

APPLYING BECK'S TUBE MAP THEORIES AND CONVENTIONS TO NON-GEOGRAPHIC SUBJECT MATTER

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Abstract.

The London Underground Tube Map has proven to be a piece of graphic genius, its author and creator Henry Beck is known for his creativity and the conventions he applied to a regular geographic map to make it more informative and easier to read. He went against popular belief to strip a map of its geographic reality and has become an icon in the graphic and cartographic world as a result.

The London Underground Tube Map has not only been a useful tool for millions of people but it has also opened a window to other graphic designers and cartographers to produce information graphics that are both useful and informative.

Taking the conventions that Beck developed and mastered there is scope to apply these to their forms of information graphics, even those that are not bound by geography. An example of this is the Multimedia Cartography programme structure, which will be explored.

1. Introduction.

The London Underground Tube Map has been considered by many a graphic masterpiece of the twentieth century. With its structure and simplistic design, and the way it can display large amounts of detailed information effortlessly in an easy to read diagram shows how much of a graphic genius it is.

Henry Beck, the creator of the map came up with the concept of taking a map bound by its geographic reality and stripping it of its geography in order for the information to be clearly displayed and not hindered by information deemed unnecessary. He took what was a mess of information and logically ordered it into a concise graphical display. By minimising the clutter and simplifying the amount of different conventions used on one graphic, he developed a system of displaying information that would prove successful not only for many years, but all over the world.

Taking these ideologies and conventions that Beck developed and worked through, there is the potential and scope to use the same ideas to apply to non-geographic subject matter such as pieces of information that would otherwise be displayed in a plain text format. Many other people have taken the theory of Beck's Tube map and applied it to their own subject matter. These cases have been researched and explained in detail below. Following on from the research that has been done in the past, I believe there is the potential to apply the conventions and methods of mapping to my own case study: the Multimedia Cartography programme structure.

2. Mr Beck's Invention.

2.1 The map that defined change -

The train network known as the London Underground today is easy to navigate through thanks to the invention of the map by Beck. Prior to the revised map, the train network in London could be associated with spaghetti with meatballs. The train lines like the strands of spaghetti with stations scattered throughout like meatballs. The first maps of the Underground were released in 1906, by the railway authorities, representing the geographically true location of each line and their respective stations; the map remained this way until 1932. The original maps showed the entire network of the Underground system as clearly as it could while keeping the lines and stations geographic integrity.

Before the conception of the new Tube Map, the geographically correct map was as confusing to tourists as it was to London's own residents. With each line shown in its true location there was a mass of colour and words that could not be classified as a piece of communication but rather a jungle of intersecting lines. The pre-Beck map as shown in figure 1 was one of the last revisions of the map prior to it being completely redesigned by Beck.

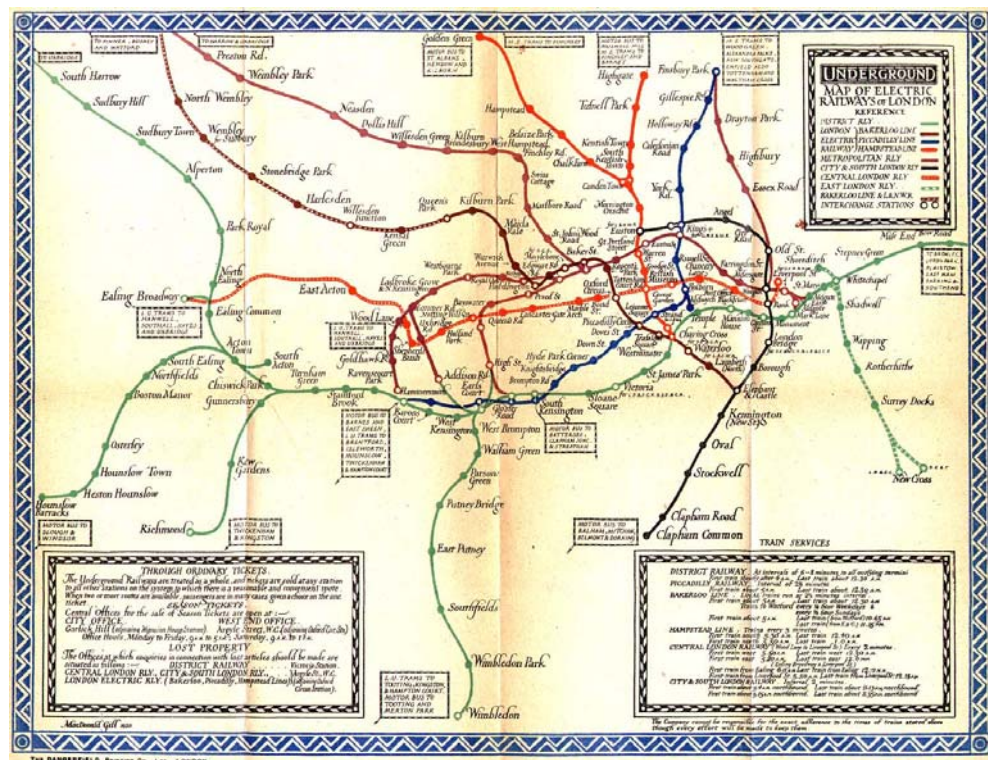


Figure 1: Pre-Beck London Underground Map

2.2 Inception of a design -

Henry Beck was an engineering draftsman who was working for the Underground Group. It is believed that his ideas came from his experience in drawing electrical circuits. He first developed the idea for the reinvented Tube map in 1931. It was his initial sketches that sparked the idea for the map. In figure 2 the initial diagram he sketched can be seen. The underpinning conventions of his idea were evident right from the very beginning. Here the significant features of all the future versions of the design: simplification of the route lines to verticals, horizontals or diagonals, expression of the central area and the elimination of all surface detail except for the line of the River Thames. Beck has described his ideas behind his invention as:

