Redesigning the Web of the City: A Chronology of how the new Subway Map of Cologne Came to Life

Benedikt Schmitz
Cologne, Germany
ben@b-schmitz.com

Abstract—**In 2018 the thesis "Das Netz der Stadt" suggested a new and revised information design for the Kölner Verkehrsbetriebe (KVB), including signage systems and subway maps. Three years later, parts of the thesis were implemented by the KVB and are now displayed in stations around the city.**

Keywords—*Cologne, Information Design, Subway Map, Usability, KVB, signage systems*

I. THE STATUS QUO (2017)

My bachelors thesis at the Köln International School of Design (KISD) in 2017/18 dealt with the topic of information design in local public transport using the example of the KVB (Kölner Verkehrsbetriebe). The city of Cologne was chosen because in over ten years of living there, the impression was created that the local information design offered many starting points for optimization. This impression was confirmed by interviews conducted with passengers as part of the thesis: Only 5% of the 120 respondents living in Cologne stated that they had never boarded the wrong train. Almost everyone has taken the line they wanted, but in the opposite direction - or got on a completely wrong train. 75% stated that this had not happened just once. Most cited inattention (65%) or haste (53%) as the reason for this, with a few respondents stating in an additional options column that it could have been due to inadequate signage. However, if one assumes that wayfinding is often only perceived unconsciously and is ideally invisible, the number may well be higher than a survey could find out.

When asked about the least popular station, Ebertplatz was named by far the most frequently (25%). The reasons given for this were "confusing", "poorly signposted" or "simply too big". Many also mentioned his „bad reputation". Appellhofplatz with its „confusing architecture" was given as the next stop on the list (12%). Several respondents stated that they had lost their bearings there and because of the large distance between the platforms (line 5 at the Zeughaus and lines 3/4 on Breite Straße) they didn't know „whether you can reach your connection or whether it's worth taking the line switch". Third place on the list of least popular stations was shared by Barbarossaplatz ("confusing", "it is an ordeal trying to catch the connecting train") and Friesenplatz ("not barrier-free", "downstairs you hardly have an overview [of] where you are ends up") with 8% each.

According to Kevin Lynch's definition, all four stations are focal points with several tracks, i.e. strategic hubs where decisions have to be made [1]. Travelers are particularly alert at such points, perceiving nearby elements with more than usual clarity. As concepts, they are just points in the cityscape, but in reality they are large, extensive squares that mark the transition from one „transport channel" to the other. Good wayfinding is therefore of great importance at these points, because this is where the connectivity of the system is particularly put to the test. Based on this survey, these types of stops were chosen for further study.
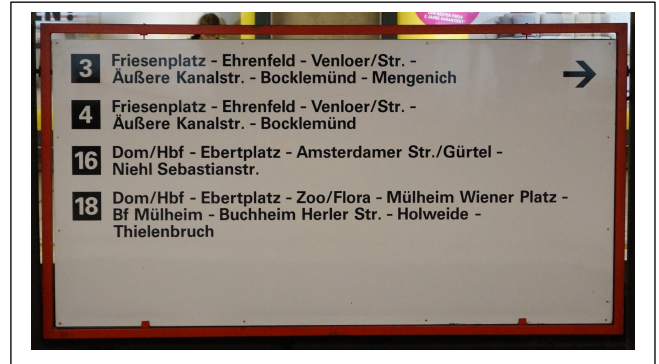

Fig.1: Signage systems in Cologne are incomplete and placed where users cannot see them if a train is already in the station.

When changing from one line to the next, users often do not have much time. Information should therefore be as present and clearly visualized as possible. In London and Berlin, the line charts at the stations are of great importance; however, these are not available in Cologne. There are signs on the platform - and on the way to it - listing a number of stations, but usually only a small proportion of the actual stops. In some cases, the districts are named instead of individual stations, which is inconsistent with the line plan and may raise questions for those unfamiliar with the area. A user who drives off from Neumarkt, for example, and has the goal „Körnerstraße" will look in vain for this station on the signs. There you can only find the corresponding district (Ehrenfeld). They can only find the Körnerstraße stop on the DinA4-sized notices and customer information. If this user is in a great hurry, they could assume that they are on the wrong platform because they cannot find the stop they are looking for right away.

