Lynk & Co Design and TU Delft

Creating tomorrow's driving experience

A concept and vision for Lynk & Co

APPENDICES

Master Thesis
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Appendix A: Context factors with clusters

Name	Tag	Type	Cluster	Source
Travel and world exploration for a wide audience will create more openness towards new other cultures.	Socio-cultural	Development	Flexibility is freedom	(Ziyan, 2023)
The wise in wealth creates new possibilities compared to the simple life of the last decades.	Economical	Development	Middle class is the new normal	(Jizhe, 2021)
In the second half of the 21st century, the world will be dominated by cities	Demographic	Development	Louder denser busier	(United Nations Department of Economic and Social Affairs, 2018)
People are focused on experiences rather than ownership, almost going towards dematerialisation.	Socio-cultural	Development	Craving physical connection	(Visser, 2020)
Urbanisation continues, especially in Africa and Asia; 68% of the world population projected to live in urban areas by 2050	Demographic	Development	Louder denser busier	(United Nations Department of Economic and Social Affairs, 2018)
As climate concerns intensify, laws that push businesses and consumers towards adopting more sustainable practices are being introduced increasingly	Policital	Development	The fight for tomorrow	(B. Bos, personal communication, January 2024)
People will stay more at home due to traffic congestion.	Demographic	Trend	Louder denser busier	(García-López et al., 2021)
Mental health days are being offered by employers as part of standard benefits packages, as mental health as a top priority is becoming generally recognized.	Socio-cultural	Development	Escaping the rush for mental well-being	(Partners, 2019)
Mindfulness and meditation apps are integrated into personal devices and environments, including vehicles, to promote mental well-being amidst the hustle of urban life.	Technological	Development	Escaping the rush for mental well-being	(Schwartz et al., 2023)
Peace and quiet is increasingly a luxury item; noise and stress are for the disadvantaged; Cities will be louder than ever	Socio-cultural	Development	Escaping the rush for mental well-being	(McMullan, 2020); (Godwin, 2018)
There is an increasing demand for corporate transparency, especially concerning environmental impacts.	Socio-cultural	Development	The fight for tomorrow	(Chen & Bouvain, 2008)
Adoption of local energy generation and storage solutions, supporting electric vehicle use for urban energy resilience.	Environmental	Development	The fight for tomorrow	(International Renewable Energy Agency, 2020)
Younger generations value brands that have a positive impact on the environment.	Environmental	Trend	The fight for tomorrow	(Chen & Bouvain, 2008)
Sustainable / circular corporate actions provide customers a guilt-free option of buying/using products.	Environmental	Trend	The fight for tomorrow	(International Renewable Energy Agency, 2020)
Sustainability will become a factor in purchase decisionmaking as soon as the average living standard meets the Western standard	Economical	Development	The fight for tomorrow	(China Britain Business Counsil, 2021)
In China, doing things alone is a luxury; generally everything is done in groups.	Socio-cultural	Principle	Escaping the rush for mental well-being	(China Britain Business Counsil, 2021)
Urbanisation and population concentration reduces personal space, and makes it a more premium asset.	Demographic	Development	Escaping the rush for mental well-being	(Gose, 2018)
Employees increasingly call in sick at work for mental illness.	Psychological	Trend	Escaping the rush for mental well-being	(Hogg, 2024)
Consumption shifts more to being experience-driven, affecting vehicle design for lifestyle and leisure activities.	Socio-cultural	Trend	Escaping the rush for mental well-being	(Chaak, 2023)
Increasing daily stress and workload take away attention from deep personal experiences and connections	Socio-cultural	Development	Escaping the rush for mental well-being	(Mogilner et al., 2018)

Name	Tag	Type	Cluster	Source
Micro-vacations (trip from urban to rural area within country/China) are becoming more popular, increasing 251% over 2021.	Socio-cultural	Development	Poetry Near Home	(Mafengwo & China Tourism Academy, 2021)
Digital nomadism enters the mainstream	Socio-cultural	Development	Flexibility is freedom	(MBO Partners, 2023)
Technology is made more human through the use of personal assistants and avatars.	Technological	Development	Craving physical connection	(Oort, Decentralized Cloud, 2022)
Access to all trends of the past through digital media leads to design nostalgia.	Socio-cultural	Trend	Never not entertained	(Lutkevich, 2023)
The effects of our digital-focused always-on society become obvious, resulting in a revaluation of deep-focus and relaxation	Technological	Principle	Craving physical connection	(Scott et al., 2016)
The Chinese middle-class wealth is increasing.	Economical	Development	Middle class is the new normal	(R. Jones, personal communication, January 2024)
Overexposure to screens results in a higher valuation of haptic interaction	Psychological	Development	Craving physical connection	(R. Jones, personal communication, January 2024)
Cars are an import indicator of wealth and taste.	Socio-cultural	Principle	Middle class is the new normal	(China Britain Business Counsil, 2021)
The asian population is more tech-savvy than the European	Socio-cultural	Principle	Never not entertained	(R. Jones, personal communication, January 2024)
90% of the demographic does not want to customize anything, but take products as they are.	Psychological	Principle	Escaping the rush for mental well-being	(R. Jones, personal communication, January 2024)
The growth of the gig economy (/freelance) pushes the need for productivity, as it directly impacts earnings.	Economical	Trend	Time spent productive is time well spent	(McKinsey & Company, 2023)
Businesses adopt four-day work weeks, enhancing worker productivity and satisfaction.	Socio-cultural	Trend	Time spent productive is time well spent	(Liu, 2023)
AI-driven task managers predict and streamline work processes, increasing efficiency.	Technological	Development	Time spent productive is time well spent	(Ali, 2023)
A shift towards more autonomous work environments where employees manage their own schedules and deliverables.	Socio-cultural	Trend	Time spent productive is time well spent	(Soga et al., 2022)
Businesses increasingly adopt flexible work policies that allow for asynchronous work hours, resulting in more freelance-like work cultures	Socio-cultural	Development	Time spent productive is time well spent	(Soga et al., 2022)
In both digital and physical social interactions, we present curated versions of ourselves. Holding onto outdated narratives can heighten internal pressures and stress.	Psychological	Trend	Time spent productive is time well spent	(House of Commons Science and Technology Committee, 2019)
We constantly seek ways to streamline processes and reduce inefficiencies in personal and professional tasks.	Psychological	Principle	Time spent productive is time well spent	(Bahn, 2024)
Well-traveled road effect: The experienced duration of a known route is shorter than a familiar route, because our attention weakens there.	Psychological	Principle	Poetry Near Home	(Dean, 2013)
Chinese live in the moment and don't look back.	Psychological	Principle	Craving physical connection	(E. Ningnan Li, personal communication, February 2024)
The most rich are likely to get even richer through their use of financial assets.	Economical	Development	Middle class is the new normal	(Malacrino, 2020)
Time flies when you're having fun	Psychological	Principle	Poetry Near Home	(R. Kierkels, March 2024)
People start valueing their local cultures more due to globalisation	Socio-cultural	Trend	Hunting common ground	(China Britain Business Counsil, 2021)
People crave have some kind of impact; Make a difference, feel important or needed.	Psychological	Principle	Excellence is in your own hands	(Robbins, 2024)
Community and hobbies become the main driver for personal identity instead of work.	Socio-cultural	Trend	Hunting common ground	(Israel et al., 2022)

