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Open Innovation in the Shared Mobility Market

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Abstract: The market for shared mobility services is growing very quickly. New types of vehicles have been introduced, and the offer of available services and functionalities has expanded, the purpose of which is to improve the quality of service. Despite all the improvements, it is still not possible to speak of achieving full availability of systems that meet the needs of users. This is due to the reluctant involvement of operators of shared mobility systems in joining Mobility as a Service platforms based on the idea of open innovation. The aim of the article is to analyze the factors influencing the limitations in the development of open innovations in the form of Mobility as a Service (MaaS) services. The authors focus on identifying the challenges and concerns faced by shared mobility service providers. The article supports the development of the concept of open innovation in shared mobility services. It also contains practical recommendations for the development of MaaS systems. The results of the developed research can be used by operators of shared mobility services, transport authorities, or IT service providers providing MaaS services to strengthen cooperation and integration using the language of mutual benefit.

Keywords: shared mobility; open innovations in shared mobility; open innovation management; MaaS; Mobility as a Service; shared mobility development; urban transport systems; sustainable transportation

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1. Introduction

The possibility of short-term rental of vehicles in urban areas, called 'shared mobility', is one of the forms of sustainable transport in cities. In recent years, these services have gained popularity all over the world. Statistics show that the value of the shared mobility market is USD 104.95 billion [1]. Services are becoming more and more attractive to customers thanks to the possibility of renting various types of vehicles. Initially, these were bicycles and cars, but in recent years scooters and electric motorcycles have become more and more popular in short-rental systems [1]. The development of services has led to the appearance on the market of many operators and their mobile applications for vehicle rental. While in one city there are single operators providing shared mobility services, the situation with vehicle rental is simple; the use of services becomes more complicated with the presence of a greater number of service providers. Then, to use the services, separate applications are required for each form of mobility. The situation becomes even more complicated when, in addition to shared mobility, the potential user also wants to be up-to-date with other forms of public transport, to be notified regarding the intelligent transport system, or to track the volume of traffic. In such a situation, the perfect solution is the concept of one application that is a mobile integrator of all mobility services in a given area. This type of mobile application is similar to travel planners, called mobility integrators, and they are part of the IT architecture referred to as Mobility as a Service (MaaS) [2,3].

Mobility as a Service is an emerging type of service that through a joint digital channel enables users to plan, book, and pay for multiple types of mobility services [4]. The idea was launched in 1996 and is now becoming more and more popular, with the growing interest in the aspects of the sharing economy [5,6]. There are many definitions related to

MaaS. For example, Szmelter-Jarosz reports that MaaS to mobility services is a collection of products that have recently emerged due to changing socio-economic trends [6]. In turn, the author Hietanen defines MaaS as a mobility distribution model that meets the transport needs of users through a single service provider interface [7]. He emphasizes that to operate efficiently, MaaS needs the appropriate stakeholder engagement, which is based on customer needs, combining services, cooperation, and interconnection as a means for transport and service provision [7]. For comparison, the Finger, Bert, and Kupfer indicate that MaaS integrates transport modes through the internet [8]. CIVITAS contractors argue that MaaS is a mobility generator that aggregates all forms through a single application [9]. In turn, Kamargianni et al. emphasize that MaaS requires proper integration and the necessity to share data [10]. All these definitions, however, have one common relationship: if MaaS is to occur, there must be cooperation and a willingness to create open innovation. Since in the shared mobility industry there is still the problem of resistance to integration in MaaS, knowledge sharing, openness to new business models in collaboration with other companies, and development of the open innovation idea [11–31], we decided to conduct research on the challenges and concerns that exist in the market from the point of view of open innovation.

The aim of the article was to analyze the factors influencing the limitations in the development of open innovations in the form of Mobility as a Service (MaaS) services. We focused on identifying the challenges and concerns faced by shared mobility service providers.

2. Open Data and Open Innovation Idea in Shared Mobility

The concept of open innovation assumes an open and cooperative approach to the process of creating innovation [32]. Through it, companies applying the open innovation model acquire the necessary knowledge and innovations within a framework of the built network of contacts and stakeholders [32,33]. According to the foundations of the idea of open innovation, companies operating according to this business model should be able to share their own experiences, but in addition, they should also learn from the experiences of other market players [32,34].

