



# The Commercial Aspects of Navigation Satellites: A Systematic Literature Review

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## 1 INTRODUCTION

Commercial space activities have been under growing interest during the last two decades (Davidian, 2021; George, 2019; Gurtuna, 2013). In this chapter, we focus on commercial activities within one specific sector (Davidian, 2021)—satellite navigation systems—as these systems are increasingly integrated into daily commercial activities (OECD, 2022). Further, satellite navigation systems have rapidly evolved since the launch

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of the first location-based services (LBS) in the 1990s (Huang et al., 2018). The Global Navigation Satellite System (GNSS) is a key method for LBS and finds application in various industries (Manulis et al., 2021). That is, the commercial use of navigation services now encompasses a wide range of products and value-added services, catering to diverse purposes and industries (see e.g., Paravano et al., 2023).

GNSS-based services are employed at both enterprise and consumer levels. The enterprise market primarily encompasses maritime navigation, agriculture, aviation, driver advisory systems, geomatics, search and rescue, rail, critical infrastructures, among others. The consumer market mainly involves system integrators such as smartphone and automotive companies (Breeman et al., 2022). According to the EU Agency for the Space Programme, the most significant cumulative revenue segments in 2021–2031 are consumer solutions (61.0%), with revenues primarily generated from sensors installed in smartphones and tablets using LBS and applications. This is followed by the road and automotive sector (29.2%), where the majority of revenue comes from devices used for navigation, including emergency assistance, advanced driver-assistance systems, and fleet management applications (EU Agency for the Space Programme, 2022). As space-based activities are highly demanding, and technology is advancing rapidly, companies operating in this sector face several challenges related to technology, organization, and management in their pursuit of success (Xue et al., 2008).

The field of LBS, including the GNSS industry, has been extensively studied across various academic disciplines. However, while GNSS plays an increasingly vital role in our daily lives and has been integrated into numerous commercial products and services, there is limited academic understanding of the commercial usage and application of navigation satellites. By promoting awareness of this field from a commercial perspective, it can provide a foundation for future research on the subject and offer valuable insights for both academic research and business practices. For these reasons, it is essential to investigate the current state of research related to the commercial aspects of navigation satellites.

The objective of this systematic literature review is to compile existing literature, map the current state of knowledge, and suggest new research directions concerning the commercial issues of navigation satellites. Specifically, the aim is to find answers to the following research question: What is the current state of knowledge about the commercial aspects of navigation satellites?

Given the ongoing development of LBS and technological advancements, it is evident that this industry is in a constant state of evolution. In this chapter, our goal is to contribute to the existing literature by providing a deeper understanding of the GNSS market. This article is organized as follows: In Sect. 2, we present the literature search process, the selection criteria for the collected data, and an overview of the data. In Sect. 3, we disclose findings from the literature review by categorizing the articles into six themes. Section 4 discusses further research directions based on the literature review. Finally, in Sect. 5, we conclude by presenting the contributions and acknowledging some limitations of this work.

## 2 METHODOLOGY

### 2.1 *Data Collection*

The data collection for this systematic literature review was conducted across five databases: ABI, EBSCO, IEEE, SCOPUS, and Taylor and Francis Online. Data searches were carried out between October 2022 and January 2023. The selected keywords for the search were ‘navigation,’ ‘satellite,’ ‘GPS,’ ‘GNSS,’ ‘business,’ ‘space economy,’ and ‘commerc\*.’ These keywords were chosen because they are associated with the studied phenomenon and are essential for finding relevant articles on the topic.

For the data search, specific criteria were established to guide the collection process. An initial search using the selected keywords, without additional selection criteria, yielded a total of 28,478 results from articles across the five databases. Consequently, it was crucial to carefully apply chosen criteria to identify suitable articles that could address the research questions. To achieve this goal, we focused on publications published in English in scholarly peer-reviewed journals. No restrictions were set on the publication years, allowing us to capture all relevant studies related to this research.

Using the selected terms and criteria, we identified 1,253 articles based on the abstracts. These included 292 articles from ABI Inform Complete (ProQuest), 43 from EBSCO, 13 from IEEE Xplore, 474 from SCOPUS, and 431 from Taylor and Francis Online. The abstract criteria required that they comprehensively describe the topic of this study. Additionally,

duplicate publications were excluded at this stage. In total, 153 articles that met the abstract criteria were selected for full-text review.