Name	Tag	Type	Cluster	Source
People become more aware about their personal 'brand' and what effect it has on their lives.	Psychological	Development	Excellence is in your own hands	(McLaughlin, 2023)
Authenticity becomes more rare ánd valuable, as all things converge due to digital availability of things.	Socio-cultural	Development	Excellence is in your own hands	(YANG DESIGN, 2023)
People want to belong to a social group, and consume according the that group.	Socio-cultural	Principle	Hunting common ground	(Pardede & Kovač, 2023)
Hobbies, instead of work, become the main identity driver for people, to feel part of something.	Socio-cultural	Trend	Hunting common ground	(Trinetti, 2021)
The competition for attention increases further. Focus becomes a luxury.	Socio-cultural	Development	Never not entertained	(Lorenz-Spreen et al., 2019)
Roads and cities are getting more congested. City centers become car-free and traffic jams worsen.	Demographic	Development	Louder denser busier	(García-López et al., 2021)
The development of the individual is the most important thing for gen Z and younger. Relationships are increasingly about supporting each other and personal development.	Socio-cultural	Trend	Excellence is in your own hands	(McLaughlin, 2023)
Our body is releasing rewarding hormones when talking about ourselves (online).	Psychological	Principle	Excellence is in your own hands	(Robbins, 2024)
As possibilities grow through increased wealth and connectivity, time becomes more valuable.	Socio-cultural	Development	Excellence is in your own hands	(China Britain Business Counsil, 2021)
People do not like to be told how to behave, but want to feel like being in charge instead.	Psychological	Principle	Excellence is in your own hands	(Fromm, 2023)
Gen Z and younger values experiences over products.	Psychological	Trend	Excellence is in your own hands	(Fromm, 2023)
Hypertasking slowly becomes the common way of working, as Gen Z and younger are contantly exposed to several triggers at once.	Socio-cultural	Trend	Excellence is in your own hands	(Çoklar & Tatlı, 2021)
Global trends vs local cultural expressions drives individuals to find innovative ways to showcase their cultural identities online.	Psychological	Trend	Hyper-expressive (digital) personalities	(VSR, 2024)
The rise of micro-communities and platforms catering to specific interests could allow for deeper, more specific expressions of identity.	Psychological	Trend	Hyper-expressive (digital) personalities	(VSR, 2024)
AI-generated content and virtual influencers could challenge human users to differentiate and show their uniqueness.	Psychological	Trend	Hyper-expressive (digital) personalities	(Hackl, 2023)
Growing privacy concerns may lead users to seek new ways of expressing themselves anonymously or through pseudonyms, giving them more possibilities in terms of expression.	Psychological	Trend	Hyper-expressive (digital) personalities	(Schimmelpenninck, 2023)
Advancements in AR offer new ways for users to craft and showcase their digital personalities in more immersive and customisable environments.	Technological	Trend	Hyper-expressive (digital) personalities	(Hackl, 2023)
Users are more likely to encounter content that reinforces their views, leading to echo chambers that could intensify the need for distinct personal expression.	Psychological	Development	Hyper-expressive (digital) personalities	(Schimmelpenninck, 2023)
Gen Z and younger are more conscious of their purchases (and of themselves), therefore brand values have to fit their personal brand seamlessly.	Socio-cultural	Trend	Hyper-expressive (digital) personalities	(B. Bos, personal communication, January 2024)
Trends are coming and leaving faster then ever. Jumping on a trends involves a high risk of it having passed by before you know it.	Socio-cultural	Trend	Hyper-expressive (digital) personalities	(B. Bos, personal communication, January 2024)
Social media and our digital tools give us the ability to creative a personal 'brand' / image that does not necessarily match the real world	Socio-cultural	Development	Hyper-expressive (digital) personalities	(Schimmelpenninck, 2023)
In the days we can't travel far, nature becomes a more common way to seek an escape.	Socio-cultural	Development	Poetry Near Home	(China Britain Business Counsil, 2021)
Big events and digital saturation makes people need to let go of tension and focus on the moment - Enjoy the things close to home.	Psychological	Development	Poetry Near Home	(YANG DESIGN, 2023)

Name	Tag	Type	Cluster	Source
Rural live becomes more popular - A counter-reaction to urbanisation over the last decades	Demographic	Trend	Poetry Near Home	(YANG DESIGN, 2023)
One in four (24.6 per cent) adolescents reported feeling mild or severe depression.	Psychological	Trend	Escaping the rush for mental well-being	(UNICEF, 2021)
81.81% of the population has anxiety, depression and other emotional distress, and more than half of the working people are experiencing "meaninglessness"	Psychological	Trend	Escaping the rush for mental well-being	(UNICEF, 2021)
The psychological problems of young people aged 18-34 are increasingly significant.	Psychological	Trend	Escaping the rush for mental well-being	(YANG DESIGN, 2023)
Its hard to feel like home for young people aged 18-34, regardless of where they live.	Psychological	Trend	Poetry Near Home	(YANG DESIGN, 2023)
Indoor plants as a hobby is very popular - "i love plants" in Xiaohongshu (Chinese Instagram) has a total of over 170 million page views.	Socio-cultural	Trend	Poetry Near Home	(YANG DESIGN, 2023)
Local tourists fall in love with familiar old places. Not so much a new tourism product as it is a new way of life.	Socio-cultural	Trend	Poetry Near Home	(YANG DESIGN, 2023)
Tourism activities are shifted from long trips to fragmented smaller activities, making it possible for locals to participate as well.	Socio-cultural	Trend	Poetry Near Home	(China Britain Business Counsil, 2021)
There are 2 million post-95s who buy fishing products every year.	Socio-cultural	Trend	Poetry Near Home	(YANG DESIGN, 2023)
Since the second half of 2021, the number of camping products on Xiecheng has increased by nearly 10 times.	Economical	Trend	Poetry Near Home	(YANG DESIGN, 2023)
Camping is growing rapidly in popularity. It creates beautiful photos for social media and is a way to escape the busy city close by.	Socio-cultural	Trend	Poetry Near Home	(YANG DESIGN, 2023)
3 of the 5 most popular content types on Xiaohongshu were related to enjoying yourself close to home. - Cooking, citytour nearby, entertainment at home	Socio-cultural	Trend	Poetry Near Home	(YANG DESIGN, 2023)
The domestic pet industry market size is expected to grow at a CAGR of about 17% by 2024	Economical	Trend	Poetry Near Home	(YANG DESIGN, 2023)
Young people are forced to find an outlet and aspire to self under the influence of huge amount of information and burnout - Every bad moment is rudely mocked as "I emo."	Psychological	Trend	Escaping the rush for mental well-being	(YANG DESIGN, 2023)
"empty-nest young people" - More and more people in their 20s and 30s are living alone	Demographic	Development	Escaping the rush for mental well-being	(Minxi, 2021)
Being alone and lonely is fast becoming a standard.	Socio-cultural	Trend	Escaping the rush for mental well-being	(Minxi, 2021)
"living alone, bleary eyes, taking out three meals and Taobao in four seasons" - A bland, lonely live is becoming normal for gen Y	Socio-cultural	Trend	Escaping the rush for mental well-being	(YANG DESIGN, 2023)
Everyone desperately wants to get social recognition, is afraid to become the bottom of society, and is afraid to be excluded.	Psychological	Principle	Excellence is in your own hands	(YANG DESIGN, 2023)
As AI starts using our language, it become accessible to all.	Technological	Development	Trusting black boxes and the people behind them	(YANG DESIGN, 2023)
Data is becoming a new driving force for economic growth, and promoting the reform of economic production methods and models.	Economical	Development	Data is gold	(YANG DESIGN, 2023)
The freshness and excitement brought by the virtual world are rare in real life, but there are still irreplaceable real experiences and feelings in real life.	Technological	Principle	Trusting black boxes and the people behind them	(YANG DESIGN, 2023)
Customers start to make more financially conscious choices as economic growth slows down, while wishing to maintain the same living standard.	Economical	Trend	Middle class is the new normal	(Zipser et al., 2022)
The new middle class of the last one/two decades will buy their second 'premium' car the next decade.	Economical	Development	Middle class is the new normal	(Cenminzhao, 2013)

