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Is 'Smart Mobility' Sustainable? Examining the Views and Beliefs of Transport's Technological Entrepreneurs

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Abstract: One of the main evolving trends in the transport system is the assimilation of Information and Communications Technologies (ICTs) and other sophisticated hi-technology innovations into it. Those processes and practices are increasingly referred to as the "Smart Mobility" paradigm. In this paradigm, 'smart' and 'sustainable' are often considered synonymous, or at least complementary to each other. This research aims to examine the extent to which 'smart' and 'sustainable' are aligned with each other by conducting a survey amongst the main actors within smart mobility. These actors are referred to as transport innovators or entrepreneurs. The survey of n = 117 entrepreneurs shows that there is a mismatch between interpretation and understanding of what is 'smart' and what is 'sustainable'. It is clear that the concern of those transport entrepreneurs is primarily with commercial considerations and that their appreciation of what it takes to advance towards a more sustainable transport system is lacking. The belief amongst those entrepreneurs, it emerges, is that technological developments alone, specifically with respect to autonomous and connected vehicles, can lead to sustainable transport. This should be a real concern if those same actors are the ones who lead and pave the way forward for transport planning.

Keywords: sustainability; smart mobility; transport entrepreneurs; technological entrepreneurs

1. Introduction

Transportation as we know it is changing. The digital revolution is now starting to converge with the traditional transportation industry and shifting it towards what is often referred to as the 'Smart Mobility' paradigm [1] (see also Section 2.2). This includes trajectories of development like those of connected and autonomous vehicles that share the common feature of reliance on 'Hi-technology' and intend to improve the transport system mainly by increasing efficiency [2]. These recent developments are led by private market entrepreneurs in start-ups and traditional transport companies. Those private actors are the main facilitators of the 'Smart Mobility' paradigm, which, at the declarative level, sees itself aligned with sustainability [1] and therefore is considered the remedy for today's unsustainable transport system.

This research aims to analyze the extent to which smart mobility entrepreneurs' views on mobility are aligned (or misaligned) with the notion of sustainable transport as outlined, for example, by Banister et al. [3]. The research hypothesis is that there is a discrepancy between the two and, as a result, the products or solutions offered under the heading of smart mobility are not necessarily contributing to sustainability. Instead, there is a risk that smart mobility acts more as a diversion from dealing with the unsustainable features of the transport system and postpones the change in thinking urgently needed to advance sustainable transport [3]. Providing empirical evidence for the misalignment of sustainability and smart mobility amongst the main private actors in smart mobility

is the main contribution of this research. It also serves to alert policymakers to not blindly follow smart transport initiatives only because they are labeled as "smart".

To answer the question whether 'Smart Mobility', as it is understood by its facilitators, is aligned with the notion of sustainable transport, a survey questionnaire was distributed amongst so-called 'transport entrepreneurs'. The survey addresses three main questions: what are the current practices and beliefs of those transport entrepreneurs with respect to sustainable transport; what, in their mind, is the likely and desirable future perspective for the transport system; and how they describe their companies (or ventures) with respect to its 'smart' and 'sustainable' features.

Following this brief introduction, Section 2 provides a short discussion and definition of Sustainable Transport and Smart Mobility. In Section 3, the research methodology and data collection procedures are described, followed by the research results in Section 4. Finally, results are discussed and the main conclusions from the research are provided.

2. Literature Review

2.1. Sustainable Transport

The myriad interpretations of the term 'Sustainability' are usually summed up in three main dimensions: preventing environmental degradation, facilitating economic growth and striving for social equity [4–7]. At present, there is consensus that the transport system is not sustainable, or at least showing many unsustainable features, which are largely the outcome of the conventional transport planning paradigm [8,9].

Rooted in this paradigm are the 'predict and provide' approach and car dependency, which emphasize the quantity of infrastructure supplied in order to meet forecasted demand and reduce travel time (speed up travel). To date, however, this approach has not led to a reduction in traffic congestion and thus to higher speed travel. Indeed, the opposite has occurred, especially in urbanized areas [8] (pp. 1–7). As a result, a vicious cycle of positive demand feedback loop is created, leading to more energy consumption, more induced-traffic emissions, increased spatial inequality, urban sprawl, and other negative outcomes, creating high carbon transportation system or high carbon mobility, that characterizes current transport system [9,10].

The notion and idea of sustainable transport can be traced back to the 90's [11]. Later the field gained a new perspective by the work of Sheller & Urry [12] who introduced the 'New Mobilities' Paradigm. The main pillar of the new mobilities paradigm is the claim that mobility, including physical mobility using the transport system, is un-separated from the social world making it a social act. This view has led to a differentiation between the term 'transportation' as the mean from getting from point A to B (often analyzed using quantitative measurements and indices), and 'mobilities' or 'mobility' as a much broader terms including the trip itself, its social and cultural considerations, and the quality function of the travel [13–15].

In turn, those insights have led to the 'Sustainable Mobility' paradigm [16], which in many respects question the foundations of the traditional assumptions underpinning conventional transport planning. First, the sustainable mobility paradigm suggests moving from seeing travel as a derived demand only towards travel as a valued activity. Second, it is about controlling and managing the demand itself [17]. It includes also moving away from the minimization of costs and time perspectives of travel towards 'reasonable travel time' [18], taking into consideration the reliability of the transport system and putting much more weight on the travel experience and the quality of the travel time—not only its quantity.

In short, the foundation of sustainable transport or mobility as articulated by Banister [16], consists of reducing the need for travel (the Avoid principle—here in particular Information and Communication Technologies (ICTs) are suggested as a potential mean for avoiding travel) [16] (p. 75), the promotion of modal shift towards more sustainable modes—mainly from private motor vehicles to alternatives such as public transport, walking and cycling (the Shift principle), and increasing travel

energy efficiency (the Improve principal—here technological solutions are suggested mainly in order to improve efficiency, but they must come hand in hand with a behavioral change and alongside or after 'avoiding' and 'shifting' strategies) [16] (p. 75). This radical and critical thinking is different from the usual sustainability paradigm. It has not yet been fully adopted in cities and governments around the world which are still preoccupied with 'fighting' congestion [19]. This is mainly due to "lack of clear vision and the seductiveness of following the high mobility option" [20] (p. 1544). Instead, as discussed below, a new approach is adopted. This approach fosters, advocates and give rise to technological fixes in order to make the transport system sustainable [21], and is often referred to as the 'Smart Mobility' paradigm.