The placement of these signs poses another problem: they are on the opposite side of the platform, which means that once a train is already on the track, they are no longer visible. Especially when travelers have to make quick decisions („Is this the right train?") They cannot find the information they want and only see the line number and their final stop in the digital display of the train itself. In addition, the signage of the KVB is inconsistent. It uses different sizes of typography and graphic elements without following a clear hierarchy. The names of stops vary for no apparent reason (Venloer/Str. or Venloer Str./Gürtel). The hyphens are sometimes inserted with and sometimes without spaces between the stops. Arrows are used both to show directions of travel and to direct passengers to the platform. This may make sense separately, but when these different uses occur on a common sign, unstructured information is the result. There is also a lack of continuity in many places, i.e. the colors of the lines are only listed on the subway maps and the diagrams. With a few exceptions, the signage is black and white.

Collectively, these problems can be described as a lack of balance between information quality and quantity. The wealth of information and its design on the signage systems seems to have been chosen arbitrarily in some places. In many places there is a multiple amount of information, for example if lines run the same way for large sections of the route (e.g. lines 3 and 4 as well as 12 and 15) and the stations served are listed twice. Elsewhere, information is sought in vain.

II. FOCUSSING ON SCHEMATIC MAPS

In his work „Underground Maps Unraveled", British psychologist Maxwell Roberts analyses and reconstructs schematic maps from all over the world. To do so, Roberts set up a set of rules for a schematic plan to work. In order to analyze the local schematic map of the KVB these rules were applied to their map of 2018, when my proposal „Informationsdesign im öffentlichen Nahverkehr" and my thesis „Das Netz der Stadt" were conceived.

Maxwell's rules can be summarized as follows:.

A. Geometric Simplicity

Geometric Simplicity (or Information Quantity): Kinks in the lines should be kept to a minimum to give each line as clear a path as possible. The fewer turns there are on a map, the less information the brain has to absorb. According to Roberts, maps with fewer kinks are therefore easier to understand. In addition, lines should be straightened in the suburbs so as to allow a focus on the city core. [2]

In Cologne, a clear form was missing. The lines on the outskirts of the city were rarely straight and thus distract from the city center. In the center (bounded in the north and south by Ebertplatz and Chlodwigplatz, in the west and east by Friesenplatz and station Deutz / Lanxess Arena) there were currently no lines without any kinks. After completion of the Nord-Süd-Bahn (currently 2028), only line 16 will run straight through. But even then there are still 18 turns in the smallest of spaces. High radius bends make it easier to follow the lines, but straightening them would greatly improve the flow.

B. Geometric Coherence

Geometric coherence (or information quality): Whenever possible, lines should have a clear trajectory and be kept parallel to each other. A symmetry should be sought and typographical elements such as the names of the stops should be aligned with each other. [3]

Due to the bends in the lines on the outskirts of the city of Cologne, they lack a clearly defined path. Apart from the routes that use the same rails, there are hardly any parallel lines. The names of the stations are mostly aligned horizontally, on the outskirts they are tilted 45° to the left. Presumably for reasons of space, there is a lack of regularity in their arrangement in some places, which makes it difficult to follow the stations.

C. Topographical Accuracy

Topographical accuracy: The actual geography of the city should not be distorted too much, if possible, in order not to confuse mental models of the city in the minds of users. [4]

A comparison of the topographical map of Cologne with the schematic one showed a high geographic overlay in the inner city and a shortening of the lines on the outskirts. This creates confusion in the center. Outside, apart from their foreshortening, the lines remain true to their topography. The resulting bends prevent a feeling of closeness and speed..

D. Balance

Balance: A clear focus and the avoidance of different densities of stations should be striven for. [5]

The former plan was divided horizontally in the middle by line 1 and vertically in the middle by line 16. The focus was clearly on the left bank of the Rhine, which creates a slight imbalance in this direction.