The development of MaaS systems is an example of open innovation [35]. It is considered a case of innovation, which is an intentional but inherently conditional process that includes both the development and implementation of new ideas that challenge conventional wisdom and break with established practices in a specific service context [35,36]. The MaaS system combines two main collections, which are mobility services and the digital economy, as shown in Figure 1.

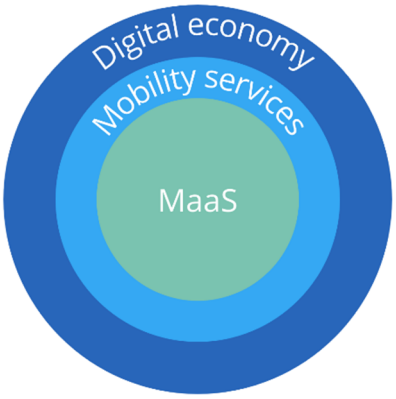

Figure 1. Structure of Mobility as a Service in the context of mobility services and digital economy.

MaaS assumes that data will be available in an open system [37]. Research shows that the use of open data can bring many benefits to both the business environment and society. First, it is an opportunity to increase the transparency and accountability of enterprises [37]. In turn, it can lead to an improvement in the quality of services provided

and increase the participation of the public in planning and reporting feedback on the services provided [38]. Moreover, open data also bring additional economic value that leads to a better understanding of the market and the creation of data-driven products [39]. In addition, open data give the opportunity to increase both the efficiency of both the company and the operation of the entire MaaS system [40]. Despite its many advantages, the open concept of MaaS is not a popular solution that is endorsed by many operators around the world. Despite the exceptionally large development of ICT and aspirations to a digital economy, only a few efficiently functioning MaaS systems can be identified, e.g., from Berlin, Hanover, Helsinki, or Vienna. Although, in Poland, despite the existence of many providers of shared mobility services, there is not a fully developed MaaS system [27]. Several pilot programs have appeared on the market, but they do not involve all stakeholders, e.g., operators, municipal and transportation authorities, or potential users [28]. In addition, the definition of MaaS in Poland is often misunderstood [27]. In Poland, MaaS is considered to be individual systems of shared mobility services or their applications, which, of course, is one of the components of MaaS, but does not fully reflect the Maas service [27]. From the point of view of indications at the national level, at the moment no executive legislative acts referring to the need to implement MaaS or its principles of operation have been identified.

The next part of the article is devoted to research on resistance to joining MaaS among shared mobility operators from an open innovation point of view.

3. Methods and Stages of Research

The assessment of barriers and concerns of operators of shared mobility services in relation to MaaS systems from the point of view of innovation required conducting our own research. This study was conducted in 2021 on a sample of a diverse group of experts representing Polish companies from the shared mobility industry (N = 25). Operators providing services in the field of short-term rental of bicycles (4 operators), scooters (10 operators), mopeds (3 operators), and cars (8 operators) were invited to the study. Experts represented services offered in the largest urban centers in Poland: Warsaw, Katowice, Gdańsk, and Wrocław. The research group was a target group, according to the requirements of conducting a statistically correct expert study according to Mishin's recommendations [41]. Due to the pandemic that occurred during the study period and due to the large geographical spread of the companies included in the research sample, qualitative research was conducted based on a research questionnaire. The survey was conducted via the Internet using the CAWI (Computer-Assisted Web Interview) technique.

As part of the research, the main research questions were formulated and were asked of the respondents, bringing them closer to the achievement of the set goal of the work. The focus was on the following questions:

Q1: What is your company's attitude to innovation?

Q2: Do you focus on closed or also open innovations?

Q3: Is your company interested in joining MaaS?

Q4: What are the main concerns about joining MaaS from the point of view of open innovation?

Q5: Do you think open data MaaS is the future of shared mobility services?

In the case of categorizing barriers related to open innovation, it was proposed to use the framework of Smith et al., which considers the existence of external, inter-organizational, organizational, and intra-organizational barriers [35]. This was also related to the basic assumptions of the innovation management model, barriers, and facilitators proposed by Hierro et al. [42]. In addition, the answers obtained regarding the barriers were used to perform a social network analysis (SNA). SNA is a method that is very often used to define all dependencies regarding the management and social aspects that take place in given processes [43–45]. Thanks to the SNA method, it is possible to characterize a network structure from the point of view of nodes/knots represented by individual actors, people, or things within the network, with the relationships described as named edges between the nodes indicating relationships or interactions that connect them [44]. In our

case, the results of the expert research were implemented to the SNA method process as presented in the Figure 2.

