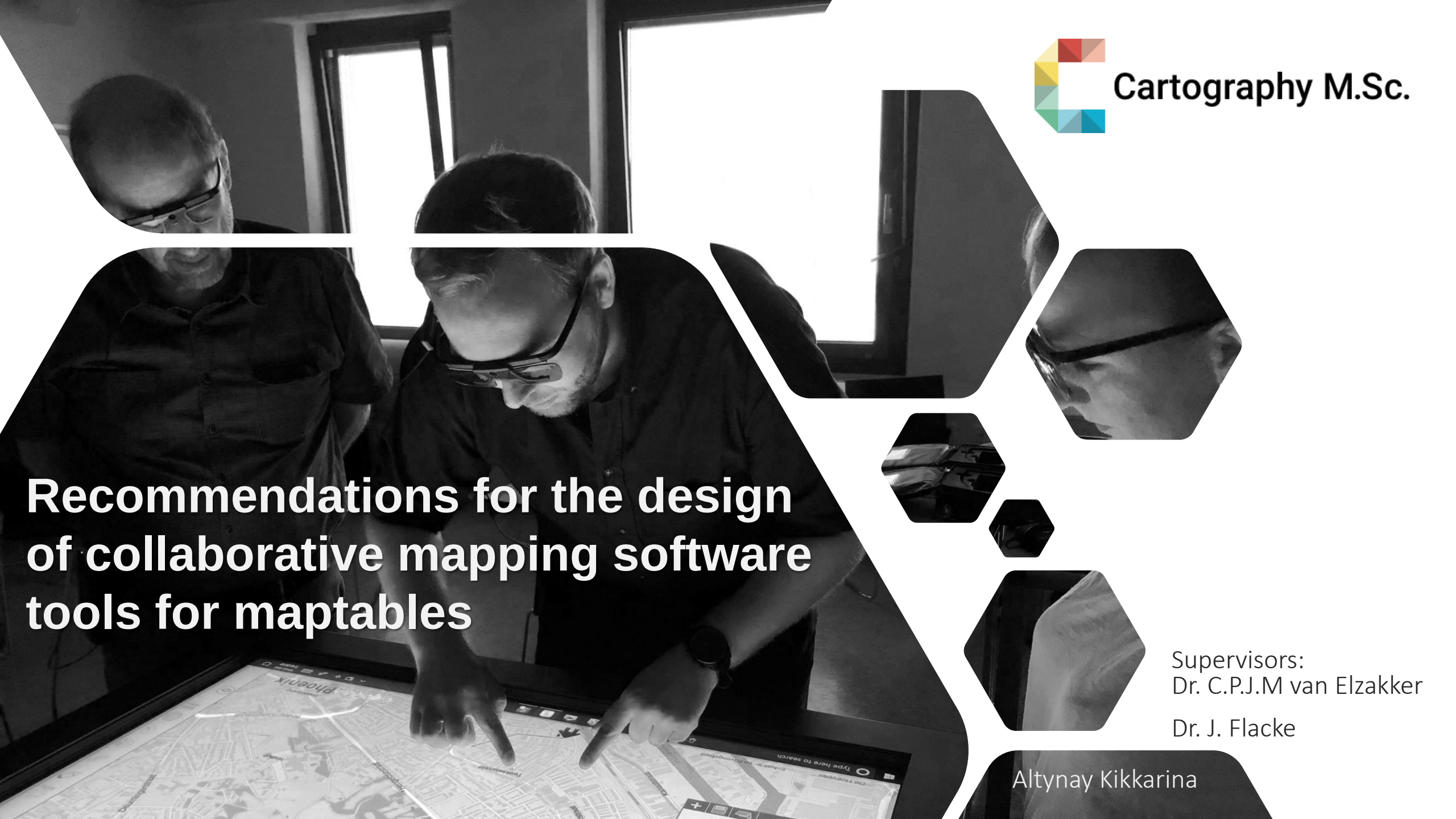

Cartography M.Sc.

Recommendations for the design of collaborative mapping software tools for maptables

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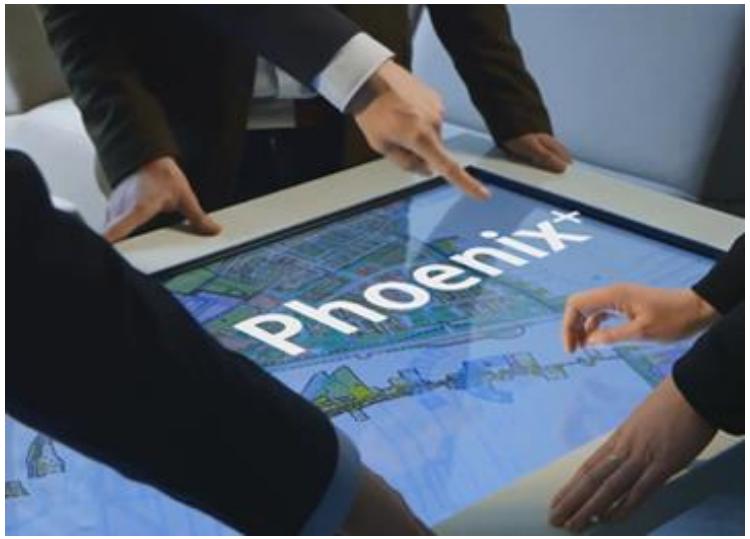
INTRODUCTION

- **The maptable** is an interactive tool that supports collaborative planning and facilitates the participation of stakeholders.
  - Maptable software tools
    - CommunityViz
    - Phoenix
    - Urban Strategy
- **Group decision-making** or collaborative decision-making is a process where stakeholders are conjointly involved in making a decision

RESEARCH OBJECTIVES

- to develop recommendations on design principles of GIS collaborative mapping software tools for maptables, based on testing and evaluating the usability of the Phoenix software
- provide recommendations for the concurrent use of several mobile eye tracking devices to investigate the usability of maptable software



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RESEARCH QUESTIONS

- What is the usability of the Phoenix software?
  - Who are the users, and what are their characteristics?
  - What are the specific requirements of the participatory use of the maptable software?
  - What are the effectiveness, efficiency, and user satisfaction of the Phoenix software for executing a collaborative mapping task?

- What recommendations could be given for the design of GIS collaborative mapping software for maptables?

- Can several mobile eye-tracking devices be used concurrently to investigate group decision processes in collaborative mapping?
  - How can data be collected? How can the collected data be synchronized and analyzed?
  - How are group decisions made?