E. Additional Information

Additional information: This should be kept to a minimum whenever possible to avoid information pollution.

In addition, colors and fonts should be carefully selected and tested to ensure sufficient readability.

A clear construction method, which is defined, for example, by a fixed number of angles and directions, is always superior to the design rules of a plan. In Harry Beck's London plan - which is considered the first schematic representation of a subway plan - there are four angles and eight line directions. This type of construction is the most common, but not the most sensible for every city. Cologne is also one of the places that has used this construction for their line network.

In the course of this work, Robert's rules were applied to give the Cologne route network a clear face. The aim was not only to reduce the turns to a minimum, but also to find a clear shape whose structure comes closer to the geography of Cologne than the previous plan.

III. NEW MAPS FOR COLOGNE

For the thesis, the Cologne map was stripped of superfluous information such as tourist attractions. The subway "U" indicating whether the stations are above or below ground has been removed as this information was considered damaging: The "U" could mislead viewers into thinking it would enlighten whether the station in question is handicapped accessible. In Cologne, however, there are stations that are inaccessible to wheelchair users, both above and below.
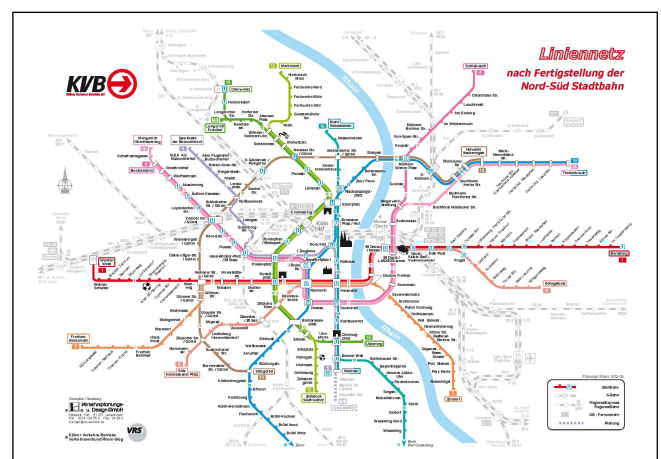

Fig.2: The old subway map of Cologne was crowded with information.

The S-Bahn lines were also removed, as these are not operated by the KVB but by the DB (Deutsche Bahn). Focus was to be put on the Cologne vehicles and the related information.

But even without all this information pollution the plan lacked a clear form. There were 41 turns on the left bank of the Rhine and 16 on the right bank; a total of 57 pieces of information that the viewer has to absorb and process. This number was to be reduced in the following.

A. 90° (Tetralinear)

It seemed sensible to start a redesign of the Cologne plans with the biggest possible angle and the fewest number of directions, and from that plan to add more and more possibilities. The 90° plan does not allow diagonals, just vertical and horizontal lines. However, with the main streets running out of the city center like the dials on a watch, i.e. Venloer Straße, Neusser Straße or Zülpicher Straße, it became clear quite early on that the city of Cologne needed more angles and directions. Following the logic of the 90° plan, turns must be built in that do not exist in reality - the opposite should actually be sought and existing turns should be avoided. As a result, the plan becomes geographically inaccurate. It is also this inaccuracy that robs the plan of a clear structure. The elements typical of Cologne's topology, such as rings and belts, cannot be seen in the angular shapes. Nevertheless, the plan creates a reduction from 57 to 43 kinks.

Fig.3: A tetralinear map of Cologne.

B. 60° (Hexalinear)

The expansion from four to six directions results in a design based on 60° angles. This results in two possible plans:

- The horizontal plan – vertical lines are not possible here. Instead, there are two types of steep diagonals.

- The vertical plan – horizontal lines are not possible here. Instead, there are two types of flat diagonals.

