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Smart Trams: A Design Proposal for a City of Interrelation

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Abstract: This paper illustrates a case study and the research hypothesis of a project elaborated by the authors for the city of Gwangmyeong in South Korea. The project, which has been developed as a design concept, consists of an innovative public transportation system that aims to favor social integration between parts of the city that might be potentially segregated from each other. Gwangmyeong's plan fits into the debate on the *Broken World*, a social and economic condition recognized by many authors as a crucial problem of contemporary society. In this project, the means of transport, along with moving passengers and goods (in addition to waste), also host itinerant collective functions (school, work, etc.) spread in a capillary manner throughout the urban territory. The infrastructure is intended to serve as a social connective tissue of the different city districts. Although conceived in an Eastern context, the design concept is proposed to serve as a model for any new or existing environments in which greater integration is deemed necessary in favor of socially sustainable living conditions.

Keywords: smart city; smart mobility; broken world; transportation; infrastructure; city and society; social sustainability

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1. Introduction

The project developed by the authors, as illustrated in this article, has been proposed as a case study for a possible innovative approach to the design of the public transportation system in an urban context. This study summarizes and outlines a plan currently underway for Gwangmyeong New Town, in South Korea (see Section 3), from which it aims to abstract general concepts that apply to existing as well as new urban environments.

Several authors recognize the contemporary city to be a reflection and product of what has been defined as the *Broken World*, a condition of cultural crisis that manifests itself at political, economic, and social levels [1]. The current world can be defined as *broken* due to the systemic disparities that characterize it: economic and social gaps, differences in access to education and welfare, and unfair or irrelevant policies on housing and services [2–5]. The cities that we have inherited are characterized, in most cases, by a division into zones that are distinct from each other in terms of their history and/or function and social structure [6]. Regardless of whether the division was intentional and planned or whether the areas have naturally diversified over time, it is well-known that this fragmentation often reflects social and economic inequalities [7].

One of the highly pursued solutions to this problem is regenerating difficult areas by specific positive insertions (e.g., functions aimed at catalyzing economic and social development) [8].

The project presented in this study is the result of exploring the possible solutions for reducing urban fragmentation and inequality (i.e., recomposing the pieces of the *Broken World* for a considerably socially sustainable urban life) but adopts a different strategy. In this project, the central role has not been entrusted to punctual interventions but an

innovative widespread transportation system. By applying software and hardware technologies, the infrastructure and vehicles used for mobility have been proposed to be turned into *places for living* and to perform collective and *itinerant* functions. Through accurate urban planning, such functions can reach and serve any area of the city, thus transforming the urban neighborhoods into an integrated system involving even the most peripheral areas. It is believed that this approach will stimulate greater interaction between zones with different socioeconomic characteristics and favor mutual understanding and cooperation between their inhabitants. Infrastructure and transportation have thus been proposed to serve as the social and economic connective tissue of the city: physical and metaphorical integration vehicles.

Indeed, other recent projects, equally aimed at creating a sustainable urban environment, have focused on urban transportation and infrastructure innovation. For example, Woven City, an experimental town of 70 ha promoted by Toyota and under construction in Japan, is based on an orthogonal grid crossed by futuristic autonomous vehicles traveling at different speeds. Such vehicles are proposed to gather in central urban places, where they provide people with various services (Figure 1) [9]. The tool that supports proposals such as Woven City is *Smart City* technology and, in particular, its *Smart Mobility* branch. The latter discipline is relatively recent, but it is the subject of various studies and insights [10–16].

(**a**) (**b**)

Figure 1. Woven City, Japan: (**a**) infrastructural grid (Source: BIG, see https://big.dk/#projects; Toyota, Woven City, see https://www.woven-city.global/ (accessed on 1 August 2022)); (**b**) the central square (source: BIG, see https://big.dk/#projects (accessed on 1 August 2022); Toyota, Woven City, see https://www.woven-city.global/ (accessed on 1 August 2022)).

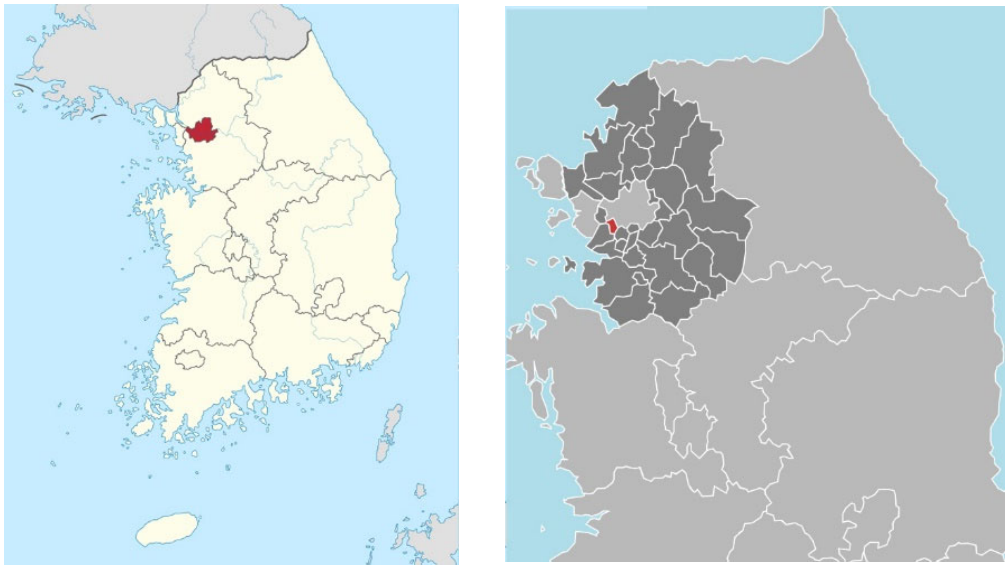
As will become clear from Section 3, the Gwangmyeong project adopts the same technology. However, in contrast to Woven City, it does not aim to create innovative vehicles or infrastructures. Instead, the main idea is to make a *smart* means of transportation that is old-fashioned but always current in reality, having crossed almost two centuries of urban history without too many transformations. The means of transportation referred to here is the tram. *Smart Trams* is, therefore, the name of the project. It is proposed to consist of an intelligent system of vehicles with detachable modules (*moving rooms*), the latter providing itinerant urban places for meeting people and "doing things".

The proposal was developed at the conceptual level, although it includes various technical insights, and is currently undergoing a specialized study to make it operational. However, even at this level, the project is not meant to be either simply technical/diagrammatic (typical of a smart city, which has no physical form) or only formal/morphological

(typical of an urban-scale design and traditional city models). Instead, it aspires to be both. The goal is a "humanistic" application of technology [17], where architecture, infrastructure, and techniques are combined to provide an alternative to the consolidated urban environment [18].