METHODOLOGY

Requirement Analysis

- Focus Group Interview

Workshop sessions: Mixed Methods

- Questionnaire
- Eye-tracking
- Thinking aloud
- Video observation
- Interview

REQUIREMENT ANALYSIS

Requirements for the functionality of a maptable software

Navigation Tools	Drawing Tools	Analytical Tools	Visualization Tools	Data Management Tools
Zoom in/out Panning Previous extent (back) Rotating The search function (by typing) Showing attributes of selected items (by a simple touch)	Freehand Boxes, shapes Adding annotation Editing	Spatial querying Selecting/grouping Showing features of freehand drawing Feedback of changes Calculations of outcome indicators Editing base information (base map) Two windows for two scenarios	3D Changing the colors quickly Additional Screen Fish-eye zooming of the map Nice dashboard Graphs: pie charts, bar charts, etc. Split interface for simultaneous drawing	Adding/ removing/ changing order of layers Import Files: Shapefiles Excel files Web features (services, web coverage services, layers) PDF Images Export Files: Images Georeferenced images Snapshots of screen

REQUIREMENT ANALYSIS

Requirements for the usability of a maptable software

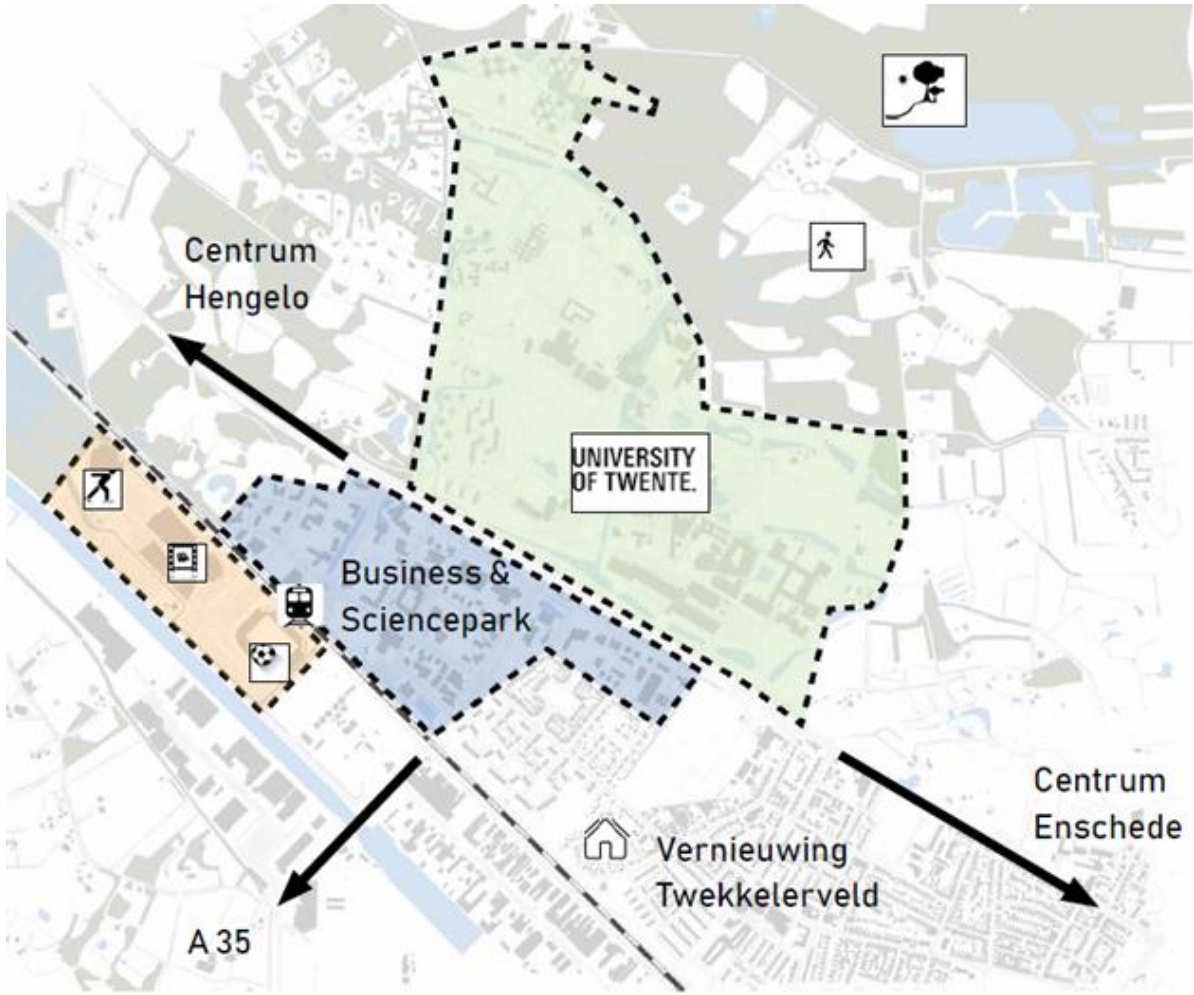
Software Interface Visualization	User Interaction	Challenges	Further Recommendations
Map as a central element As fewer buttons, as possible Toolbar with available tools Main tools always visible Navigations tools Table of content (be able to be easily hidden) Good icons	Two-finger gestures (zoom in/out) Map navigation as in Google Maps Slider between the windows of two scenarios Switching to Edit/ Non-Edit mode Undo button Undo for the extent of the map	Editing of drawings Selecting items Editing by multiple users at the same time Speed of data processing (software, internet)	Voice control Turning the interface towards editing person Screen recording with sound Online access for remote participation Holograms

CASE STUDY
The Kennispark Twente area

The goal of the workshop session –

to get inputs from different groups of stakeholders on the development needs for the Kennispark area to better integrate the two parts of it and to create a lively urban atmosphere.

- The steps of the workshop
  - Warm-up
  - Step 1 – Sharing knowledge
  - Step 2 – Identifying development needs
  - Step 3 – Designing a possible location for the new ITC Hotel



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USER TESTS

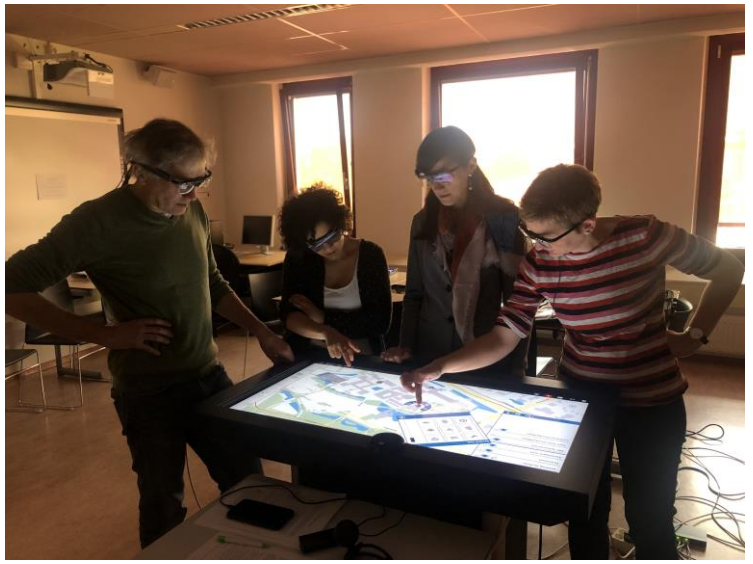
- Pilot Test
- Actual Experiments with 3 groups