2.2. Smart Mobility

The 'Smart mobility' concept and methodical origin can be found in the 'Smart City' paradigm [1,22,23]. Smart City is a term and a practice adopted by a variety of governments, local authorities and international bodies all over the world and is often used as a tool for economic growth and global "presence" for an actor or organization which adopts it [24]. In its declarative form, Smart City aims for a better quality of life with emphasis on technology as a mean for sustainability [1,24]. At the conceptual level, the Smart City becomes attached to sustainability within the "smart sustainable cities" holistic approach as suggested by some authors [25]. Smart City is based on Information and Communication Technologies (ICTs) that are implemented in the city's "hard" infrastructure including, for example in households, roads and electricity, creating a "smart grid" which contribute to a low energy conception cities [26]. On the other hand, ICT are also integrated in the cities' so-called "soft" tissue that includes culture, governance, and education systems in order to provide better communication between citizens and authorities [1,22].

Some argue that beneath the surface lies a more narrow and intent political agenda that can be described as 'high-tech urban entrepreneurialism', which does not address and deal with real social problems such as injustice, equity or 'sustainability' in a comprehensive manner [27,28]. In addition, others claim that the Smart City is basically a "marketing concept to attract investment, businesses, residents, and tourists", and that the connection between the concept of a Smart City and ecological sustainability is indeed very weak" [26] (p. 60). This is why the paradigm's critics assert that "smart" needs to consider a more holistic, tailor-made mechanism that adjusts itself according to specific local goals and needs and not as a 'shopping list' where both "hard" and "soft" indicators are pursued and ticked off [1]. This becomes an even more important consideration when entrepreneurs and policymakers are sometimes considered as one 'social organism' of innovative activity [29] which influences and shapes policy.

As a component of Smart City, Transport or 'Mobility' as it is referred to, relates to the "hard", 'techno-centric' domain of Smart City, both in theory and to a great extent in practice. This is reflected in much of the investments worldwide and innovation in the 'mobility' sector. Neirotti et al. [22] found that the transport and mobility domain has the highest number of initiatives worldwide within the approach of Smart City in what has been declared to be the 'Smart Mobility' paradigm [2].

A rich academic literature, as well as dozens of recently published official governmental reports, attempt to grasp the full scale of this, rapidly evolving, 'Smart mobility' ecosystem, its main (technological) features, and its stakeholder's interpretation. A large share of studies in the field of smart mobility are related to sustainable thinking (see for example [2,30–32]). Benevolo, Dameri and D'Auria [23] create a useful taxonomy of the large and rapidly evolving initiatives within "smart mobility". These initiatives fall largely under two sub-fields: alternative fuels and propulsion vehicles (including electric, hybrid, hydrogen, fuel cells, and Compressed Natural Gas (CNG) vehicles) and the integration and assimilation of Information and Communication Technologies into the traditional road transport, automobile sector, enabling it to produce new travel forms and practices. Within the second field, further sub-groups of initiatives are identified. First, automated and autonomous features and vehicles. Second, integrated and connected vehicles (vehicle to vehicle (V2V) and vehicle

to infrastructure (V2I)). Third, users' apps for car sharing, car-pooling, ridesharing, ticketing, parking, navigation, information, etc. Finally, Intelligent Transport System (ITS) which refers mostly to transport infrastructure technologies for collecting data (by cameras and other sensors), analyzing it and creating dynamic "smart" traffic control systems that are able to monitor and manage demand for and supply of transport [23] (pp. 17–24). The last two sub-groups are also often referred to as 'Mobility as a Service' (MaaS) which shares many common characteristics with, or is part of, smart mobility [33].

According to Lyons [34], this "techno-centric approach can lead us to the so-called technological solutions looking for problems or solutions that fail to achieve sustainability goals due lack of comprehensive thinking" [34] (p. 4). To that, we can add technological lock-in mechanisms that in turn could produce rebound effects that will keep the transportation and mobility system close to where it is at present [21]. For example, making the private car more convenient and attractive to use via autonomous and contented-car technologies could enable private car users to use time more effectively while traveling (e.g., for work, rest, play etc.). Thus, when considering the social and psychological effect of the private car [34,35] with the absence of proper policy measures, it may generate more demand in terms of car ownership and miles traveled as suggested in some circumstances by Grush et al. [36]. Furthermore, Lyons [37] notes that the lack of a clear interpretation of "smart" means that it will be difficult to know how it relates to sustainability. Adding to that, Papa and Lauwers [2] claim that a paradigm shift is taking place from the conventional transport planning paradigm to the 'Smart Mobility' paradigm.

3. Research Methodology

To answer the research question, we conducted a survey targeting the main actors in the field of 'Smart Mobility'. These were considered to be entrepreneurs working in start-ups or established transport companies (referred to here as "ventures") that are developing new, innovative products for the transport sector which rely and are based on technological (ICT) innovation and application. We refer to these actors simply as "innovators" or "entrepreneurs". Thus, an innovator is an owner or headquarter (senior management) member of a technological venture, while a venture in this respect relates to the main or the newest development of a private business entity on the scale from initial idea through to a startup company and all the way to large corporation.

The Smart Mobility ventures, and those working in them (the innovators), were targeted first through online databases and later were contacted face-to-face in different events which were marketed under the 'Smart Mobility' title or associated with it.