2. Project background

The core of the project was developed on the occasion of a workshop for the design of the abovementioned new town of Gwangmyeong, in the southern area of Seoul, South Korea (Figure 2). The town is intended to accommodate around 300,000 inhabitants. Seoul has a population of 9.976 million inhabitants (2022), while Gwangmyeong has 347,000 (2021).#



(**a**) (**b**)

Figure 2. (**a**) Location of Seoul (source: Wikipedia); (**b**) Location of Gwangmyeong; in dark grey, the Gyeonggi Province, with Seoul at the center (source: Wikipedia).

The term *New Town* is currently used in Korea to indicate a considerable expansion in an existing city, specifically, a new district. The master plan was commissioned by the Union of Land Owners of Gwangmyeong as a proposal to submit to the Municipal Government for approval. The workshop aimed to fix the general guidelines for the plan and was developed over several months from 2019 to 2021. The design team was composed of international professionals from several fields (architecture, urban planning, transportation, landscape design, etc.) and was coordinated by Sang Gil Kim, CEO of ATEC Architects of Seoul (http://m.atec.co.kr/main (accessed on 1 August 2022)). The scope of the master plan included seven conceptual areas (industry, housing, education, welfare and community, energy/waste/disposal systems, traffic and mobility systems, culture, and sports). The authors of this paper (architects) were in charge of the concept design for the mobility system and its infrastructure.

While working individually on the development of the assigned sector, the team members maintained close and frequent contact with each other, as in a permanent workshop, to share feedback on the project's development. The methodological principle was the reciprocal "cross-pollination" of the various disciplines involved (architecture, landscape, transport, commerce, etc.). Such an approach is uncommon in the Korean context, where the development of the different project aspects, while maintaining the necessary technical coherence, often proceeds on relatively independent tracks.

The administrative process of the project is currently on hold while the design team develops and works out its technical aspects.

The preparatory phase of the design started with a field trip among European cities, such as Milan, Madrid, and Barcelona, and an in-depth analysis of urban and mobility strategies in established urban contexts of similar sizes, such as Strasbourg (France), Bergen (Norway), and Nottingham (England).

The direct experience and the elaboration of the collected data led to the conviction that the mobility option best suited to the context of Gwangmyeong was the *Trackless Tram System* (see Section 5.1), which became the technological device around which the concept was elaborated. The most popular means of public transport in Seoul today are the subway (23 lines, including the extra-urban ones) and bus routes. However, it is worth mentioning that a tram service was active from 1899 to 1968 [19].

3. Project Concept

The *15-minute City* idea, which has recently been attempted to be implemented in towns such as Paris, Barcelona, and Milan, seeks to answer many of the needs of citizens within a 15 min walk to/from their homes [20]. The concept provides for the decentralization of most of the urban services: schools, commerce, theaters, entertainment venues, and workplaces. The goal of proposing such a concept is to allow life to unfold fully in the neighborhood without the need to go downtown or too far away from home. This model, which has been inspired by sustainable policies (especially the social and environmental ones), proposes a polycentric city in which the neighborhoods develop a sense of proximity and community, and participatory networks among citizens are established [21]. Beyond these excellent intentions, the risk embedded in the *15-minute* concept is the formation of internally cohesive areas, which, however, are mutually independent of one another (new "ghettos").

The city model proposed for Gwangmyeong is different. Unlike the decentralization of functions of the *15-minute City*, the project envisages the significant urban services (school, cultural, religious, and commercial facilities) to be centralized and grouped in specific areas that serve the entire city. Public transport will not be a simple means to reach these functions but will provide them with ancillary services (see Section 5). For example, schools in Gwangmyeong will consist of central buildings hosting gymnasiums, laboratories, auditoriums, libraries, and, of course, classrooms. At the same time, specific wagons of the *Smart Trams*, opportunely equipped (*moving rooms*), will serve as study rooms for pre- or after-school activities, itinerant classrooms or laboratories, recreational spaces, etc. As described in the further subsections, the tram service circuit will serve the entire city territory, connecting all its neighborhoods.

On the one hand, transportation time will no longer be "wasted time" but a time that people can intelligently invest while moving from one place to another. On the other hand, centralizing the main functions and gathering people from each neighborhood in the *moving rooms* aims to contribute to smoothing social, cultural, and economic differences, favoring comparison, direct experience, and, therefore, integration between different components of the urban community. The goal is to make infrastructures and transportation spaces of interrelation and not just mere places of transit.

4. Project Features: The Master Plan of Transportation

The master plan of Gwangmyeong New Town has been designed according to a linear layout articulated into blocks. The new city will wind along a river in the north–south direction in the southern area of Seoul (Figure 3).