These plans are similar in their construction, but clearly different in appearance. The horizontal plan allows for a straight route for line 1, whereas line 16 has to be "squeezed" through several turns. With the vertical plan it is the other way around. But while the horizontal plan gets a clear, modern hexagon shape, which in its basic structure is already reminiscent of the rings and the belt, the vertical plan appears unbalanced. Because Line 1 runs north-east on the right bank of the Rhine, there is a large gap in the south-east. Both plans are largely simplified by reducing the number of their turns to 43 on the horizontal and 42 on the vertical. Nevertheless, the horizontal plan seems to correspond much more to the true shape of the city. Geographical accuracy is much more pronounced here than with the 90° plan. Cologne doesn't seem to get by without diagonals. However, the 60° plans always

allow only a part of the lines leading out of the city center to run straight without turning and thus appear insufficient.
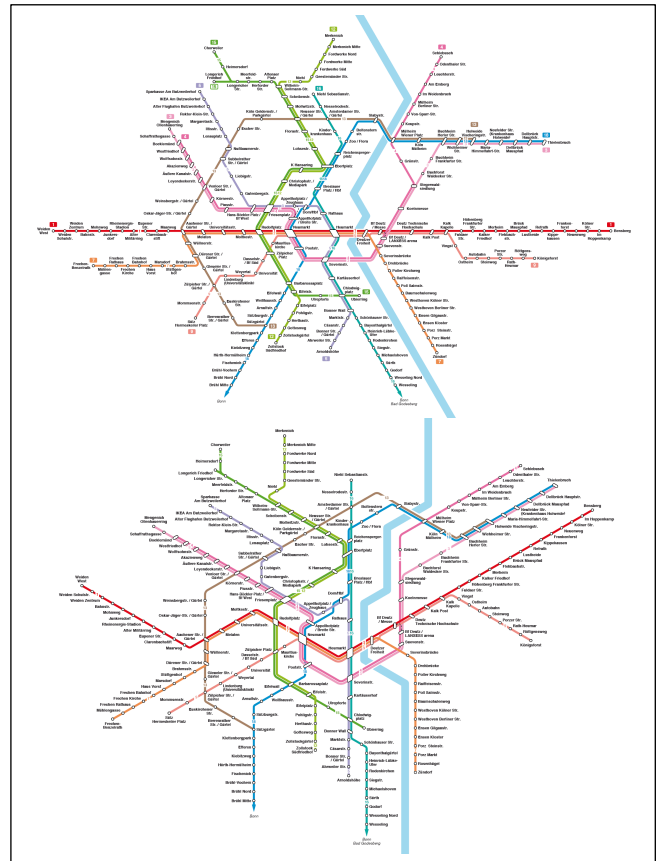

Fig.4: Two different versions of hexalinear maps of Cologne.

C. 45° (Octolinear)

The „classic" among the construction methods. The plan created here was created without comparing views of the current KVB plan in order to explore new routes. The straight lines on the outskirts are striking, helping to focus the view of the center and reducing the number of turns to 42. The result is a mixture of the two 60° plans, which shows the best properties of each, but brings little innovation with it. Unfortunately, the problem that turns have to be built in that do not exist in reality also exists with this plan. There are two bends on line 9 in the southwest, which seem necessary. It became clear that Cologne needed more than four possible directions for diagonals for optimal representation.

Fig.5: An optimized octolinear map of Cologne.