Israel sees itself as a main actor in developing, importing and exporting knowledge and technologies regarding fuel alternatives and smart mobility. Israel's high ambitions to become a leading global player in the 'Smart Mobility' arena build to a large extent on its branding as the 'Start-up Nation'. These ambitions are backed by strong governmental support, expressed mainly by the establishment of the Fuel Choices and Smart Mobility Initiative (FCSMI) (http://www.fuelchoicesinitiative.com/) in 2012, which is part of the prime minister's office and is responsible for cooperation on this matter between ten governmental ministries and offices [38]. In order to create an ecosystem of innovators, contacts and connection with different stakeholders in the field, the FCSMI coordinates an online database of 'Smart Mobility Companies' (http://www.fuelchoicesinitiative.com/community/companies/) that holds a dynamic list of about 500 ventures. This is the first database used. An email request to participate in the research with a link to its questionnaire was sent to 400 available (with email addresses) contacts on the list.

Second, a non-profit body named 'Ecomotion' (http://www.ecomotion.org.il/) that was established by the FCSMI and partly financed by it to further create a vibrant and attractive entrepreneurs' smart mobility community in Israel and beyond was approached. Ecomotion holds an internal personal entrepreneurs' contact list with over 2500 members named under 'smart mobility' ventures. Unfortunately, access to this list was not given, but instead, a special request to participate in the survey was approved and posted on Ecomotion's Facebook group and LinkedIn pages. This

provided the potential to reach over 2500 members of Ecomotion. Third, a self-search provided the possibility to contact another 100 or more relevant companies, to which a link to the online survey was sent.

In addition to the above, the survey was distributed in three "Smart Mobility" related events that took place in Tel-Aviv, Israel and Montreal, Canada where face-to-face contact was made to recruit respondents to fill up the questionnaire. The first, in chronological order, and the smallest event was the TAU innovation exhibition that took place during 7–9 May 2017 in Tel Aviv University (http://tau-innovation.com/) and included only several companies in the field of smart mobility. The second and largest event visited took place as part of the UITP's biennial conference during 15–17 May 2017 in Montreuil Canada (https://uitpsummit.org/exhibition/). This event was chosen since it is the biggest exhibition of Public Transport businesses and companies and is "the business place where over 300 companies present their latest innovations, products, and solutions for the public transport market". The aim was to allow investigation of smart mobility within the Public Transport sector, which we expected to be more 'sustainable', or more aware of the notion and meaning of sustainability than the general sector of smart mobility innovations. The third event was the smart mobility exhibition, which was part of Ecomotion's annual conference that took place on 18 May 2017 (http://www.ecomotion.org.il/main-event-2017). This event brought together about 100 exhibitors in the field of smart mobility, mainly from Israel. It was targeted since it is the largest known smart mobility exhibition in Israel, and claimed by the organizers to be "the largest in the world". In total, this study targeted about 3400 potential respondents from the general population of innovators in the smart mobility sector.

The online questionnaire was created and later analyzed using 'Qualtrics' software (https://www.qualtrics.com/login/). It contained three sections. Section A, the 'venture section', focuses on the characteristics of the venture and includes several short open questions and one multiple choice question regarding the 'smart' and 'sustainable' nature of the venture. In Section B, the 'scenario section', respondents were asked to rank a list of travel attributes and different future transport scenarios in terms of probability and desirability. The last section, Section C, aimed to collect information on the technical and institutional nature of the venture, its orientation, and status. For the full questionnaire see Appendix A.

To begin with, an online pilot questionnaire was sent to several colleagues, which can be regarded as entrepreneurs in the field of smart mobility during late March 2017. Following that, the questionnaire was finalized and its online distribution began on 1 April 2017. The survey continued for two months until 1 June 2017. In this way, only 22 questionnaires for analysis were obtained. We will comment on this extremely low (less than 1%) response rate in the conclusion section. In contrast, the printed questionnaire distributed at the different exhibitions mentioned above produced in total 122 questionnaires for analysis (almost all of them were filed on the printed version). In total, the sample included 144 respondents. 27 questionnaires were filtered out due to partial filling (12 questions was set as the minimum answers to be counted in), leaving 117 questionnaires for analysis. Overall, 22 complete questionnaires were obtained from the online survey, 68 from the UITP event, 23 from the Ecomotion event, and finally 4 questionnaires were obtained from TAU's exhibition.

It should be noted that to arrive at this sample, considerable efforts were made to convince relevant innovators to take part in surveys which required 'headhunting' in the events and a considerable amount of email chasing and persuasion. The 'face to face' persuasion in particular often involved an unpleasant sense of bothering and often was met with a constant refusal to participate, attributed to the lack of time on the potential respondents' side and a more general lack of interest to participate in academic research. It is important to emphasize that at the recruitment stage potential participants did not and could not know the researcher's view on "smart mobility". While this might suggest something about the smart mobility community, we have no reason to believe that it introduces any significant bias in the response.

Table 1 summarizes the main profile of the entrepreneurs and ventures participating in the survey. The nature of the respondents indicates a profile of relatively mature companies or ventures, focusing largely on land transportation and varying in their orientation towards private or public transport. In addition, the main targeted smart mobility market was the vehicle itself with a large portion of novelty introduced onboard the vehicle.

Table 1. Profile and main characteristics of the participating entrepreneurs and ventures.

	Cases	Frequency
Respondent type		
Venture's member	78	68%
Venture's owner	36	32%
	n = 114	100%
Financing development phase		
Pre-seed	12	1%
Seed	–	0%
Capital/FFF/Angels/Equity	23	2%
Early stage	27	24%
Later stage	35	31%
IPO/SPO	17	15%
	n = 114	100%
Product development phase		
Prove of Concept/Prototype	20	18%
Product development/R & D	26	23%
Initial testing (Alpha-Beta)/MVP	14	12%
Scale-up/Growth	53	47%
	n = 113	100%
Targeted form of transport		
Land	98	84%
Maritime	1	1%
Aviation	3	2%
Land-maritime	5	4%
Land-aviation	2	2%
Land-maritime-aviation	8	7%
	n = 117	100%
Targeted smart mobility market		
Vehicle	41	35%
Services-data-apps	19	16%
Infrastructure	10	9%
Other	9	8%
Vehicle-services-data-apps	9	8%
Energy-propulsion	7	6%
Other combinations * (12)	22	18%
* For example Infrastructure-Vehicle-Energy	n = 117	100%
Transport market orientation		
Only public	45	38%
More public	12	10%
Both	32	27%
More private	2	2%
Only private	26	22%
	n = 117	100%

Table 1. *Cont.*

	Cases	Frequency
Freight vs. Passenger orientation (of the product)		
Only Passengers	66	56%
More for Passengers	16	14%
Both	28	24%
Only Freights	7	6%
	n = 117	100%

Note: FFF—"Family-Friends-Fools" and "Angels" as notions of early financing sources of a product/venture. IPO/SPO—Initial/Second Public Offering as an indicator of established financing stages of the product/venture. MVP—Minimum Viable Product—early version product.

