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Research and Design:
Innovative Digital Tools to Enable Greener Travel

Analysis of Journey Planner Apps and Best Practice Features

12.6.1 Report

October 2016
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cityverve

Contents

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Aims and Objectives

This report aims to form an investigative report in existing journey planner apps and to identify best practice features. The result of the study will inform subsequent research and design of innovative digital tools to enable greener travel.

Key Objectives:-

- Select multi-transport journey planner apps.
- Identify high level features in journey planners.
- Conduct a usability test on each selected app.
- Identify best practice qualities and recommendations.

Abbreviations

App	Application
API	Application Programming Interface
GIS	Geographic Information System
GPS	Global Positioning System
POI	Point of Interest
UI	User Interface

Introduction

Journey Planner

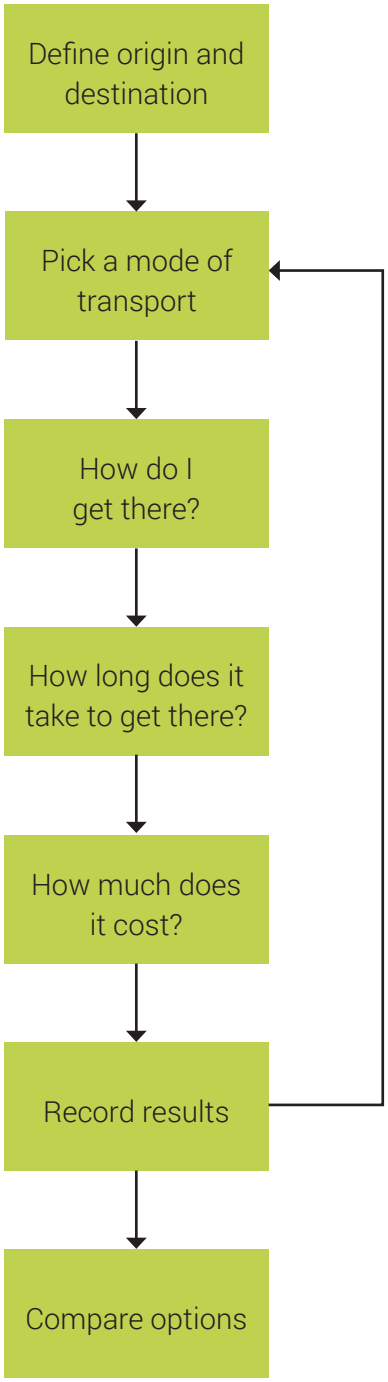
In principle, the process of planning a journey from one location to another involves decisions on the mode of transportation (E.g. car, cycle, public transport or on foot) and potential routes to get to the destination. Factors such as journey time and cost are typically the main considerations in the choice of routes and mode of transport.

Historically, this involved a decision on the mode of transport and formulation of a route on a printed map or with bus and train schedules. If alternative routes were to be explored, e.g. a route that takes less time to reach the destination using a different mode of transportation, the process had to be repeated and the new route compared to the initial one based on estimated time of arrival.

Since the early 2000s large scale web-based route planners such as the Google Directions service and public transport journey planners such as the Transport for London journey planner and the Transport Direct portal have become available as a service. These allow travellers a more efficient service to identify and compare possible routes. They also provide the possibility of retrieving service schedules at specific times of travel without the need to look up paper or static online timetables.

Reports from Public Health England [1] and Department of Transport [2] suggest that a majority of short car journeys could be replaced by a journey on foot with the potential benefits of lower cost, reduced pollution, reduced traffic and resultant improvement to citizen's health through higher levels of physical activity integrated into daily travel.

As journey planners improve overtime with vendors conducting their own surveys [3], more data sets becoming available and the process of cleaning the data becoming more refined, we are increasingly able to compare and evaluate the additional benefits of different routes. Some journey planners now display results that allow us to compare the estimated cost, carbon emission and health benefits to help us make an informed decision on the choice mode of travel and route.



The process of planning a journey.