Connecting four eye-tracking glasses
to the tablet with Tobii Glasses Controller Software
via Ethernet cables and a switch

Test Groups

Group 1
PhD students (geographical background)

Group 2
PhD and Master Students (mixed backgrounds)

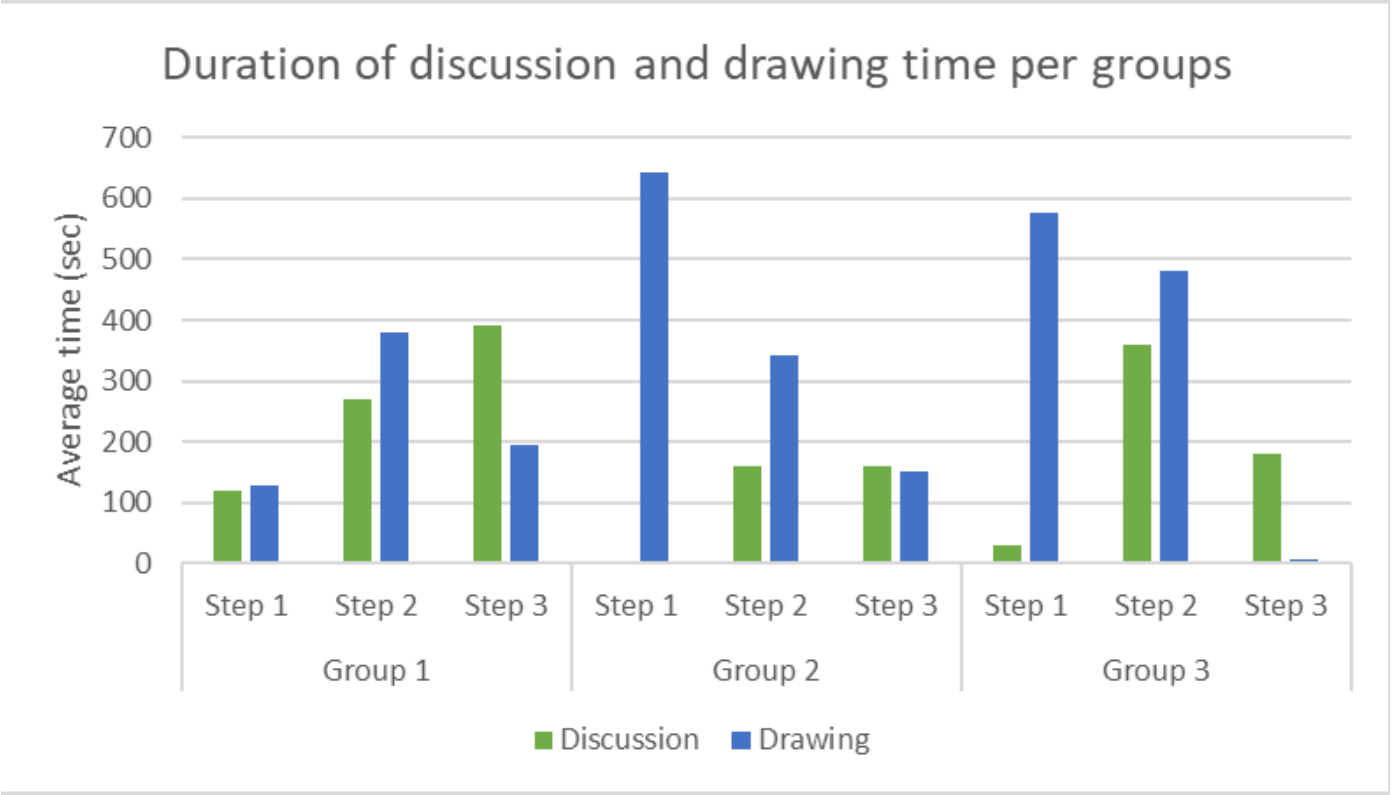


Group 3
ITC staff members with a PhD degree

- The eye-tracking glasses 2 participants in Group 1 were recorded without calibration
- Lost connection of two participants' pair of glasses

GROUP DECISION-MAKING PROCESS OBSERVATIONS

- Participants were mainly looking at the maptable
- They rarely looked at each other during the discussion, usually for 2-3 seconds
- No explicit leaders were observed
- Most active participants were mostly standing in the middle or on the right side of the maptable

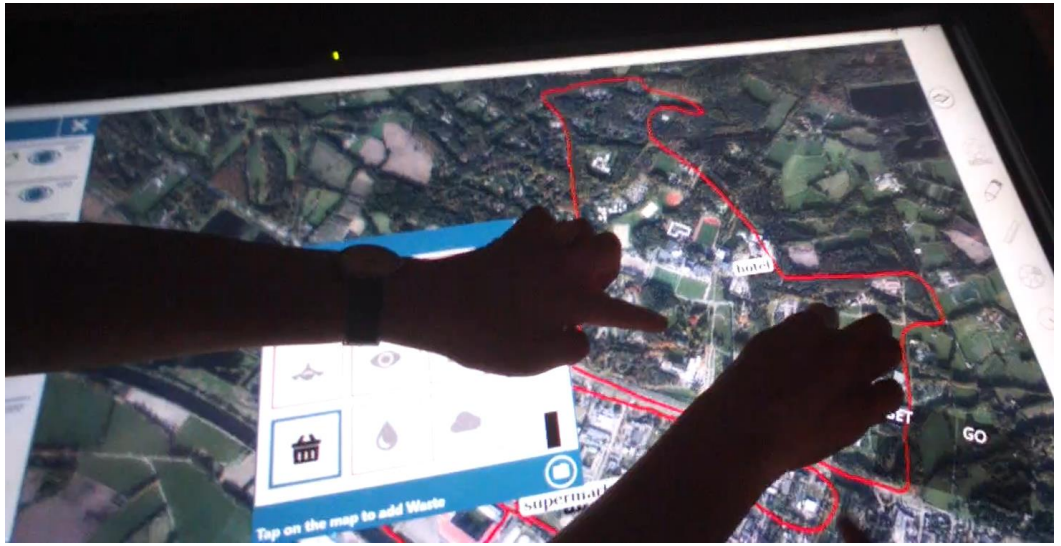


ANALYSIS OF THE RESULTS

	Codes		Sample quotes
1	Functionality	Navigation	Participants used the extent tool to go back to Kennispark area
		Drawing	P3 about the symbols “sometimes it is not easy to find the right symbol because they are not grouped in one specific group.”
		Visualization	P6 commented that editing windows of the symbols overlap “when you press each function, they maintain, so it will be nice if one appears, and you press another function, it will close, so you can see only one function.”
		Analytical	P5 and P4 opened the ruler, adjusted the ruler, then zoomed in the area
		Data Management	P7 switched off the layers
2	Interface		P5 commented that she thought the “x” button in the edit menu of the line was for deleting it
3	User Interaction		P5 tried to drag and drop the symbol from the symbols tool
4	Challenges/Errors		P3 added a new layer, made a typo, accidentally pressed “Enter”