'Looking at the old map of the Underground railways, it occurred to me that it might be possible to tidy it up by straightening the lines, experimenting with diagonals and evening out the distance between stations. The more I thought about it the more convinced I became that the idea was worth trying, so selecting the Central London Railway as my horizontal base line I made a rough sketch. I tried to image that I was using a convex lens or mirror, so as to present the central area on a larger scale. This, I thought would give a needed clarity to interchange information.' (Garland, p17)

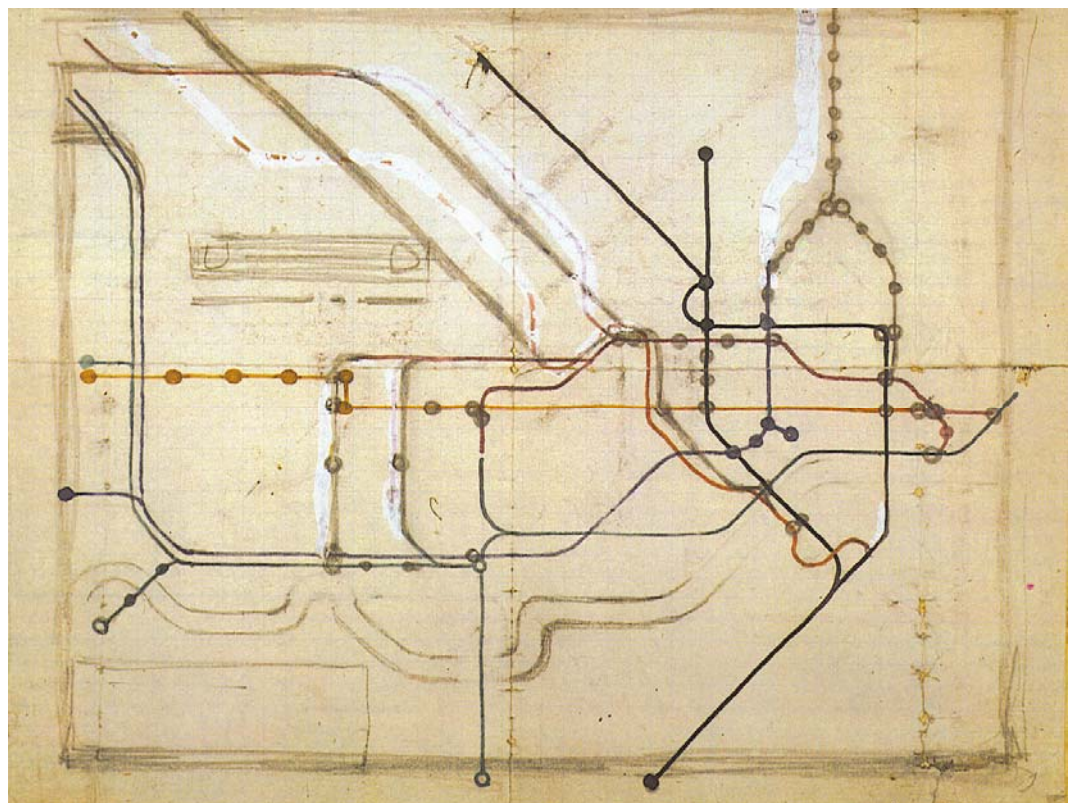


Figure 2: Beck's Initial Sketch

As his account states, his focus in cleaning up the map was to stray away from the geographical accuracy of the locations of rail-lines and stations in the effort of making a map that was clear to navigate. He also considered the idea of evening out the distances between stations regardless of where they were in geographical accuracy in order to make it clearer. By adapting this idea it would allow the central part of the map to be shown at a larger scale and the outer sections of the map to remain constant but still be clear enough to read.

Once Beck had completed his idea of the new Tube map, he submitted it to the Railway board, only to be rejected as it was thought to be too revolutionary. They feared that the new map would prove 'too strange and incomprehensible to the travelling public' (Garland, p17). So it was rejected much to the disappointment of Beck. However he did not give up on his idea of simplifying the network...

'About a year later [in 1932] I had another look at the drawing, and decided, without much hope to try again. This time... it was considered. [They were] going to print it. Thus it was, and only, as I believe, through my pertinacity, that the London Underground diagram was born.'
(Garland, p17)

2.3 Refinement of the design –

The first of Beck's diagrams, the 1931 edition has a strong claim to the electrical circuit diagram theories and this can be seen in figure 3. The map Beck created has all the classic elements that have remained the same and are still ever present in today's Tube map.

From 1931 to 1933, the refinement of the station representation was polished. Beck had experimented with the use of diamonds as opposed to blobs from the previous versions to show the interchange stations. Also the use of handwritten station names were beginning to be replaced with an approved Sans typeface, which as remained the same until the present day map. The second edition saw the addition of a North arrow, not by Beck but by 'a busybody who had no appreciation of the difference between a map representing geographical reality and a purely geometric, straight line diagram representing connections'. (Garland, p 25) It was later taken away as it was deemed unnecessary.