1 Working Together to Promote Active Travel 2016, Public Health England
2 Cycling and Walking Investment Strategy 2016, Department of Transport
3 For example, Google Ground Truth

Executive Summary

20 Journey planner apps [4] were selected and evaluated using comparative analysis methods focusing on (A) Functionality, (B) Usability and (C) Popularity.[5]

Key

High level features

Usability

Popularity

A) The comparative analysis for high level features suggests Google Maps [4], TripGo [10], Here WeGo [11], Citymapper [6] and My TfGM [3] are the top 5 apps, based on the following criteria:

1) Modes of transportation supported
2) Identified features supported

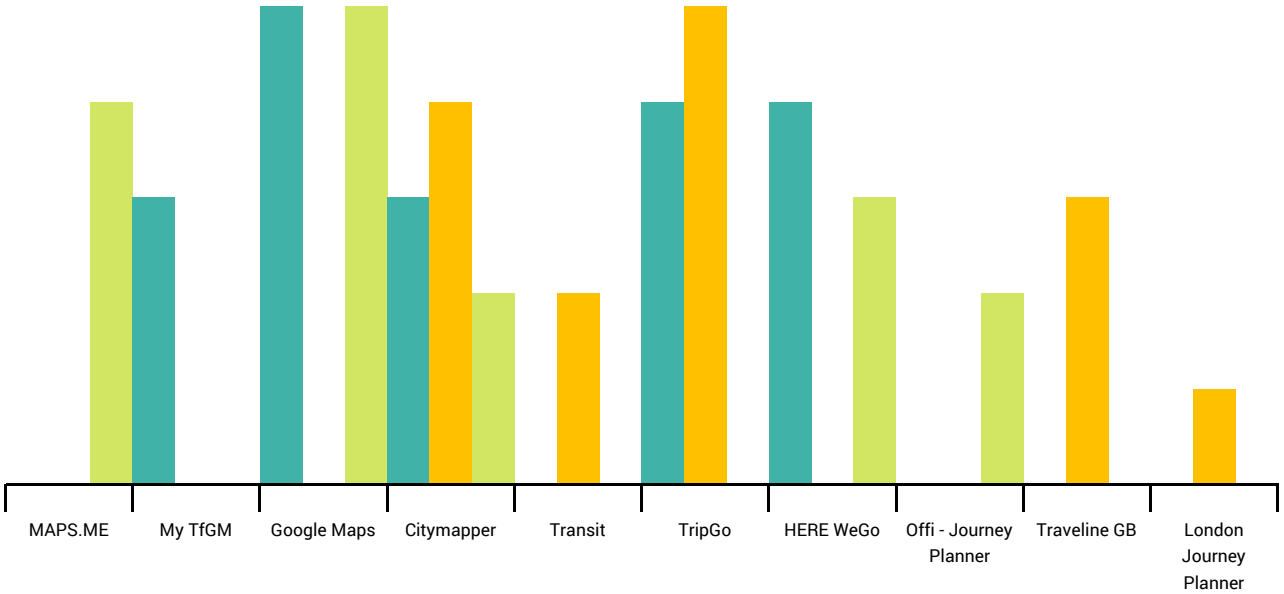
B) The comparative analysis for usability evaluation suggests TripGo [10], Citymapper [6], Traveline GB [15], Transit [8] and London Journey Planner [16] are the top 5 apps, based on the following criteria:

1) Effectiveness
2) Efficiency
3) Satisfaction

C) The comparative analysis for popularity evaluation suggests Google Maps [4], MAPS.ME [1], Here WeGo [11], Citymapper [6] and Offi [13] are the top 5 apps, based on the following criteria:

1) Estimated installs per day
2) Weighted user rating by number of reviews

4 14 apps works in Greater Manchester
5 Note: Method used described within the report appendix.