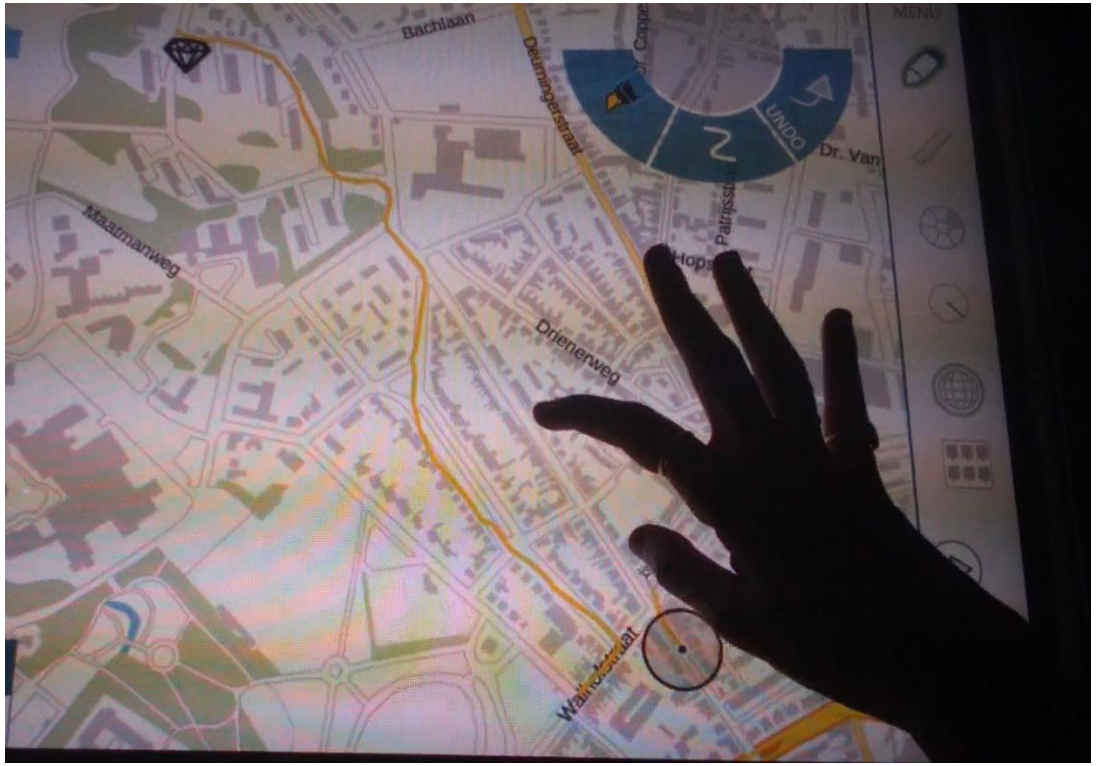
1 Functionality

- *Navigating*
  - Zoom in and out, panning and the extent tools were easy to use
  - Participants wanted to rotate the map



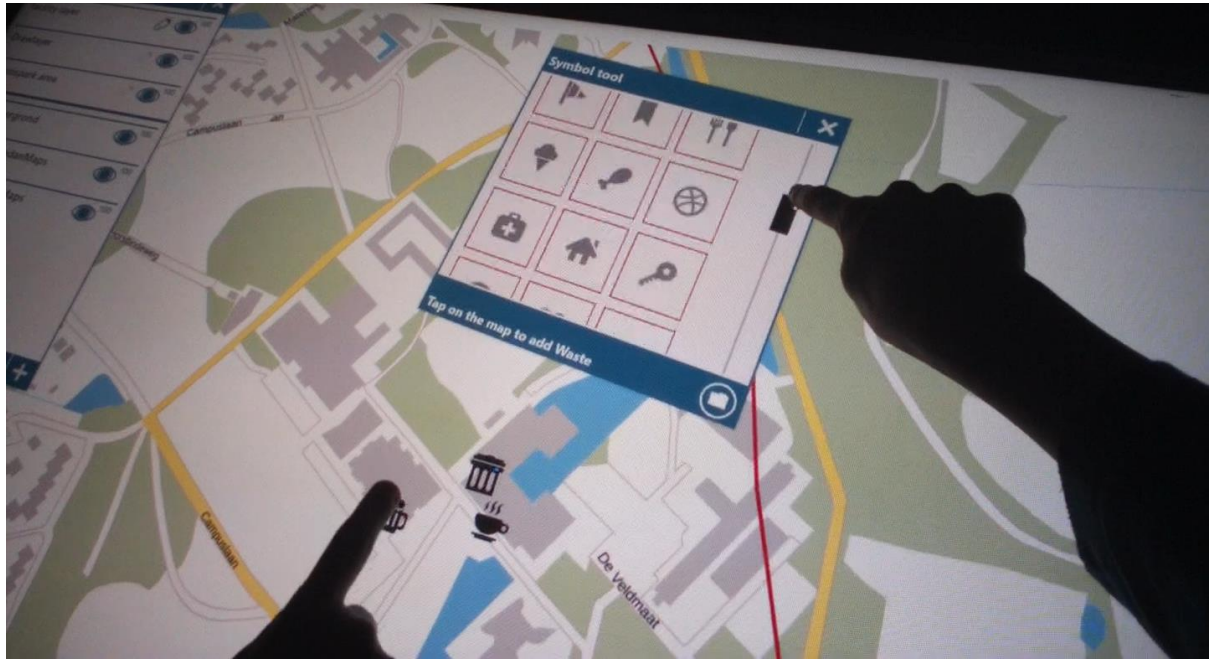
1 Functionality

- *Drawing tools*
  - The drawing tool
    - Users easily drew points, lines, and polygons
    - Not possible to continue the previous line with snapping, especially when users had to pan the map
    - Absence of ready-made drawing shapes, such as rectangle, triangles, circles, etc., users had to draw by hand
    - Participants could not do the handwriting with the drawing tool