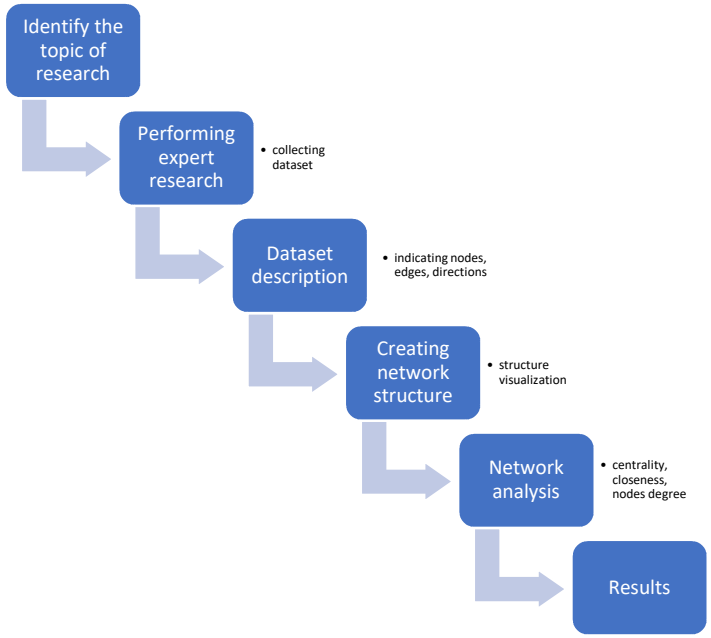

Figure 2. Structure of the research methodology using the SNA method.

The method allows indicating the direction of each relationship, interrelationships between elements, and their influence on the defined sets of issues [46,47]. The main advantage of the SNA method is its ability to reconstruct, visualize, and analyze complex and multilevel relationships occurring in a given phenomenon, taking into account both direct and indirect relationships between issues [44]. Research with the use of SNA analysis allows determining the influence of individual groups on the processes taking place in a given network [43,44].

Therefore, it is an excellent tool for determining the impact of given aspects on a given phenomenon—in the case of this article, defining the significance of individual barriers in the process of developing open innovation.

4. Results

As a result of the conducted research, interesting answers were obtained, which allow a broadening of the knowledge about the attitude towards open innovations and MaaS services based on the opinions of shared mobility operators.

From the point of view of operators' openness to innovation, the answer was that 100% of the respondents are open to implementing all kinds of innovation in their companies. Importantly, however, openness to innovations begins to have a completely different meaning in the case of open and closed innovations. The responses received show that only 40% of respondents are ready to support open innovation. A total of 40% of the respondents who expressed interest in open innovation were micro-mobility operators of scooters, mopeds, and bicycles. A detailed diagram is presented in Figure 3.

In the case of questions regarding interest in connecting to a MaaS system, a 7-point Likert scale was used, where respondents expressed their opinions by providing answers of (1) absolutely no, (2) no, (3) probably not, (4) I do not know (5) I think so, (6) yes, and (7) absolutely yes. A detailed diagram is presented in Figure 4.