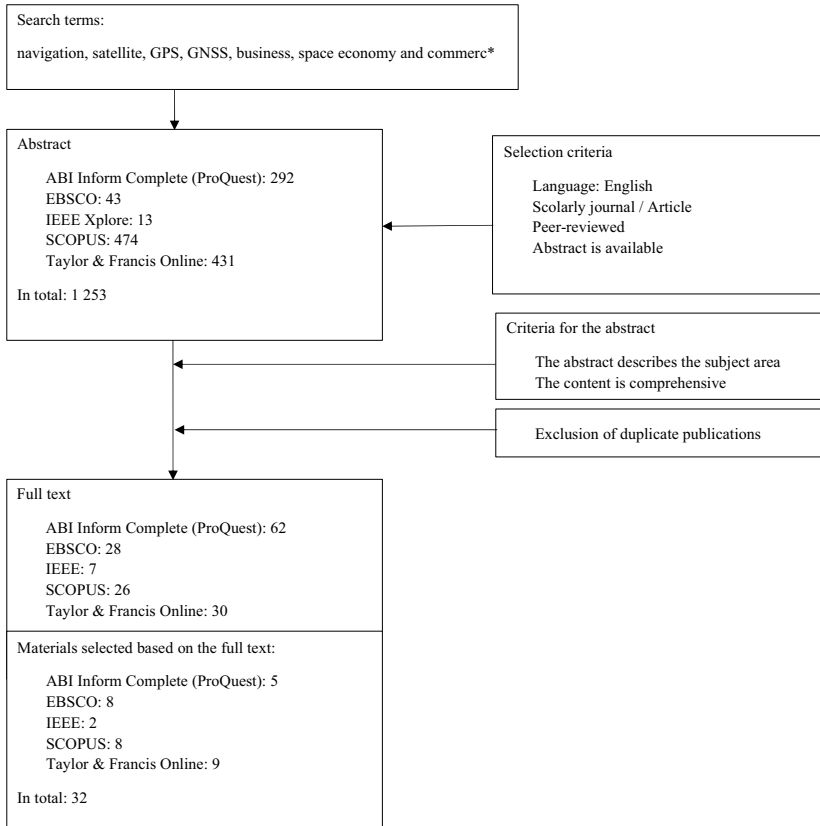
During the full-text review, it became evident that some of the articles primarily focused on the technical aspects, with the commercial dimension being less prominent in the study. For instance, Prol et al. (2022) surveyed the potential of Low Earth orbits (LEO) for positioning, navigation, and timing (PNT) systems, delving into technical elements while also touching on the commercial prospects of the industry's current and future market. However, this article was omitted from the literature review because it primarily focused on the technical aspects of LEO-PNT, with the commercial dimension being a minor component in relation to the overall content of the article.

Based on the full texts, a total of 32 articles were deemed suitable for inclusion in this systematic literature review. Most of the articles were obtained from Taylor and Francis Online, totaling nine articles, while EBSCO and SCOPUS each contributed eight articles. Additionally, ABI yielded five articles, and IEEE provided two articles. Figure 1 illustrates the process by which data were searched, articles were selected from the database search, and articles were ultimately included in the final analysis. In Table 1, all 32 articles selected for this literature review are listed, presenting the authors, journals, publication year, databases from which they were retrieved, and the research themes covered in these articles.

## 2.2 *Overview of the Data*

The distribution of the selected studies for this literature review by year is presented in Fig. 2. The articles were published between 2002 and 2022, with the majority in 2021 (3), 2019 (5), 2013 (5), and 2011 (3). The distribution of selected studies by year indicates that researchers have been actively studying and contributing to the understanding and advancement of this field over a significant span of time.

Over the years, as navigation satellite systems have become prevalent in our daily lives, they have sparked interest among researchers. Numerous studies about the industry have been conducted from various perspectives and across multiple disciplines. However, while most of the studies have focused on the technical aspects of navigation satellite systems, there also appears to be a growing interest in commercial and business-oriented research. This broad interest among different disciplines can also be observed in the various journals in which the selected articles are



**Fig. 1** Search process and selection criteria

published. Table 2 shows the journals and the corresponding number of publications from each. The reviewed articles were published in 26 different journals. The most common journals among the publications were the Journal of Location-Based Services (4), the Journal of Spatial Science (2), Sustainability (2), and Regional Studies (2).

The articles included in this literature review employ a diverse range of research and analytical approaches. The following categories were used to distinguish the different methodologies adopted in the studies:

Table 1 Selected articles

<i>Article title</i>	<i>Authors</i>	<i>Journal</i>	<i>Year</i>	<i>Database</i>	<i>Research themes</i>
Agent-Based Modeling (ABM): Support for Emphasizing the Air Transport Infrastructure Dependence of Space Systems	Bucovetchi, Georgescu, Badea and Stanciu	Sustainability	2019	ABI	Space systems; modeling; air transport; critical infrastructures; governance
An Organisational Model for a Unified GNSS Reference Station Network for Australia	Higgins	Journal of Spatial Science	2008	SCOPUS	GNSS, reference station networks, precise positioning, RTK, organizational models, business models
Application of Tracking Technologies to the Study of Pedestrian Spatial Behavior	Isaacson and Shoval	The Professional Geographer	2006	Taylor & Francis Online	Pedestrian, spatial activity, tracking
Battles in Space: De facto Standardization of Global Navigation Satellite Systems	Breeman, Grillo, and van de Kaa	Journal of Engineering and Technology Management	2022	SCOPUS	GNSS, Standards battle, Technology battle, De facto standard, Standard dominance
Cyber Security In: Analysis of Threats, Key Enabling Technologies and Challenges	Manulis, Bridges, Harrison, Sekar, and Davis	Journal of Information Security	2021	ABI	New Space, Cyber security, Satellites, Constellations, COTS
Geographic Information Technologies for Cultural Research: Cultural Mapping and the Prospects of Colliding Epistemologies	Gibson, Brennan-Horley, and Warren	Cultural Trends	2010	EBSCO	Geographic Information Technologies, Geographic Information Systems (GIS), Global Positioning System (GPS), Geoweb, cultural mapping; creative city, cultural planning

<i>Article title</i>	<i>Authors</i>	<i>Journal</i>	<i>Year</i>	<i>Database</i>	<i>Research themes</i>
Getting into Networks and Clusters: Evidence from the Midi-Pyrenean Global Navigation Satellite Systems (GNSS) Collaboration Network	Vicente, Bolland, and Brossard	Regional Studies	2011	Taylor & Francis Online	Knowledge, Networks, Economic geography, Cluster, Global Navigation Satellite Systems (GNSS)
GPS as a Method for Assessing Spatial and Temporal Use Distributions of Nature-Based Tourists	Hallo, Becco, Goetcheus, McGee, McGehee, and Norman	Journal of Travel Research	2012	SCOPUS	GPS, spatial distributions, visitor use, tracking, time-space
Identification of Preconditions for an Emerging Mobile LBS Market	Khurri and Luukkainen	Journal of Location-Based Services	2009	Taylor & Francis Online	Mobile location-based services; Global Navigation Satellite System; smartphone; value network; value proposition
Identifying Motion and Interest Patterns of Shoppers for Developing Personalized Wayfinding Tools	Millonig and Gartner	Journal of Location-Based Services	2011	Taylor & Francis Online	Spatio-temporal behavior; methods triangulation; wayfinding; clustering; pedestrian typology
Impact of Galileo Commercial Service on Location-Based Service Providers: Business Model Analysis and Policy Implications	de Reuver, Skournetou, and Lohan	Journal of Location-Based Services	2013	Taylor & Francis Online	Galileo; location-based services; business models; satellite technologies; GPS
Interference Localization for Satellite Navigation Systems	Dempster and Cetin	Proceedings of the IEEE	2016	IEEE	Global Navigation Satellite Systems (GNSS) vulnerability; jamming; radio frequency interference

(continued)

Table 1 (continued)

<i>Article title</i>	<i>Authors</i>	<i>Journal</i>	<i>Year</i>	<i>Database</i>	<i>Research themes</i>
Location-Based Services—The Market: Success Factors and Emerging Trends from an Exploratory Approach	Uphaus, Beringer, Siemens, Ehlers, and Rau	Journal of Location-Based Services	2021	Taylor & Francis Online	Location-Based services; market exploration; content analysis; theoretical sampling; strategic application management
Location-Based Services Deployment and Demand: A Roadmap Model	Petrova and Wang	Electronic Commerce Research	2011	SCOPUS	Mobile services, Location-based services, Location-aware services, LBS, Case study
Managing Knowledge Sharing-Protecting Tensions in Coupled Innovation Projects among Several Competitors	Rouyre and Fernandez	California Management Review	2019	EBSCO	Open innovation, cooperation, management, project management, third-party intervention
Mobile Targeting	Luo, Andrews, Fang, and Phang	Management Science	2014	EBSCO	Mobile commerce; mobile targeting; randomized field experiment
National Positioning Infrastructure: Identifying and Evaluating high-Accuracy GNSS Service Coverage Across Australia	Hausler and Collier	Journal of Spatial Science	2013	SCOPUS	National Positioning Infrastructure (NPI); Continuously Operating Reference Station (CORS); Global Navigation Satellite System (GNSS)
Personal Information Privacy and Emerging Technologies	Conger, Pratt, and Loch	Information Systems Journal	2013	EBSCO	Personal information privacy, data sharing, data leakage, data integration, data collection, emerging technologies