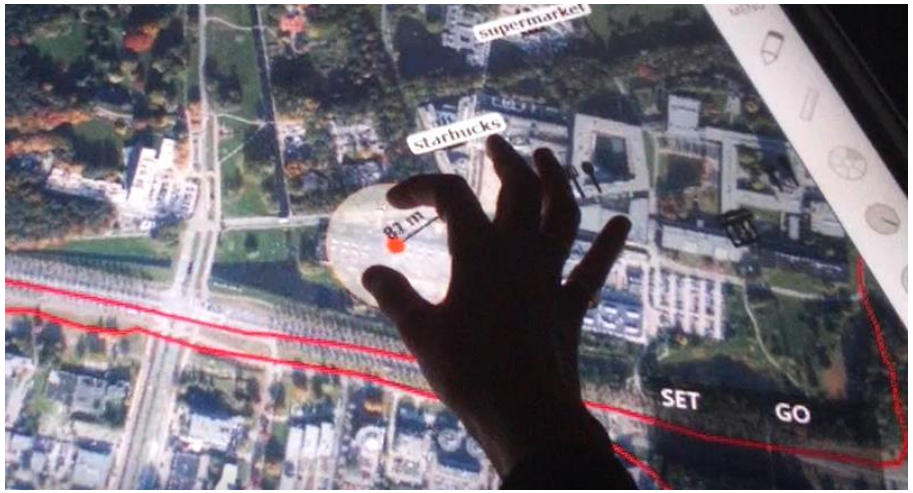
1 Functionality

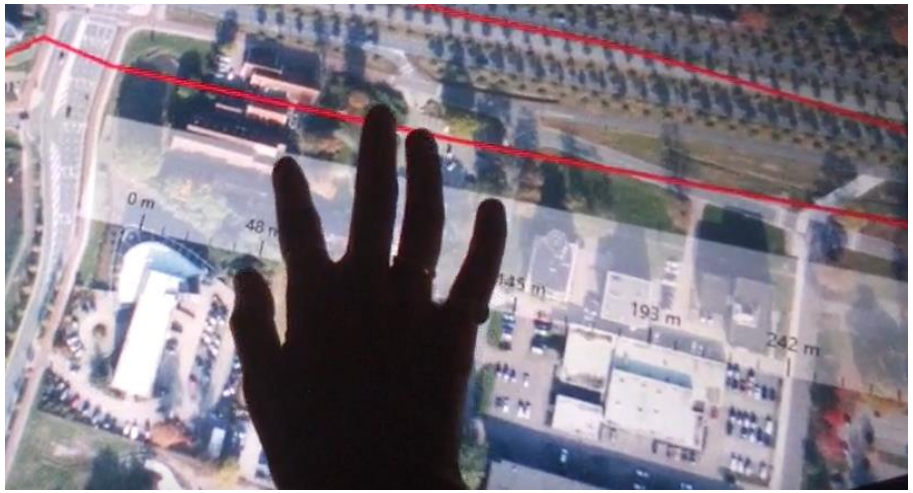
- *Drawing tools*
  - The symbols tool
    - Most used tool in the workshop sessions
    - Variety of symbols
    - Scattered arrangement of symbols in the tool window (not grouped)
    - The annotation was covering the symbol
    - All symbols were black (except two icons)



1 Functionality

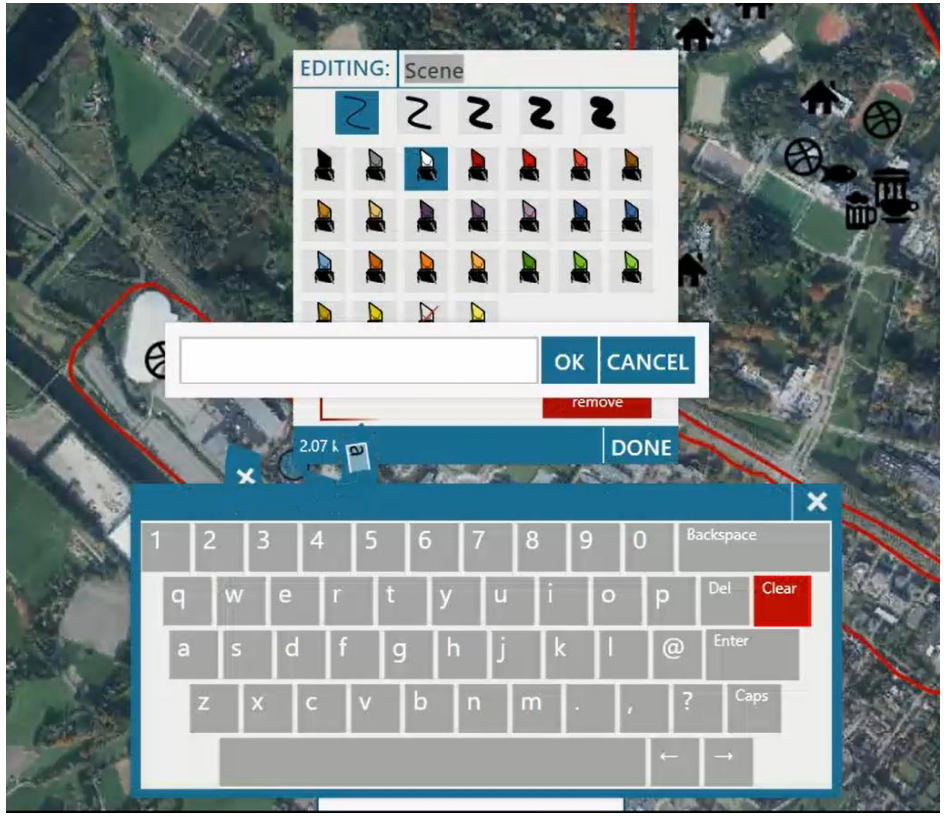
- *Analytical tools*
  - The ruler and buffer tools were actively used by participants and they found them easy and helpful
  - The tools were showing additional information of the drawings, but participants did not use that
  - No option of assigning exact numbers to the tools (i.e. buffer tool)