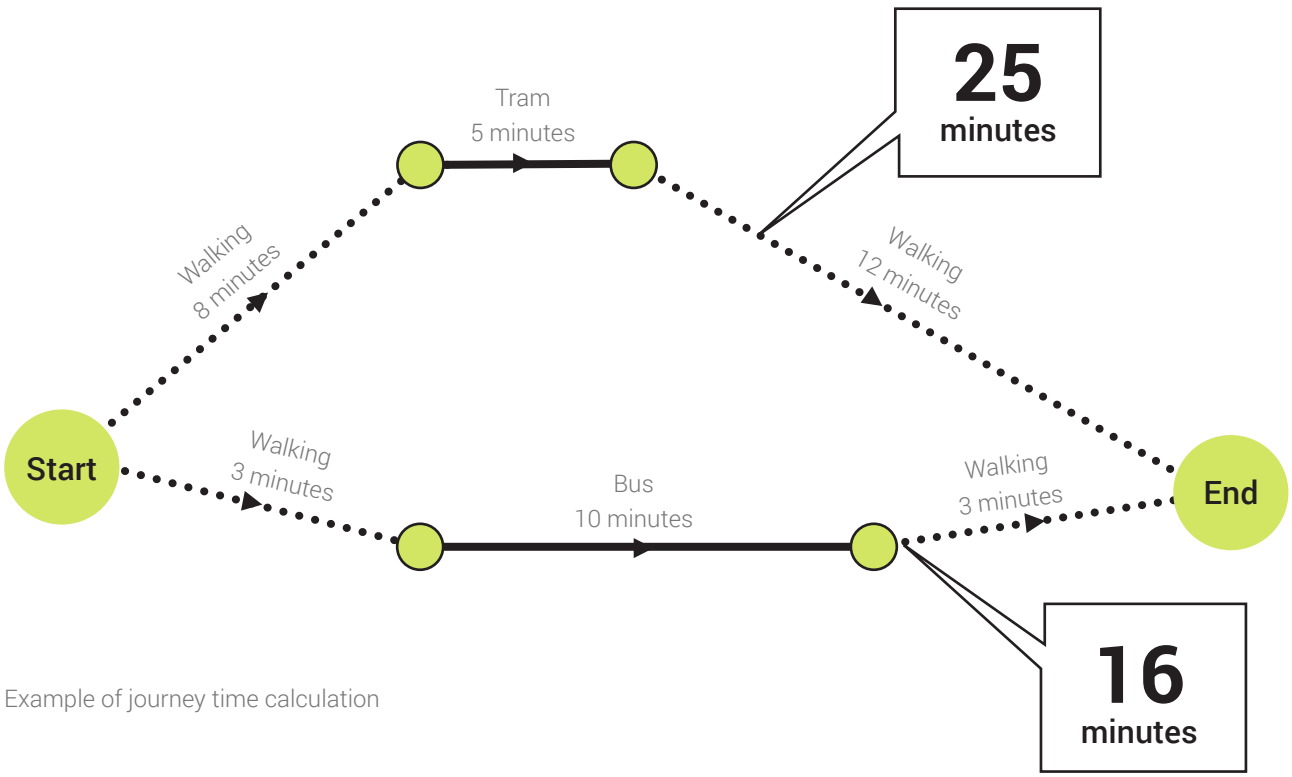


Scope

How does a journey planner app inform decisions?

This study focuses on door-to-door journey planners that support multiple modes of travel with the ability for users to choose different travel options. The integration of different modes of travel is integral to the possibility of making informed decisions on which mode of transport and route to use.

A door-to-door journey planner takes into account the route and time taken to get from the starting point to the desired destination, including all segments of travel. For example, while a tram journey may be faster than a bus journey between two stops, the tram stop may be further away from the origin or the destination or both. An increase in walking time increases the overall journey time and a journey by tram may end up taking longer than a journey by bus. This is also dependent on the time of day and the schedules of the modes of transport.



Example of journey time calculation

Background

Completeness, Consistency, Accuracy, Integrity

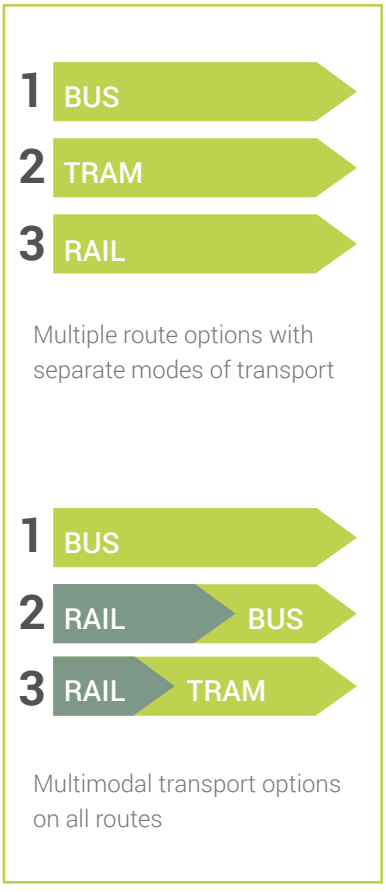
Data quality is one of the limiting factors of a routing service within a journey planner. The completeness, consistency, accuracy and integrity of the data sets determines the reliability of a journey planner.

Route planner

A route planner relies on a complete road map in the form of a network graph. This allows a route to be plotted through a pathfinder algorithm. Driving, walking and cycling works in the same way with a different map that describes the tangible paths for each corresponding mode of transport.

Public transport journey planner

A public transport journey planner relies on a complete service map in the form of a network graph. Some journey planners only support routing between stops on the transport network such as tram or train stations or bus stops. Door-to-door journey planners incorporate a route planner from any point of origin to destination.



Routing algorithm

Most apps havetheir own routing algorithms. These are essential for incorporation of additional layers of information and additional options that influence the route calculations.