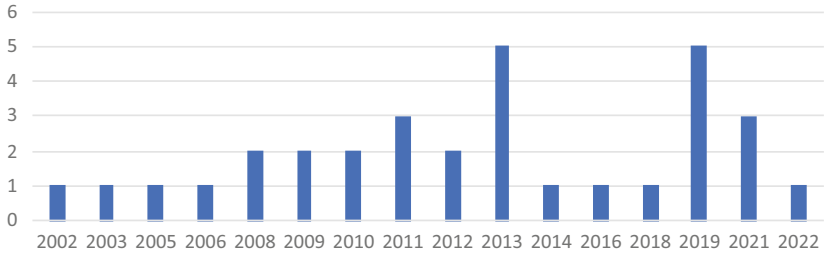
<i>Article title</i>	<i>Authors</i>	<i>Journal</i>	<i>Year</i>	<i>Database</i>	<i>Research themes</i>
Proximity and the Evolution of Collaboration Networks: Evidence from Research and Development Projects within the Global Navigation Satellite System (GNSS) Industry	Balland	Regional Studies	2012	Taylor & Francis Online	Collaboration networks, Proximity, Economic geography, Dynamic network models, Global Navigation Satellite System (GNSS)
Satellites and the Security Dilemma	Lubojeński	Astropolitics	2019	Taylor & Francis Online	Movement, mobility tracks, tracking, mobility data,
Semantic Trajectories Modeling and Analysis	Parent, Spaccapietra, Renso, Andrienko, Andrienko, Bogomy, Gkoulalas-Divanis, Macedo, Pelekis, Theodoridis, and Yan	ACM Computing Surveys	2013	EBSCO	trajectories, trajectory behavior, semantic enrichment, data mining, activity identification, GPS
Structural and Geographical Patterns of Knowledge Networks in Emerging Technological Standards: Evidence from the European GNSS Industry	Balland, Suire, and Vicente	Economics of Innovation and New Technology	2013	SCOPUS	Economic geography; knowledge networks; social network analysis; EU Framework Programs; technological standards; GNSS
SWOT-AHP Analysis of the Korean Satellite and Space Industry: Strategy Recommendations for Development	Lee, Kim, Kim, Kang	Technological Forecasting and Social Change	2021	SCOPUS	Satellite, Strategy, South Korean space and satellite industry, SWOT-AHP, Topic modeling
Synchronization of Critical Infrastructures Dependent Upon GNSS: Current Vulnerabilities and Protection Provided by New Signals	Falletti, Davide, Marucco, Morella, Nicola, and Pini	IEEE Systems Journal	2019	IEEE	Critical infrastructures, Global Navigation Satellite System (GNSS), spoofing, synchronization, timing

(continued)

Table 1 (continued)

<i>Article title</i>	<i>Authors</i>	<i>Journal</i>	<i>Year</i>	<i>Database</i>	<i>Research themes</i>
Technology, Security, and policy Implications of Future Transatlantic Partnerships in Space: Lessons from Galileo	Zervos and Siegel	Research Policy	2008	SCOPUS	Public-private partnerships, Security, Technology, Galileo, Transatlantic
The Importance of Coordination in National Technology Policy: Evidence from the Galileo Project	Zervos and Siegel	Prometheus	2005	EBSCO	Galileo; navigation; space; technology policy; transatlantic
The Market Turn in EU Governance—The Emergence of Public-Private Collaboration	Mörth	Governance	2009	EBSCO	
The Price of Convenience: Privacy and Mobile Commerce	Ng-Kruelle, Swatman, Rebne, and Hampe	Quarterly Journal of Electronic Commerce	2002	EBSCO	Privacy, mobile commerce, location-based services, pervasive computing, attitudes, behavior
User Needs for Location-Aware Mobile Services	Kaasinen	Personal and Ubiquitous Computing	2003	ABI	Location-aware services, Mobile services, Usability, User evaluation, User needs
Using Global Positioning Systems as a Marketing Tool: An Analysis of U.S. Consumers' Use and Perceptions	Cobanoglu, Ciccarelli, Nelson, and Demicco	Journal of Hospitality Marketing and Management	2010	Taylor & Francis Online	Global positioning system, GPS, location-based services, marketing, marketing tool, hospitality
Visitor Mobility and Spatial Structure in a Local Urban Tourism Destination: GPS Tracking and Network Analysis	Sugimoto, Ota, and Suzuki	Sustainability	2019	ABI	Visitor mobility; urban tourism; spatial structure; GPS tracking; network analysis; Ueno district

<i>Article title</i>	<i>Authors</i>	<i>Journal</i>	<i>Year</i>	<i>Database</i>	<i>Research themes</i>
What Drives Users' Intentions to Purchase a GPS Navigation App: The Moderating Role of Perceived Availability of Free Substitutes	Wang, Lin, Wang, Shih, and Wang	Internet Research	2018	ABI	Global positioning system (GPS) navigation app, Innovation diffusion theory (IDT), Mobile applications (apps), Perceived availability of free substitutes (PAFS), Value-based adoption model (VAM)



