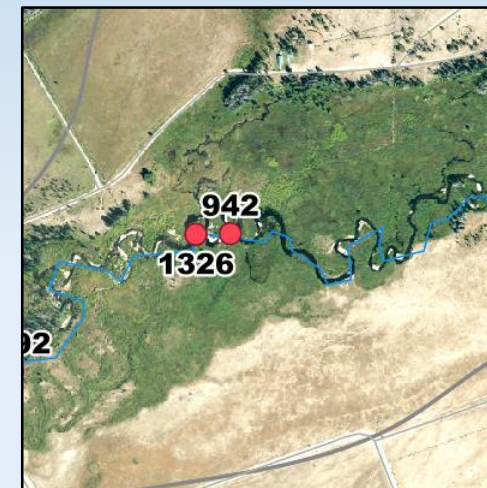
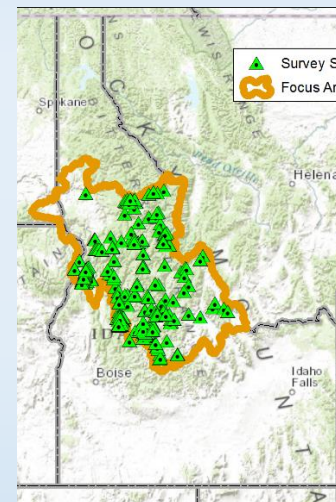
Bluetooth PIT tag readers (RFID tags)



Custom maps & aerial imagery

– Find sites (mainly)

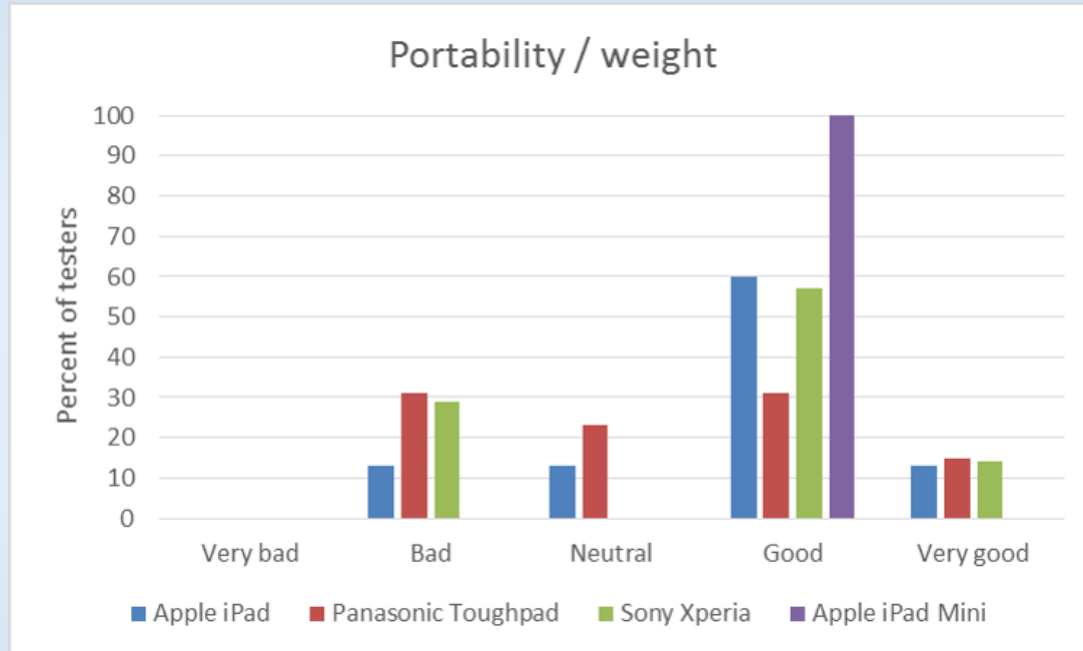
- Pre-loaded sampling sites
- Topo maps, directions
- NAIP 0.5 m imagery
- Boundaries (landowner, watersheds, etc.)
- Roads, trails, towns, stream & lakes
- GPS on tablets