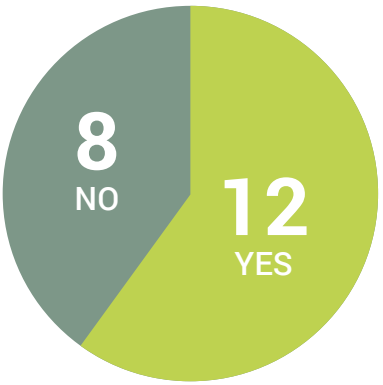
Some apps rely on a third party routing provider. The providers include Google Directions API, Here Routing API and MapQuest Directions API. In addition, some apps make use of region specific routing API, for example Transport for London.

High level features

Multimodal

A multimodal journey planner provides the choice for routes with more than one mode of transport. E.g. For a multiple leg journey involving walking, bus and train use.

All apps compared here support multiple modes of transport. However, there are some apps in use that only contain single mode of transport per route. These are not considered multimodal for the purposes of this report.



Multimodal?

Navigation

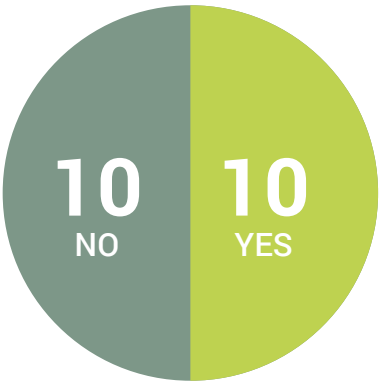
Some apps keeps track of the user's movement and provide navigation guidance activated by the user at the end of route planning and route selection.

Real time information

A route planner can display and respond to road traffic conditions. Those involving built-in GPS navigation can notify users about traffic conditions and re-route to avoid unforeseen delays.

Real-time information for public transport includes arrival or departure times and any delays and line closures. With up-to-the-minute information users can informed plans. Journey planners can automatically re-route to alternative routes or inform users about forthcoming departures. They can re-calculate new estimated times of arrival based on choice of service selected.

In recent there has been an increase in the availability of real-time datasets such as the National Rail real-time information for trains in the UK and the nation-wide UK bus live departure time through the NextBuses API from Traveline.



Handles real-time information?

Collecting data in reality - Crowdsourcing data

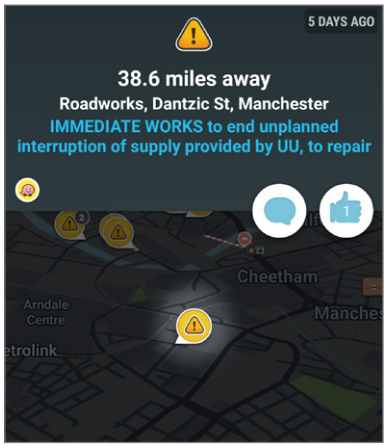
Crowdsourcing involves a number of users contributing information to a system. When this is applied to journey planners information can be submitted by users and location data can be collected in the background. Users are able to report specific events at their location within the transport network - delays, accidents, discrepancies between the information provided by the app and reality. The information is shared

Interface to edit Openstreetmap data

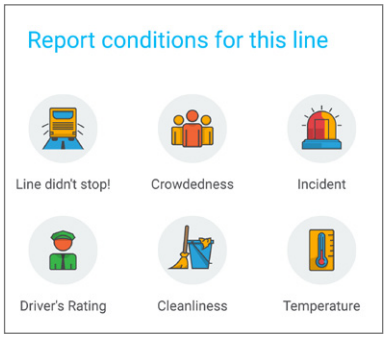
Incentivise Google Local Guides

User reporting

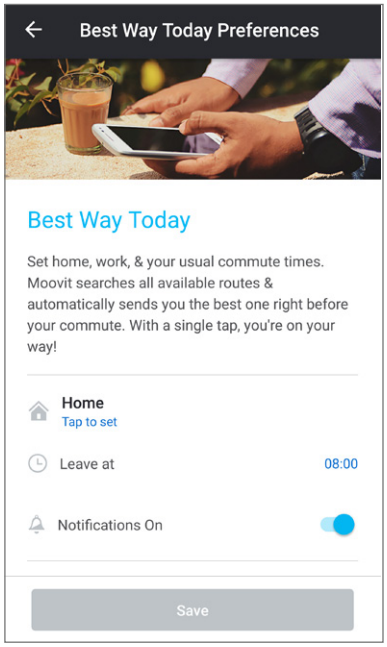
Different types of crowdsourcing employed by different apps



Screenshot of user report as viewed by other users in Waze



Screenshot of user report in Moovit



Screenshot of personalisation setup in Moovit

amongst other users who can respond accordingly. The route taken and the speed of travel can also be collected in the background.