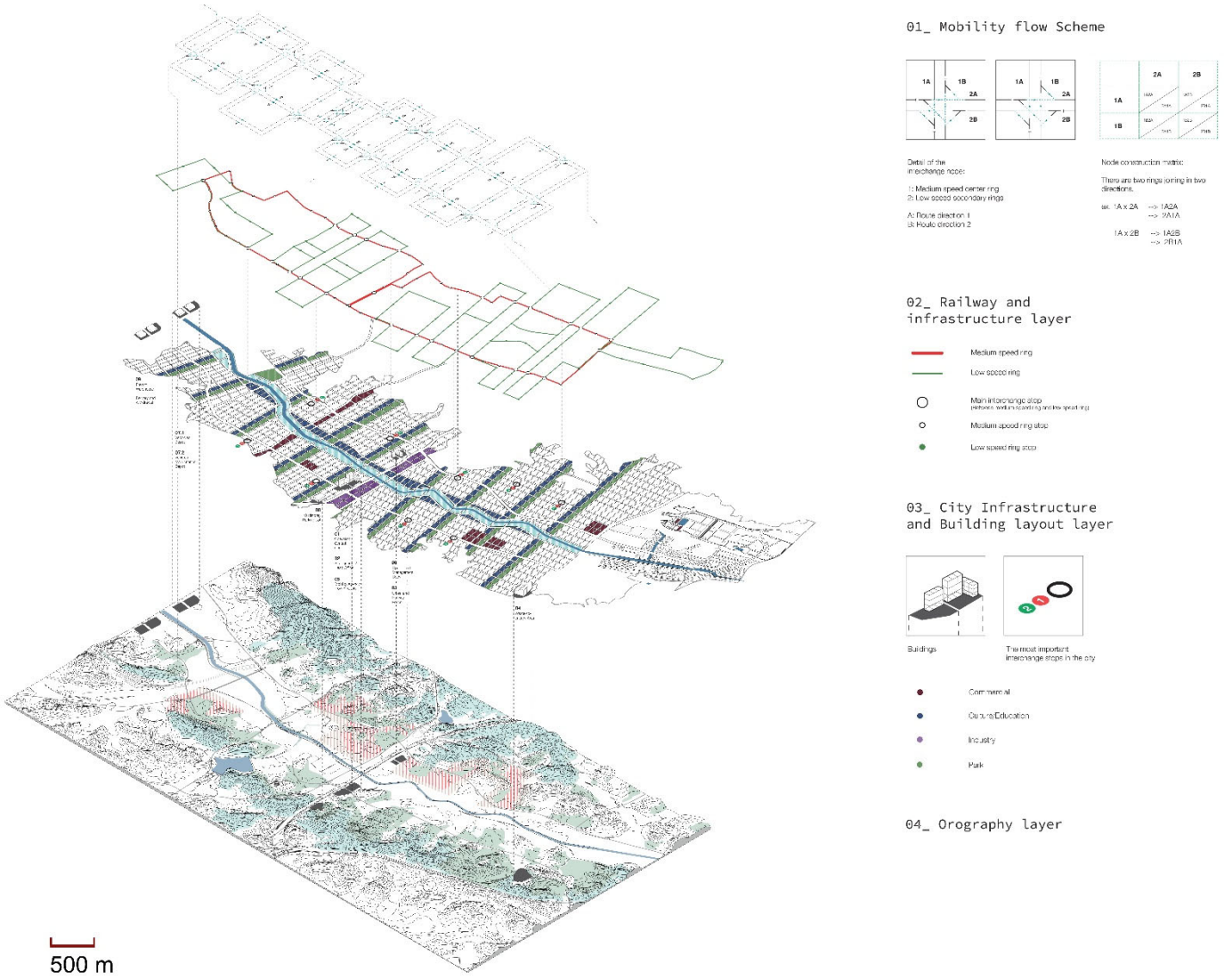


Figure 3. Urban master plan for Gwangmyeong, including topography (bottom) and transportation plan (top) (source: authors).

The transportation plan follows the logic of the urban layout (Figure 4). Although the specific form of the plan is, for the scope of this paper, less important than the general principles embedded in it, this section gives a brief description of it to provide a better understanding. One of the main objectives of the plan is the capillarization of the transport system, which will be fundamental for the diffusion of the functions performed by the *Smart Trams* within the city territory.

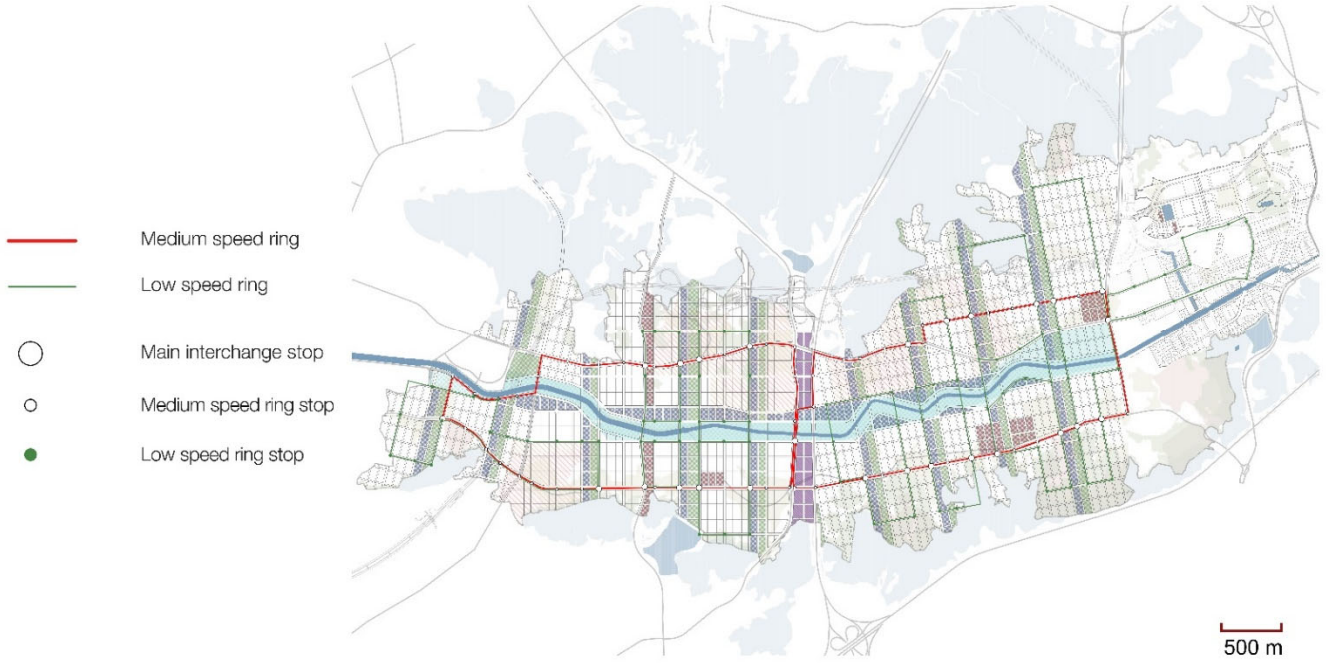


Figure 4. Master plan of the transportation system in Gwangmyeong (source: authors).

The plan provides three infrastructures for three different travel speeds. The speed depends on the number of stops (Figure 5). *A high-speed (HS) transport* line (few stops) connects the city to national areas and international hubs (e.g., the airport). This line has supra-municipal relevance and is being planned by regional authorities. Although the design team is waiting for the final layout, the project schematically identifies four interchange points with the urban lines (Figure 5, IS01-04). The HS line, in turn, is linked to a *medium-speed (MS) transport* ring, which runs through the city center and provides a route for the rapid movement of people and goods. Finally, at selected points, the MS ring intercepts the *low-speed (LS) transport* circuit. The latter is articulated in several secondary rings for the capillary delivery of people and goods to different neighborhoods. The LS circuit is, in turn, linked to a "last mile" individual transport system, which offers door-to-door public and semipublic services to homes.

The locations of the stops and interchange stations have been designed to optimize the network efficiency and valorize urban places (Figure 6).

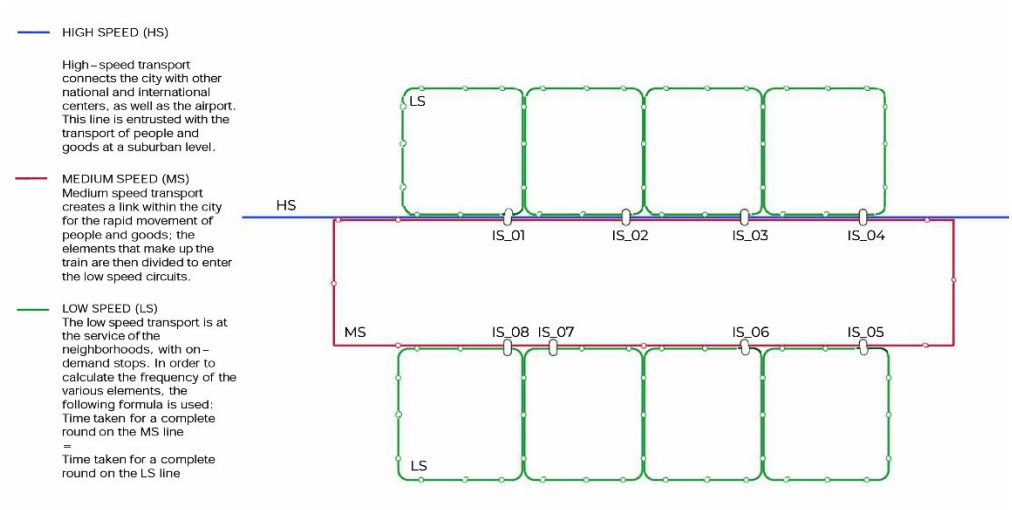


Figure 5. Mobility flow corresponding to different speeds (source: authors).