During the early editions of the map the colour coding of the rail lines was also a matter of great discussion. There was some confusion among the travelling public in regards to the red and orange lines of Bakerloo and Central London lines respectively. The colour scheme needed to be carefully thought out as Beck needed to accommodate for a range of situations such as lighting conditions where the map would be used, colour-blindness of a percentage of the travelling population, and the general discerning

of different colours. Once the colours were worked out and chosen they have remained the same since their inception, with new lines adding extra colours to the combination.

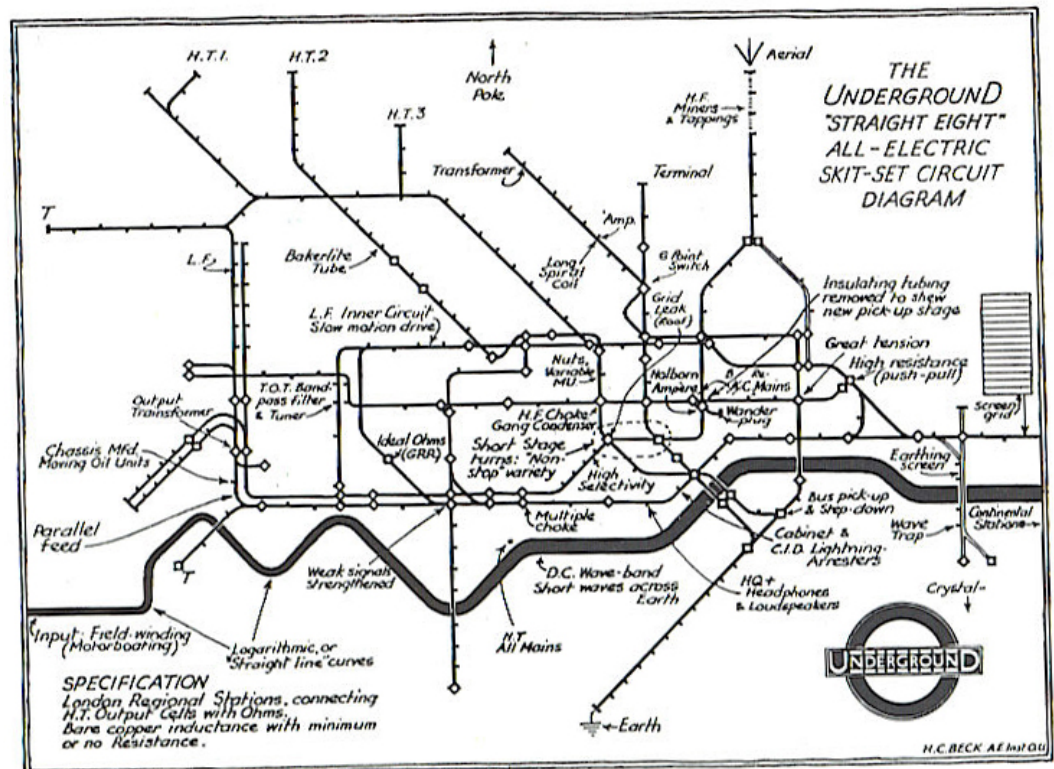


Figure 3: Beck's Map based on an Electrical Circuit Diagram

Many suggestions to the diagram were made by the Underground management and much to Beck's disagreement he made the changes only to prove they were not successful representations. An example of some of these ideas can be seen in figure 4, where the main stations were suggested to be represented as large diamonds with the information internally contained. With many of the ideas that were discussed, Beck totally disapproved but loyally incorporated them each time changing the appearance of the map. Beck hoped the map in figure 4 would be seen straight away 'for the aberration it was' (Garland p25).

Then in 1939, Beck set about with yet more changes to the map in the hope of making it more legible and clear, he introduced the idea of interlinked rings to denote interchange stations, but it was later seen that this idea merely added complexity rather than increasing clarity. He also decided to change the angle of the diagonal lines from 45° to 60° to the horizontal.

During 1940 there were yet more changes that would be made, one of these changes was to make the map more rectangular on a whole and reduce the amount of diagonal lines. When these revisions were introduced in early 1941 it raised some criticism from London Transport. The diagram with these changes had moved even more from the

reality and geographic accuracy, but for Beck this was just another step in the refinement of the map and the search for ultimate simplicity and clarity. The map from this point remained unchanged until 1959.

Beck's last published map was in 1960, when he redrew it completely with only minor changes. It is not known why he redrew it and the changes are only apparent to the keen observer.