Crowdsourcing in journey planner can be used to create a new dataset that describes real situations on the ground supplementing the other datasets used within an app.

Waze is the leading crowd source road route planner and navigation app. Users can report events on real-time traffic conditions, feeding into the navigation routing methods and helping other Waze users to automatically re-route to avoid severe delays. [6]

Moovit also incorporated this idea in its public transport journey planner. Users can submit a user report under the categories of 'line didn't stop', 'crowdedness', 'incident', 'platform change', 'driver's rating', 'cleanliness' and 'temperature'.

Another form of crowdsourcing is observed in MAPS.ME, which provides an interface to edit places stored on Openstreetmap and Google Local Guides, incentivising contributions in the form of photographs, reviews and other information associated to places.

Personalisation

Personalisation is a method of meeting user's need more effectively and efficiently. This is typically achieved by tailoring an experience based on a user's previous behaviour. E.g. some apps will store and use 'home' and 'work' settings to push notifications and present information that is relevant to a recurring commute route automatically based on a given time and location.

A number of apps such as Google Maps, Moovit, Citymapper, Journey Planner TFI, Here WeGo, TripGo allow the user to save a preset location for 'home' and 'work' as a shortcut to access routes to, from and between the two locations.

Moovit in particular uses this information for personalisation. The app detects the user location and notifies the user about the latest transit details near one of the saved locations by default.

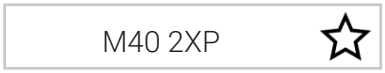
6 Dennis, E., 2015. Crowdsourcing Transportation System Data

Usability

Map and Points of Interests

The location input from a user can be acquired by locating a point on a map which translates to latitude and longitude coordinates or it can be retrieved from location information within predefined points of interest (POI), stops and stations stored within a database. The predefined locations can be incorporated into the search feature.

This relates to usability test task 2 - save a location. Google Maps, Journey Planner TFI, HERE WeGo, Transit: Real-time transit app and Moovit appear to take the least time to complete this task.

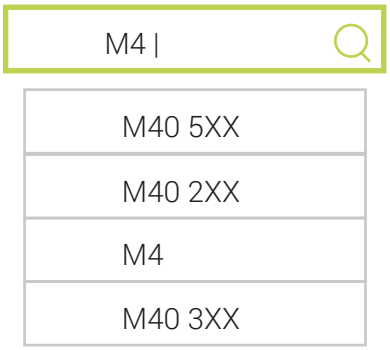


Familiarity and convention from internet browser icon for “favourite”

Geocoding - Search for address and post code

There are third party providers that provideservices to convert address or postcode into latitude and longitude coordinates such as the Google, Openstreetmap, Microsoft Virtual Earth and Yahoo Geocoding API.

To aid ease of data entry, some apps implement auto-completion within search inputs. This searches for known postcode address or places from partial inputs and allows users to pick the required location from a drop down list.



Auto Completion from a partial input

Other methods reduce the need to input data as text. This include a list of previous selections within a search history. Users can pick from a list of items and define them as the origin or destination to make a journey plan. Users can often also save locations that can be accessed and reused again in the future. The most common feature is to use the device’s current location as a location input.

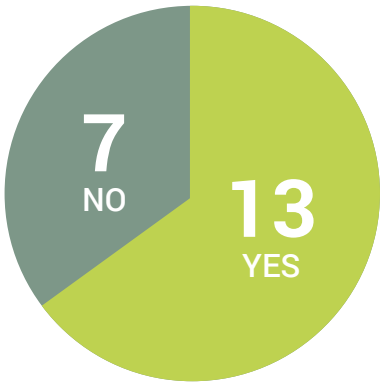
This relates to usability test 1 - finding a route for specific origin and destination.

Time of travel

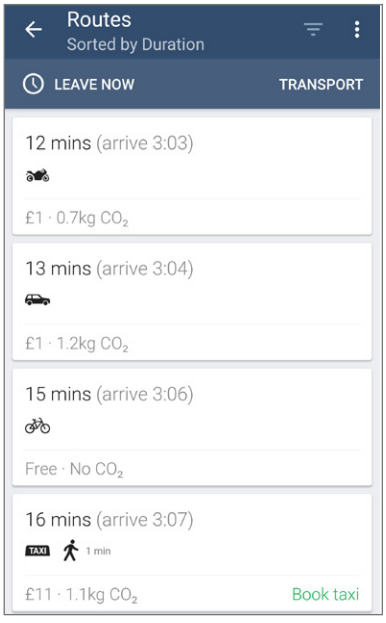
Time of travel is an important variable used in public transport journey planners to include the available services in the routing process at a given arrival or departure time.