4. Results

In order to analyze the extent to which smart mobility, as it is understood by the entrepreneurs—the facilitators of smart mobility, is aligned with the notion of sustainable transport, the results of the survey are presented in three parts. The first part presents general beliefs and preferences of the innovators with respect to today's transport's unsustainable features. The second part pays attention to the predictable vs. desirable future of the transport and mobility system as envisioned by the respondents. The last part focuses on the venture and examines its purpose and motive with respect to 'smart' and 'sustainable' considerations.

4.1. Innovator's Current Perspective on the Transport System and Its Problems

Respondents were asked to mention the three most negative impacts (outcomes) or unsustainable features of today's transportation system and rank them by order of importance from the most influential (1) to the least influential (3) (Q7) (Qx for question number as appeared in the study's questionnaire. See Appendix A). The answers provided by the respondents were categorized into several common groups according to each answer's main subject and repeated words and are presented in Table 2.

Table 2. The transport system unsustainable and negative impacts according to respondents.

Ranking	1st	2nd	3rd	Frequency
N/A	30	37	47	114
Environmental impact	24	16	9	49
Congestion (time, cost)	16	13	8	37
Inefficiency (fuel, energy, vehicle)	18	9	4	31
Bad service public transport	4	14	8	26
Bureaucracy	2	5	11	18
High cost of transport	4	5	8	17
Safety	4	2	9	15
Automobile dominance	8	3	1	12
Lack of infrastructure	3	3	2	8
Uncertain future	1	5	2	8
Lack of intermodality	0	3	1	4
Not smart	0	0	4	4
Insufficient parking	2	0	1	3
Human factor/behavior	0	2	0	2
Level of motorization	1	0	0	1
Not sustainable	0	0	1	1
No sharing of resources	0	0	1	1

Note: Responses were in free-text and were grouped by the authors into the above categories.

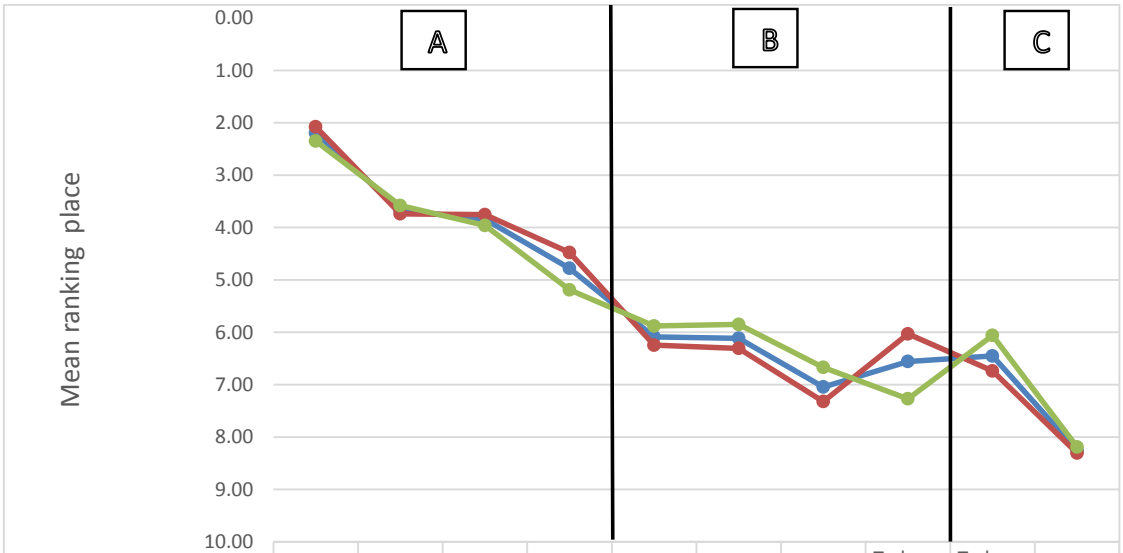
In total, the most common reply was in the "N/A" group (32% of the overall responses). It includes blank replies or "don't know" replies. It is reasonable to assume that this is mostly the outcome of a deliberate disregard or lack of real knowledge. The replies that were categorized into the "Congestion" (time, cost) (11%), "Inefficiency" (fuel, energy, vehicle) (9%), "Not smart" (1%) and "Insufficient parking" (1%) groups can be seen as one 'super' group that is concerned with direct use of the transport system. It constitutes in total 22% of the cases. Ranked third is what we term the "Environmental impact" group, which was dominated by expressions like "pollution", "noise" and "CO_2 emissions". This group, directly related to sustainability, appeared in 14% of the cases.

However, the "Environmental impact" group together with the groups that are directly related to the other dimensions of sustainability constitute 26% of the cases. Included here are economic aspects like "High cost of transport" (5%) and "No sharing of resources" groups; demand management aspects such "Automobile dominance" (4%), "Level of motorization" (1%) and "Lack of intermodality" (1%) and social aspects like "Human factor/behavior" (1%) group (groups with less than 1% were not included). The remaining group, which constitute 20% of the cases (All of them are unique), could not be easily related to a specific aspect or aggregated to a theme due to the use of generic phrases like "structure", "order", "the use".