Our experience programming

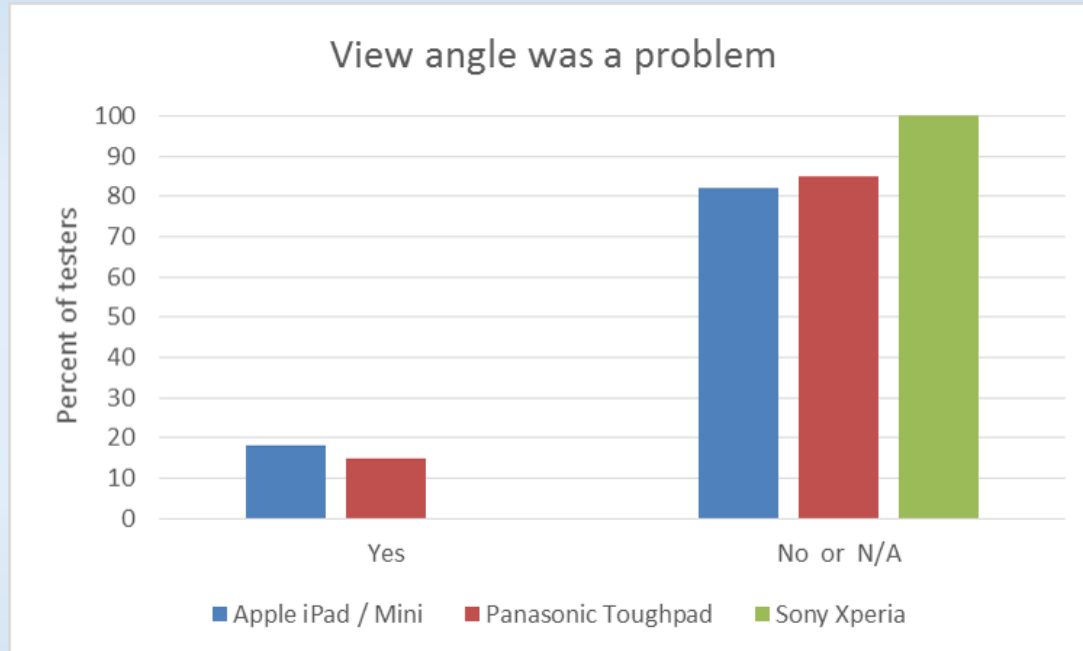
- **Design & create forms: ~ 8 hrs/form**
- **Create back end database at PSMFC: ~ 4 hrs.**
- **Code to fetch data from Fulcrum: ~ 4 hrs.**
- **Code for web service to send data to end user: ~ 8 hrs.**
- **Access VBA code for end user to fetch data: ~ 8 hrs.**

Users' experience



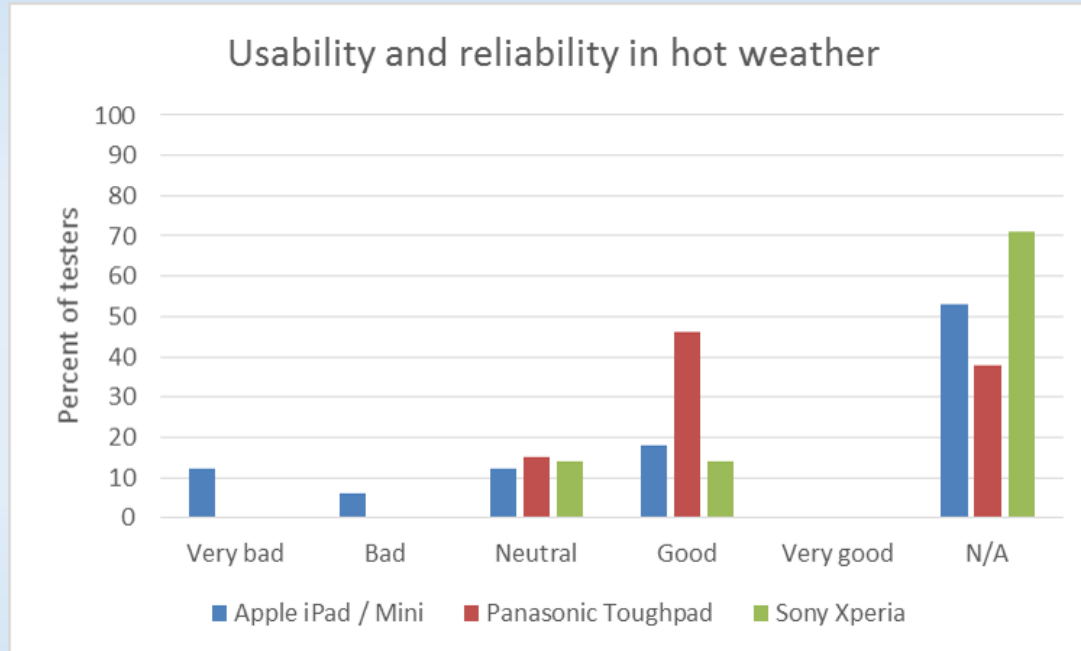
- **80% said neutral /good / very good**
- **iPad Mini stood out at 100%**