Some road route planners make use of the time of travel with an

Some apps lack the ability to revert to current time after searching for a different estimated time of departure (above my TfGM)



13 apps allow some form of customisation.



CO_2 emission comparison above: screenshot of TripGo

additional traffic dataset that incorporates estimated delays in traffic into the route calculation method.

This relates to usability test 3 - routing with specific date and time.

Customisation

Customisation in a journey planner provides user options to fit the preference, needs or requirements of the user. In 13 out of the 20 apps compared here, users can make a choice and select preferred modes of transport. The choice of selection controls the way in which the routes are calculated.

This relates to usability test 4 in which a specific mode of transport is to be chosen.

Citymapper in particular does not include options for mode of transport but it categories the routes that relate to the choices offered by others in a clear manner and for this reason it took the least time to complete this task.

Results display

The display of results is a key stage where users can compare the different route options.

The key essentials that are common in all apps:-

- Journey Time
- Multiple-leg journey (if present) visualise as icon sequence or timeline

Additional information display per route includes the following:-

- Cost
- Fuel/Energy use
- CO_2 emission
- Calories

Usability test 5 is devised to evaluate such features.

A number of questions arise from observing the list of results. For example, the basis for CO_2 emissions in TripGo where taxis and cars have a different estimated emission. What do the numbers mean to the user?

Conclusion

A) High level feature evaluation

The top 5 apps based on the comparative analysis for high level features are Google Maps [4], TripGo [10], Here WeGo [11], Citymapper [6] and My TfGM [3]. Analysis is based on the following criteria:

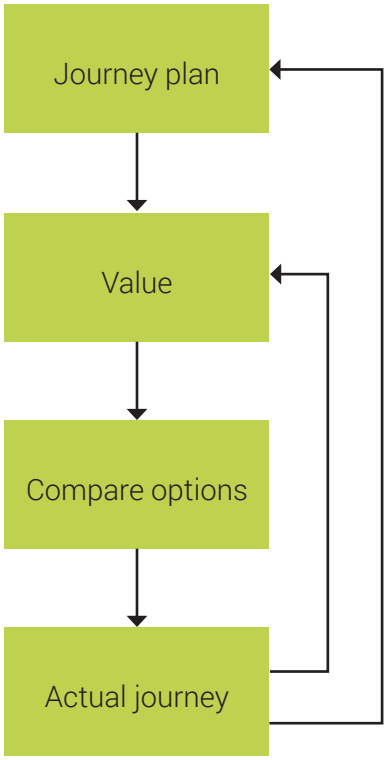
1) Modes of transportation supported
2) Identified features supported

Recommendations

Out of the top five, Google Maps and Here WeGo (formally a GIS data provider named Navteq and as a subsidiary of Nokia) has previous history in their **own mapping data creation**, and have been applied to driving navigation.

All five apps integrate multiple datasets and develop their **own routing algorithm**. This enables usage of real-time data in the route calculation to enhance the accuracy of the result.

Additional data collection methods such as **crowdsourcing** can provide new data sets, enabling new features within journey planners as well as improved user experience in journeys.



Journey planning as a feedback loop. Data from actual journeys can feed back to inform the subsequent use and users.

B) Usability evaluation

The top 5 apps based on the comparative analysis for usability evaluation are TripGo [10], Citymapper [6], Traveline GB [15], Transit [8] and London Journey Planner [16]. Analysis is based on the following criteria:

1) Effectiveness
2) Efficiency
3) Satisfaction

This study has identified a number of **desirable qualities** which help to improve usability:

i) **Ease of data input**
- Auto completion
- Reduced textual input

- UI elements follow the platform convention [7]
- Providing user feedback to validate input [8]

ii) **Customisations**
- Options are clearly visible [9]
  or
- The button to the option menu adhere to the platform convention [10]

iii) **Results display**
- Information appears in a natural and logical order [11]
- Additional information should be relevant to the user's needs only. [12]

C) Popularity evaluation

The top 5 apps based on the comparative analysis for popularity evaluation are Google Maps [4], MAPS.ME [1], Here WeGo [11], Citymapper [6] and Offi [13]. Analysis is based on the following criteria:

1) Estimated installs per day
2) Weighted user rating by number of reviews

Key Findings

Overall, there appears to be a direct relationship between the number of installs and the availability of the car navigation feature. When we consider the number of installs together with the user rating, the top 3 apps include a car navigation function.

Distortions: The app "Google Maps" is typically pre-installed with the Android mobile operation system, this appears to contribute to the high number of estimated installs.