It seems that in the eyes of the majority of the respondents today's transportation system is unsustainable or at least has negative features that share a common theme: the need to improve what already exists, be it the traffic, environmental footprint or inefficient energy use. Only a relatively small share of the respondents suggested or hinted at the need for a change in thinking with respect to the human factor, lack of intermodality or the dominance of the automobile as the most popular mode of travel. In addition, what is apparent is a lack of knowledge of the negative aspects of today's transportation practice, reflected in frequent 'don't know answers' in all the rankings.

Next, in order to better understand the current worldview of the entrepreneurs and innovators, a list of ten travel attributes was provided and respondents were asked to rank them from the most important (1) to the least important (10) (Q8—see Figure 1). The respondents were asked to consider a social perspective in their responses instead of their own personal preferences. For the analysis, the statements were divided into three sections (A to C in Figure 1). Section A includes four travel attributes related to destination and travel efficiency and it is characterized by more 'quantitative' attributes considering travel to be mainly a trip from point A to B. Within this section, the value of travel time seems to be the most important attribute (mean ranking of 2.19). Section B includes four attributes that give a wider meaning to the trip itself, focusing on quality features that make the trip more comfortable and the travel time better utilized, more effective and more flexible. In other words, it focuses more on the travel experience than on travel time. Section C, which contains the two lowest ranked attributes, focuses on attributes that are external to the traveler and have a direct sustainable value. These include the environmental aspect (6.45) and, at the lowest mean ranked (8.26), social issues. It is important to note that the list of attributes was not given in the order appeared in Figure 1. To conclude, for the majority of entrepreneur's societal perspective, the most important traveling attributes concerns the rapidity and smoothness of the travel with less concern for the how.

The low ranking of the travel attribute "keeping the environmental footprint as low as possible" contradict the relatively high ranking of the negative environmental issues mentioned above (Table 2 and Q7). This could suggest that as far as the entrepreneurs are concerned, the environmental footprint of transport is not so significant at the journey level while it is an overall concern from a societal perspective at the system level. In contrast, the high ranking of the trip destination attributes (Section A) is consistent with the high frequency of answers related to an increase in efficiency, and time and energy reductions in the previous analysis (Q7).



	To get there on time	To get there ASAP	To get there as smoothly as possible	To be able to plan it in advance and on the go	To enjoy and relax on the way	To work on the way	To not be disturbed on the way	To have multiple travel modes optiones (max flexability)	To keep as low an environmental footprint as possible	To socially interact on the way (to network)
Total	2.19	3.67	3.84	4.78	6.09	6.12	7.04	6.56	6.45	8.26
PT respondents	2.08	3.74	3.75	4.48	6.25	6.31	7.32	6.03	6.74	8.31
Rest of respondents	2.35	3.58	3.96	5.19	5.88	5.85	6.67	7.27	6.06	8.19

Figure 1. Travel attributes ranking and ecosystem differentiation. Note: ASAP—"As Soon As Possible". PT—Public Transport.

In the analysis, respondents were also divided into three groups including those considered to be associated more with public transport, those respondents that were approached at the UITP conference (57% of respondents) and the rest more heterogenic group of respondents (43%). Surprisingly, there are no significant differences that can be detected among these groups (Figure 1). An exception is the relatively large gap in the "to have multiple modes options" attribute that was ranked higher by the Public Transport group. Overall, it is clear from the results that the segmentation of the respondents into public transport and others less specific group does not result in marked differences. One considerable explanation for this could be the groups' common interest in commercial considerations as suggested by Papa and Lauwers [2].

4.2. Entrepreneurs' Envisioning of the Future of the Transport System

The research questionnaire incorporated a list of 12 scenarios for the year 2050. The aim of the list is to try and unravel the beliefs and wants of the entrepreneurs regarding the next decades to come, and thus trying to project or implicate their future steps and intentions. The respondents were then asked to score on a scale of 1 (the least) to 5 (the most) the probability (Q9) and desirability (Q10) of each scenario. The 'Probable' and 'Desirable' columns indicate the mean score for each scenario, while the 'gap' column shows the difference between the two with a negative sign showing that the scenario is more desirable than favorable and vice versa for a positive sign. Table 3 presents the results with the scenarios ranked by their desirability score.

Table 3. Desirable vs. Probable scenarios for the year 2050.

Scenario	Desirable	Probable	Gap
Public mobility will be fully autonomous	3.89	3.66	−0.23
Crude oil dependency in the transport sector will be reduced dramatically	3.79	3.31	−0.48
Public mobility will be connected to others * and objects (v2v, v2I)	3.78	3.84	0.06
Walk and cycle inside cities will increase dramatically	3.74	3.44	−0.3
Private mobility will be connected to others * and objects (v2v, v2I)	3.71	3.78	0.07
The private car will no longer be the most popular form of travel	3.68	3.11	−0.57
Congestion problem will decrease dramatically and even solved	3.62	2.85	−0.77
Large portions of road infrastructure inside cities will be removed and changed in favor of open spaces and alternative modes of travel	3.62	3.08	−0.54
Private mobility will be fully autonomous	3.50	3.34	−0.16
Private mobility will be a service, not based on private ownership	3.49	3.47	−0.02
Freight transportation will increase dramatically—mainly maritime and aviation	3.05	3.31	0.26
Future demand for transport (in total) will decline in comparison to today	2.69	2.24	−0.45

* Subjects.

The first and the most prominent observation is the lowest relative ranking of "Future demand for transport (in total) will decline in comparison to today" scenario both in terms of probability (2.24) and desirability (2.69). This scenario holds several meaningful implications for possible and plausible future changes in travel practice and transport planning. Firstly for the innovators, it does not look probable or desirable that people will want to travel less in the future in comparison to today. This could mean that they do not believe in avoiding travel by means of travel substitutes (e.g., video-conferencing) and reducing travel by means of travel demand management to the extent that overall demand will be lower. It could also imply that technology is mainly seen as a facilitator of travel, but less as a substitute for travel even in the internet and digital age. Furthermore, the entrepreneurs do not see this scenario as desirable, pointing perhaps towards a strong revenue-oriented interest, as less travel in total will likely result in less income for their ventures. It is interesting to note that this scenario was also ranked the lowest in terms of desirability amongst respondents from ventures oriented towards public transport only (Q12) (2.23 compared to 2.69 for all respondents), although they were expected to be more aware of or aligned with the notion of sustainability.