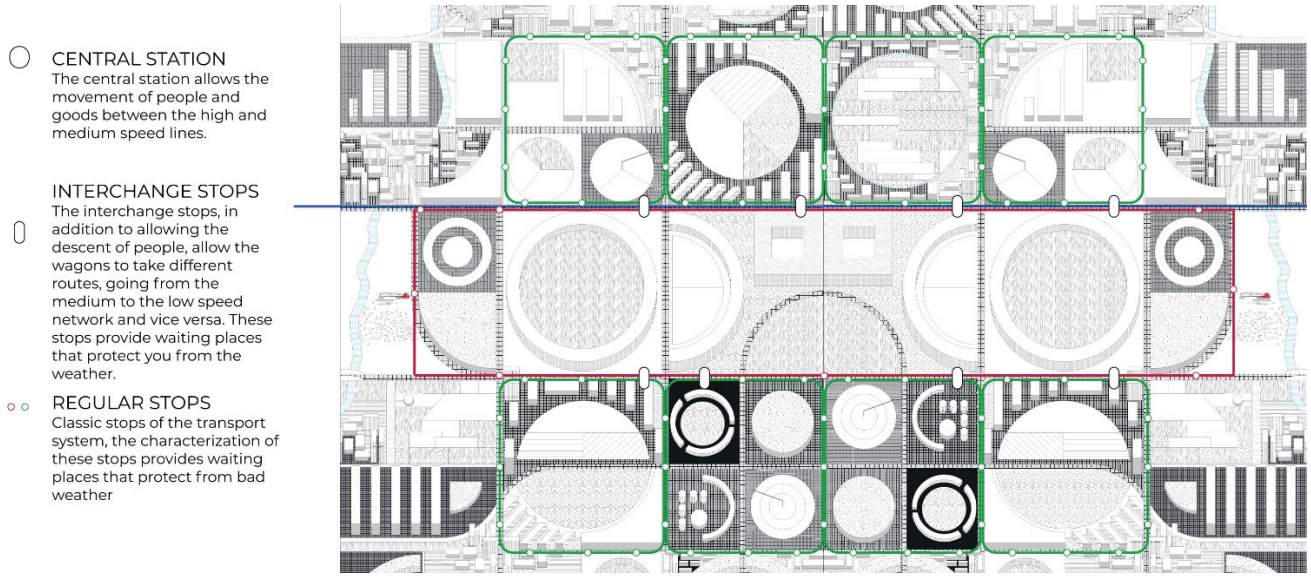


Figure 6. Stations and stops (source: authors).

5. Smart Trams, Moving Rooms, and Livable Infrastructures

The core of the project consists of the aforementioned *Smart Trams*. The *Smart Tram* wagons, thanks to a specially designed section housing sealed containers that are loaded and unloaded in collection centers, can simultaneously perform the functions of (1) passenger transport, (2) freight transport, and (3) waste disposal (Figure 7).

Smart Trams include *moving rooms*, namely, those components (wagons) that provide additional collective services. Using appropriate equipment, the *moving rooms* host collective activities such as classrooms, conference rooms, and coworking, commercial (shops), and leisure spaces (bars, cafes, etc.) (Figure 8). The path and the number of *rooms* used for this purpose can vary flexibly depending on the needs of the community.

Smart Trams travel on the MS ring (cf. Section 4). *Moving rooms* can travel on this route or, if requested, can detach themselves from the main convoy at the interchange stations with the LS ring and, through this ring, can reach any inhabited areas of the town to ensure their service is delivered in each neighborhood (Figure 9). For example, a citizen might decide to call a wagon to his home to work in while he reaches a meeting place or his office. Instead, a group of people can use a *moving room* for a traveling party, class, or study trip with specifically designed stops.

If this happens in existing cities where the disparity between the neighborhoods is marked, citizens of different origins, social backgrounds, economic conditions, education, etc., will participate in these collective activities. In this manner, the tram will become the "no man's land" or "everyone's land" where exchange and knowledge can occur, even between very different individuals. As we know, knowledge is the first step toward integration.

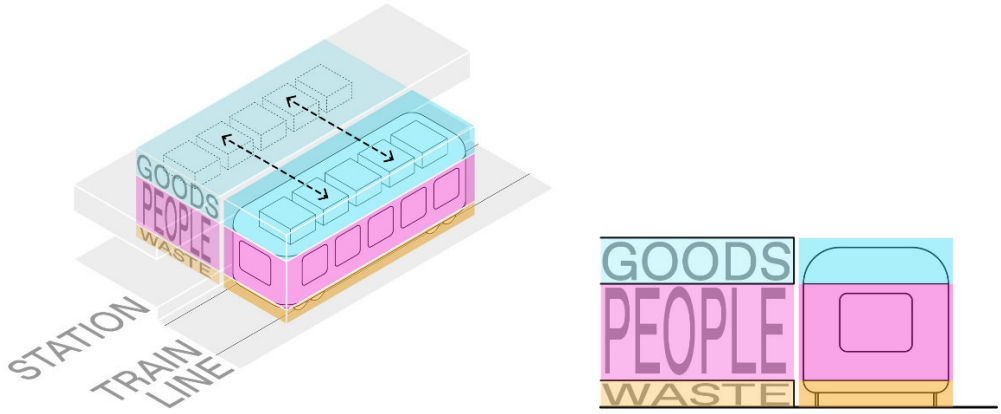


Figure 7. Management of the integrated systems: waste, goods, and people (source: authors). Sealed containers are also housed in the waste section of the wagon; however, this axonometric representation shows only the containers for goods.