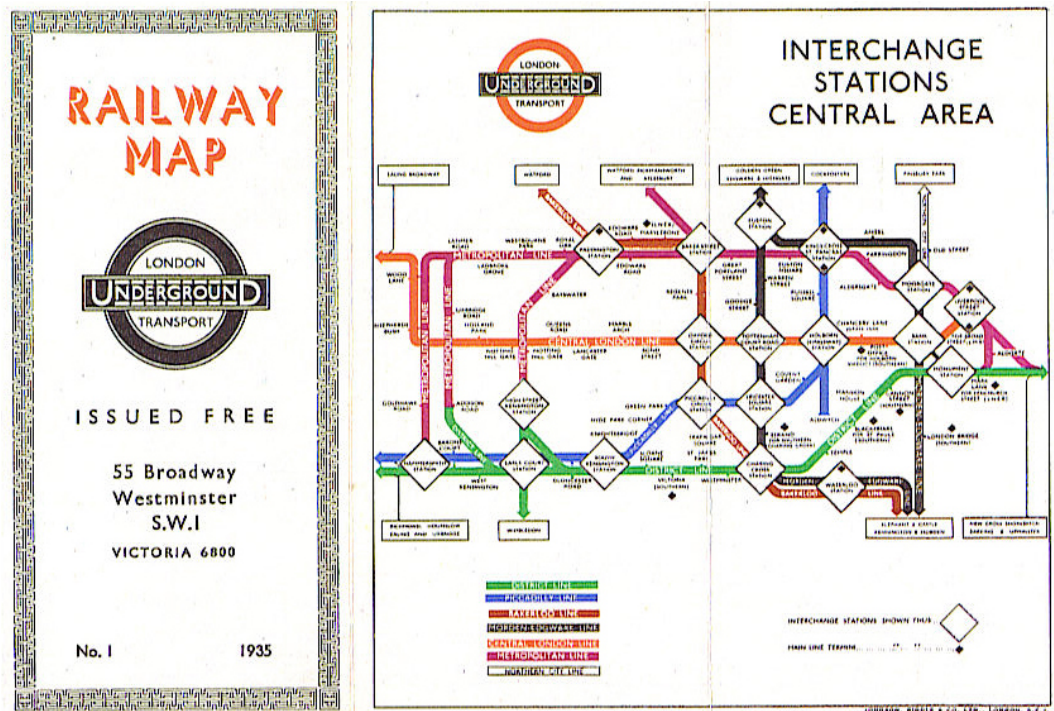


Figure 4: Ideas expressed for the London Underground Map

2.4 The importance and significance of the map -

There is no doubt that the invention of the London Underground made an important contribution to the development of graphic design and cartography in the 20th century. There are very few works that have had such an influence worldwide like that of Henry Beck's map. Not only has it been an influence for other designers, but it has taught the graphic community that 'for a product to be effective: information design must start, not merely end, with its users, their needs, their perceptions.' (Garland, p 62) It is undoubtedly right to say that Beck's map has '...achieved both visual distinction and proven usefulness in equal measure.' (Garland, p 62)

3. Applications to non-geographic subject matter.

3.1 *The Great Bear*

Simon Patterson created a piece of work titled 'The Great Bear' in 1992. His work was in the effort of reinterpreting existing information systems into pieces of art. In his piece he began with the London Underground Map as his reference point. In this piece Patterson has remained faithful to the map look and design but has replaced all the station names with a variety of famous people, for example the Circle Line stations are the names of philosophers, while the Northern Line is a list of film actors. Patterson's aim behind this work was to show how these particular people of society relate and connect to one another while having vastly different professions or fields. An example of Patterson's map can be seen in figure 5.

While this application has taken Beck's map directly and only changed the 'station' names, it can still be considered a good example of how cartographic conventions can be applied to non-geographic subject matter. It is cases like this that help the viewer make connections between different subjects in a visual way that by other means may be more challenging.



Figure 5: The Great Bear by Simon Patterson

3.2 The Sun Years

Another example of how cartographic methods have influenced design in various forms is a very interesting and somewhat original piece of work by design students from Stuttgart in Germany. Mark Stapelberg and Daniel Fritz produced this poster series for an annual design magazine. The work was titled 'AM7' and the major theme of the work was 'communication'.

The AM7 Sun Poster elaborates on an article written in a magazine called 'Sun Years', which is a fictional story about 'Elvis being kidnapped after an alien race listened to his music which was on the golden record sent on a voyager probe in 1977' (Fawcett-Tang, p55). Thus the poster being based on this article shows a series of elaborate and stylistic maps of the fictional world 'Planet Roosta' whose continents bear a striking resemblance to a portrait of the *King* himself. The artists have created maps of the imaginary solar system, a world map, a map of the Sun Islands focusing on their roads, waterways and cities. A map of Wayon, the capital of North Alacarecca, a map of Sun, the capital of Sun Islands with a zoomed in section of the Sun-Downtown street map and also a ferry map for Sun Island, which can be seen in the figures below. The ideas behind this work can clearly be seen to have an influence from Beck's maps where they have produced any map containing a road network or similar. Such as can be seen in the figures below where the roads network is shown on the islands. They follow the conventions of horizontal, vertical and diagonal lines.



Figure 6: The Sun Years Map



Figure 7: Various sections of the Sun Years Map

3.3 Body Rail Network

A fellow RMIT student, Geoff Williams, in 2006 chose to create an interactive product on the human body as his choice of topic. The product he created was an atlas that contained a range of maps covering the human body. These maps included a city centre map of the human brain, an atlas map of the entire body, a road map of the body and a rail map of the human body. The map of focus for this paper is the rail map that Williams produced. He took on the approach of using Beck's conventions for the Tube map and created a map in the form of a human body, creating rail lines as different sections of the body and the stations as main parts of body. The map as shown in figure 8 displays William's efforts to display the human body as a rail network. He has in his attempt to create a map with likeness to Beck's included such things as the airport. While these things add an element of reality or geographic relation to the map, they are not necessary to create a useful information product.



Figure 8: The Body Rail Map by Geoff Williams

3.4 Knowledge Visualisation

One company, based in Switzerland; *Vasp Datatecture*, have based their company and all their works on the ideologies behind Beck's Tube map. They are a company who "investigate(s) how to exploit our innate abilities to process visual formats to create more business impact". They have found that "...visual representations have various emotional, cognitive, and social advantages - complementary to textual and numeric representations". (www.vasp.ch)

The mission statement of their company states that "With customized visual representations you will get the attention of your target group, accelerate understanding through coherent structures and visual clues, facilitate the elaboration of knowledge in groups, explicate scenarios and visions, reduce the complexity to an understandable level of detail, and you will evoke emotions and desires for your content". This in a nut shell is the complete goal of Beck's Tube map.