Name	Tag	Type	Cluster	Source
Commuting individually is more comfortable, safer, and more private than public transport, but also more expensive.	Economical	Principle	Middle class is the new normal	(Steg, 2003)
Increased wealth leads to cars available to more people, gradually losing their value as status symbols.	Economical	Development	Middle class is the new normal	(China Britain Business Counsil, 2021)
The current rate of urbanisation is unsustainable, as cities don't allow for unlimited inhabitant density.	Demographic	Development	Middle class is the new normal	(Kuddus et al., 2020)
Wellness and health focused consumption is growing as a result of increased wealth.	Economical	Development	Middle class is the new normal	(Allison, 2022)
The middle class has grown from 10% to over 30% of the population, and is expected to grow to over 50%. It is the biggest middle class of the world	Economical	Development	Middle class is the new normal	(Jizhe, 2021)
Everything that happens in the metaverse is synchronous, has no delay, is not limited by space, and can be entered at any time.	Technological	Principle	Trusting black boxes and the people behind them	(YANG DESIGN, 2023)
AD allow users to use the car as an extension of their living space.	Technological	Development	Flexibility is freedom	(D. Mitchell, 2023)
Air quality will worsen, and will be an increased concern for society; especially in the cities	Environmental	Development	Louder denser busier	(Shepherd, 2023)
Storytelling and humanisation helps user relate to the product they are using.	Psychological	Principle	Trusting black boxes and the people behind them	(YANG DESIGN, 2023)
Our economy relies on constant growth to keep working the way it does.	Economical	Principle	Never not entertained	(China Britain Business Counsil, 2021)
Millennials believe the things they read (online), Gen Z and younger are used to filtering online information.	Psychological	Principle	Never not entertained	(Mitchell, 2023)
Gen Z and younger are constantly online.	Socio-cultural	Trend	Never not entertained	(Mitchell, 2023)
AI will know things about us that we don't even know about ourselves.	Technological	Development	Trusting black boxes and the people behind them	(Sharma, 2023)
Frequent natural disasters will be daily business, and affect daily lives and living decisions.	Environmental	Development	The fight for tomorrow	(International Renewable Energy Agency, 2020)
Flexible, remote ways of work replaced 'traditional' physical, 9-5 ways of working, and are there to stay	Socio-cultural	Development	Flexibility is freedom	(Cook, 2023)
Marriage can be a economical decision between two families.	Socio-cultural	Principle	Middle class is the new normal	(Gao et al., 2022)
The ability to focus leads to increased satisfaction, happiness, and productivity.	Psychological	Principle	Never not entertained	(Bellet et al., 2019)
Our main device, our phone, acts as the baseline for all other digital experiences.	Psychological	Principle	Never not entertained	(Hackl, 2023)
High population density in urban areas leads to disease spread and air population, leaing to millions of deads worldwide.	Demographic	Development	Louder denser busier	(World Health Organization: WHO, 2016)
The best algorithms lead to much wealth, leading to a small wealthy group owning these algorithms.	Economical	Development	Trusting black boxes and the people behind them	(Weber et al., 2016)
The best technologies will be available to the rich, leading to an increasing gap with the poor.	Economical	Development	Trusting black boxes and the people behind them	(Weber et al., 2016)
People who don't use technology to increase their capacities will stay behind.	Economical	Development	Trusting black boxes and the people behind them	(Weber et al., 2016)
Urban density makes the car less time efficient as urbanisation continues.	Demographic	Development	Louder denser busier	(Fujiu et al., 2024)

Name	Tag	Type	Cluster	Source
Social media blends with our daily lives, and will accompany people in everything they do.	Socio-cultural	Development	Never not entertained	(Allen, 2019)
The use of shared mobility is rising. However, not showing any effect on car industry yet.	Socio-cultural	Trend	Flexibility is freedom	(Grosse-Ophoff et al., 2017)
Time spent in the car will move from driving to consuming media.	Socio-cultural	Development	Never not entertained	(China Britain Business Counsil, 2021)
Gen z quickly loses interest in things.	Psychological	Principle	Never not entertained	(China Britain Business Counsil, 2021)
AD will allow drivers to continue multi-tasking even better.	Socio-cultural	Development	Never not entertained	(B. Bos, personal communication, January 2024)
Consumer attention is a value asset for modern companies.	Economical	Principle	Never not entertained	(Hackl, 2023)
Digital media moves from its own island to being mixed with our physical reality.	Technological	Development	Never not entertained	(Hackl, 2023)
AI will beat us in making complex decisions.	Technological	Development	Trusting black boxes and the people behind them	(Sharma, 2023)
Data will become the most value asset, as it powers all AI.	Policital	Development	Data is gold	(Powell, 2023)
All (simple) personal data can become sensitive data.	Policital	Development	Data is gold	(Powell, 2023)
In the near future, almost all products/services/function will use some sort of AI	Technological	Development	Trusting black boxes and the people behind them	(Sharma, 2023)
AR will result in a more intuitive way to interact with digital systems.	Psychological	Development	Never not entertained	(B. Bos, personal communication, January 2024)
Tangibility helps to remember experiences.	Psychological	Principle	Craving physical connection	(Scott et al., 2016)
Using over owning, due to access to anything, anytime.	Technological	Development	Flexibility is freedom	(Oeschger et al., 2023)
Non-physical objects are becoming the main driver of the economy/society.	Economical	Development	Trusting black boxes and the people behind them	(China Britain Business Counsil, 2021)
The idea of happiness in a capitalist world is gaining wealth to create meaningful experiences with your loved ones.	Socio-cultural	Principle	Craving physical connection	(Desmet & Pohlmeyer, 2013)
Millennials always had constant feedback, and are comfortable while receiving it.	Psychological	Principle	Never not entertained	(Mitchell, 2023)
The results of growing up in a digital-native, always-on environment are becoming clear.	Socio-cultural	Development	Never not entertained	(China Britain Business Counsil, 2021)
Virtual spaces will be a part of our shared social living environments	Socio-cultural	Development	Never not entertained	(B. Bos, personal communication, January 2024)
The will be an increasing amount of legislative control around social media, due to its effects on privacy and health.	Policital	Development	Data is gold	(Powell, 2023)
Gen Z have a shorter attention span than gen Y and older.	Psychological	Principle	Never not entertained	(Hackl, 2023)
Digital safety (e.g. privacy) will an increasing concern in the daily lives of people.	Technological	Development	Data is gold	(Powell, 2023)
Working(/education) from home during COVID19 showed the advantages in terms of work/life balance.	Socio-cultural	Development	Flexibility is freedom	(MBO Partners, 2023)
Humans have natural crave for novel experiences; things need to stay interesting for them.	Psychological	Principle	Craving physical connection	(R. Jones, personal communication, January 2024)