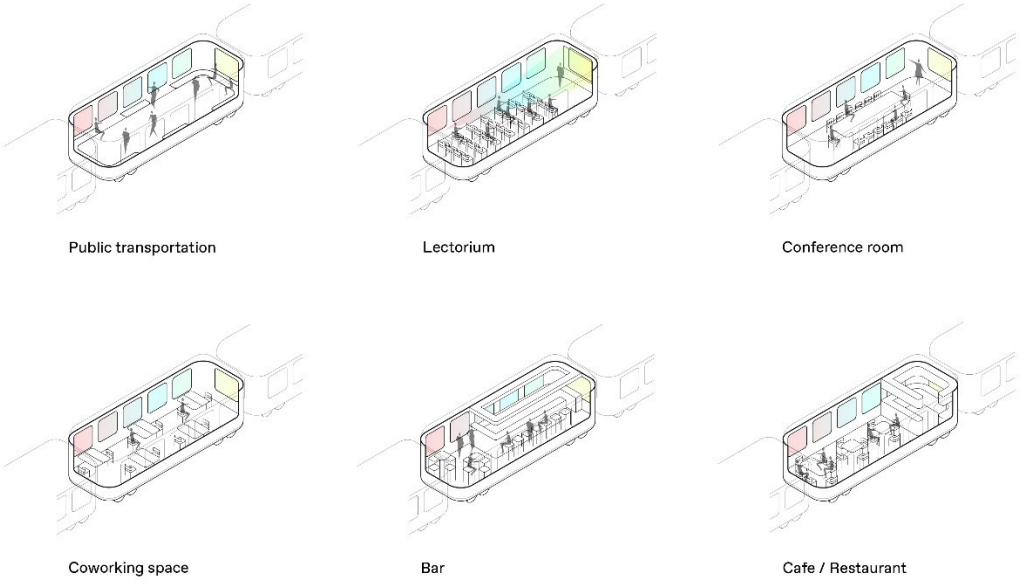


Figure 8. Management of the integrated systems: people (source: authors).

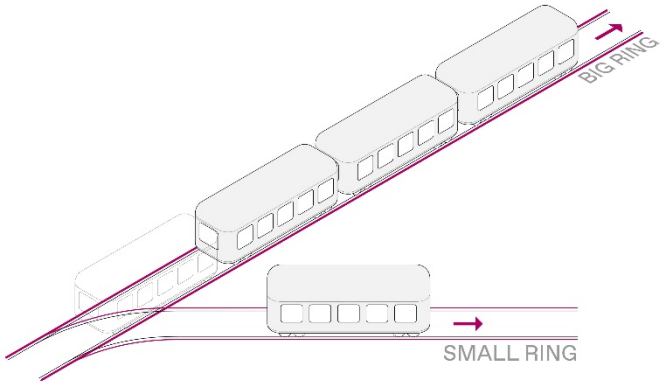


Figure 9. The detach–attach system of the tram wagons (source: authors).

Each itinerant function is designed to be related to specific facilities hosted in selected districts of the city (goods-sorting stations, garbage collection, transit stations, school facilities, offices, etc.) (Figures 10–12).

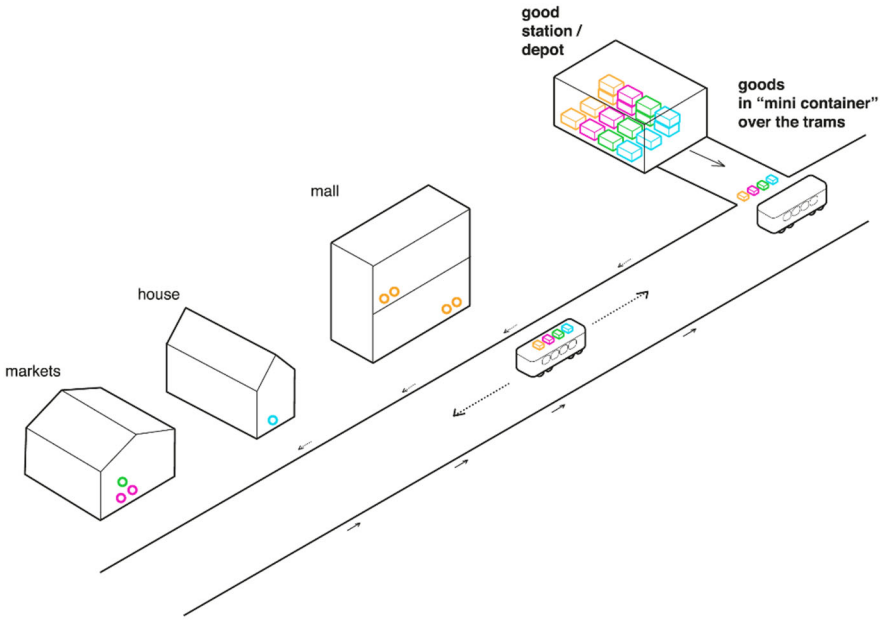


Figure 10. Management of the integrated systems: goods (source: authors).

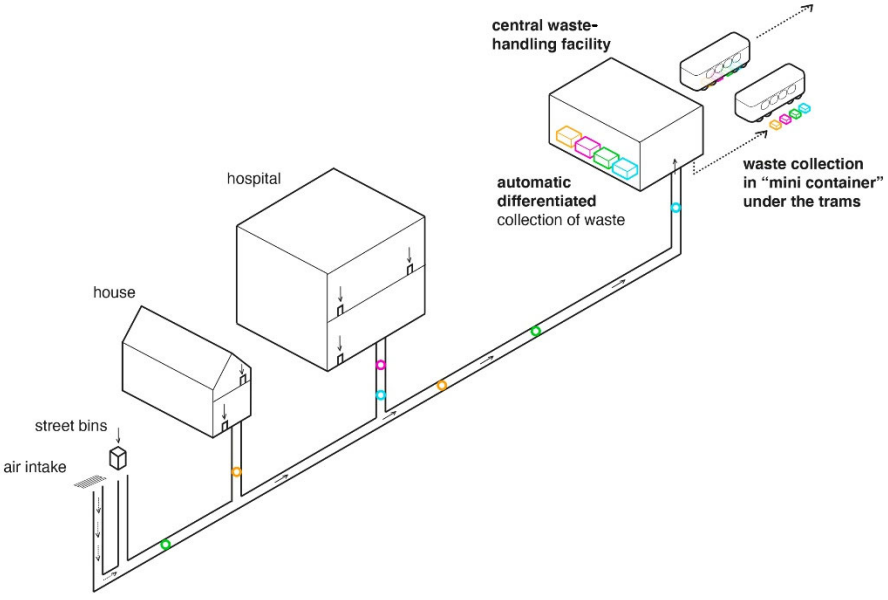


Figure 11. Management of the integrated systems: waste (source: authors).

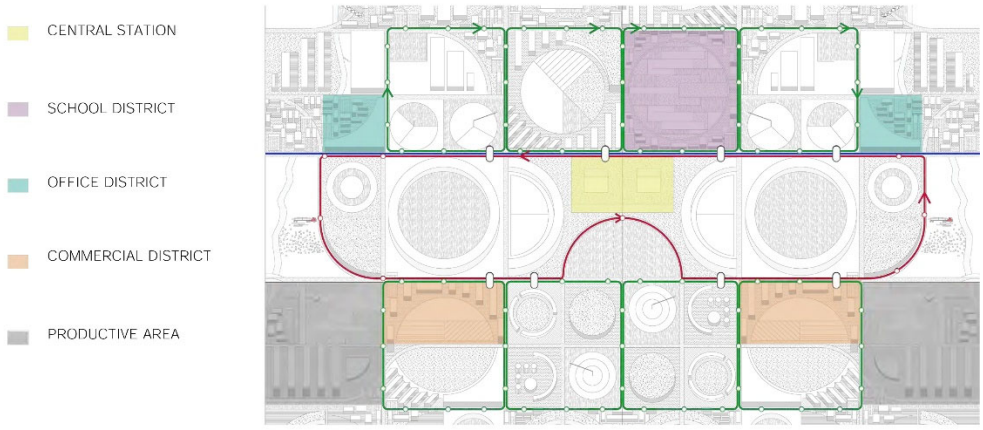


Figure 12. Distribution of various districts depending on the facilities they provide (source: authors).