7 Nielsen J, 10 Usability Heuristics for User Interface Design 1995 - 4. Consistency and standards
8 as above - 9. Help users recognize, diagnose, and recover from errors
9 Nielsen J, 10 Usability Heuristics for User Interface Design 1995 - 6. Recognition rather than recall
10 as above - 4. Consistency and standards
11 as above- 2. Match between system and the real world
12 US Department of Health & Human Services usability guidelines 16:7

Appendix: Ranking Table

		Features			Usability				Popularity		
App		Modes supported	Features	Overall	Effectiveness	Efficiency	Satisfaction	Overall	Estimate installs per day	Weighted User Rating	Overall
1	MAPS.ME - Map & GPS Navigation	5	3	8	4	17	13	16	5	1	2
2	Voyager: Route Planner	5	5	12	5	20	12	17	11	5	9
3	My TfGM	1	4	3	3	14	11	13	17	11	16
4	Maps - Navigation & Transit (Google)	1	2	1	2	5	7	7	1	3	1
5	MapQuest GPS Navigation & Maps	5	4	11	3	15	11	14	6	5	7
6	Citymapper	2	2	3	1	2	1	2	10	1	4
7	Transit Directions by Moovit	5	1	4	2	4	6	6	4	3	5
8	Transit: Real-Time Transit App	4	3	7	2	7	2	4	9	4	8
9	TRAFI - Public transport app	3	3	5	1	12	4	6	8	2	6
10	TripGo:Transit,Maps,Directions	1	3	2	1	1	1	1	13	12	14
11	HERE WeGo - City Navigation	1	3	2	3	6	8	9	3	2	3
12	Journey Planner (TFI)	4	3	7	3	9	5	8	12	6	10
13	Offi - Journey Planner	4	5	11	3	18	8	12	7	1	4
14	Maps, Navigation & Directions	5	4	11	5	19	14	18	2	5	5
15	Traveline GB	5	3	8	2	3	3	3	15	8	12
16	London Journey Planner	4	4	9	2	11	2	5	14	7	11
17	TRACKR FREE: Bus & Train Times	5	3	8	2	8	9	9	18	10	15
18	Tripotnik - Sustainable travel	2	5	6	3	13	11	11	20	12	17
19	Merseytravel	6	3	10	3	10	10	10	16	9	13
20	MOVESMART (Certh-iti)	2	5	6	3	16	11	15	19	13	18

Note:

The numbers represent the outcome from each evaluation criteria. 1 is the highest (Green)
Each column is normalised for each evaluation and averaged with equal weighting to produce the overall ranking.

Appendix: Features

		Supported mode of transport													
		Route planner			Public transport										
App		Car	Walk only	Bicycle	Train	Tram	Bus	Others	Modes supported (%)	Multi-modal?	Navigation	Real-time data	Crowdsource	Personalisation	Features (%)
1	MAPS.ME - Map & GPS Navigation	■	■	■					43		■		■		33
2	Voyager: Route Planner	■	■	■					43						0
3	My TfGM	■	■	■	■	■	■	■	100	■					17
4	Maps - Navigation & Transit (Google)	■	■	■	■	■	■	■	100	■	■	■	■		67
5	MapQuest GPS Navigation & Maps	■	■					■	43		■				17
6	Citymapper		■	■	■	■	■	■	86	■	■	■		■	67
7	Transit Directions by Moovit				■	■	■		43	■	■	■	■	■	83
8	Transit: Real-Time Transit App				■	■	■	■	57	■		■			33
9	TRAFI - Public transport app			■	■	■	■	■	71			■	■		33
10	TripGo:Transit,Maps,Directions	■	■	■	■	■	■	■	100	■		■			33
11	HERE WeGo - City Navigation	■	■	■	■	■	■	■	100	■	■				33
12	Journey Planner (TFI)				■	■	■	■	57	■		■			33
13	Offi - Journey Planner				■	■	■	■	57						0
14	Maps, Navigation & Directions	■	■	■					43	■					17
15	Traveline GB				■	■	■		43	■		■			33
16	London Journey Planner				■	■	■	■	57	■					17
17	TRACKR FREE: Bus & Train Times				■	■	■		43	■		■			33
18	Tripotnik - Sustainable travel	■	■	■	■		■	■	86						0
19	Merseytravel				■		■		29	■		■			33
20	MOVESMART (Certh-iti)	■	■	■	■		■	■	86						0

Appendix: Usability test

Methodology

A series of five test tasks are devised to evaluate the usability of the selected apps.