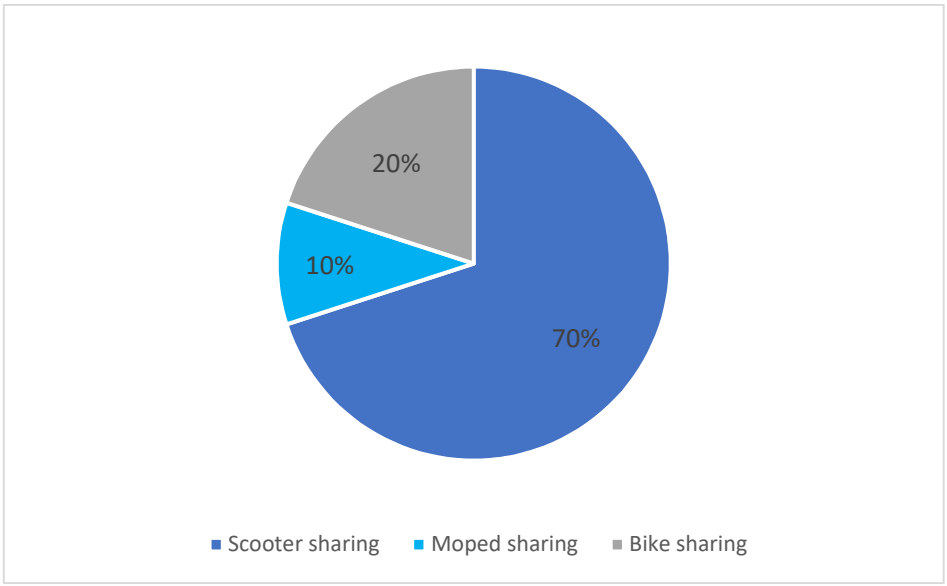

Figure 3. Open innovation enthusiasts in the shared mobility market.

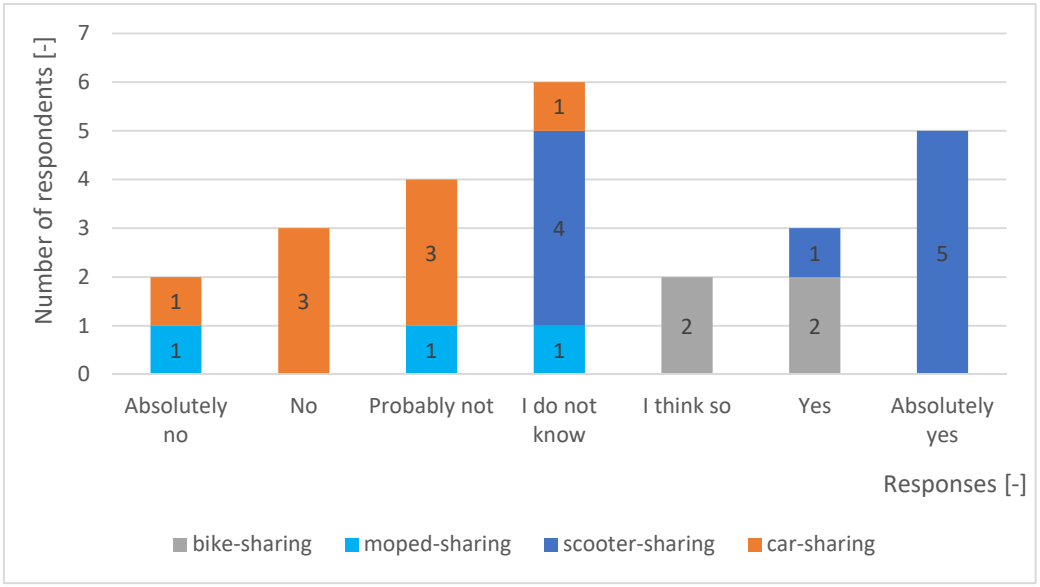

Figure 4. Interest in connection to Mobility as a Service system.

The results show that most of the respondents are unsure about joining MaaS. Interestingly, the operators who expressed their opinion as "yes" or "absolutely yes" were the operators of micro-mobility services, such as scooter-sharing and bike-sharing operators. Once again, the most reluctant group were car-sharing operators, who expressed their opinion as "absolutely no", "no", and "probably not". Moped-sharing systems are an uncertain group to join MaaS.

The next stage was to diagnose problems related to barriers to the development of open innovation and MaaS systems. The responses received from the respondents were classified according to the Hierro's open innovation framework. The results are presented in Table 1.

Table 1. Structured barriers to the development of open innovations in shared mobility.