The circulation of *Smart Trams* would continue, even at night, carrying out the same activities but to economically optimize freight transport and waste disposal.

Smart Trams require infrastructure, which the project also conceptually redefines. In fact, *Smart* technology allows the flexible use of their space. Trackless trams can cross pedestrian and vehicular routes using varying speeds and travel characteristics [22]. Therefore, a hybrid area can be created in which every type of means and people can traverse and carry out activities simultaneously (Figure 13). Infrastructures are, thus, transformed from transitional to *livable* spaces. The shape and size of these areas can be adapted to the characteristics of the context, new or existing.

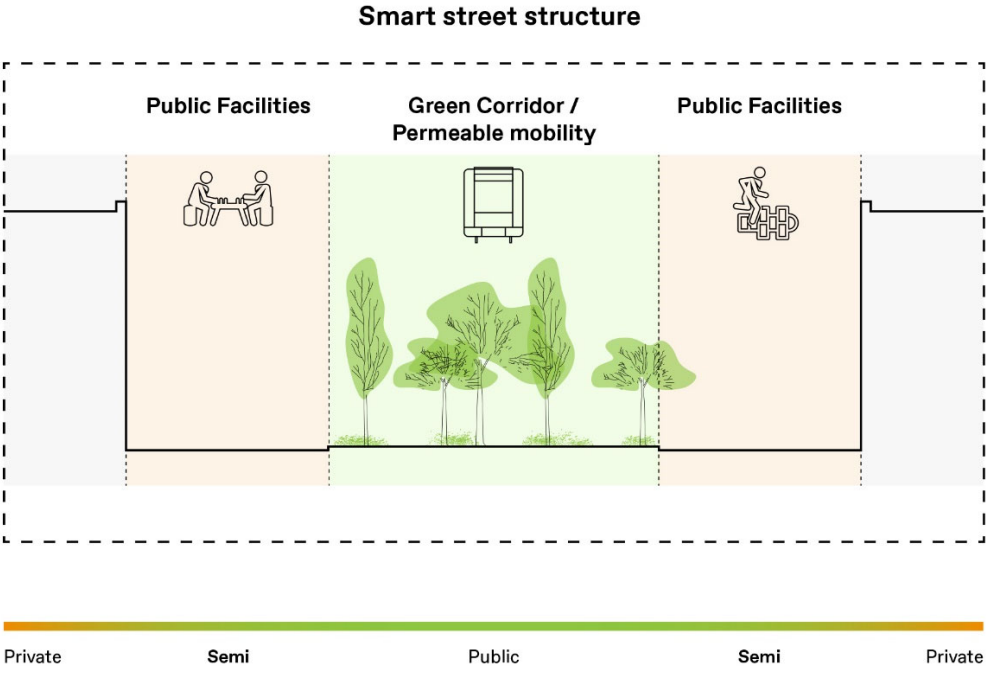


Figure 13. Livable infrastructures: section of a *Smart street* (source: authors).

5.1. Technological Outline

The Gwangmyeong *Smart Trams* project is not without precedent. To elaborate, the authors conducted several case studies of past and present designs that put the tram, or

rather its *smart* version, at the center of their proposals [23]. Among them is the Korean "Mini-tram," a vehicle that can be used in places where short intervals between trains are needed and passengers head to multiple destinations (e.g., shopping malls, airports, etc.) [24], and the "SMrTram," a "horizontal elevator" meant to rapidly connect different parts of the town (e.g., spots along a shopping lane or in business districts, college campuses, and airports) from where passengers can reach services by foot [25]. Moreover, examples were also considered that adopt more traditional technologies but envisage alternative vehicle uses in addition to passenger transport, such as *cargo trams* (Dresden, Zurich) or ATMosfera in Milan [26, 27]. A *Smart Tram* prototype is currently under study by the authors for a European company.

Although the main objective of this article is to illustrate the urban and social aspects of the project, an outline of the technology that supports the proposal seems necessary to provide it with a solid foundation.

As mentioned in Section 2, the concept of *Smart Trams* adopts the trackless tram system technology [28]. *Smart Trams* are self-driving and remotely controlled vehicles that allow different routes according to the population, goods, and services. The autonomous driving system relies on sensor fusion perception platforms to improve road safety. The technical equipment has been divided into that applied to the tram and that applied outside the tram. This equipment is summarized in Figure 14.