Concept mapping researchers such as those from Vasp Datatecture are developing visually enriched concept maps and to integrate complementary visualization techniques, such as story telling.

In this example (figure 9) a development process had to be communicated and established in an education centre for health-care professions. Gantt charts and traditional project plans did not reach their goal for the intended purpose. As a result, the client was looking for a concept or knowledge map that complemented the Gantt chart. The 'Tube Map Visualization' (figure 9) maps the whole project based on the visual metaphor of a tube map. In the Tube Map Visualization, each tube line represents a target group and each station a milestone.

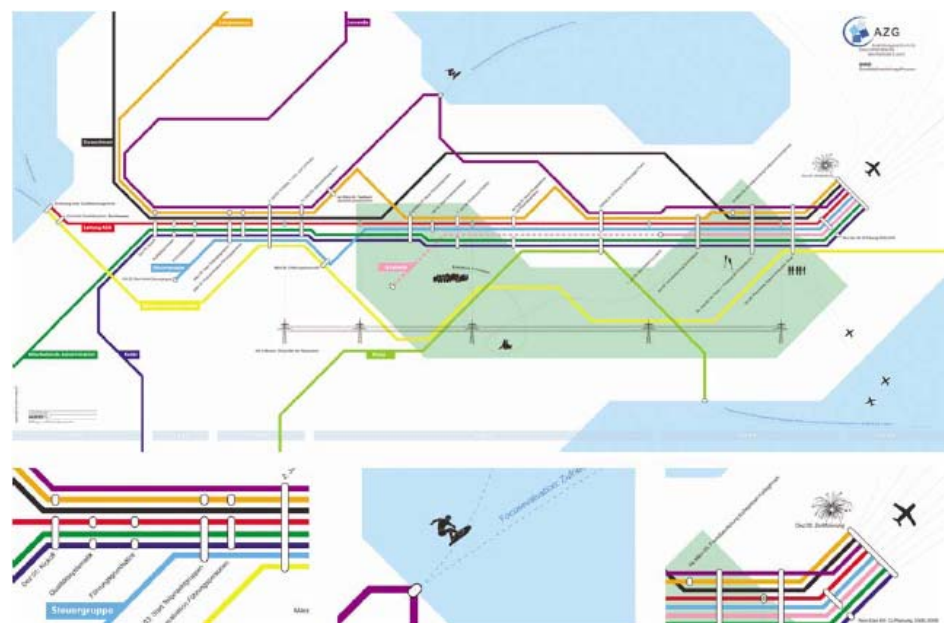


Figure 9: Gantt Chart displayed in the Tube Map format

Works such as these have shown that the Tube Map visualization is a powerful metaphor to communicate a complex project when different groups of persons are involved. The producers of the graphic considered the Tube Map Visualization useful because it provides an overview and can display detailed information in one image and because it helps create a mental model for the abstract concept of a quality development process.

3.5 Web Trends Map 2007 Version 2.0

Another example of effective graphic communication is a map that was recently released by *information Architects*. It is a graphic display that is based on the Tokyo Tube map and it shows the 200 most successful websites that have been ordered by category, proximity, success and perspective.

The designers at information Architects has chosen to display the connection between websites on the internet, with the product making it easier to understand as opposed to a plain text version that may have otherwise been released. As you can see in figure 10 each of the train lines represent the type of website category the site falls into, and the stations being the website itself. And in figure 11 the entire map can be seen with a comparison to the original Tokyo Tube map in figure 12.