Users' experience



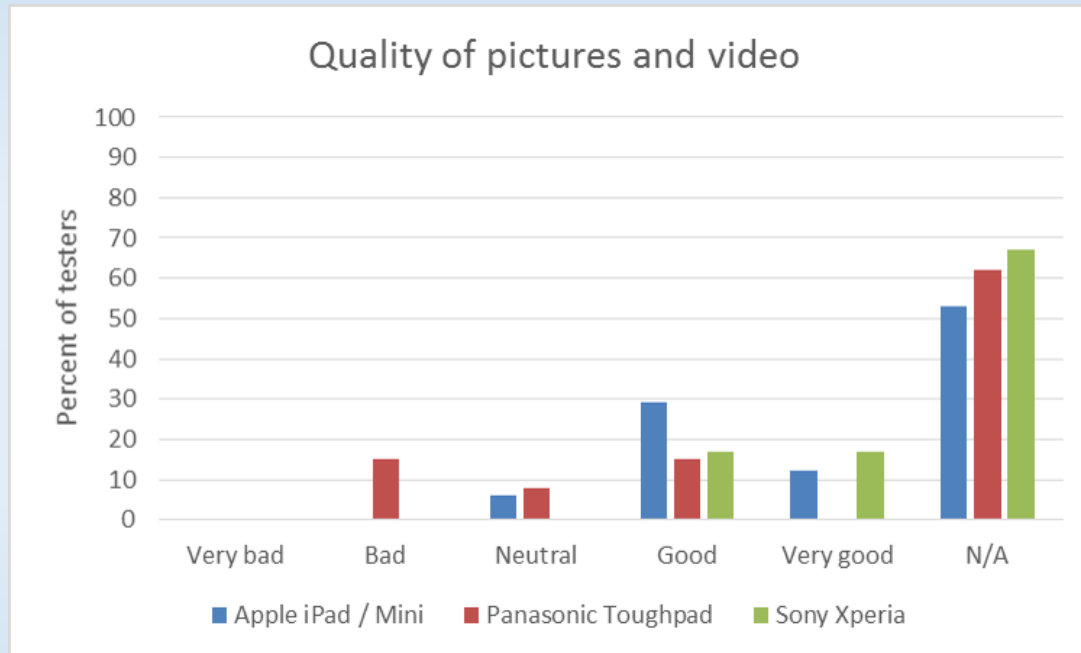
- Few thought so

Users' experience



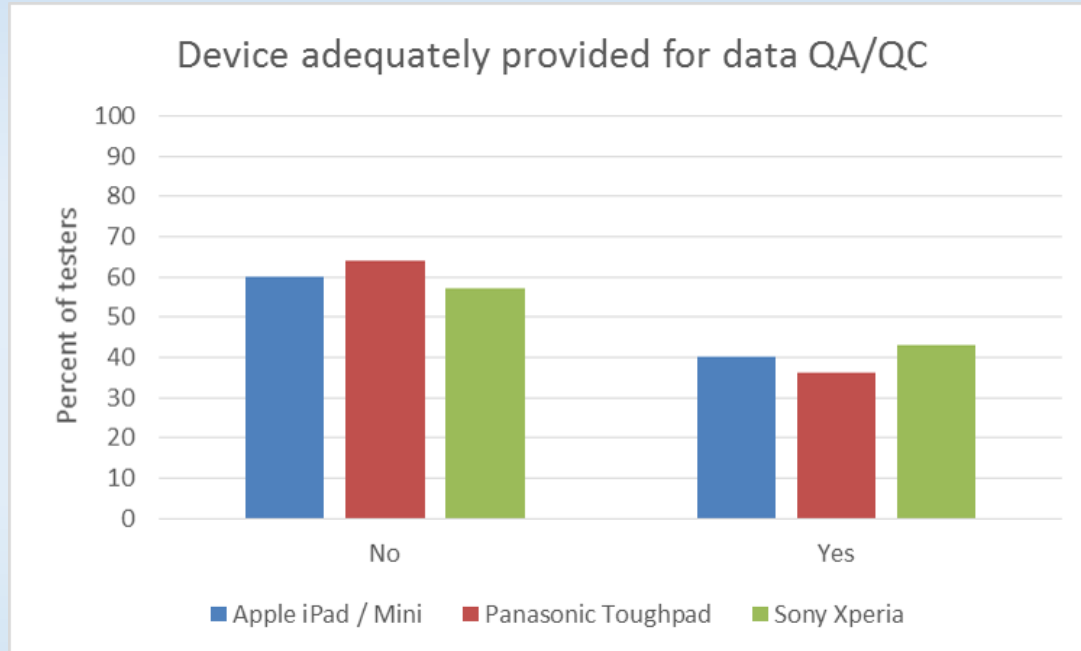
- **iPads sometimes shut down in hot weather**
 - May have been due in part to the ruggedized case
 - Will not restart until ~20 minutes after returning to desired temperature.
 - An occasional dip in the stream solved the problem.

Users' experience



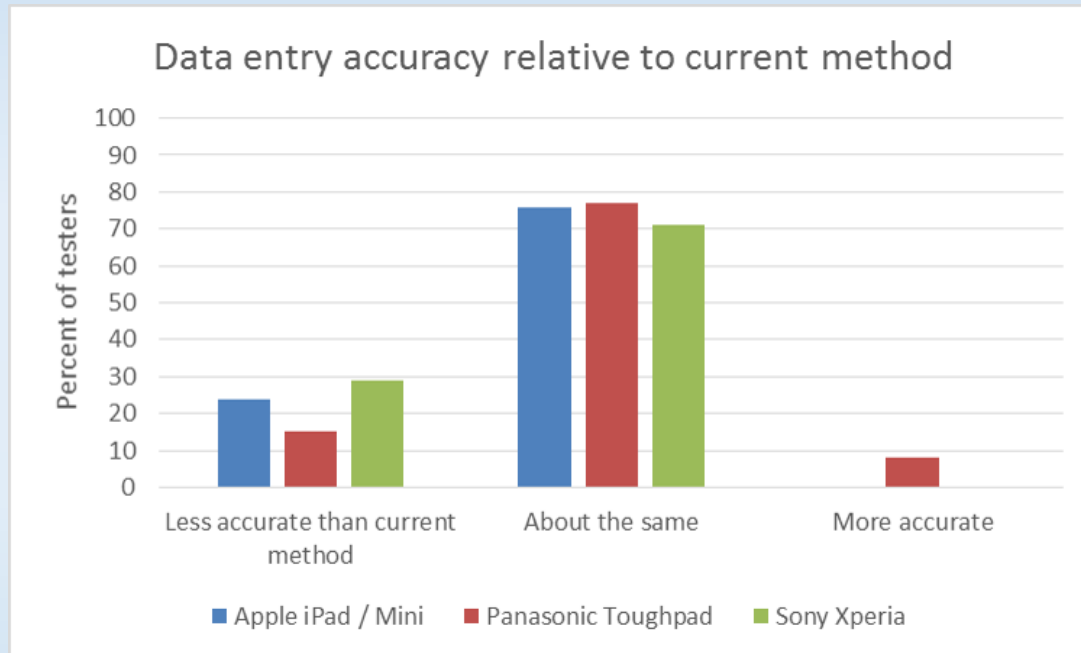
- **Generally good.**
- **2 of the 5 Toughpad users rated it “Bad”**
 - Don't know why

Users' experience



- **A bit over half said no.**
- **Perceptions may not have matched reality in this case.**

Users' experience



- **“Less accurate than current” was all by people who currently used paper forms**
- **“About the same” a mix of paper and electronic**
- **“More accurate” was current paper user**