Barrier Category (C)	Examples of Barriers (B)
External (C1)	• B1. Lack of local policies according to MaaS regulations and open data sharing • B2. No additional funding from the state encouraging the implementation of open innovations and Maas • B3. Lack of attractiveness for various customer groups, i.e., the elderly
Inter-organizational (C2)	• B4. Increase in market competitiveness • B5. The need to share data with external stakeholders • B6. Problems with the General Data Protection Regulation (GDPR) • B7. Increasing the transparency of the organization
Organizational (C3)	• B8. The system cannot be adapted to MaaS (technical aspect) • B9. Reluctance to adapt external innovations
Intra-organizational (C4)	• B10. The necessity to interfere with the pricing policy • B11. Necessity to interfere with the resources of the organization (HR and technical resources)

Subsequently, structured barriers made it possible to perform an SNA analysis, thanks to which it was possible to identify which of the barriers constitute the greatest problem for the development of open innovation in shared mobility services. Moreover, the social networks analysis conducted allowed for the identification of relationships occurring in the topographical structure of the open innovation barriers (OIB) network model. Associating OIB with different groups of barriers reflects the complexity of the model in question. The investigated OIB network structure was calculated as the central proximity to the network. The value of the indicator (1) determines the importance of the barrier (B) in the network and its impact on the functioning of the network.

$$C(x) = \frac{1}{\sum_y (x, y)} = 0.111 \quad (1)$$

For each barrier analyzed (B), the average distance between the nodes was calculated. Values greater than the calculated value of *C(x)* highlight the barriers that have the greatest impact on network performance. The values of the mean distance of each node are shown in Table 2.

Table 2. The average distance of the nodes between barriers in the open innovation model.

Barriers (B)	Average Node Distances
B1	0.376
B2	0.686
B3	0.172
B4	0.970
B5	0.125
B6	0.250
B7	0.343
B8	0.436
B9	0.730
B10	0.884
B11	0.385

The results obtained for each barrier indicate that the barriers B4 and B10 are the most important barriers. On the other hand, the least significant barriers are the B5 and B3.

The last stage of the research was to check whether, according to the respondents, open innovation and MaaS are the future of shared mobility services. Responses were ranked according to the Likert scale. The obtained results are shown in Figure 5.

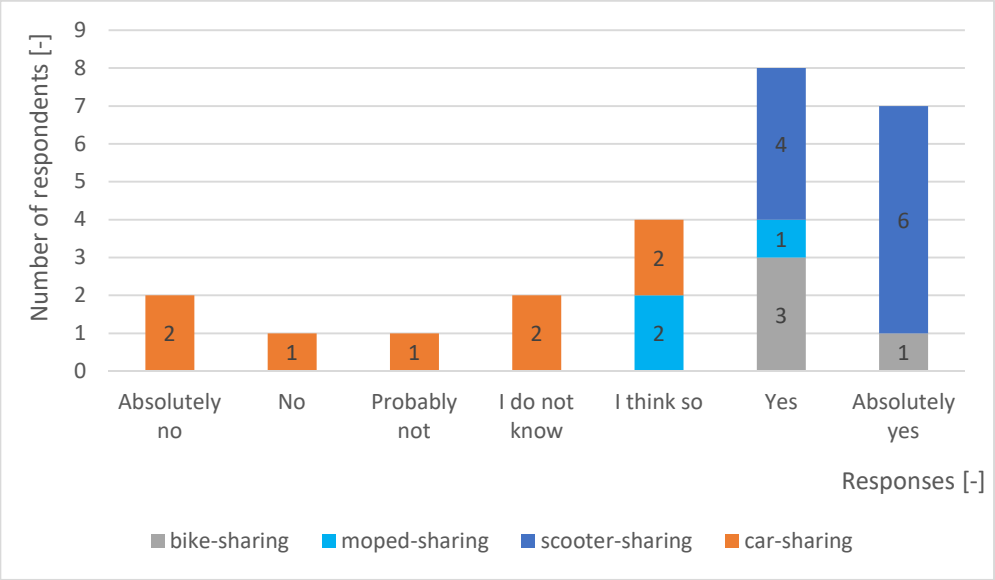

Figure 5. Anticipating whether open innovation and MaaS will be the future of shared mobility services.