Name	Tag	Type	Cluster	Source
Trends are shared by all worldwide through social media, and are not linked to a physical place anymore.	Demographic	Development	Never not entertained	(China Britain Business Counsil, 2021)
Drivers don't enjoy driving in busy metropole centers.	Psychological	Principle	Louder denser busier	(Venable, 2017)
The impact and size of social commerce continues to grow.	Economical	Development	Never not entertained	(Deloitte Analysis, 2023)
People are lazy, and want to have a certain convenience once they experienced it.	Psychological	Principle	Never not entertained	(Hackl, 2023)
Habitants of metropoles don't leave the city in their daily lives.	Demographic	Principle	Louder denser busier	(Cysek-Pawlak & Pabich, 2020)
First- and last-mile mobility solutions will work together seamlessly with public transport systems.	Technological	Development	Flexibility is freedom	(Oeschger et al., 2023)
Developments in AI will result in very accurate predictions of human actions and decisions.	Technological	Development	Trusting black boxes and the people behind them	(Sharma, 2023)
Data from vehicles will be used to optimize the traffic, especially in metropoles.	Technological	Development	Data is gold	(Lesser, 2023)
More wealth increases the amount of mobility options.	Economical	Principle	Flexibility is freedom	(Oeschger et al., 2023)
The centralisation of entertainment and news on social media makes targeting customers easier than ever.	Technological	Development	Data is gold	(Powell, 2023)
Tech brands play on the needs and feelings of customers through the use of 'micro-moments'.	Technological	Trend	Never not entertained	(Google, n.d.)
As tech giant focus on addictive algorithms, people can not control the time spent online.	Technological	Development	Never not entertained	(Hackl, 2023)
Consuming content from influencers is daily business for the majority: 87% uses Douyin (TikTok) each month	Socio-cultural	Trend	Never not entertained	(Thomala, 2024)
Healthcare will move to the people: daily care is done through personal devices; doctors act as consultants	Technological	Development	Trusting black boxes and the people behind them	(Campos-Ferreira et al., 2023)
Social media is the main source of news; and not only for Gen Z and younger.	Socio-cultural	Trend	Never not entertained	(Statista, 2023)
Health monitoring systems will be integrated in vehicle interfaces for real-time health feedback.	Psychological	Development	Trusting black boxes and the people behind them	(Campos-Ferreira et al., 2023)
People will be carrying a set of (connected) smart devices: Smartphone, AR glasses, smartwatch, (laptop?).	Technological	Development	Never not entertained	(Hackl, 2023)
Status outside the house is more important than a comfortable living space.	Socio-cultural	Principle	Louder denser busier	(China Britain Business Counsil, 2021)
Most of the time it is too warm to stay inside the house.	Environmental	Principle	Louder denser busier	(Mishra, 2023)
Living space is limited; therefore life is mainly happening outside of the house.	Demographic	Principle	Louder denser busier	(García-López et al., 2021)
Battery prices will drop, and with that ranges will increase. However, you will still have to take a break from time to time for a toilet visit or a coffee.	Technological	Development	Louder denser busier	(B. Bos, personal communication, January 2024)
AD will be mandatory in some areas in dense metropoles, to improve traffic flow and safety.	Technological	Development	Louder denser busier	(Fujiu et al., 2024)
Companies will be watched, and judged, on their way of using and protecting user data.	Technological	Development	Data is gold	(Lesser, 2023)
Adoption of solar panels on vehicles will increase driving range further.	Environmental	Development	Flexibility is freedom	(D. Mitchell, 2023)

Name	Tag	Type	Cluster	Source
Growth of vehicle-to-infrastructure (V2I) communication to improve traffic flow and safety.	Technological	Development	Trusting black boxes and the people behind them	(Weber et al., 2016)
AI-driven personal assistants for in-car productivity and convenience will be integrated.	Technological	Development	Trusting black boxes and the people behind them	(Sharma, 2023)
Flexible working arrangements and hours lead to changes in peak traffic intensity and hours, and vehicle usage of people.	Socio-cultural	Trend	Flexibility is freedom	(Van der Loop et al., 2019)
5G networks enabling real-time vehicle to everything (V2X) communication.	Technological	Development	Trusting black boxes and the people behind them	(Weber et al., 2016)
An increased focus on pedestrian safety features in vehicle safety systems.	Demographic	Development	Louder denser busier	(Cysek-Pawlak & Pabich, 2020)
Vehicles will be more customisable to adapt it to more different use cases.	Socio-cultural	Trend	Flexibility is freedom	(D. Mitchell, 2023)
Increase in pedestrian-friendly urban designs, promoting walkability and reducing the reliance on personal vehicles for short distances, especially in busy metropoles	Demographic	Trend	Louder denser busier	(Cysek-Pawlak & Pabich, 2020)
Instant gratification: Animals (and humans) tend to give in to pleasures without considering long-time effects.	Psychological	Principle	Never not entertained	(Urban & TED, 2016)
Faster travel solutions result in people to travel longer distances, not just travel the same trips in a shorter time.	Psychological	Principle	Flexibility is freedom	(Ziyan, 2023)

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Appendix B: Automotive haptics

In HMI design, a combination of visual, auditory and haptic feedback is used to communicate with the driver. Figure xx shows the potential areas for the different types of sensory feedback, with potential indicated from green (high potential), orange (medium potential), to red (low potential, and finally to white (no potential).

HAPTIC FEEDBACK

Whereas visual and auditory feedback is used throughout all vehicle interactions, haptic feedback is still in an early stage of integration in vehicles.

Use cases haptic feedback

TOUCHSCREEN UI

The integration of touchscreens in automotive cockpits has transformed driver-vehicle interactions. With the rise in touchscreen features, it is crucial to allow drivers to maintain focus on the road. Haptic feedback provides immediate confirmation of actions, reducing the need for drivers to look at the screen. For instance, haptic feedback can confirm the activation of climate controls without visual verification, enhancing driver concentration and minimising distractions.

ALERTS

Haptic alerts are used for high-priority notifications, such as collision warnings or navigation cues. These alerts capture the driver's attention immediately, providing critical information. For instance, a vibration on the steering wheel, gas pedal, or seat, can indicate a possible collision or close object.

SITUATIONAL AWARENESS

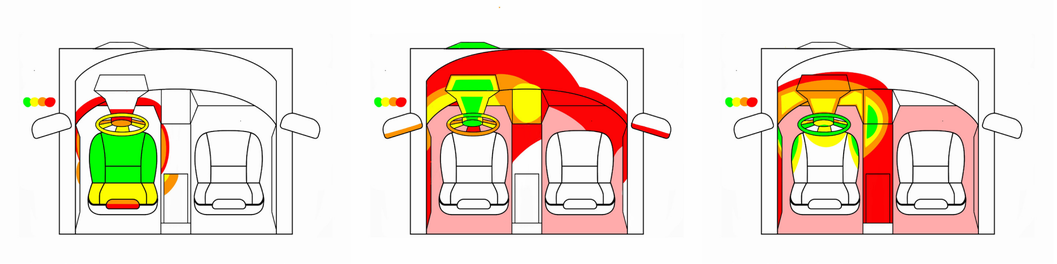
Haptic feedback enhances situational awareness by providing information about road conditions and environmental factors. This is particularly important in vehicles with electric steering and drive-by-wire systems, where tactile feedback is reduced. For example, vibrations in the steering wheel can indicate lane changing, helping drivers to stay in their lane.

SPECULATIVE USE CASES

Future applications of haptic technology in vehicles could include new ADAS functions, enhanced navigation guidance, and adaptive haptic feedback based on real-time driving conditions.

Haptic technologies

VIBROTACTILE



Vibrotactile feedback uses electromechanical actuators to produce vibrations felt on the skin. This type of feedback leverages the human sense of touch, using vibrations to convey information. Vibrotactile feedback can range in frequency from 50Hz to 1KHz, making it suitable for various automotive applications such as touchscreens, seats, and steering wheels.

Actuators:

- DC Motors
- Eccentric Rotating Mass (ERM)
- Linear Resonant Actuators (LRA)
- Piezoelectric Actuators

KINESTETIC

Kinesthetic feedback provides dynamic force feedback. This technology is typically found in pedals, where it can simulate various forces to enhance the driving experience. For example, varying the stiffness of the gas pedal can encourage fuel-efficient driving, or simulating resistance can improve driver response in emergency situations.