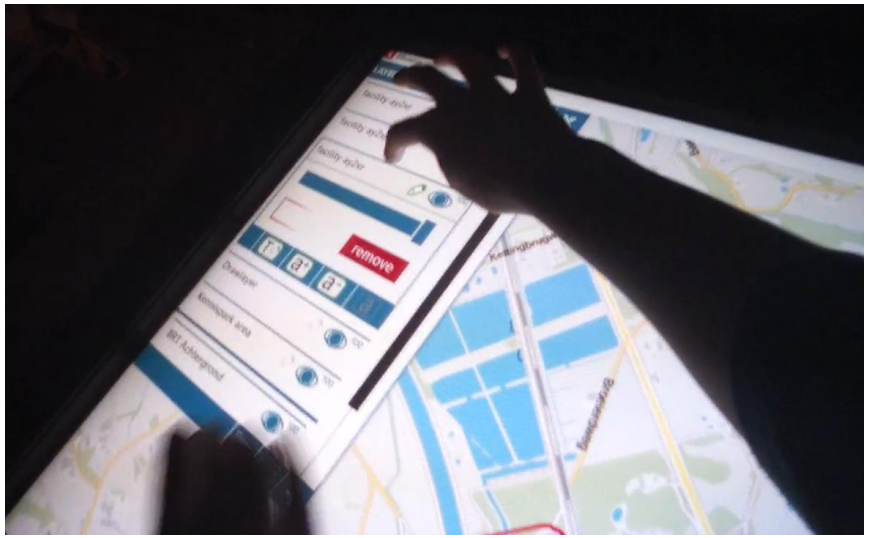
1 Functionality

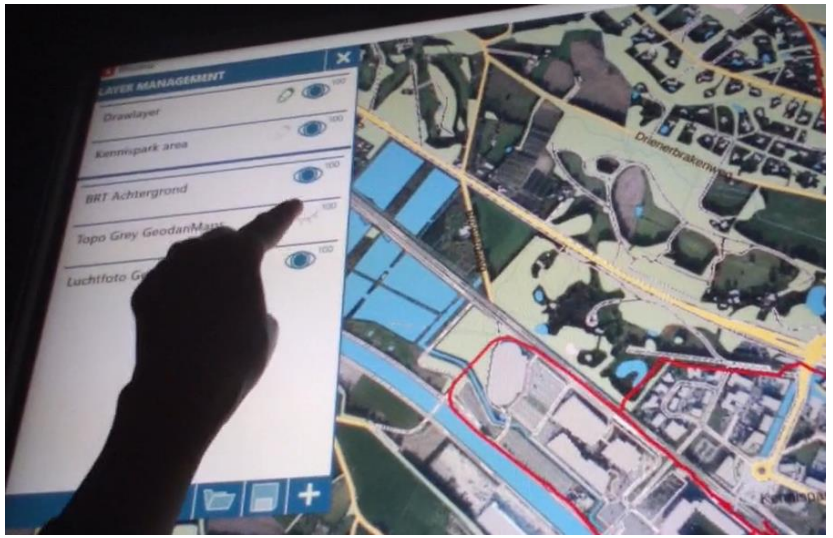
- *Visualization tools*
  - Shows one main window with the map as central element
  - Too many editing windows confused the users



Functionality

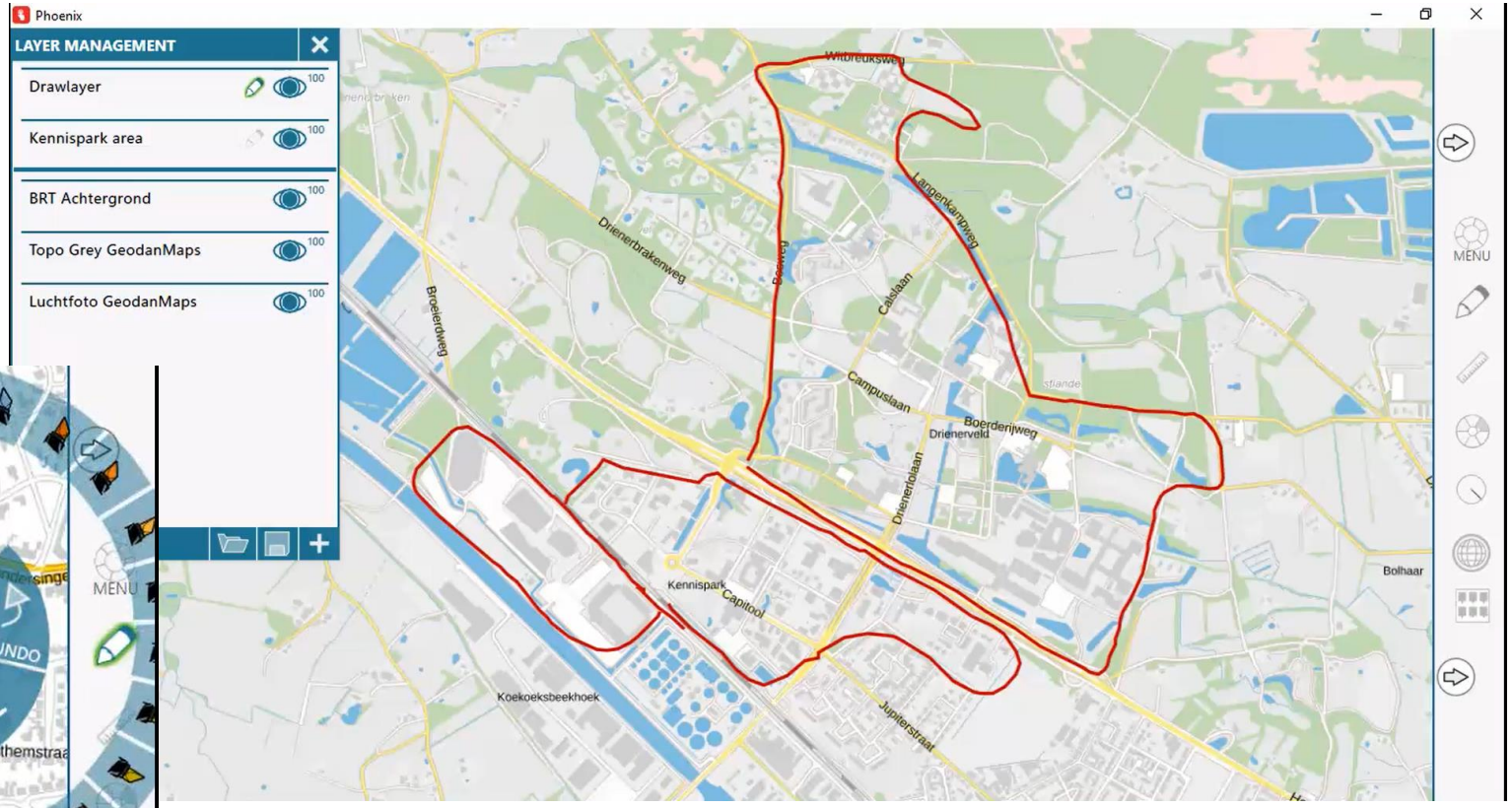
- *Data Management*
  - Participants were switching the layers often and quickly
  - Participants rated well the quality and accuracy of the aerial image and maps
  - Additional manipulations with layers were not intuitive, such as reducing the transparency of the layer, editing and removing