D. 30° (Dodecalinear)

The dodecalinear form of representation with twelve possible directions and 30° angles allows both vertical and horizontal lines, as well as four different diagonals (two steep and two flat). This plan finally manages not to use any turns where they don't actually exist. The various main roads run without problems from the city center via the rings and the belt out of town. The unusual form of representation may seem restless at first, but manages to reduce it to just 38 kirks. In a second step, line 13 and later also lines 3, 4, 12, 15 and 18 (in the city center) were rounded, eliminating further kinks and making the plan manage with only 28. For the first time, rings and belts are clearly recognizable as such, allowing for an almost accurate geographical representation of the cityscape.
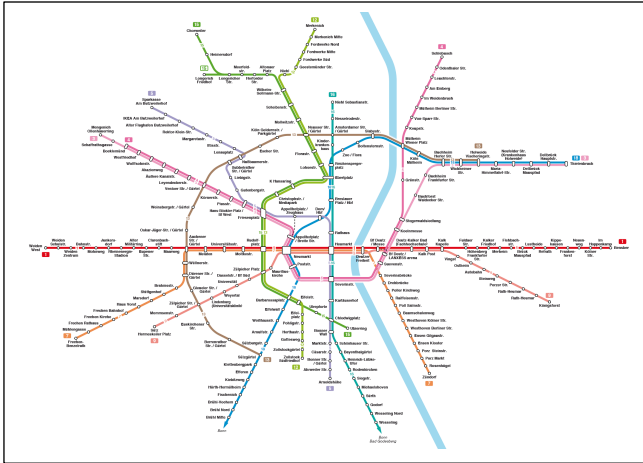

Fig.6: The first draft of a dodecalinear map of Cologne. A later draft smoothed out the rounding of line 13.

E. Concentric

The final form of representation of the KVB line network for the time being was a concentric one that was not based on a predetermined number of directions and angles, but on circular forms that revolve around the Heumarkt stop. From the inside out, these are lines 3 and 4, lines 12 and 15 (rings), and line 13 (belt). The main roads all lead to the central station – the Heumarkt. There is a reduction to 34 turns, which is slightly higher than the number of kinks in the dodecalinear plan. Nevertheless, the plan seems more balanced and clearer at first glance, since its construction principle can be recognized more quickly.

F. Accessibility

A main problem for the KVB and its communication of information is the issue of accessibility. A large proportion of Cologne's stops are not accessible by wheelchair – including central stops such as Friesenplatz or Appellhofplatz/Zeughaus. Parts of the stations operated by DB, such as Cologne West, Cologne South, Cologne Messe Deutz and even the main train station, also have limited or no accessibility.

On the previous plan of the KVB, all stations that are accessible without steps have a small wheelchair symbol - all other stations lack one accordingly. However, since most stations are barrier-free, the symbol is repeated numerous times. A first step towards a solution was to "reverse" the logos. For example, stations that are inaccessible to the disabled could be given a crossed-out wheelchair symbol, which would significantly reduce the number of symbols. With a view to integration and inclusion, however, such a

symbol might send the wrong signals. One possible solution would be to divert the focus of the design from the target group and direct it to the technology. Instead of a lack of accessibility for wheelchair users, for example, the lack of elevators could be communicated. Conversely, this could also be interpreted as a step towards the inclusion of the target group: Not only wheelchair users are informed here, but everyone who is dependent on an elevator, i.e. parents with strollers.

Fig.7: Different iterations of symbols for accessability (or the opposite) could make the map more inclusive, while getting rid of superflous information.

G. Workshop

A workshop with individual interviews was held to find out which of the newly designed line plans worked well and which worked less well. A total of 20 people from different backgrounds were interviewed. Two of the respondents were only visiting Cologne and were therefore less familiar with the city. The remaining participants had lived in Cologne for a longer period (from eight months to six years) and traveled regularly with the KVB.

After the first questions about the length of stay, „home station" etc., the participants were asked to draw a map of Cologne from their heads within a maximum of two minutes. It was striking that the Rhine played a central role in all the drawings. Most participants started their map with the river and then moved on to the part of the city on the left bank of the Rhine. Most participants used the ring structure as part of their drawing, and half of those surveyed used the cathedral or the main train station as a central landmark.
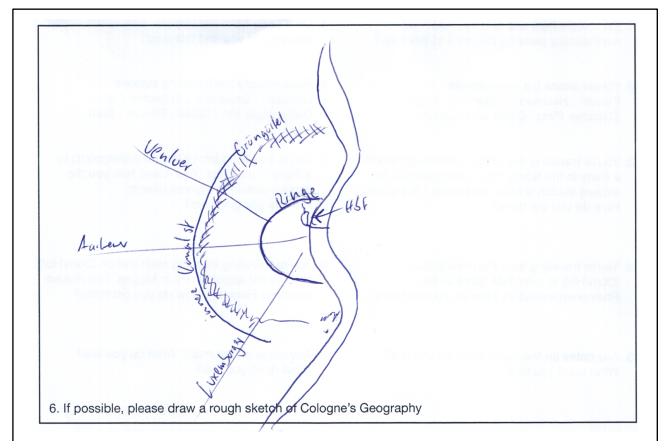

Fig.8: Workshop participants were asked to draw a map of Cologne based on their own image and memory.