Actuators:

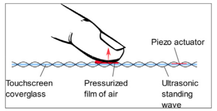
- DC motors
- Spring tension modulation systems

SURFACE FRICTION MODULATION

Surface friction modulation, or surface haptics, alters the friction between a finger and a touch surface to create the sensation of different textures. This is achieved through two primary methods:

Actuators:

- Piezoelectric Actuators, reducing friction and creating a textured effect
- Electroadhesion, creating an electric field between the screen surface and the finger

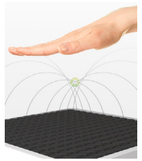


ULTRASOUND (WITHOUT CONTACT)

Ultrasound haptics generate tactile sensations through variable air pressure, felt without direct contact with the surface. These systems use ultrasonic transducers to create perceivable effects on the skin, offering a contactless method of providing haptic feedback.

Actuators:

- Ultrasonic transducers
- Array of piezoelectric elements



GREWUS possibilities

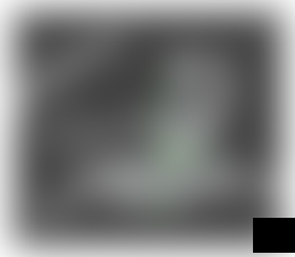
GREWUS GmbH, one of the major manufacturers of acoustic signalling devices and active haptic feedback components showed their haptic technologies. They already work with several automotive OEM's on the dashboard interaction, and are currently developing haptic feedback components for the seat.

Their use cases for haptics in automotive:

- Safety: Gentle motion patterns for ADAS warnings reduce cognitive load and improve reaction times.
- Comfort: Motion patterns can enhance relaxation, maintain alertness during long journeys, and prepare drivers for upcoming driving scenarios.
- Entertainment & Gamification: Seats can deliver subwoofer-like sensations, enhancing the experience of music, video, and games through precise frequency mapping.
- Drive Modes: Haptics can redefine driving experiences in electric vehicles, offering various sensations from eco-friendly to luxurious modes.

The haptic technologies offered by GREWUS:

- Exiter Actuators:
  - Provide vibrational feedback by exciting a surface.
  - Used in various automotive applications for tactile feedback.
- Piezoelectric Actuators:
  - Generate haptic feedback through precise and rapid mechanical movements.
  - Suitable for applications requiring high-frequency response and fine control.
- Linear Resonant Actuators (LRA):
  - Produce vibrations through linear motion.
  - Commonly used in applications requiring consistent and strong feedback.
- Eccentric Rotating Mass (ERM):
  - Utilize a rotating mass to create vibrational feedback.
  - Often used in handheld devices and smaller applications.
- Voice Coil Actuators:
  - Provide high power at low frequencies and broad frequency range.
  - Deliver high-definition haptic response and customizable feedback.



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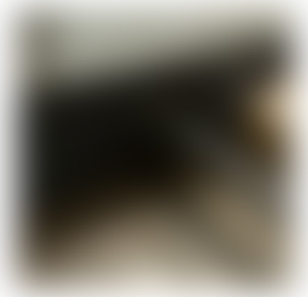

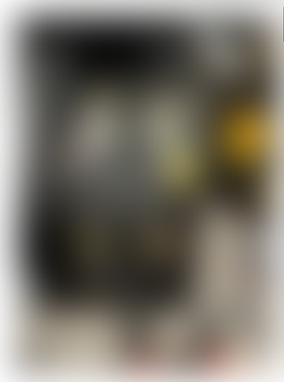

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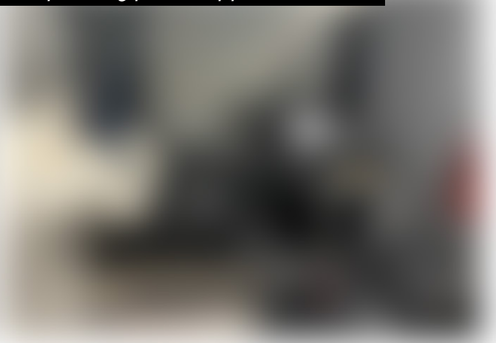
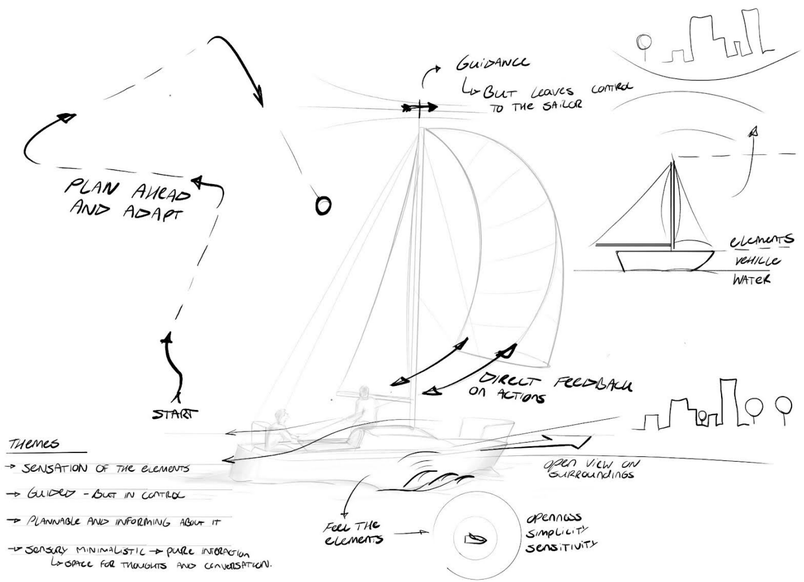


Appendix D: Analogy themes



Appendix E: Future context workshop

This appendix provides an overview of the workshop done on February 8, 2024. The workshop aimed at getting input from the team in Gothenburg, focusing on non-visual cues and intuitive user experiences, and involving the team members in my thesis project.

WORKSHOP OBJECTIVES

- Explore and redefine familiar in-car interactions.
- Ideate on interaction concepts for Lynk&Co's future car models.
- Gather context factors for the ViP method.
- To involve team members in my project

Length: 90 minutes.

Location: Horbury Hall, Lynk&Co office, Gothenburg.

WORKSHOP STRUCTURE

Introduction (10 minutes):

- Presentation to show the workshop context
- Divide the group in teams

Activity 1 - Defining Familiarity (15 minutes):

- Signal Output Familiarity: Decide on the placement and type of signal outputs (e.g., speed, navigation) for a completely intuitive interaction, using icons, screens, ambient lights, etc.
- Signal Input Familiarity: Determine the placement and type of signal inputs (e.g., media controls, HVAC) for optimal familiarity, considering touchscreens, buttons, voice control, etc.

Activity 2 - Rethinking Interactions (15 minutes):

- The teams rethink how in-car functions are controlled using input and outputs, based on the following objectives:
  - Improved joy of driving.
  - improved social interaction within the car.
  - Increased interaction with the external environment.

Fika (15 minutes):

- Break with fika

Activity 3 - Envisioning 2030 (15 minutes):

- The teams are asked to take a step back from their daily work, and brainstorm on context factors like lifestyle changes, communication habits, in-car activities, and the automotive landscape in 2030.

Activity 4 - Future-Focused Idea Generation (15 minutes):

- Using insights from activity 3, the teams create new interaction layouts and ideas that fit within the projected future scenarios.

Wrap-Up and Sharing (10 minutes):

- Wrap up and sharing the best idea generated with the other teams

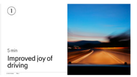
MATERIALS

- Blank Lynk&Co car interior canvases.
- Function cards.
- Drawing materials.
- Post-its for additional ideas and notes.
- Cinnamon bun cake and coffee for the fika.