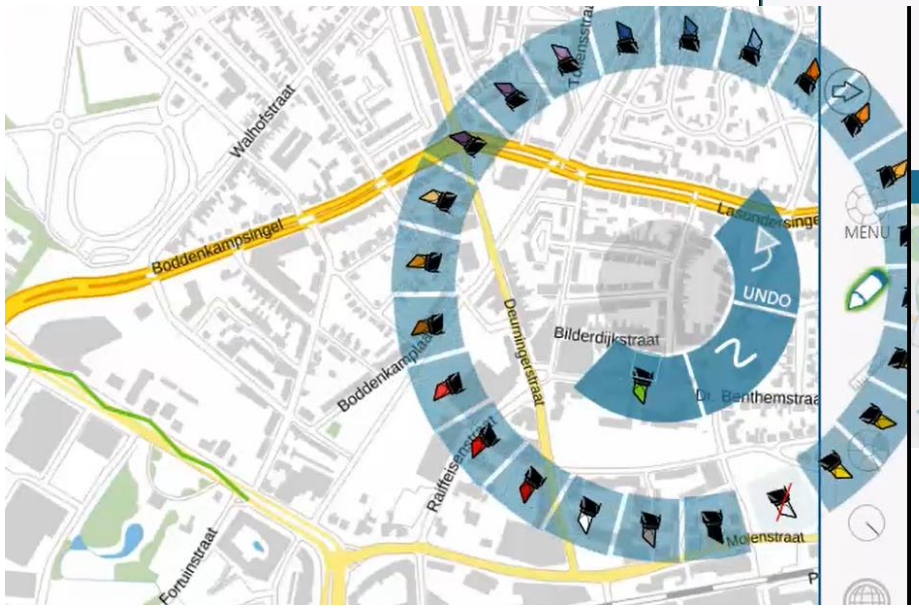




2 Interface

- Intuitive
  - Few tools and simple design
- Easy to use tools





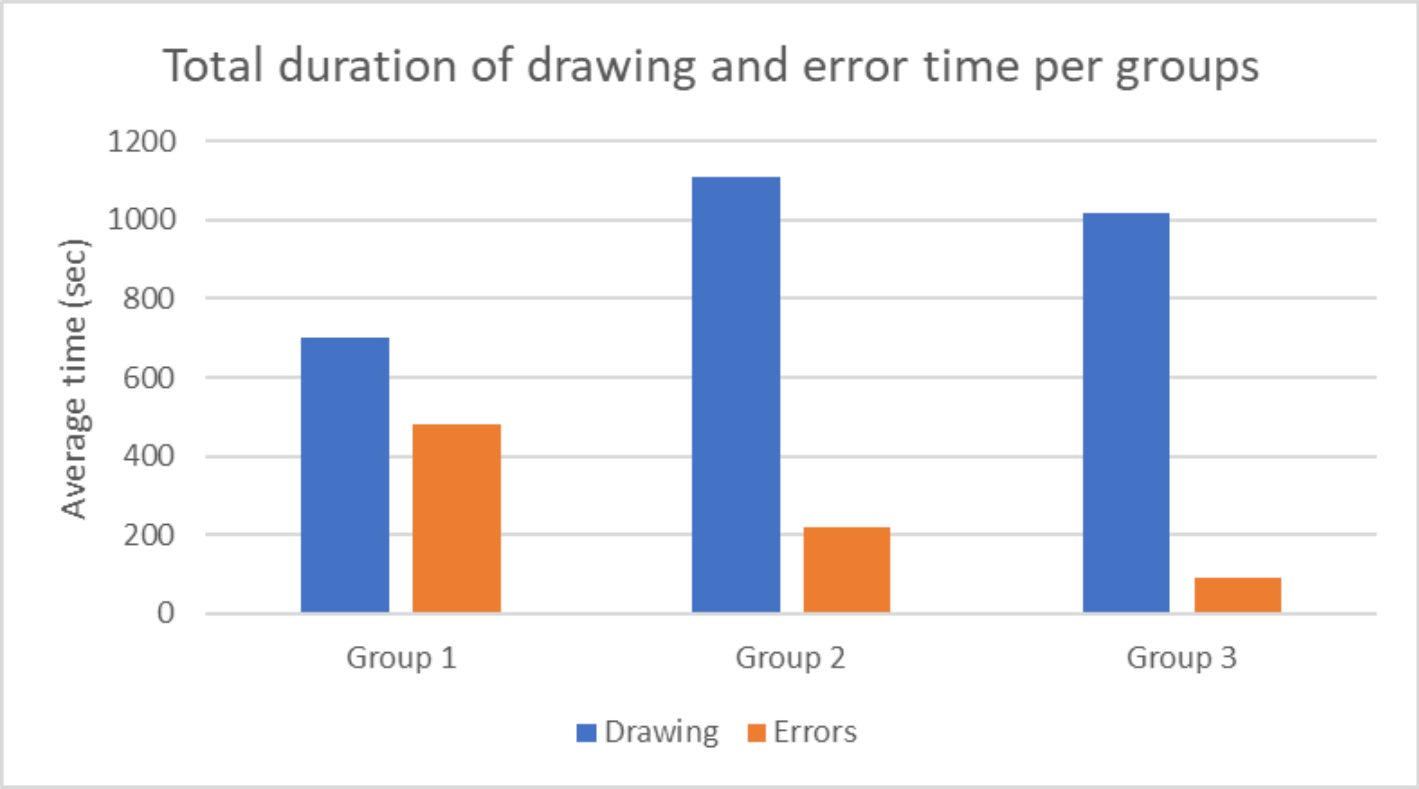
2 Interface

- Challenges with deleting and removing

3 User Interaction

- Map navigation was intuitive
- Participants actively used dragging and shifting for the windows
- Challenges in panning the map while the drawing tool being active
- Tapping on a map of one user could ruin the drawing of another one

4 Errors and Challenges



Duration of the indicated drawing time includes the error time

4 Errors and Challenges

Categories	Errors	Frequency
Symbols	Dragging the symbol from the symbol tool to the map	5
	Wanting to move the just located icon by dragging, and/then long-pressing	2
	Trying to add the same symbol twice on a map by selecting it once in the symbols tool	1
	Trying to annotate the symbol by one tap	1
	Opening another additional editing window (ID, annotation, edit) of a symbol	2
Drawing	In handwriting, the tool creates a polygon once the line closes, and dots	3
	Not being able to draw/add a symbol within the buffer	1
	Adding dots by long press, when he wanted to activate the editing mode of the line	1
	Wanting to add a symbol, but adding a dot, because the drawing tool was active	1
	Tapping the “Done” button of the edit menu to close the window, that was covering the map while editing the vertices of the line, and stopped the editing	1
Navigation	Dragging the map while the drawing tool is active, and adding an accidental line	8
	Trying to rotate the map	1
Keyboard	Tapping the “Del” button instead of “Backspace”	3
	Tapping the “Enter” button instead of “Backspace”	3
	Low sensitivity of the keyboard while typing	7
Interface	Trying to edit the layer name, could not open the keyboard	1
	Could not switch off the layer	1
	Opening another tool	2
Deleting	Trying to delete a symbol with a long press	1
	In the layer management window clicking edit button to remove the layer	1
	Tapping the “Remove” button instead of sliding	3
	Sliding the “Remove” button in another direction	1
	Pressing the “X” (close) button to delete	3