Following the drawings, five of the plans created were presented to the participants. They were first asked to rate how aesthetically pleasing they found the plan without going too far into functionality. Plans that travelers perceive as "beautiful" tend to get more attention and are considered more accessible. The participants should now find six stations per plan and plan different trips. Time was taken to measure the effectiveness of the plans. Finally, the respondents were asked for feedback. It was interesting that some participants

described the tetralinear plan as clear and rated it as good with a 7.2 of 10, but it turned out to be very impractical, since the stations here were searched for the longest and its structure was least reminiscent of Cologne. The superfluous turns were perceived as annoying. The second plan (hexalinear) was perceived as less aesthetic, albeit geographically more accurate. The travel planning here took on average much longer than with the first plan. The octolinear plan also seemed inadequate: planning the trip took the longest here, averaging 16 seconds. The subjects perceived it as clear, but also as boring.

Overall, the dodecalinear and concentric plans performed best. The first was described by some participants as inconsistent and restless, but by others as clear, novel and very geographically accurate. It proved to be very efficient for finding stations and planning routes. The concentric plan got by far the best rating with 8.8 points and was the fastest for route planning with an average of 8.68 seconds. The feedback on this plan was extremely positive, so that even the negative comments were to be interpreted as requests for changes.

H. Final Steps of the thesis

The final dodecalinear plan of the thesis reduced the number of turns to 28, almost half the number of turns in the original KVB plan. This makes it mathematically the simplest, "cleanest" plan in the series. However, it was perceived by participants as less harmonious than the concentric plan. With 34 turns, this is mathematically more complex, but due to its clear shape it is quicker to decipher.

Fig.9: The final concentric map smoothed out the rhine to be more geographically accurate. It was rated the best map in the workshop.

IV. SIGNAGE SYSTEMS

A. Redesigning the line diagrams

The line diagrams provided for the KVB in the course of this work pick up the color of the respective line and are as reduced and clear as possible in their design. In contrast to the currently available line diagrams in the vehicles, no geography is used here. The only exception is the indication of the Rhine, which offers guidance to those familiar with the city.

The diagrams follow a clear information hierarchy, which indicates on the first level which lines go to which stations and on a second level shows the journey time and transfer options. This hierarchy is designed to ensure that passengers who are in a hurry can find their way to their destination even if they only have a few seconds to make the appropriate decisions.

Lines that run parallel for more than three stations are not listed repeatedly, but indicated by their corresponding line. Their corresponding number is at the beginning and at the end of the line that runs into white when the paths separate again with the main line shown. This avoids information overload.

Further avoidance of overloading is also achieved in the diagrams by dealing separately with the issue of accessibility: instead of highlighting the stations that are wheelchair accessible, those that are not are marked accordingly.

Fig.10: A graphic preview of the line diagrams, designed for the station "Hans-Böckler-Platz / Bf West".

B. Wayfinding in subway stations

As elaborated in the proposal, the current wayfinding of the KVB can be described as insufficient and inconsistent. There is a lack of balance between information quality and quantity, so that information is searched for in some places, while other places are so overloaded that viewers can lose track.

You won't find any line charts in Cologne that tell users which train goes to which station – except for small information printed on A4 sheets, hanging in windows at stations. There are signs on the platform listing a number of stations, but only a small percentage of the actual stations. In some cases, the districts are named instead of individual stations, which is inconsistent with the line plan and may raise questions for those unfamiliar with the area.