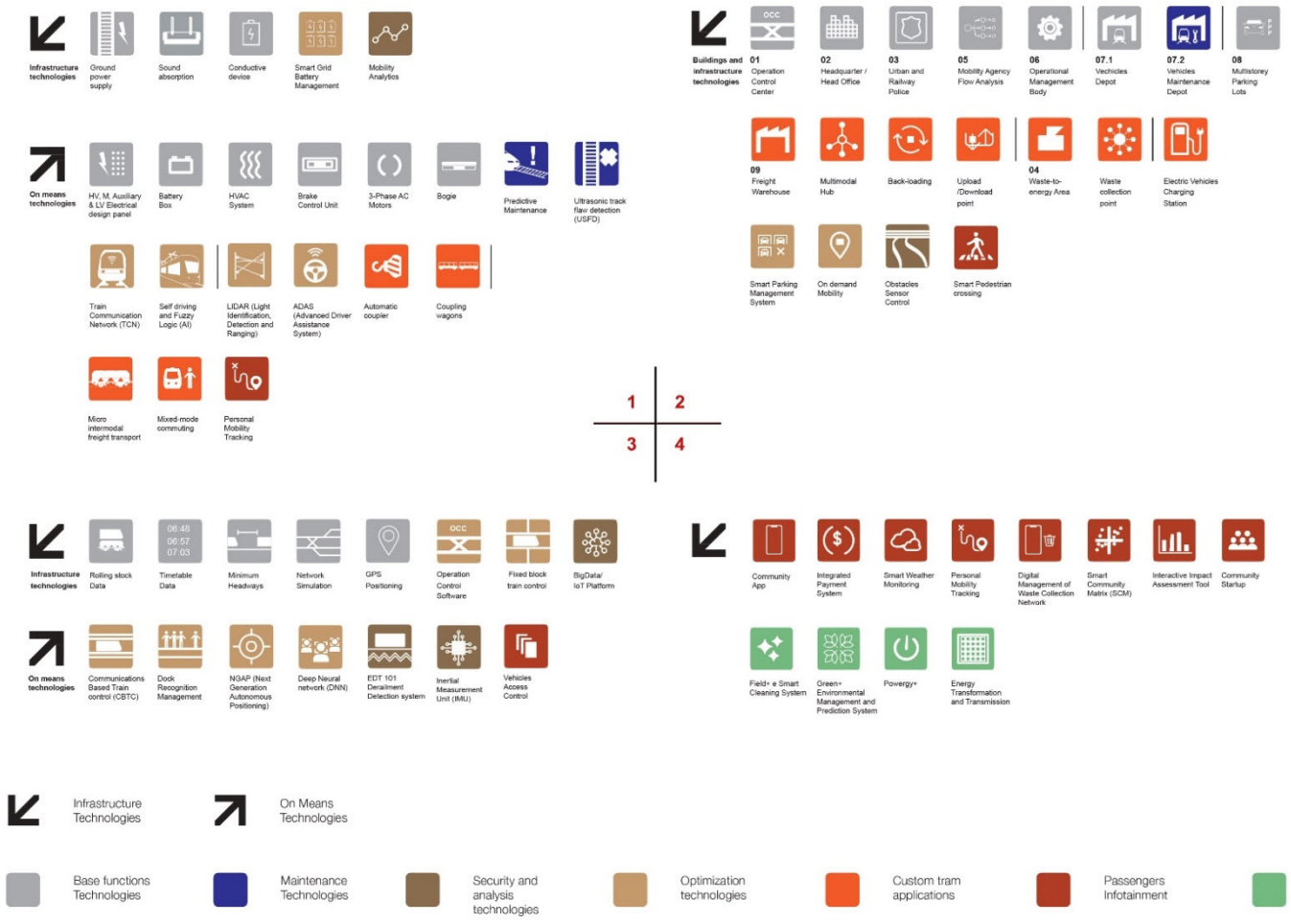


Figure 14 Technical equipment, software, and hardware. (1) Vehicle equipment (divided into that applied outside the vehicle (infrastructure technologies) and to the vehicle (on means technologies),

(2) buildings and public space technologies, (3) technologies for data exchange with central control, and (4) technologies for users (source: authors).

6. Discussion

6.1. Design and Broken World

This study primarily intends to stimulate reflection on the role and contribution of design activity in the effort to solve the problems of contemporary cities and societies. We mentioned the crucial question of the *Broken World*. Today, the city is the stage of all human manifestations, even negative ones. The fragmentation of the urban territory into socially and economically distinct parts is a problem that more or less intensely affects various world realities. The project presented in this paper, beyond its actual achievements, manifests the conviction of the authors that the best way to contribute to overcoming the problems of contemporary cities and society is by taking a position through an actual design proposal (without prejudice against the importance of theoretical research, which must support every project gesture). In its design dimension, the city becomes an entity to be treated and, at the same time, a possible medicine.

6.2. Peculiarity of Gwangmyeong Compared to the 15-minute City and Woven City

With regards to the specific contents of the project, the authors believe that they address the problem of the quality of urban life from an original point of view compared to other proposals that aim at the same goal, such as the Woven City and the 15-minute City. Indeed, in these two cases, transport also plays a fundamental role, albeit with opposed outcomes. In the 15-minute City, transport is almost eliminated, as the primary services are decentralized at the neighborhood level and can be reached on foot. In Woven City, transportation is developed in the futuristic technological aspect, making it sustainable on a technical and social level (reducing pollution and increasing travel speed).

However, as mentioned at the beginning of this article, the proposal of the 15-minute City risks segregating the different city neighborhoods, making them self-sufficient entities. This condition can only aggravate the aspects of the *Broken World*.

Instead, the proposal of Woven City appears more similar to Gwangmyeong since it is also based on centralization. In fact, Woven City provides central spaces where strategic urban functions are gathered, favoring integration at the city scale. However, for its unique infrastructure layout, derived from the characteristics of the futuristic cars that will run along it, the Woven City model is difficult to apply to contexts not designed from scratch.

On the other hand, Gwangmyeong proposes itself as a concept for a city of interrelation, not segregation, applicable to both *new* and *existing* contexts. The centralization of urban functions and the capillarization of transportation is on its agenda. However, there is no intention to renew the transport means, making them need new and peculiar types of infrastructures. Instead, the strategy is to update a traditional vehicle, the tram, which is universally implementable because ever since its inception it has adapted itself to changes in the society it serves without degenerating. The applicability of the model to any existing urban context is crucial if the plan is to be considered a tool for recomposing problematic realities (*Broken Cities* of the *Broken World*).

6.3. Gwangmyeong's Approach to Smart Mobility Technology

As a principle, *Smart Trams* place themselves in an intermediate position between the traditional public service tram (the function they perform on most of their wagons, which is universally affordable in terms of the cost/benefit ratio) and the more elite means (according to the same criteria), such as Woven's or some advanced Smart Mobility examples referenced above (Section 5.1). Strategically, the "service" functions of *Smart Trams* (people, goods, and waste transportation) amortize the cost of operating the system, keeping the costs of the *moving rooms* reasonable.

Investing in such a traditional means as the tram (although remodeled and updated) aims at meeting the needs of users from very different social, cultural, and economic backgrounds, favoring social inclusion. The *Smart Trams* concept addresses, in particular, two issues of the *Broken World* that are becoming increasingly crucial in the current Smart Mobility trends: so-called "transport poverty" [14] and "digital inequality" [13], namely, the non-accessibility by the less well-off or digitally educated classes to a wide range of modern smart means of transport. *Smart Trams* pursue, thanks to the mechanism explained above, the affordability of their services, which if performed by more technologically advanced means, would undoubtedly be more expensive. Moreover, they allow universal access to such services since they can be enjoyed by booking online or simply waiting for the vehicle at the station.

The dual identity (traditional and smart) of the *Smart Tram* concept is reflected in the project's approach to Smart Mobility technology itself. In developing the project, the authors maintained the belief that such technology is a tool and not the goal. The primary objectives of the proposal are, in fact, spatial and social, namely, architectural. Although the most updated technologies can ease the implementation of the idea, it is believed that such an idea would not lose its power, even if applied with more traditional technical means. In other words, *Smart*, in the context of this project, can be intended as an adjective whose meaning is between the technical and the everyday language.

7. Conclusions

The project for Gwangmyeong is still in the conceptual phase, although it is currently under technical deepening for the next steps of its realization. This condition can be considered a limitation of the contents of this study since there is no possibility so far to test the proposals of this project. However, although enjoying a great worldwide reputation, the 15-minute City itself is a concept that has so far seen only partial applications. On the other hand, Woven City is under construction, but it is a prototype, limited in size. Therefore, only its future growth will be able to verify its effectiveness. Thus, time still needs to pass to enable us to know which model, or which parts of the different models, can effectively contribute to making our urban lives more satisfying and sustainable.