Conversely, the three highest ranked scenarios in probable terms were the "Public (3.84) and Private (3.78) mobility will be connected to others and objects (v2v, v2I)" and that "Public transport will be fully autonomous" (3.66). Considering that connected and autonomous transport technologies are already implemented and tested in their early versions, the scores are not surprising although they seem to be cautious (scored less than 4). For desirability, in relative terms, it seems that the 'right' future in the eyes of the entrepreneurs is the autonomous one, both for public (3.89) and private (3.50) transport. Although in absolute terms, here as well, the scores are not extremely high, what makes autonomous transport desirable is not clear. Whether it is its emission reduction potential and/or congestion reduction potential it is not stated (see below discussion related to congestion). It seems that to a large extent technological development is seen as a goal in itself, not a means to achieve a certain (better) future. The end of the dependency on crude oil as the main energy source for transport is also apparent in desirability terms (3.79). All of these results paint a future transport system that seems to be connected, autonomous and rely on alternative fuel technologies.

Several additional scenarios and their ranking are worth to have a closer look. The first is the "Walk and cycle inside cities will increase dramatically" scenario which received a relatively high ranking and score both in probable (3.44) and desirable (3.74) terms. This is an encouraging result from

a sustainability perspective. Also encouraging are the high desirability scores for the complementary scenarios: "Large portions of road infrastructure inside cities will be removed and changed in favor of open spaces and alternative modes of travel" (3.62) and "The private car will no longer be the most popular form of travel" (3.68). This could indicate a good understanding of sustainable transport. Yet, the problem lies in the way respondents see the way to get there, which is reflected in the low-ranking score for the "Future demand for transport (in total) will decline in comparison to today" scenario discussed above, and in the relatively high ranking score of "Congestion problem will decrease dramatically and even [be] solved" scenario.

Interestingly, the "Congestion problem will decrease dramatically and even [be] solved" scenario is relatively desirable (3.62) but not so probable (2.85) and exhibit the largest gap amongst the scenarios between desirability and probability (−0.77). From a technological development perspective, it suggests that using technology to 'fight' congestion is a worthy but futile pursue. The innovators believe (relatively) that this scenario is unlikely to materialize even as far in the future as 2050. Further interpretation of this result highlights a puzzling situation. The entrepreneurs see as the most desirable (and probable) a future of connected and autonomous vehicles (together with alternative fuels technologies) as well as a future with less congestion, but they do not believe that these technologies will deliver less congestion. This raises an important question. If the entrepreneurs desire a future with less congestion, why are they so keen about technologies that they do not think will reduce congestion, even in the longer term?

4.3. The Venture—Is It Smart and Sustainable?

Respondents were asked to describe their venture in terms of its 'smart' and 'sustainability' levels by selecting one of six phrases presented to them and without any explanation given about each of the terms (Q4). Conspicuously, "both smart and sustainable" phrase was found to be the most suitable phrase to describe the company or venture in 66% (77) of the cases. In comparison, the next most frequently chosen phrases were "totally smart" (15%) and "smarter than sustainable" (9%) phrases (Table 4).

Table 4. The venture's smart and sustainable orientation from the entrepreneurs' perspective.

Phrases	Total Relative Frequency
My/Our venture is totally 'smart'	15%
My/Our venture is totally sustainable	2%
My/Our venture is both 'smart' and sustainable	66%
My/Our venture is more 'smart' than sustainable	9%
My/Our venture is neither sustainable nor 'smart'	3%
My/Our venture is more sustainable than 'smart'	5%
	100% (N = 117)

Respondents were then asked "What is the main characteristic that makes your company smart?" (Q5) and "What is the main characteristic that makes your company sustainable?" (Q6). The textual replies to Q5 were coded into three groups: 'Technological' with frequency of 75 Cases (64%), 'Venture-oriented' with 33 cases (28%) and 'Null' with 9 cases (8%) (See the "Total" row in Table 5). The 'Technological' group included only technology-related reasons (e.g., "Algorithms", "Technology", "Open platform", "Software", "Artificial intelligent", "Intelligent transport" and "Novel system"). The 'Venture-oriented' group aggregated responses characterized as related to collective self-esteem (e.g., "we are people with special solutions", "agility", "our R & D team", and "we deliver relevance to the market"). Finally, the 'Null' group is simply a missing answer, not available or "don't know" answers. This was the case, for example, in the "ultra-fast charging (5 min)" venture that indicates "none" in the smart venture characteristic (in this case, the same answer was given to the question

"why sustainable?"). From Q5 it appears that 'Smart' is mostly about technology and about the venture itself (self-oriented).

Table 5. The main characteristic that makes the venture 'Smart' and/or 'Sustainable' from the entrepreneurs' perspective.

Phrases *	What Makes Your Company "Smart" (Q5)			What Makes Your Company "Sustainable" (Q6)				
	Tech.	Venture-Oriented	Null	Economic	Environment	Social	Null	Tech.-Innovation
'smart'	71%	24%	5%	6%	0%	0%	59%	35%
sustainable	0	50%	50%	0	1	0	0	0
smart' and sustainable	63%	32%	5%	3%	32%	4%	8%	54%
more 'smart' then sustainable	73%	27%	0	0	27%	0	9%	64%
neither sustainable nor 'smart'	33%	0	67%	0	33%	0	67%	0
more sustainable than 'smart'	86%	14%	0	14%	14%	14%	14%	43%
Total	64%	28%	8%	3%	26%	3%	18%	49%

Note: As in Table 4. The percentages are summed to 100% for each row (phrase) in Q5 and Q6 separately. In total $N = 117$ for Q5 and $N = 116$ for Q6.