**Fig. 2** Distribution of the chosen articles by year

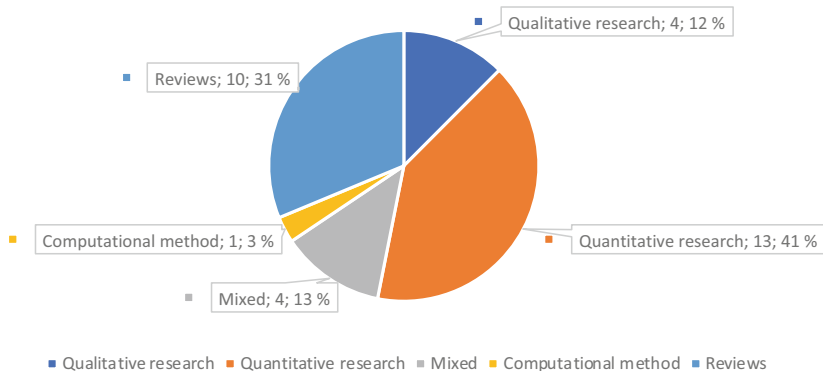
**Table 2** Distribution of the chosen articles by journal

<i>List of journals</i>	<i>Number of articles</i>
ACM Computing Surveys	1
Astropolitics	1
California Management Review	1
Cultural Trends	1
Economics of Innovation and New Technology	1
Electronic Commerce Research	1
Governance	1
IEEE Systems Journal	1
Information Systems Journal	1
International Journal of Information Security	1
Internet Research	1
Journal of Engineering and Technology Management	1
Journal of Hospitality Marketing and Management	1
Journal of Location-Based Services	4
Journal of Spatial Science	2
Journal of Travel Research	1
Management Science	1
Personal and Ubiquitous Computing	1
Proceedings of the IEEE	1
Prometheus	1
Quarterly Journal of Electronic Commerce	1
Regional Studies	2
Research Policy	1
Sustainability	2
Technological Forecasting and Social Change	1
The Professional Geographer	1

1. Qualitative research
2. Quantitative research
3. Mixed methodology (e.g., both qualitative and quantitative research)
4. Computational methods
5. Literature reviews, overviews, and mapping studies

The distribution of different methodologies is presented in Fig. 3. Due to the nature of the topic, it is common for the studies to involve various domains of research methods. In the business-related literature, it is evident that there are methodologies that combine both business and technical principles.

The majority of the reviewed studies employed empirical research. Quantitative research was the most widely used method, with a total of 13 studies employing this approach. Additionally, the review category, which encompassed overviews and mapping studies, consisted of ten studies. Mixed methodologies, meaning in this context the use of multiple research methodologies, such as a combination of qualitative interviews and quantitative data, were employed in four studies. Additionally, four studies conducted qualitative research. Lastly, one study used a computational method, more precisely, agent-based modeling. Interestingly, five studies applied a case study approach along with the main research method.



**Fig. 3** Distribution of research methods

### 3 ANALYSIS AND FINDINGS

The purpose of the following subsections is to offer an overview of the existing knowledge on the topic and to present six key themes that have emerged from the literature. This will establish a foundation for the subsequent section where we will explore potential directions for future research in this area.

The research topic of commercial aspects of navigation satellite systems has generated interest for studies in various contexts and for various purposes. Given the broad nature of this industry and its engagement with various domains, the research themes are extensive. Based on the systematic literature review, six themes have emerged from the reviewed articles. Table 3 summarizes the themes and the number of publications in each theme.

LBS are an integral part of the utilization of navigation satellite systems, and it was expected that this topic would be discussed in the literature. LBS were discussed in several studies, yet four articles were categorized in this theme group, as they had a prevailing focus on LBS in their research agenda. Mobility and spatial data are also relevant topics concerning commercial aspects of navigation satellite systems, with a total of six studies focusing on these themes in their research. In total, eleven articles covered topics of collaboration, coordination, and knowledge networks while studying navigation satellite systems. The consumer and user point of view were covered by four studies. A popular theme among the studies was security, privacy, and personal information privacy, and

**Table 3** Themes observed in the literature

<i>List of themes</i>	<i>Number of publications</i>
Location-based services (LBS)	4
Mobility/Spatial data	6
Collaboration/Coordination/Knowledge networks	11
Consumer/User point of view	4
Security/Privacy/Personal information privacy (PIP)	4
Critical infrastructures	3

this category included four articles. Lastly, three articles discussed navigation satellite systems from the critical infrastructures viewpoint. In the following section, the themes are introduced, and the research on each theme is elaborated.