Regarding, in particular, the development of the work presented in this study, the authors, in addition to its technical deepening, which, as mentioned, is in progress, plan to undertake studies for the implementation of the concept of urban realities other than Gwangmyeong. The effort, in this case, will focus on theoretical research, regardless of professional commitment. The goal is to collect data to help assess the effectiveness of the model, in particular in cities with a consolidated urban layout. Among the targets of this next phase are European contexts such as Barcelona and Milan.

The authors believe that studies and projects such as these, although partial and at times visionary, should be disseminated since they have the power to fuel a debate on the city of tomorrow. Different and contrasting points of view are needed while waiting for a new paradigm to establish itself.

Author Contributions: D.M.B., F.D. and G.M. developed the project and its illustrations; the three authors conceptualized the article, whereas F.D. and G.M. wrote, reviewed, and edited its final version. All authors have read and agreed to the published version of the manuscript.

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References

1. Marcel, G.; Hanley, K.R. *Gabriel Marcel's Perspectives on the Broken World*; Marquette University Press: Milwaukee, WI, USA, 1998.
2. Jackson, S.J. 11 rethinking repair. In *Media Technologies: Essays on Communication, Materiality, and Society*; Gillespie, T., Boczkowski, P.J., Foot, K.A., Eds.; MIT Press: Cambridge, MA, USA, 2014; pp. 221–239.
3. Jackson, S.J. Repair as transition: Time, materiality, and hope. In *Repair Work Ethnographies*; Strebel, I., Bovet, A., Sormani, P., Eds.; Palgrave MacMillan: Singapore, 2019; pp. 337–347.
4. Mattern, S. Maintenance and Care. 2018. Available online: https://placesjournal.org/article/maintenance-and-care/?cn-reloaded=1 (accessed on 30 March 2022). https://doi.org/10.22269/181120.
5. Mbembe, A. *Necropolitics, Theory in Forms*; Duke University Press: Durham, NC, USA, 2019.
6. Marcuse, P. Cities in Qua rters. In *Readings in Urban Theory*; Fainstein, S.S., Campbell, S., Eds.; Willy-Blackwell: Hoboken, NJ, USA, 2011; pp. 167–179.
7. Cassiers, T.; Kesteloot, C. Socio-spatial inequalities and social cohesion in European cities. *Urban Stud*. **2012**, 49, 1909–1924. https://doi.org/10.1177/0042098012444888.
8. Battarra, R.; Gargiulo, C.; Pappalardo, G.; Boiano, D.A.; Oliva, J.S. Planning in the era of information and communication technologies. Discussing the "label: Smart" in South-European cities with environmental and socio-economic challenges. *Cities* **2016**, 59, 1–7. https://doi.org/10.1016/j.cities.2016.05.007.
9. Toyota Woven City. Available online: https://www.woven-city.global/ (accessed on 30 March 2022).
10. Stratigea, A. The Concept of "smart cities". Towards community development? *Netcom* **2012**, 26–3/4, 375–388. https://doi.org/10.4000/netcom.1105.
11. Benevolo, C.; Dameri, R.M.; D'auria, B. Smart mobility in smart city. In *Empowering Organizations*; Springer: Cham, Switzerland, 2016; pp. 13–28.
12. Butler, L.; Yigitcanlar, T.; Paz, P. Smart urban mobility innovations: A comprehensive review and evaluation. *IEEE* **2020**, *8*, 196034–196049.
13. Durand, A.; Zijlstra, T.; van Oort, N.; Hoogendoorn-Lanser, S.; Hoogendoorn, S. Access denied? Digital inequality in transport services. *Transp. Rev.* **2022**, *42*, 32–57.
14. Groth, S. Multimodal divide: Reproduction of transport poverty in smart mobility trends. *Transp. Res. Part A Policy Pract.* **2019**, *125*, 56–71.
15. Paiva, S.; Ahad, M.A.; Tripathi, G.; Feroz, N.; Casalino, G. Enabling technologies for urban smart mobility: Recent trends, opportunities and challenges. *Sensors* **2021**, *21*, 2143.
16. Porru, S.; Misso, F.E.; Pani, F.E.; Repetto, C. Smart mobility and public transport: Opportunities and challenges in rural and urban areas. *J. Traffic Transp. Eng.* **2020**, *7*, 88–97.
17. Bruno, D. *Questione di Metodo: Analisi, Sintesi, Teorie, Esempi Sulla Metodologia Progettuale;* Aracne: Rome, Italy, 2009; p. 24.
18. Mattern, S. *A City Is Not a Computer: Other Urban Intelligences*; Princeton University Press: Princeton, NJ, USA, 2021.
19. The Trams of Seoul. Available online: https://museum.seoul.go.kr/eng/board/NR_boardView.do?bbsCd=1042&seq=20191212214227566&q_exhCd=all#:~:text=In%201899%2C%20120%20years%20ago,character%20of%20a%20modern%20city (accessed on 30 July 2022).
20. Carta, M. Città della prossimità aumentata. In *Roma Come Stai?* Carpenzano, O., Catucci, S., Toppetti, F., Zammerini, M., Balducci, F., Di Cosmo, F., Eds.; Quodlibet: Macerata, Italy, 2021; pp. 87–93.
21. Bertoni, A. Il valore della cultura nella città dei 15 minuti. In *Economia & Management: La Rivista Della Scuola di Direzione Aziendale Dell'Universitá*; Bocconi, L., Mondadori: Segrate, Italy, 2021; Volume 11; pp. 69–72.
22. Di Palma, C.; Galdi, V.; Calderaro, V.; De Luca, F. Driver assistance system for trams: Smart tram in smart cities. In Proceedings of IEEE Industrial and Commercial Power Systems Europe (EEEIC/I&CPS Europe, 2020) IEEE International Conference on Environment and Electrical Engineering, Madrid, Spain, 9–12 June 2020; pp. 1–6.
23. Comparison Matrix of Ready and Emerging Innovative Transportation Technologies. Available online: http://faculty.washington.edu/jbs/itrans/techtable.htm (accessed on 30 July 2022).
24. Railway Technology. Available online: https://www.railway-technology.com/uncategorized/newskorea-develops-new-vertically-movable-unmanned-mini-tram-4455727/ (accessed on 30 July 2022).
25. Village Technology. Available online: https://web.archive.org/web/20060116063348/http://www.villagetechnology.com/smrrtram.html (accessed on 30 July 2022).
26. ATMosfera ATM, Azienda Trasporti Milanesi. Available online: https://www.atm.it/en/AltriServizi/TempoLibero/Pages/ATMosfera.aspx. (accessed on 20 June 2021).

27. Euro Gunzel. Freight trams of Europe. Available online: https://www.eurogunzel.com/2018/09/freight-trams-of-europe/ (accessed on 20 June 2021)
28. Newman, P.; Hargroves, K.; Davies-Slate, S.; Conley, D.; Verschuer, M.; Mouritz, M.; Yangka, D. The Trackless Tram: Is it the Transit and City Shaping Catalyst we have been waiting for? *J. Transp. Technol*. **2019**, 9, 31–55. https://doi.org/10.4236/jtts.2019.91003.