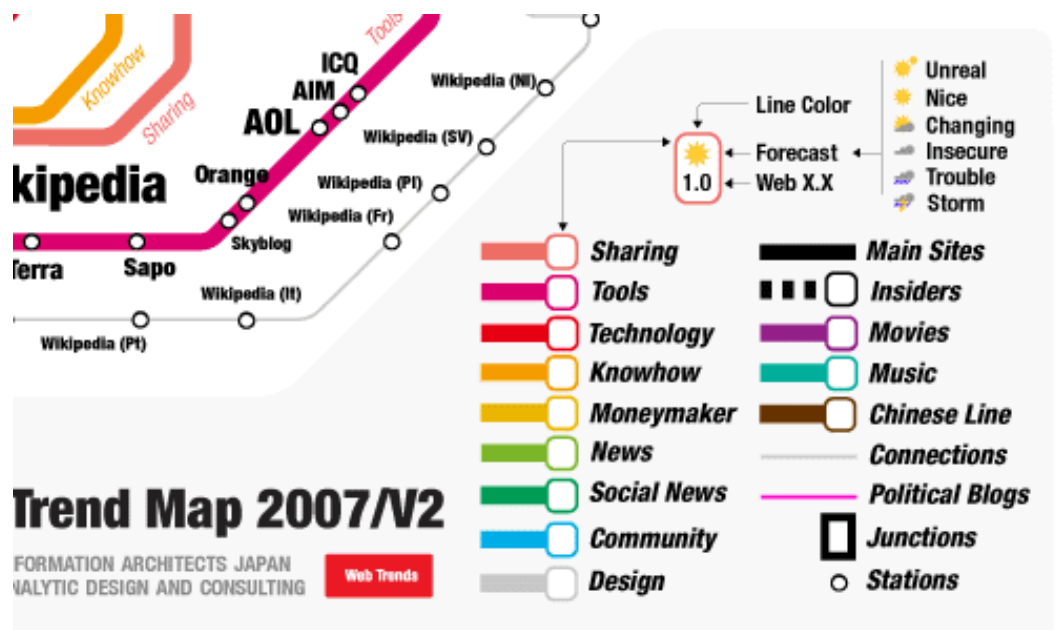


Figure 10: Rail lines of the Internet Map v2.0

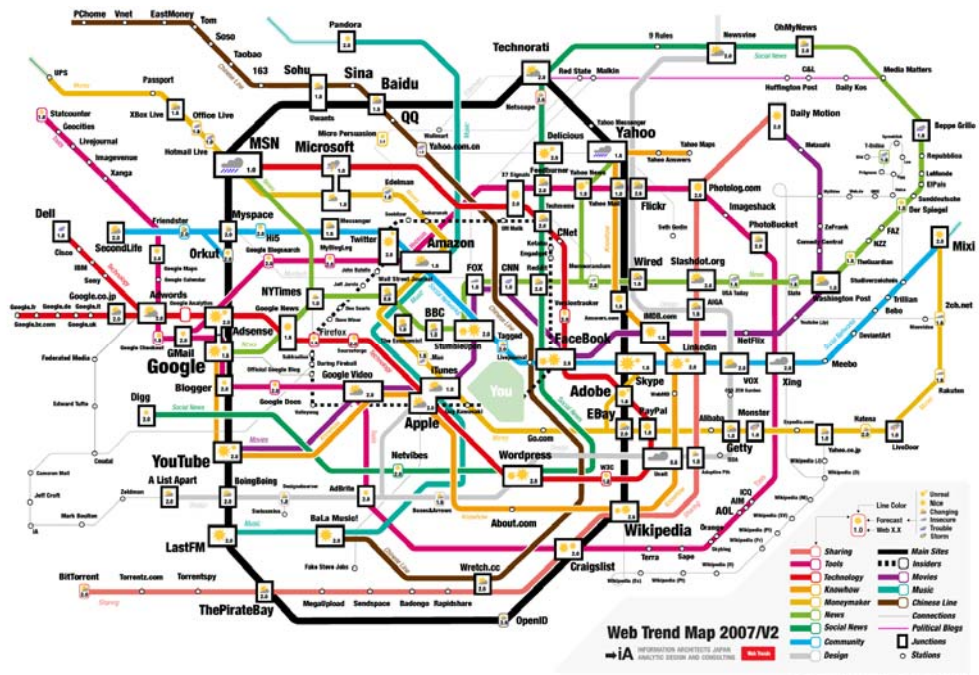


Figure 11: Web Trends Map v2.0

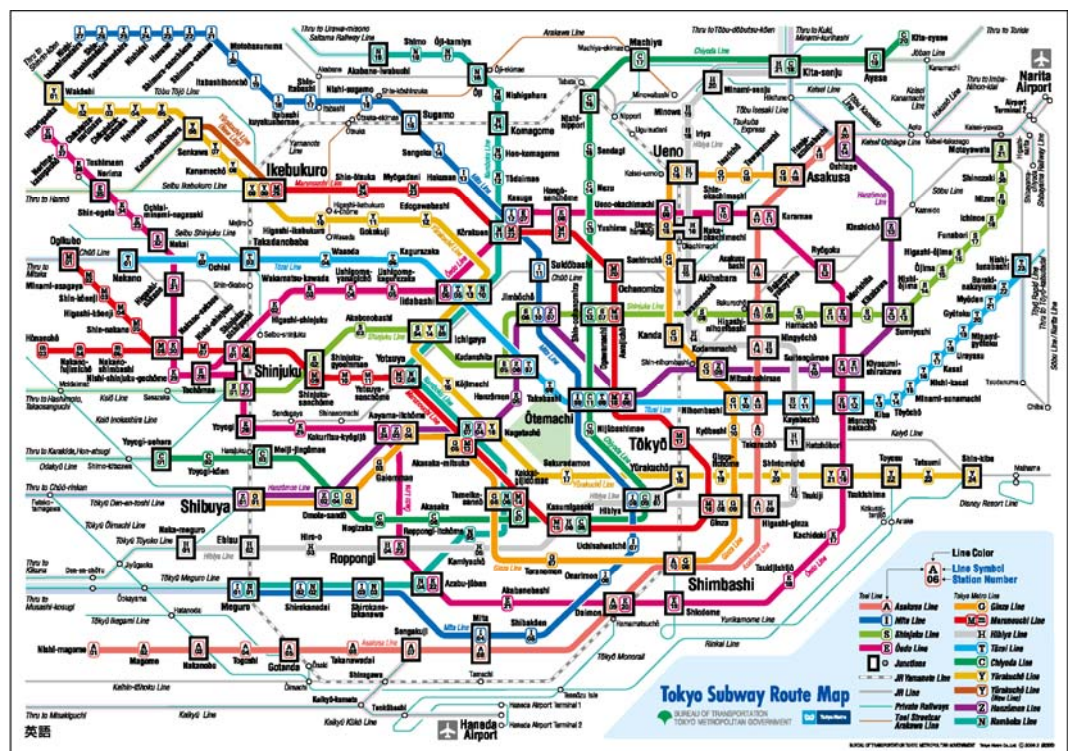


Figure 12: Actual Tokyo Subway Map

4. Hypothesis of applying Beck's theories to the Multimedia Cartography programme.

The London Underground is the perfect example of how a communication product with such high levels of detail can be clearly displayed and informative. Beck developed a system that can take large amounts of information and arrange it in such a way that it can be interpreted with ease.