In addition, there is the spatial attachment of the signs: These are often located on the other side of the track, so that the information disappears from the visible area as soon as the train has entered. So when travelers don't have much time to make decisions (when the train is already waiting at the platform), they look in vain for the information they want.

Furthermore, the design of the KVB signs is limited to black lettering on a white background, which is inconsistent with the rest of the design of line maps and diagrams in the vehicles. There, each line has an assigned color that makes it easy to identify it.

C. Infiltrating a station

In order to check the line diagrams for their practical suitability, one station was selected for revision. If possible, this station was supposed to meet various criteria:

- More than one line should be available here

- It should be used as a transfer station

- It should be at least partially underground in order to be able to simulate a closed wayfinding system

- It should have an intersection between KVB and national public transport (DB)

The question was whether to inform the KVB about the project and ask for approval, or to go beyond the legal limits at this point and act without permission. With the risk in mind that the company might refuse to work with them, the latter was ultimately chosen. A request with a possible refusal from the official side would destroy a subsequent guerrilla action. The criteria listed above were therefore expanded to include a final one that would allow signs to be affixed:

- The station should be unguarded

The station „Hans Böckler Platz / Bf West" was ultimately chosen, meeting the criteria above: It is used by lines 3, 4 and 5 as well as by regional and national DB trains and thus serves as a transfer station. It is underground and has a mezzanine floor with a kiosk between the street and the platform, which offers space for a wayfinding system.

The planned redesign had to be both efficient and unobtrusive. Ideally, travelers only subconsciously perceive a good wayfinding system. As a utopian ideal, these systems are completely invisible. [6] The redesign should therefore not only be based on the specifications of the KVB, but implement them in such a way that not only travelers assume that the signs were put up by the company itself - but also the company's own employees. Ideally, nobody should question the origin of the new signage. For this purpose, the existing signs at the stop were measured in a second inspection. The black squares, in which white numbers indicate the respective line, should be pasted over by squares in the colors of the corresponding line. For this purpose, an adhesive film was produced that holds the 100 x 100 mm stickers for the inside and the 210 x 210 mm stickers for the outside. Two line diagram signs were produced on aluminum dibond panels for each direction of travel, one of which was to be attached to the intermediate level and one to be attached to the track. In the end, the only question that remained was whether the installation should take place at night between 2:00 a.m. and 5:00 a.m. when operations have ceased. Or whether you should do it „officially" during the day - dressed in safety vests - to enable direct feedback from passers-by during the installation. With regard to the documentation, the second variant was finally chosen, even if the risk of being caught in the act seemed greater here.
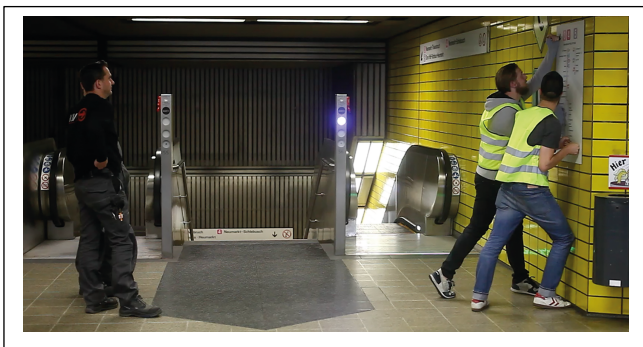

Fig. 11: Attaching the signage systems.

The new signage was fixed on the morning of June 25, 2018. Since the video surveillance is only on the lowest level of the station (by the track), it was decided to work from the top down, starting with the big stickers at the entrances, followed by the small numbers on the inner intermediate level. Safety vests suggested an official character during the attachment, which meant that even the KVB staff who happened to be present examined and commented on the signs, but let us go about our work undisturbed. Only our photographer, who always stood a little to the side without a safety vest to document our work unnoticed, aroused the suspicion of the kiosk owner on the intermediate level. But nobody intervened. After about 30 minutes all the signs and stickers were in place and we left the station.