### *3.1 Location-Based Services*

LBS are services that comprise technologies enabling the geographic information of a mobile user's real-time location and provide personalized information for their users (Uphaus et al., 2021). The development and deployment of LBS have been studied by Petrova and Wang (2011) through a case study approach. The focus is on the LBS landscape and reveals that regulatory factors have been crucial for commercial success in the LBS markets, yet innovative business approaches have also played a significant role in generating customer demand. The findings suggest that economies aiming to adopt LBS should prioritize the establishment of a supportive environment that nurtures the development of services tailored to meet the specific needs and requirements of the target customer market.

A recent study by Uphaus et al. (2021) presents a comprehensive overview of the current LBS market. They investigated the existing use cases of LBS and identified the relevant players and value creation models within the market. By analyzing providers, areas of application, functions, and technologies, the study establishes a category system that helps identify success factors in well-established services based on application type, technology, business models, and other characteristics. The research highlights the promising opportunity of using location analytics to improve the user experience in current LBS implementations. Overall, the study introduces a novel framework for future market explorations in this field.

The work by Khurri and Luukkainen (2009) focuses on identifying and analyzing the necessary conditions for the development of a mobile LBS market in its phases of evolution. They found that there are favorable conditions in place to initiate the implementation of LBS. However, the authors indicate several areas that require further research, such as understanding the societal impact, value proposition, and risks related to security and privacy. Additionally, the authors state that creating sustainable business models and establishing a balanced mobile LBS ecosystem that offers equal profit opportunities for all participants is crucial for the success of the LBS market. Additionally, De Reuver et al. (2013) have conducted research on the topic of business models of LBS providers and how these will be impacted by the advantages of Galileo commercial services.

### 3.2 *Mobility/Spatial Data*

The rapid mobility of people and goods has been facilitated by the widespread availability of ubiquitous computing and LBS. The emergence of GPS and other positioning devices has further enabled the collection of real-time location data for objects moving in geographical space. As a result, vast amounts of tracking data have been generated, opening up new commercial possibilities for innovative applications built upon this movement information. Researchers from various fields, including database management, geographic information systems (GIS), visualization, data mining, and knowledge extraction, have contributed to the development of models and techniques for analyzing mobility patterns and extracting valuable insights from this data (Parent et al., 2013).

The survey conducted by Parent et al. (2013) delves into the fundamentals of mobility data, addressing its definitions and investigating the challenges associated with its management. The study also offers a comprehensive overview of various approaches and techniques for three critical aspects: (1) constructing trajectories from movement tracks, (2) enriching trajectories with semantic information to facilitate meaningful interpretations of movements, and (3) utilizing data mining to analyze semantic trajectories and extract insights, including behavioral patterns of moving objects. Likewise, Isaacson and Shoval (2006) conducted an examination of tracking technologies for gathering data on pedestrian spatial behavior. Their study primarily focuses on two key tracking technologies: satellite navigation systems and land-based navigation systems. In a separate study, Millonig and Gartner (2011) delved into the spatio-temporal behavior of shoppers, investigating the factors that influence their commercial behavior within specific groups. Moreover, research has explored the potential of applying Geographic Information Technologies, such as GPS, in cultural research, as demonstrated by the work of Gibson et al. (2010).

Visitor mobility plays a crucial role in supporting sustainable local economies and effective management in urban tourism destinations. When researching visitor mobility, much attention has been focused on uncovering the underlying patterns and structures of spatial visitor behavior (Sugimoto et al., 2019). Traditional approaches to gathering data on spatial and temporal visitor activity have posed challenges for both survey participants and researchers. However, advancements in geospatial

technologies have provided alternative methods for collecting and visually presenting information about activities in specific locations. Among these technologies, GPS has emerged as a valuable tool for data collection related to commercial behavior.

In their study, Hallo et al. (2012) explore the use of GPS technology for tracking nature-based tourists and underscore its benefits compared to traditional tracking methods. Their research revealed that GPS provides numerous advantages, including increased reliability, accuracy, and precision in data collection. By leveraging GPS technology, researchers can examine the actual movements of visitors, yielding valuable insights into visitor use patterns, as opposed to relying solely on self-reported data. In a study conducted by Sugimoto et al. (2019), researchers investigated the connection between visitor mobility and urban spatial structures through an exploratory analysis. They collected data on visitors' movements and characteristics using surveys that combined GPS tracking technologies and questionnaires. Based on these works, it is evident that GPS technology offers several advantages that can be applied for different tourism related businesses.