Taking these conventions and with the elements of Beck's map in mind, and the applications that already proven successful in many other communication models, it is clear there is the potential to apply these conventions to the structure of the Multimedia Cartography Programme and display the three years of courses in their relation to one another. With the programme being so complicated and often difficult to present or explain, this plan would provide a clean and concise way of representing the programme in a visual format.

It is a prime example of how non-geographic information can be better displayed using cartographic and geometric methods. Not only do I wish to hypothesise about the prospect of having such a model, but I also want to create a model that is functional and fully informative to both students and lecturers relating to Multimedia Cartography programme. With this being such a large task to undertake, the paper or static version of the 'map' will be the first priority, then time permitting the interactive version can be developed.

4.1 Zones

In theory the first year courses would start in the centre of the map, in a similar way that the city centre railway line of the London Underground map is centred on the map. Then following the structure of the London Underground map the second and third years of the course would progress to the outers of the map respectively. Courses that run in consecutive years will have one railway line that extends through the relevant zones. The zones would be displayed similarly to the original London Underground as faded grey areas on the lowest hierarchical level of the display. Although given the complexity of the degree and the fact that many topics are covered in multiple years, this part of the map may be difficult to apply.

4.2 Railway Lines

The 'map' as I visualise it would symbolise each of the courses as railway lines. Each course would have its own line that would run in a direction in relation to the other courses. There would ideally be a main line which would for example be a first year subject, perhaps 'applied geospatial techniques' that would run as the central main line, from where all the other lines would originate and branch out. The justification for choosing this course as the central line is that its contents are broad and it covers much of the content that other course then follow on from in greater detail.

Following Beck's methods of representing railway lines they would be graphically shown run horizontally, vertically and diagonally at an angle of 45°. The lines would have the same aesthetics as the more recent London Underground maps with the rounded edges where the line would bend.

The colour coding of the railway lines would be selected in the same way the original Tube map colours were selected, with the factors of colour misinterpretation and confusion playing a major role. The issue of varying lighting conditions won't play such an important role in the design of the map as the conditions of viewing this map won't be so varied. However the colours need to be carefully selected so they can be clearly distinguished from each other.

An example of the proposed railway lines can be seen in figure 13.



Figure 13: Rail lines for the Multimedia Cartography Programme Map

4.3 Stations

The stations of each railway line would be used to symbolise the topics that each course covers. The major stations would be topics that other courses on other rail lines also teach and these would show their relations to other course by interconnecting stations, as can be seen in figure 14. Minor stations would then show all the other topics that are not major and interconnecting. These would be shown in same way as the minor stations are on the London Underground map (figure 15).

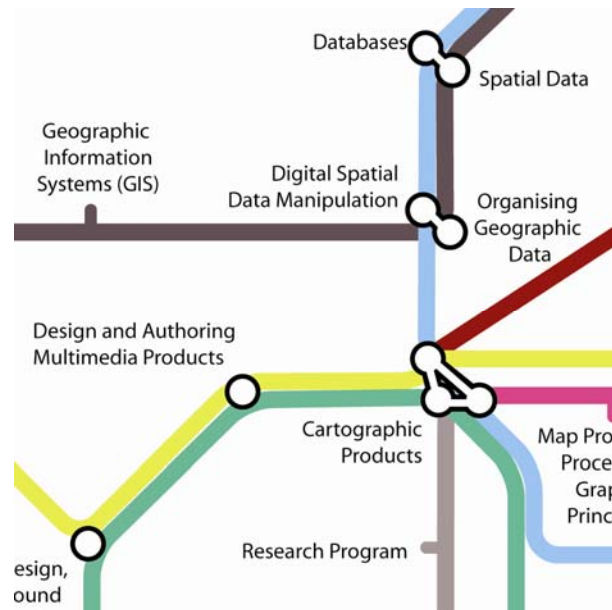


Figure 14: Interchange Stations

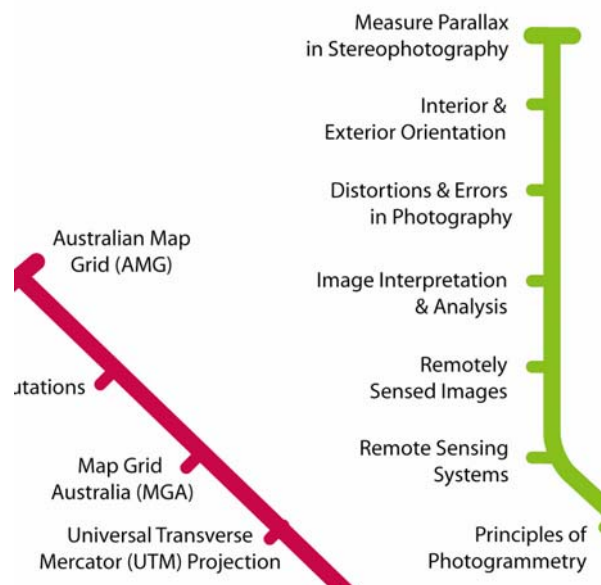


Figure 15: Regular Stations

4.4 Other details

Unlike the London Underground map with its simplification of the River Thames, the Multimedia Cartography map would not have any external details to relate it to a geographic location, as it is a non-geographic subject. Perhaps the only other details it would contain, similar to the London Underground is the reference grid.

4.5 Interactivity

Ideally, the resulting product would be a 'map' showing the interconnectivity of the courses within the programme. There is the potential for the product to be an interactive communication product, and there is the scope for each of the stations to be clickable and contain information such as their respective course guide. And the potential for the interconnecting stations to have hover panels with small amount of information.