Passing passengers used the signage for orientation. Many noticed the renewal, others seemed not to notice. A team of four KVB security staff commented on the signposts as they passed by with a short "Yes, they're new here now." – and that on the day of attachment. Only after a whole month, employees of the KVB noticed that these signs were not supposed to be here and had them removed subsequently.

V. A BRIEF CHRONOLOGY OF WHAT HAPPENED NEXT

The contents above were all part of a bachelors thesis that was published in 2018. The thesis and its results were subsequently nominated for the Cologne Design Prize 2018. And even though the design agency „Die Informationsdesigner" helped with essential parts and provided a direct contact to the KVB, it took another year until a presentation was held at the KVB headquarters (August 2019). This presentation included an updated version of the concentric subway map, featuring information on regional trains, operated by the DB. The KVB seemed as interested as they seemed reluctant, resulting in radio silence right after the presentation. Even though they were contacted several times about the project and its progress, nothing happend.

In early 2021, a year into the global pandemic, the city of Cologne came up with innovative ways to use public advertising spaces that were currently not in use. As part of this campaign it called for open suggestions on how to „decorate" the station Ebertplatz, allowing designers and artists to apply with unique projects. The concentric map was chosen to be displayed, refreshing the contact with the KVB. The transport company started an online survey, asking its users about their opinion on the map. The survey was taken down after three days, exceeding the number of participants by far with over 4000 – mostly positive – replies. However, yet again, nothing happened.

Finally, in June 2021, the traffic committee of the city decided to put pressure on the KVB, submitting an official application. The application got approved, and the KVB was forced to change the subway map. Along with „Die Informationsdesigner" a series of workshops was held, in which the map was revised from the concentric result of the thesis to the final outcome that is now hanging in stations since December 2021. Main changes compared to the original octolinear map of the KVB include not only the switch to the concentric version, but also a massive reduction in information pollution by omitting the U-symbols as well as a simplified display of tariff zones. Unfortunately, in some parts, the concentric principle is disregarded to make the plan geographically more accurate, resulting in a loss of visual balance.
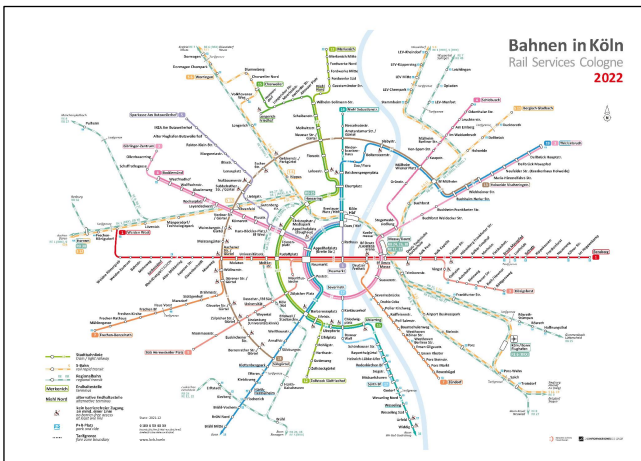
Fig. 12: The final concentric map, redesigned by "Die Informationsdesigner", implemented in December 2021.

Overall, the change of maps was received positively. If the KVB will see this as a affirmation about the importance of good information design and apply the aforementioned proposals for signage systems as well – one will see.

[1] Kevin Lynch, Bauwelt Fundamente, Bd.16, Das Bild der Stadt, 2. Aufl. (Gütersloh: Birkhäuser Verlag, 2001)., P. 12

[2] Maxwell J. Roberts, Underground Maps Unravelled (Wivenhoe: Capital Transport Publishing, 2017)., P. 4

[3] Maxwell J. Roberts, Underground Maps Unravelled (Wivenhoe: Capital Transport Publishing, 2017)., P. 149

[4] Maxwell J. Roberts, Underground Maps Unravelled (Wivenhoe: Capital Transport Publishing, 2017)., P. 149

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[6] David Zweig, Invisibles: The Power of Anonymous Work in an Age of Relentless Self-Promotion (New York: Penguin, 2014)., P. 32