### 3.3 *Collaboration/Coordination/Knowledge Networks*

Balland (2012) has made significant contributions to the literature in the GNSS industry. His highly acclaimed article explores the impact of proximity on the development of the GNSS collaboration network (Balland, 2012). The study's primary focus is to understand how organizations select their partners, with a specific emphasis on proximity or distance. It empirically analyzes how organizations choose their partners based on various dimensions of proximity, including geographical, cognitive, organizational, institutional, and social factors (Balland, 2012). Another study by Balland, conducted in collaboration with Vicente and Brossard, analyzes clusters within collaborative knowledge networks in a specific technological field. It examines the interface between clusters and networks, aiming to enhance our understanding of collaboration across different locations and cognitive domains. The research specifically investigates the Midi-Pyrenean cluster in the GNSS industry, utilizing a relational database constructed from collaborative research and development projects funded at various levels in Europe (Vicente et al., 2011). These collaborative networks are important for commercialization of innovations (Balland, 2012; Balland et al., 2013) Additionally, Balland

et al. (2013) have studied how innovation is influenced by specific structural characteristics of knowledge networks and its impact on geographical patterns.

The topic of public–private partnerships (PPPs) has garnered interest among researchers in GNSS literature, particularly concerning the European Galileo case. Mörth (2009) has studied the relationships between the public and private spheres through an analysis of three European collaboration cases involving public and private actors. The study includes cases of the European satellite navigation program (Galileo), the European Investment Bank (EIB), and the European financial market. The article examines the balance between managerial autonomy and democratic accountability in European public–private collaborations, emphasizing the importance of political control for democratic legitimacy, rather than evaluating efficiency.

In their paper, Zervos and Siegel (2008) explore the role of multi-public partnerships in the space industry in promoting commercially viable space programs, addressing market failures, and tackling transatlantic security concerns. The paper specifically focuses on the benefits and policy implications of transatlantic multi-public–private partnerships through a case study of the Galileo space-based navigation system. In another publication by Zervos and Siegel (2005), they examine the advantages of transatlantic collaboration in technology policy, particularly in publicly-funded R&D space projects like Galileo. Using an industrial organization methodology, the research investigates the negative security impacts of unilateral space projects, highlighting the importance of transatlantic coordination in technology policy to enable the space industries to benefit from cross-border strategic research partnerships (SRPs). Rouyre and Fernandez (2019) conducted a case study on Galileo to examine the challenges associated with balancing knowledge sharing and knowledge protection in collaborative innovation projects involving competitors. Additionally, *de facto* standardization concerning GNSS has also been studied in the literature, with a focus on GPS, GLONASS, and Galileo (Breeman et al., 2022).

Higgins (2008) and Hausler and Collier (2013) studied GNSS coverage and precise positioning in Australia. Both studies address the challenges and opportunities associated with establishing a comprehensive and accessible National Positioning Infrastructure in Australia. They highlight the limited coverage of high-accuracy GNSS services in Australia and identify inefficiencies and factors that have hindered nationwide access

to high-accuracy positioning services, such as inefficient investment and lack of coordination. Higgins (2008) introduces a model to identify the distinct roles played by organizations involved in delivering precise positioning services. It emphasizes the importance of governance mechanisms that enable collaboration among partners, ensuring transparency regarding their respective roles and maintaining user confidence in the services provided. In their work, Hausler and Collier (2013) identify organizational business drivers and technical methodologies that have resulted in a lack of nationwide access to high-accuracy positioning services and inefficient investments in Australia. The study by Lee et al. (2021) focuses on analyzing the Korean satellite and space industry and developing strategies for its growth. The researchers utilized the SWOT-AHP method to assess the priorities of various factors and proposed detailed strategies based on their findings.

### *3.4 Consumer/User Point of View*

Given the extensive research conducted on GNSS from various perspectives and domains, it is evident that commercial literature also explores the consumer's or user's viewpoint in relation to the market. Furthermore, there has been an interest in examining the value proposition of GPS and other navigation satellite systems for their users, as well as analyzing their impact at a consumer level.

A paper by Kaasinen (2003) studies location-aware mobile services from the user's point of view and has received significant attention among scholars. In her study, Kaasinen conducts a thorough analysis of user needs in location-aware services through a comprehensive approach encompassing user interviews, laboratory, and field evaluations, as well as expert evaluations. The study identifies key issues and presents user needs across five main themes: topical and comprehensive contents, seamless user interaction, personalized and user-generated contents, cohesive service entities, and privacy concerns.

Luo et al. (2014) study how mobile technologies allow marketers to target consumers based on time and location. Their work examines the effects of different combinations of mobile targeting on consumer responses to mobile promotions. Using a large-scale randomized experiment involving 12,265 mobile users, the researchers draw on contextual marketing theory to formulate hypotheses. Overall, the article emphasizes

the importance of understanding the timing, location, and strategies used in mobile targeting.