Suggested Improvements for Phoenix

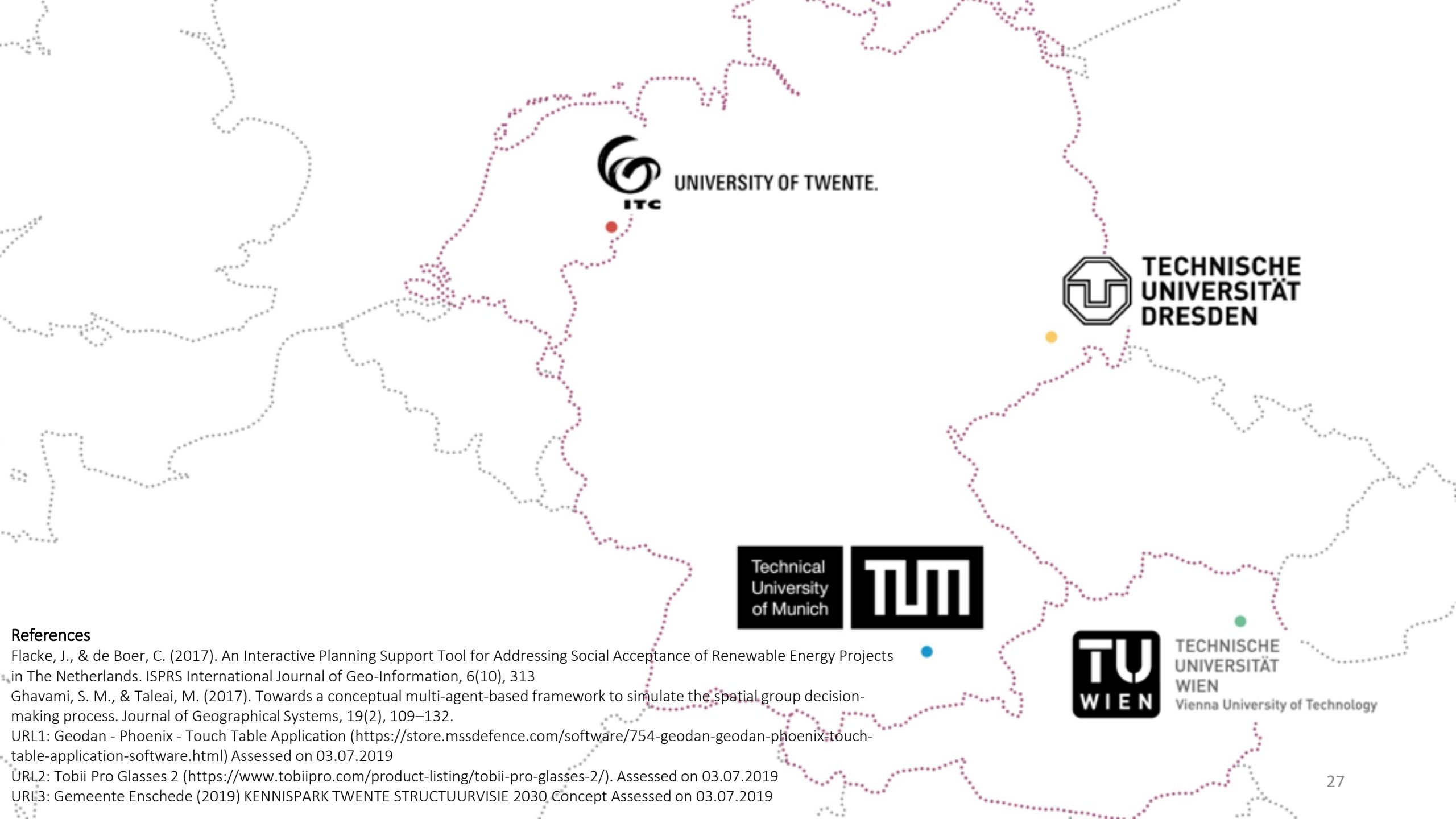
Issue	Improvements
Icons of the editing menu	Red “x” for “delete,” green checkpoint for “done,” pen for “edit,” arrow for drag menu, grey color for non-active sections.
Accidental actions	Redo and undo buttons in the toolbar.
Map navigation	Panning the map with two fingers at any active tool.
Drawing tool	A choice of point, line or polygon and colors in the menu. In case of choosing the polygon: square, circle, triangle, freehand.
	Option to continue drawing by snapping to vertices.
Keyboard	Keyboard with the following buttons: letters, arrow keys, caps lock, enter, backspace, and clear.
Buffer	An option of drawing within the buffer, assigning exact numbers.
Interaction	Clicking on one drawing tool deactivates the previous one.
Editing and removing the feature	Long press on a feature to open the context menu with options such as delete, annotation, color, edit (including change the position of a symbol), and done.

RECOMMENDATIONS FOR THE DESIGN OF GIS COLLABORATIVE MAPPING SOFTWARE FOR MAPTABLES

- The software interface and the tools need to be as simple as possible, with intuitive icons and buttons.
- The map should be the central element of the interface, with intuitively simple gesture navigation. It is important to design the navigation gestures in such a way that they will not conflict with other editing gestures. Because users not only interact with maps but also make changes on them.
- Depending on the users, the maptable software needs to have simple functions for non-expert stakeholders and advanced tools for experts. The solution for that could be placing the most essential functions on the foreground of the interface and activating more advanced functions only in case of need.
- Adding an option of simultaneous drawing for two users could be a good solution for supporting the collaborative (group) mapping purpose of the maptable software.

CONCLUSIONS

- Concurrent use of four eye-tracking glasses is possible
- The group decision-making processes in the experiments were observed
- The usability of the Phoenix software tool was investigated
- The recommendations for the design of maptable software were developed



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URL2: Tobii Pro Glasses 2 (https://www.tobiipro.com/product-listing/tobii-pro-glasses-2/). Assessed on 03.07.2019

URL3: Gemeente Enschede (2019) KENNISPARK TWENTE STRUCTUURVISIE 2030 Concept Assessed on 03.07.2019