Each task applied to each of the apps are conducted with the same equipment, parameters and similar conditions with the exception of certain pre-defined locations due to some apps being limited to specific regions.

Task 1: Find the quickest route from A - B
Objectives: Results display; Ease of data entry for location input

Task 2: Save a location
Objectives: Ease of data entry to save location

Task 3: Find a route from A - B for a specific date and time
Objectives: Results display; Ease of data entry for date and time input

Task 4: Find a route from A - B by tram or train only
Objectives: Specific mode of transport; Results display; Ease of data entry to specify mode of transport

Task 5: Find the route from A - B for the current time, consider either the cost, calories, energy use and make a selection
Objectives: Results display; Explore additional parameters other than journey time

Metrics collected

1. Effectiveness
Completion rate (Y/N)
Number of errors with short description.

2. Efficiency
Time taken to complete the tasks. (seconds)

3. Satisfaction
How difficult is the task? Rate from 1 (easy) - 5 (difficult)

App	Task 1			Task 2			Task 3			Task 4			Task 5			Effectiveness (%) [1]	Efficiency (task/minute) [2]	Satisfaction (%) [3]
	Completion	Time	Difficulty	Completion	Time	Difficulty	Completion	Time	Difficulty	Completion	Time	Difficulty	Completion	Time	Difficulty			
1		68	3		40	3		30			10			10		40	2.4	13
2		91	1		10			10			10			20		20	0.7	20
3		62	1		23			40	3		42	2		40		60	3.9	30
4		66	2		10	1		42	2		58	2		40		80	9.4	46
5		50	2		44	2		10			10			51	2	60	3.7	30
6		18	1		26	1		23	1		12	1		15	1	100	17.2	100
7		20	1		18	1		35	2		30	2		20		80	10.0	53
8		30	1		18	1		41	1		40	1		20		80	8.3	80
9		38	1		72	3		58	1		55	2		40	1	100	6.0	63
10		15	1		12	1		30	1		15	1		15	All	100	19.0	100
11		21	1		15	1		35	2		37			21		60	8.6	45
12		45	1		11	1		62	1		23			21		60	7.8	60
13		60	2		30			80	1		100	1		20		60	2.4	45
14		40	2		20			38			38			42		20	1.5	10
15		22	1		24	2		23	1		25	1		25		80	10.2	64
16		62	1		22	1		65	1		40	1		20		80	6.1	80
17		17	1		39	2		27	1		62	4		18		80	8.3	40
18		30	2		24			25			30	2		32	2	60	5.9	30
19		23	2		30	2		28			38	1		23		60	6.2	36
20		56	2		32			63	2		40			55	2	60	3.1	30

Note

1 Effectiveness = Number of tasks completed successfully / Total number of tasks * 100%

2 Efficiency = Sum for all tasks (completion/time) * 60

3 Satisfaction = 1/Average(Task Difficulty) * Effectiveness

Appendix: Popularity

App	Estimate average installs [1]	Date of release [2]	Days to 01/10/2016	Estimate installs per day	No. of reviews	User Rating	Weighted Rating (%) [3]
1	30000000	14/08/2012	1509	19881	610390	4.5	90
2	300000	07/07/2015	452	664	1972	4.2	82
3	7500	25/01/2016	250	30	27	4.0	28
4	3000000000	12/12/2012	1389	2159827	6644782	4.3	86
5	30000000	12/01/2012	1724	17401	48134	4.1	82
6	3000000	18/04/2013	1262	2377	46309	4.5	90
7	30000000	18/10/2012	1444	20776	421388	4.3	86
8	3000000	30/07/2013	1159	2588	29758	4.2	84
9	3000000	13/01/2014	992	3024	55138	4.4	88
10	300000	07/01/2012	1729	174	2676	4.1	80
11	30000000	11/02/2015	598	50167	308630	4.4	88
12	300000	30/06/2012	1554	193	572	3.7	68
13	7500000	17/01/2012	1719	4363	77419	4.5	90
14	30000000	03/01/2016	272	110294	118161	4.1	82
15	30000	16/01/2015	624	48	210	4.1	66
16	75000	22/08/2012	1501	50	304	3.9	67
17	7500	09/09/2015	388	19	40	4.0	36
18	300	24/09/2013	1103	0	12	4.8	19
19	30000	29/05/2014	856	35	243	3.5	58
20	75	18/05/2016	136	1	1	5.0	2

Note

1 Data from Google Play as of 01/10/2016

2 Data from http://www.appannie.com

3 weighted rating (WR) = (v ÷ (v+m)) × R + (m ÷ (v+m)) / 5

R = Rating

v = No. of reviews

m = minimum reviews (50)

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