The textual answers to Q6 were coded into five types of reasons. Three groups of reasons are aligned with the main dimensions of sustainability, namely 'Economic', 'Environmental' and 'Social'. Two additional types of reasons are the 'Null' and 'Technology-Innovation'. The 'Null' group is the same as in Q5, but in Q6 it includes a higher share of the responses, with 21 cases (18%). The largest group was the 'Technology-Innovation' group comprising 56 cases (49%) of the sample. This group is characterized by hi-technology, digitation and novelty replies. For example, "management of data ticket", "we are an app company", "quality of innovation", "digital products", "tech", "software", etc.

The environmental reason type is the most common group within the sustainability groups covering 30 cases (26%). It includes direct environmental effects such as "no chemicals", "no batteries no fuel", "clean green transportation", "batteries are essential for renewable energy sources", "solar-powered bike stands", etc. The remaining types were less common and were usually an additional factor to environmental issues. This includes "reducing pollution, costs & congestion" for the economic type, and "adapting to the needs of a broad population" for the social part, each account for 3% of the cases.

When shifting the attention towards "My/Our venture is both 'smart' and sustainable" phrase, as shown in Table 5, both 'smart' and 'sustainable' nature of the ventures are explained mainly by Technological (63%, Q5) or Technological-innovation (54%, Q6) reasons. As for the three dimensions of sustainability (Q6), the main dimension is the environmental one including issues related to emission and noise reduction. It seems that besides environmental issues, most answers relate to attributes that are not directly related to sustainability. This is especially notable for the phrase "My/Our venture is more sustainable than 'smart'" in which about 43% of respondents selected a 'Technology-innovation' type of reason. No major differences were observed between public transport-oriented ventures (those sampled at the UITP conference or those marked 'only public' in response to (Q12)) and other transport-oriented ventures.

These final findings point to two main possibilities, which are not in contradiction. The first is a lack of real knowledge concerning the (un)sustainable features of the transport system and the second is that the notion of 'sustainable' and 'smart', as reflected in the aims of the ventures (seen from the innovators' perspective), are viewed as similar and even identical. So, for most innovators and in their subjective perspective, there is an alignment between the notion of smart and sustainable mobility. Yet, if adopting the notion of sustainable transport as described for example by Banister [16], other evidence from the survey suggests that the 'smart' and 'sustainable' notions are not aligned at all.

The way innovators and the private sector more generally pursue 'smart' is not aligned with how research (or the literature) views sustainable transport.

5. Discussion

This research aim was to investigate the extent to which "Smart Mobility" is aligned with the notion of sustainable transport, as defined for example by Banister [16]. The perspective taken was that of 'transport entrepreneurs', or innovators—those working in companies (ventures) that are developing new products for the transport sector relying on technological (hi-tech) innovation and application.

The picture that emerges of the transport and mobility system from a survey of n = 117 entrepreneurs is a fuzzy and incoherent one with respect to the notions of 'smart' and 'sustainable'. In many respects, it is also worrying because too many respondents could not, or did not want to articulate what the main problems of the current transport systems are. Those who did, referenced known problems like congestion and the unsustainable attributes of the systems like its environmental impact. There was no apparent recognition of the need for a change of approach, although the question did ask about this.

It appears that the future in the eyes of the entrepreneurs, both from public and private transport perspectives, is heading towards a connected, autonomous, and alternative fuel technology system. As such, this is not necessarily a problem or a limitation. It is a problem, however, since it seems that in many respects technological developments in the transport sector are seen as an end rather than a means to an end. This results in misalignment between what needs to be done and the way to achieve it. In turn, this is reflected in how the entrepreneurs see and describe the ventures (companies) they work at and the focus of these on technological development and innovation for the sake of technological development, and/or potential commercial profits. Sustainability as a goal to advance is not central to the (business and development) efforts of these ventures. Policymakers must be aware of that and be wary of following smart mobility ideas only for their apparent "smartness". Instead, they must explicitly ask and analyze how innovations in transport can contribute directly to goals such as increasing accessibility (not travel) and reducing transport's overall (not only relative) impact on the environment. The most desirable scenarios in the eyes of the innovators are not aligned with the sustainable future they themselves recognize as desirable. The problem is in the discrepancy between what needs to be done and what is currently pushed forward (e.g., autonomous and connected vehicles) which is not necessarily sustainable.

The unsustainable features of today's transport system in the eyes of the entrepreneurs are, from a contemporary transport planning research perspective, representative of the traditional approach to transport planning that we ought to move away from (e.g., [8,16]). Specifically, the notion of "how we get there", i.e., the travel experience, seems to be missing from the entrepreneurs' perspective and worldview of transport (planning). In addition, sustainability and environmental footprint, in particular, appear second to the objective of making travel more efficient.

Even if most entrepreneurs identify their ventures as being both "smart" and "sustainable", these two terms seem to be mixed up and technological development is seen as a contributing factor to sustainability. Somewhat surprisingly, there was no significant difference in response to the different questions in the survey between the public transport-oriented ventures and other ventures. It seems that all ventures, regardless of whether seeing themselves as more public or private transport-oriented are concerned primarily with business and profit considerations. These concerns cause surveys such as the one used here to be met with suspicion and/or general lack of interest by the general population of entrepreneurs. This is reflected in the difficulties had in recruiting participants to the survey and the extremely low response rate. Private business actors are expected, even required, to be concerned primarily with the commercial goals of their companies and with profitability. However, it becomes a problem if these same actors and companies are the ones who set the agenda, drive, and largely determine transport policy and planning, and are the ones who lead public transport policy and research institutions. There is a reason to fear that this is the case, but this requires further research.

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Author Contributions: Kfir Noy led the research including the literature review, filed work and the writing. Moshe Givoni closely supervised the research throughout and helped in all of its stages.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. The Study's Questionnaire

Dear Entrepreneur/Innovator, My name is Kfir Noy and I'm a graduate student at the Department of Geography and Human Environment, Tel-Aviv University. I'm conducting research on various ventures and companies in the field of transport and mobility in a view to better understand the nature of development and innovation in the field. I would appreciate if you would contribute to this research effort by filling in short survey. There is no need to specify your name or provide any identifying information. However, it would be helpful if you would agree to supply your personal email and/or company's web page for optional follow-up at the bottom of this form. All your answers will be kept anonymous and without any personally identifiable information. Thank you!