Workshop

Planning

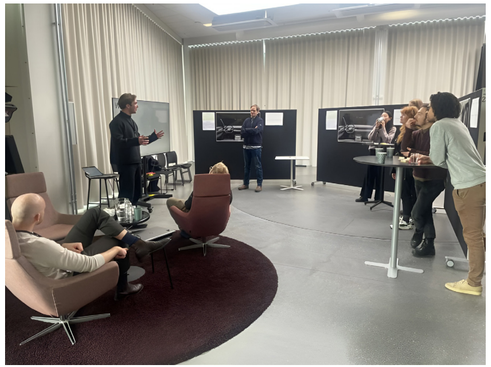
00 Intro
02 Starting point
03 Now
04 2030
05 Wrap-up

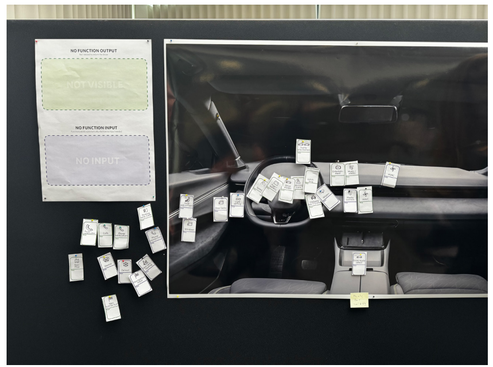


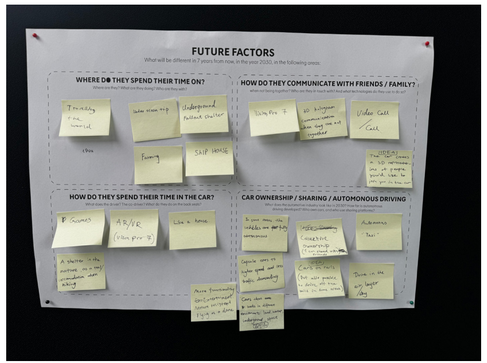
One generation further

One generation further
Envisioning the year 2030

Thank you

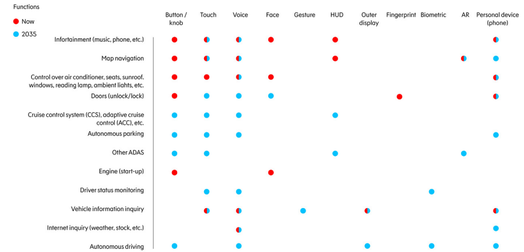






Appendix F: HMI functions

This figure lists current HMI functions and their medium for input and output. In blue, the same functions are projected onto the year 2035, as expected. The diagram categorises various vehicle functions such as infotainment, climate control, and autonomous driving. It shows the control mediums—ranging from conventional buttons and touch interfaces to more advanced methods like voice, facial recognition, and augmented reality—that are anticipated to have changed by 2035.



Appendix G: 23 Shanghai and 24 Beijing auto show insights

2023 Shanghai Auto Show

MARKET SPECIFIC DESIGNS

- Models specifically for the Chinese market.
- Integration of new technologies into traditional vehicle designs.
- Retro-tech styling.

BRAND CHALLENGES

- Difficulty in differentiating multiple brands within large automotive groups.
- Need for clearer brand positioning and distinct identities.

CULTURAL DEFINITION OF LUXURY

- Incorporation of traditional cultural elements into luxury vehicle designs.
- Blend of heritage and modern design appealing to the Chinese luxury market.

PRODUCTS ARE THE SAME

- Larger screens, business-class seats, aircraft feel.
- Risk of diluting brand uniqueness and impacting consumer perception.

2024 Beijing Auto Show

OFF-ROAD POPULARITY

- Increase in EV off-road vehicles.

LARGER THE BETTER

- Focus on larger SUVs with lower prices.
- Shift from business-focused to family-oriented.

INCREASED PASSENGER COMFORT

- Larger seating configurations (5, 6, 7 seats).
- Comfort and utility, especially when the vehicle is parked.
- MPV feel within SUVs for passenger comfort

EV AND SUV COMPETITION

- Strong competition in the EV segment with through technologies and design
- Aggressive pricing strategies in the SUV market to capture market share.
- Influence of local brands leads to global brands innovating and adapting.

NEW VEHICLE CLASSES

- New vehicle classes tailored to local consumers.
- Focus on intelligent and driver-centric models.

SHARED PLATFORMS AND PARTNERSHIPS

- Partnerships between international and local manufacturers are settled for better China-tailored products
- Shared platforms are created between Chinese and other OEMs.

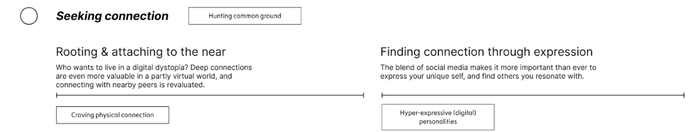
Appendix H: Alternative framework dimensions

DIMENSION 1: THE PRIVILEGE OF MOBILITY

The factors show three different positions in mobility, given the new availability of mobility through new middle class wealth. It provides flexibility and a feeling of freedom in a world where pressure intensifies, but due to urban population density and inefficient mobility solution, this creates limitations, which is the second position. The third is the conscious choice of sticking to locality in time of freedom of movement.

DIMENSION 2: SEEKING CONNECTION

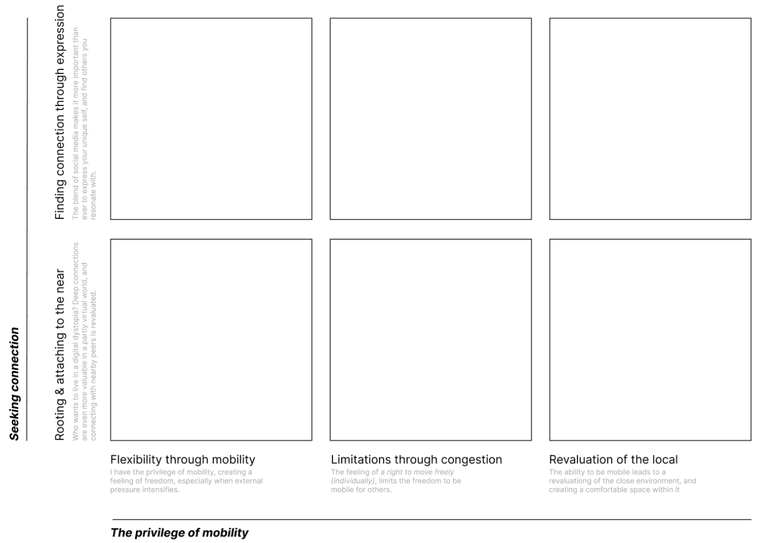
The drivers show two different attitudes to seeking connecting in times of digital dystopia. On the one hand we see a counterreaction to digital overconsumption, and preferring deep roots and attachment to that/those near. On the other hand connection and sought after through expression, aiming to find others to resonate with.



DIMENSION 3: HOW WE CARE FOR OURSELVES

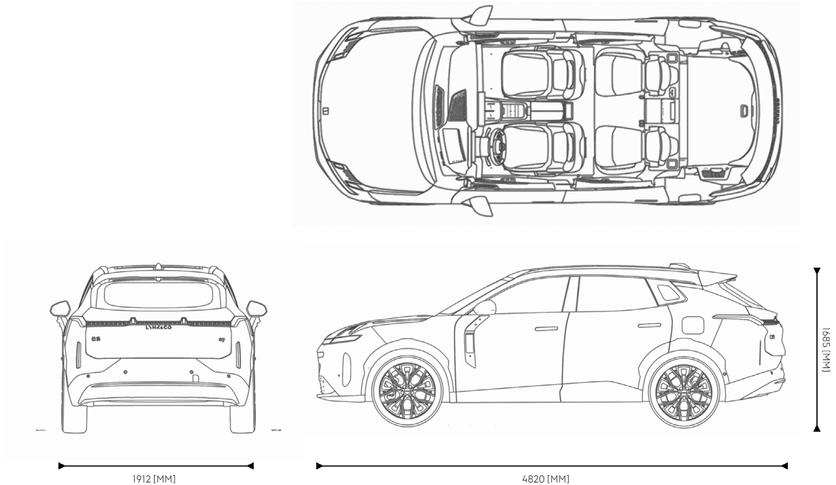
Pressure from different directions increase the need of self-care, especially regarding mental health. The clusters show three different attitudes to coping with this external pressure; A variation on fight, flight, freeze.