4.6 Variations of the idea

There was suggestion of the idea of copying the layout of the original London Underground Tube map as 'the Great Bear' did, but in this instance replacing the stations with the respective course subjects themes. The only difficult challenge that is associated with this is having the connections of the subjects falling in the right place to fit in with the already existing locations of the current connecting stations. There is also a problem if the original London Underground was to be adapted and that is of the number of railway lines, the London Underground map is two lines short in comparison with the lines required to substitute courses within the programme.

Another suggestion that was made was to base the map on the Melbourne Central Business District, as it would be easier to create a map based on geography rather than trying to create a map in space. However this also presents its own set of challenges, such as which paths to base the railway lines on. For example the lines could not be placed on the existing Melbourne railway lines as there are no where near enough lines to carry the capacity required. Another option would be to use the road grid to overlay the 'map' on but this would possibly steer the 'map' away from the London Underground structure and instead create a map that would be extremely grid like.

4.7 Summary

With the potential for this product to be created there is the prospective for it to become a tool that can be used as an information base for students and lecturers alike. It could be used as a data source to explain the structure of the programme in a way that can be quick and clear. Figure 17 shows an example of a portion of what the map has the potential of looking like.

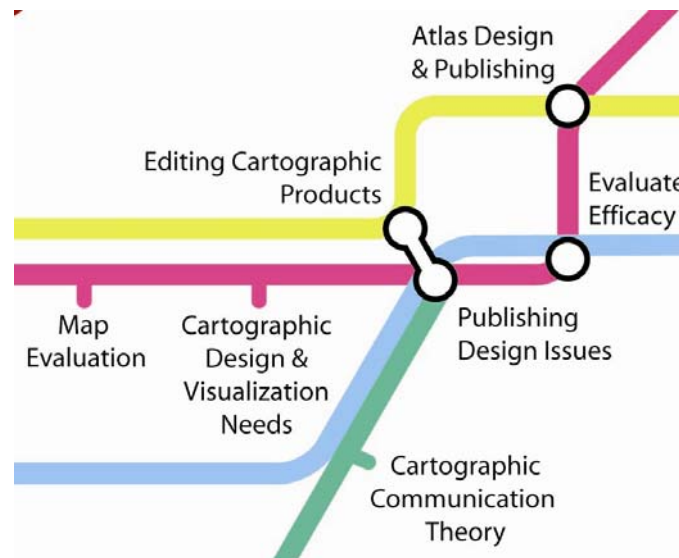


Figure 16: Trial Map v1.0 for Multimedia Cartography programme

5. Evaluation

5.1 Hypothesis

The hypothesis I tested was: The tube map metaphor is an effective method for communicating a complex information product. I evaluated several assumptions and these were:

- Attention – The new map of the Multimedia Cartography programme created visual interest as opposed to the previous information product being a list of information.
- Overview – The viewer can quickly and easily get a clear overview of the course programme structure.
- Details – The amount of detail on the map was sufficient to translate what the information product was attempting to display.
- Suitable Metaphor – The user has decided that this method of information display is effective for its target audience.

5.2 Target Group

The target group for the evaluation consisted of current students at RMIT who were all currently completing the Multimedia Cartography degree. The students were all shown the tube map visualization; in total approximately 10 people, who represent the whole population of the final year students enrolled in the course. The students who viewed the visualisation all have the same educational background, with all of them studying the same course.

5.3 Method

The list of subjects that each student learns while completing the course and the list of core topics covered in each subject was shown to the group as a whole. Then the new visualisation version of the Tube Map style map was shown, displaying the same information but in a graphic format.

5.3 Response

From all the students who examined the new graphic agreed that it was a better and easier way to display the programme structure. They unanimously agreed that the hypothesis was proven successful and that information can better be displayed in the form of a visual format.

6. Conclusion.

Mr Beck changed the style of presenting information graphics and maps over seventy years ago. He revolutionised the way that maps were seen and how great volumes of information were presented, taking a map that was strongly grounded on geography and stripping it of the non-essential information to create a geometric diagram that has assisted millions of travellers not only on the London Underground but on many other rail networks all over the world.

Beck managed to change the mind set of people who were stuck in the old ways of thinking and introduced them not only to a map that worked but a map that could accommodate change and extensions with relative ease.

The London Underground map has now paved the path for many who strive to communicate information via the medium of a map. Like the examples that have been shown in the previous sections, the guidelines and conventions that Beck established have been applied to many situations and successfully portrayed to their audience the intended message.

It is for this reason that I believe it feasible that the conventions of the London Underground Tube map can be applied to the programme of the Multimedia Cartography degree to explain and demonstrate not only the major learning aspects of the programme, but also every topic that each course covers and how these relate to each other to eventuate into a degree in not only cartography but in multimedia and Geovisualisation.

While there may be other ways or methods of displaying this mass of information, I believe this is the most logical and concise way of showing the relationships and connections between the varying courses. The possible outcomes by mapping the multimedia cartography programme in this way can be a clear map in a static paper format, and there is also the potential to increase the products usability by creating a multimedia version of the product. A multimedia product would enhance not only the usability but the information that could be extracted that the paper product could not provide.

Therefore from the research that has been conducted, I have come to the conclusions that the conventions that Beck developed are particularly useful for displaying large amounts of information in the form of a map. And that these maps can be used to display not only geographic data such as rail networks but also non-geographic data such as the relationship between subjects in a tertiary degree.

*ON THE FOLLOWING PAGE V1.0 OF THE MULTIMEDIA
CARTOGRAPHY PROGRAMME MAP CAN BE SEEN*

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