SEC A Section A: About Your Firm/Venture

1. Please briefly describe the problem, need or opportunity that your venture addresses within the mobility and transport system

2. How, in what way, is your venture addressing (resolving, alleviating or mitigating) the problem/opportunity?

3. What is your firm's motivation for addressing the problem?

4. Please mark the most suitable phrase that describes your company.

- ❍ My/Our venture is totally 'smart' (1)
- ❍ My/Our venture is totally sustainable (2)
- ❍ My/Our venture is both 'smart' and sustainable (3)
- ❍ My/Our venture is more 'smart' than sustainable (4)
- ❍ My/Our venture is more sustainable than 'smart' (5)
- ❍ My/Our venture is neither sustainable nor 'smart' (6)

5. What is the main characteristic that makes your company smart?

6. What is the main characteristic that makes your company sustainable?

SEC B Section B: About the Mobility and Transport System

7. Please state three negative outcomes or unsustainable features in today's transportation practices by order of importance (Number 1 as the most significant), in your personal opinion. Please note technical issue! After filling your free text choices, you have to drag and rank, even if the choices are already arranged in the right order.

_____Free text (1)
_____Free text (2)
_____Free text (3)

8. Regarding the following attributes in traveling (physically) from point A to B, please rank the list from the most important (1) to the least (10) from a wide social perspective (not necessarily according to your personal needs).

_____To get there ASAP (1)
_____To get there on time (2)
_____To get there as smoothly as possible (3)
_____To be able to plan it in advance and on the go (4)
_____To work on the way (5)
_____To enjoy and relax on the way (6)
_____To not be disturbed on the way (7)
_____To socially interact on the way (to network) (8)
_____To keep as low an environmental footprint as possible (9)
_____To have multiple travel modes options (max flexibility) (10)

9. Rank the following scenarios from most (5) to least (1) probably for 2050 in OECD nations.

	1 (1)	**2 (2)**	**3 (3)**	**4 (4)**	**5 (5)**
Private mobility will be a service, not based on private ownership (1)	❍	❍	❍	❍	❍
Private mobility will be fully autonomous (2)	❍	❍	❍	❍	❍
Private mobility will be connected to others and objects (v2v, v2x) (3)	❍	❍	❍	❍	❍
Public transport will be fully autonomous (4)	❍	❍	❍	❍	❍
Public mobility will be connected to others and objects (v2v, v2x) (5)	❍	❍	❍	❍	❍
The private car will no longer be the most popular form of travel (6)	❍	❍	❍	❍	❍
Future demand for transport (in total) will decline in comparison to today (7)	❍	❍	❍	❍	❍
Freight transportation will increase dramatically—mainly maritime and aviation (8)	❍	❍	❍	❍	❍
Congestion problem will decrease dramatically and even solved (9)	❍	❍	❍	❍	❍
Large portions of road infrastructure inside cities will be removed and changed in favor of open space and alternative modes of travel (10)	❍	❍	❍	❍	❍
Walk and cycle Inside cities will increase dramatically (11)	❍	❍	❍	❍	❍
Crude oil dependency in the transport sector will reduced dramatically (12)	❍	❍	❍	❍	❍

10. Rank the following scenarios from most (5) to least (1) desirably for 2050 in OECD nations.

	1 (1)	**2 (2)**	**3 (3)**	**4 (4)**	**5 (5)**
Private mobility will be a service, not based on private ownership (1)	❍	❍	❍	❍	❍
Private mobility will be fully autonomous (2)	❍	❍	❍	❍	❍
Private mobility will be connected to others and objects (v2v, v2x) (3)	❍	❍	❍	❍	❍
Public transport will be fully autonomous (4)	❍	❍	❍	❍	❍
Public mobility will be connected to others and objects (v2v, v2x) (5)	❍	❍	❍	❍	❍
The private car will no longer be the most popular form of travel (6)	❍	❍	❍	❍	❍
Future demand for transport (in total) will decline in comparison to today (7)	❍	❍	❍	❍	❍
Freight transportation will increase dramatically—mainly maritime and aviation (8)	❍	❍	❍	❍	❍
Congestion problem will decrease dramatically and even solved (9)	❍	❍	❍	❍	❍
Large portions of road infrastructure inside cities will be removed and changed in favor of open space and alternative modes of travel (10)	❍	❍	❍	❍	❍
Walk and cycle Inside cities will increase dramatically (11)	❍	❍	❍	❍	❍
Crude oil dependency in the transport sector will reduced dramatically (12)	❍	❍	❍	❍	❍

Appendix A.1. SEC C Section C: Final Technical Details

11. What is your current roll at the venture:

❍ Owner (1)
❍ Member (2)

12. What is the Firm's/Venture's transportation orientation?

	1 (1)	**2 (2)**	**3 (3)**	**4 (4)**	**5 (5)**
Public:Private (1)	❍	❍	❍	❍	❍
Passengers:Freights (2)	❍	❍	❍	❍	❍

13. What is the Firm's/Venture's focal platforms?

	Land (1)	**Martime (2)**	**Aviation (3)**
Main Platforms (1)	❑	❑	❑

14. What is the Firm's/Venture's main transportation segments

	Vehicle (1)	**Infrastructure (2)**	**Energy-Propulsion (3)**	**Services-Data-Apps (4)**	**Other (5)**
Segments (1)	❑	❑	❑	❑	❑

15. What is the main Firm's/Venture's product development phase

- ❍ Initial idea (1)
- ❍ Prove of Concept/Prototype (2)
- ❍ Product development/R&D (3)
- ❍ Initial testing (Alpha-Beta)/MVP (4)
- ❍ Scale-up/Growth (5)

16. What is the Firm's/Venture's Financing development phase

- ❍ Pre seed (1)
- ❍ Seed capital/FFF/Angels/Equity (2)
- ❍ Early stage (3)
- ❍ Later stage (4)
- ❍ IPO/SPO (5)

17. For follow-up (optional) please fill the following:

Email (1)

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