These dimensions are combined and tested by combining them in all ways possible. Due to the similarities in dimension 1 and 3, and the ability to map the clusters from dimensions three onto the framework constructed from dimension 1 and 2, it was chosen to take these for a framework.

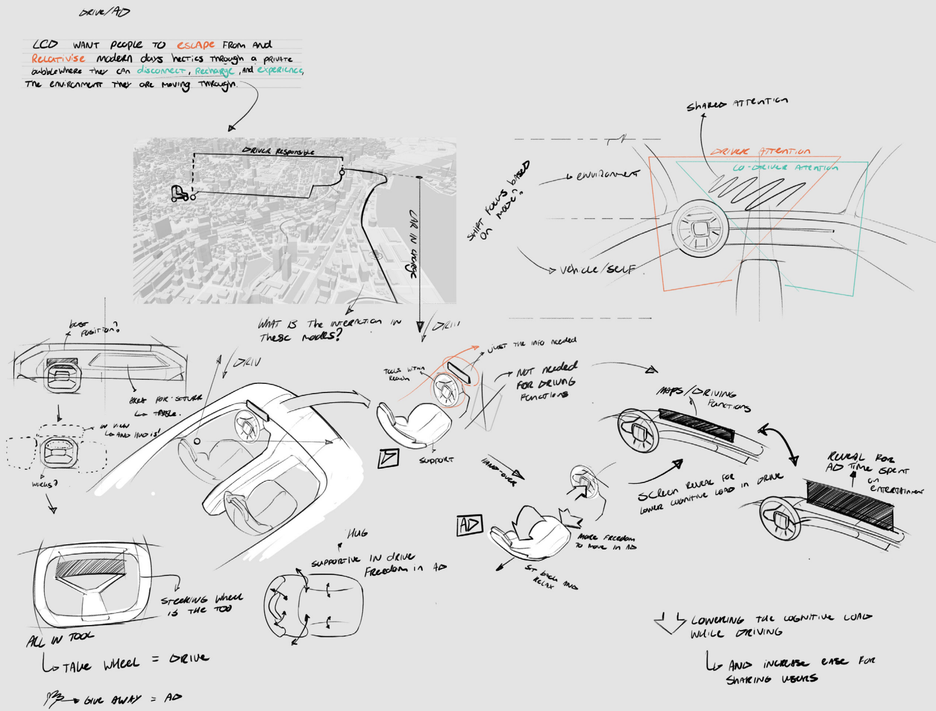


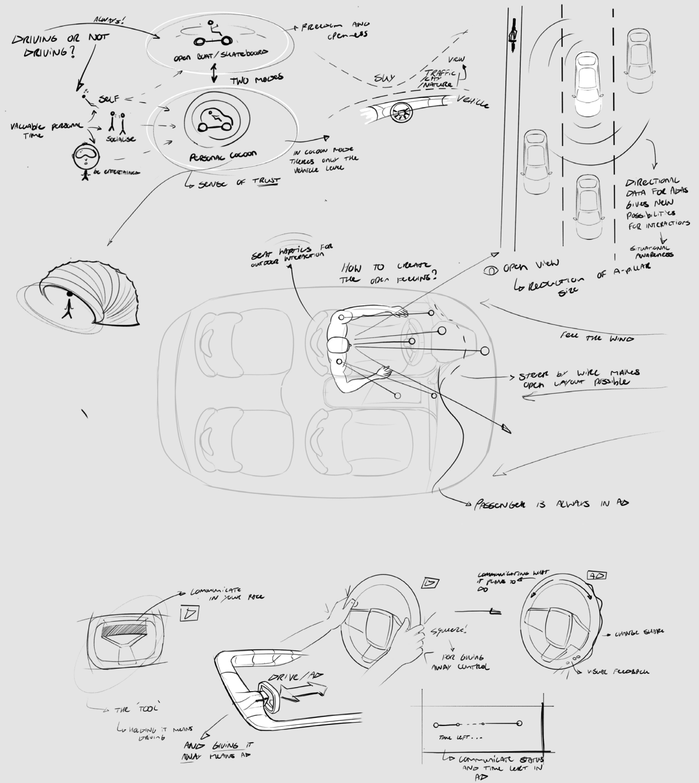
Appendix I: Vehicle package

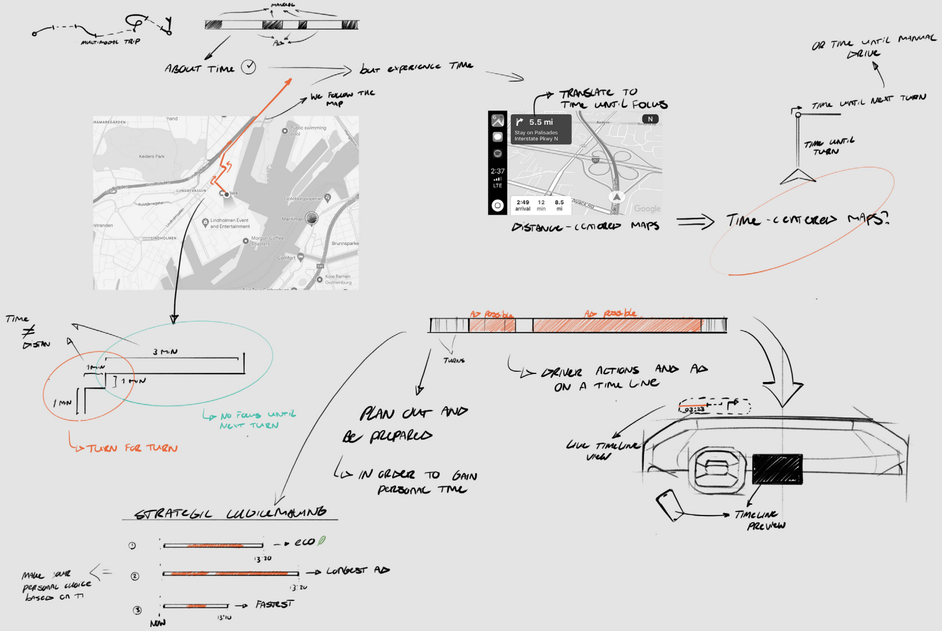
In the development of the vision concept. The Lynk & Co 08, a mid-size crossover SUV, and one of the latest released models, is taken as a platform to design on top of. The 08 was released in 2023, currently solely in China, and is based on the CMA 2.0 platform.



Appendix J: Ideation sketches







Appendix K: Approved project brief

DESIGN FOR our future

TU Delft

IDE Master Graduation Project

Project team, procedural checks and Personal Project Brief

In this document the agreements made between student and supervisory team about the student's IDE Master Graduation Project are set out. This document may also include involvement of an external client, however does not cover any legal matters student and client (might) agree upon. Next to that, this document facilitates the required procedural checks:

- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project

STUDENT DATA & MASTER PROGRAMME
Complete all fields and indicate which master(s) you are in

Family name	Kierkels
Initials	R.M.
Given name	Rens
Student number	[redacted]

IDE master(s): IPD ✓ DfI ☐ SPD ☐
2nd non-IDE master
Individual programme (date of approval)
Medisign ☐
HPM ☐

SUPERVISORY TEAM
Fill in he required information of supervisory team members. If applicable, company mentor is added as 2nd mentor

Chair	Matthijs van Dijk	dept./section	HCD / DA
mentor	Susie Brand-de Groot	dept./section	HCD / HCID
2nd mentor	David Gillblom		
client:	Lynk & Co Design		
city:	Gothenburg	country:	Sweden
optional comments			

! Ensure a heterogeneous team. In case you wish to include team members from the same section, explain why.
! Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.
! 2nd mentor only applies when a client is involved.