5. Discussion: Sharing in New Mobility Industry and Open Innovation

5.1. Sharing in New Mobility Industry

The results obtained during the performed research show that the shared mobility services industry is aware of the issue that open innovation and the Mobility as a Service system is the future of transport services. Although the respondents declare that the industry is 100% open to implementing innovations, the results show that the industry approach is one of closed innovations. Interestingly, the most enthusiastic operators in the field of open innovation are representatives of the micro-mobility sectors, i.e., scooter-bike- and moped-sharing. This may be related to the fact that the micro-mobility industry is currently very popular and, in many cities, there is more than one operator. Moreover, young people are the clients of micro-mobility services, which is why it is a successful target for implementing innovations in the field of Mobility as a System. An additional advantage in favor of open innovations in the micro-mobility industry may also be the fact that they have a very large fleet of vehicles, and these vehicles are relatively small and very mobile; therefore, for micro-mobility operators, there are solutions such as mobility accelerators that give the possibility of indicating the huge fleets of a given operator, which can bring additional benefits from the point of view of marketing and visual merchandising. For comparison, the results show that car-sharing system operators are the least interested in MaaS systems and open innovations. This is evidenced by the fact that these systems are very focused on their own closed innovations and monitoring their own data. Operators point out that open data are would require them to disclose their internal customer information. Furthermore, operators fear that open data would enable them to monitor the exact journeys of their customers, which could be exploited by competitors. In addition, car-sharing systems do not always function in the free-floating model, as is often the case in micro-mobility, which may also make the service unattractive from the point of view of marketing in the MaaS systems.

From the point of view of barriers to the development of open innovations in shared mobility systems, the results show that the most important barriers are those related to an increase in market competitiveness and the necessity of interfering with the pricing policy. In turn, the least important problems are the issues related to the need to share data with external stakeholders and the lack of attractiveness for various customer groups, e.g., the elderly. These are very interesting results because they challenge the stereotype and the main fear of operators that the implementation of open innovation is primarily associated with the need to share data. In addition, the results also indicate that operators should not worry that open innovation will only target specific customer demographic groups. This confirms the main assumption that open innovation is supposed to support society and be a tool that improves the quality of life of each person, not individual demographic groups [48].

5.2. The Relation between Shared Mobility Industry and Open Innovation

From the point of view of the dynamics of the development of open innovations, the results obtained indicate that in the case of shared mobility, companies are worried. Companies tend to focus on closed innovations without developing their dynamic abilities in the form of competencies to integrate, create, and reconfigure internal and external resources of their company to adapt to changing environmental conditions and the possibility of shaping them.

The results obtained show that the worrisome process of innovation dynamics in shared mobility systems may be one of the future problems with adopting company business models to new market solutions based on the idea of synergy. In the event of a further lack of dynamics in the innovative development of enterprises in the near future, they will not be ready to implement modern solutions such as, for example, public–private partnerships, creating mobility hubs, open databases, or highly integrated MaaS systems. At this point, it is worth highlighting that the shared mobility market originates from the sharing economy, in which the principles of openness of data and resources should be the integral to the functioning of their transportation services [49–56]. Furthermore, from the point of view of open innovation, the sharing of open data should also be particularly important in shared mobility. It is especially important in times of current crises (such as the COVID-19 pandemic) to remember that open innovation may be a way to survive in the market, to ensure the long-term profitability of companies, and to achieve a real level of sustainable development of the shared mobility industry.

6. Conclusions

In conclusion, the conducted research has shown that open innovation and the implementation of MaaS systems are considered as the future of the rapidly growing industry of shared mobility by a majority of Polish stakeholders. Despite this, the beliefs of stakeholders indicate that only micro-mobility service operators, such as the scooter- and bike-sharing operators, are prepared to implement and develop open innovation. An uncertain group to join MaaS are moped-sharing systems. Interestingly, the research results show that the most reluctant to implement open innovation are car-sharing service providers.

Although experts from Poland took part in the research process, it should be mentioned that they represented international corporations; therefore, the obtained results can also be applied to foreign shared mobility markets.

The research carried out made it possible to achieve the aim of the work in the form of indicating barriers that delay the development of the implementation of open innovations. Moreover, they also allowed an indication of which barriers are the most important and which are the least important.

The article may support MaaS service providers and transport authorities as well as other stakeholders involved in developing appropriate support policies for shared mobility service providers to implement open innovation. The article also supports operators by offering the opportunity to learn about barriers indicated by those in the industry. The

work also supports researchers in developing all kinds of concepts for the development of open innovation in shared mobility systems.

In further research, the authors plan to carry out extended analyses of responses of experts representing other countries in Europe and the world. Thanks to this, it will be possible to learn the opinions of others with regard to open innovation and MaaS in countries where MaaS systems are already prospering.

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