APPROVAL OF CHAIR on PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in by the Chair of the supervisory team

Sign for approval (Chair)

Name Matthijs van Dijk Date 29 januari 2024 Signature

DESIGN FOR our future

TU Delft

Personal Project Brief – IDE Master Graduation Project

Name student Rens Kierkels Student number 4674863

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT
Complete all fields, keep information clear, specific and concise

Project title
Reimagining in-car interactions for future Lynk & Co models

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

In the rapidly evolving world of mobility, where cars increasingly resemble high-tech gadgets, the design of Human Machine Interfaces (HMI's) plays a major role in shaping the user experience. Modern car dashboards, often criticised for their unintuitive, cluttered designs, stand in contrast to the elegang and efficient UI's of our other digital devices, which have improved at a fast pace over the past years (Babich & Kuznetsov, 2021). This project, in collaboration with automotive manufacturer Lynk & Co, aims to bridge this gap, creating an in-car experience that is both intuitive and in harmony with the vehicles journey.
The current trend within in-car interactions tends towards isolating the driver from the external environment. This project centres on redefining the in-car experience, moving away from a vehicle being merely a 'smartphone on wheels', as what Toyota's Akio Toyoda called its fun-Vii concept car back in 2011 (Kageyama, 2011).
Lynk & Co is making its mark in the automotive industry by their unique ownership models and modern user experiences. The company is looking for innovative interaction design for their future models, to continue providing novel, well-designed user experiences to their users, while also fitting their mission of making more efficient and durable use of their vehicles (figure 1).

This project focuses on performing research on the in-car experience and implementing user-centred design principles to enhance the longevity and quality of in-car interfaces. By emphasizing intuitive usability and sensory feedback, the aim is to create a more engaging and less isolating driving experience.

The domain of this project encloses automotive interior design and in-car user experience, with a specific focus on improving the dashboard interaction.

→ *space available for images / figures on next page*

introduction (continued); space for images

image / figure 1 Lynk & Co 08 in-car interface - Centre touchscreen

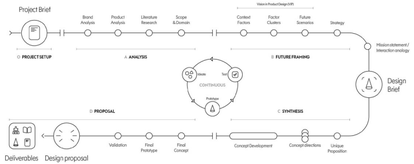


image / figure 2 Project structure diagram

DESIGN FOR our future

TU Delft

Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

- Modern car dashboards are often criticised for being unintuitive, cluttered, and distracting, filled with unnecessary information. Over the years the contrast increased compared to the elegant and efficient UI designs of our other digital devices, which improved at a fast pace (Everdell, 2015).
- The constant exposure to our digital devices has severe effects on stress and mental health, distancing us from reality (Mheidly, 2020). With cars moving to the digital domain as wel, it only adds another devices to our oversaturated digital lives.
- Automotive manufacturers are aiming to counteract these effects by adding features like ambient light, or going even further by projecting images of nature on the dashboard, distancing the user even further from the real world.
- Lynk & Co's sharing platform makes a short learning curve even more important, allowing to use their products instantly, intuitively.

- The aim is to create an experience that truly senses and responds to the world it moves through, without relying purely on vision; in order to create a truly intuitive and novel in-car interaction.
- This means evaluating the necessity of the current interface information, questioning the current reliance on controls, and exploring how interfaces can adapt automatically to diverse driving situations and user needs.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Create a unique, timeless in-car experience design for future Lynk & Co models through intuitive use and sensory feedback, addressing the changing landscape of mobility and preventing early obsolescence through lacking vehicle interfaces.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

The graduation project will be executed in 100 working days, starting the 18th of January until the 14th of June (with the graduation ceremony plannend one week later, on June 21). I plan to take 5 days off for personal holidays, and there are 2 days off for Swedish national holidays during the project.
The project will be sructured in 4 phases, over 20 weeks (exluding the preparation phase and 1 week holiday):

- **Phase 0 - Project Outline** - Preliminary research, project brief and project setup // 3 weeks
- **Phase 1 - Analysis** - Understanding user requirements, brand and design principles // 4 weeks
- **Phase 2 - Future framing** - Researching future context, and defining a frame for future concepts // 3 weeks
- **Phase 3 - Synthesis** - Concept development and prototyping/testing // 9 weeks
- **Phase 4 - Final proposal** - Final design development and final prototype / communicative material // 4 weeks

The activities within these phases are based upon *user-centered design methods* and *Vision in Product design (ViP)*. In this way, aesthetics, user experience and functionality are integrated with a clear strategic vision. An overview of these activities can be found in figure 2.

Project planning and key moments

To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a ***kick-off meeting, mid-term evaluation meeting, green light meeting*** *and* ***graduation ceremony****. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	January 18
Mid-term evaluation	March 13
Green light meeting	May 15
Graduation ceremony	June 21

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	
Number of project days per week	

Comments:
Full planning enclosed in Gantt-chart on page 7.
-> Final presentation Lynk & Co: June 14
-> Graduation ceremony: June 21

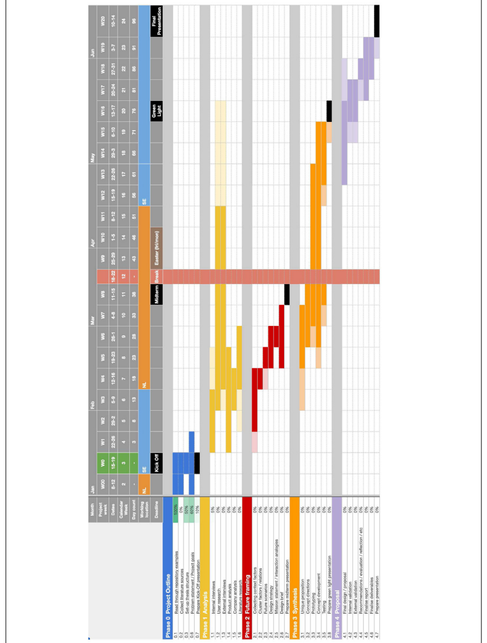
Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

Throughout my experiences the past years, the more complex and holistic projects spoke to me most, where many factors had to be taken into account; technological, strategic, aesthetic, viability. This led me to designing for mobility. Combined with a passion for well-designed products on wheels, a project for an automotive manufacturer is the perfect graduation for me.
I see the graduation project as the bridge from the academic world to the professional world, and therefore this project should be of value to both me as a designer/engineer and for Lynk & Co. I will make use of the acquired competences of my past years of studying; The ability to bring well-grounded design proposals based on research, the ability to show the feasibility of concepts and inspire, present visually and verbally well, and the ability to initiate and deliver an individual R&D project within the automotive sector from start to finish. I would like to develop myself in terms of professional communication and internal pitching of ideas, using and communicating design methodology in a professional environment, and improve my hard skills for both conceptual and practical product development.

My personal goals:
- Experience working in an automotive company, bridging the gap between academic and practical work in a professional way.
- Create valuable long-lasting design, in line with both the company vision and my personal vision.
- Follow a structured, pre-defined project planning.
- Present findings and concepts in a compelling and inspiring way.



Rens Mathias Kierkels

Graduate Student - MSc Integrated Product Design

Göteborg, June 2024