A study by Wang et al. (2018) explores consumer purchase decisions regarding mobile GPS navigation apps, drawing on the value-based adoption model and innovation diffusion theory. It also examines the moderating role of perceived availability of free substitutes (PAFS) in the relationship between perceived value and purchase intention. For the study, authors' analyzed data from 219 mobile users using the partial least squares approach. With this study, they aimed to contribute to advancing knowledge in mobile internet marketing and analyzed consumer purchase intentions in the mobile GPS navigation app context.

Navigation satellite systems have also raised interest from a marketing perspective. In their research, Cobanoglu et al. (2010) investigate how consumers perceive the possibility of using GPS devices as marketing tools, specifically in the context of services for travelers. It is based on a survey of 200 randomly-selected online consumers, gathering insights into their usage patterns and attitudes toward GPS. The findings suggest that GPS devices are indeed employed as marketing tools, but there is notable resistance among consumers toward businesses reaching out to them through GPS.

### 3.5 *Privacy/Personal Information Privacy (PIP)/Security*

When discussing locations and activities that concern individuals' personal lives, such as their residences, workplaces, visited places, and social interactions, this information should be regarded as personal and safeguarded from being shared without authorization. Many countries around the world have established norms and laws to limit the gathering and utilization of personal data. Nevertheless, privacy regulations are unable to fully shield personal information from malicious entities, namely those intentionally seeking unauthorized access to protected data (Parent et al., 2013). In their study, Ng-Kruelle et al. (2002) discuss the hidden aspect of mobile commerce concerning private information, such as personal location, that must be provided for benefits like navigation support; hence, this can be perceived as a significant cost. The authors introduce the concept of the "price of convenience," which addresses how users' privacy is exchanged for convenience. More specifically, the study examines the decision-making process of individuals.

The topics of personal information privacy and security have been studied considerably in navigation satellite systems-related literature. The overall topic of privacy concerning individuals' locational data has received increasing interest among researchers, and it is considered an important aspect related to the industry. A study by Conger et al. (2013) introduces a comprehensive model of personal information privacy (PIP) that goes beyond just collecting transactional data and also considers the sharing of data in interorganizational settings. This study examines how emerging technologies impact the management of PIP. It also explores various research avenues related to privacy, technologies that protect privacy, interorganizational data sharing, and the development of policies in this field. For a better understanding of the motives and traits of adversarial threats, Manulis et al. (2021) examine past instances of security threats and incidents targeting satellites. According to their analysis, ground and radio frequency communications have been the primary targets so far. Yet, with the growth of satellite constellations expected in the near future, there is a need to shift focus toward securing the space segment as well. Lubojemski (2019) contributes to the security discussion by examining the security dilemma linked to satellites. By applying concepts and theories from international relations studies, the dual-use nature of satellites provides valuable insights into understanding their influence on the international system.

### 3.6 *Critical Infrastructures*

GNSS, like GPS, is increasingly relied upon in modern infrastructures due to its positioning and timing capabilities, hence making GNSS itself a critical infrastructure. These infrastructures are essential systems that contribute to the operations of the economy, government, and businesses. Moreover, they are essential for maintaining the economical operations, societal functions, well-being, health, safety, and security of citizens and states (Bucovetchi et al., 2019; Dempster & Cetin, 2016). Fields such as finance, telecommunications, and energy distribution use GNSS as a timing source for network synchronization. However, GNSS can face issues by becoming a target of hackers, spoofing attacks, and such, as some of these networks can also be classified as critical infrastructures (Falletti et al., 2019).

The literature review identified three articles that considered critical infrastructures in their research and highlighted the significance of

GNSS's role in the operations of critical infrastructures. Bucovetchi et al. (2019) emphasize the vital role of critical infrastructure. The study showcases a modeling exercise revealing the global air transport infrastructure's reliance on space systems, underscoring the potential impact of disruptions and the necessity for tools to support policy and decision-making in safeguarding and designing infrastructures.

In their study, Falletti et al. (2019) discuss the dependence of critical infrastructures on GNSS and GPS for time synchronization and consider the vulnerability of their receivers to spoofing attacks. It emphasizes the need for increased awareness and potential mitigation strategies to address this vulnerability of GNSS. Similarly, Dempster and Cetin (2016) discuss the increasing reliance on GNSS, specifically GPS, in safety-critical infrastructures. It highlights the vulnerability of GNSS to radio frequency interference (RFI) from intentional (jamming) or unintentional sources, which has become a significant concern. As a result, GNSS itself is now considered critical infrastructure that requires protection and mitigation of its vulnerability to interference. In this study, Dempster and Cetin (2016) present an overview of the existing systems and a comparison of different interference geo-localization techniques based on literature.

#### 4 FUTURE RESEARCH DIRECTIONS

Navigation satellite systems have become an intriguing subject of investigation spanning a wide range of research areas. Beyond their primary applications in technical, engineering, and aerospace sectors, navigation satellite systems have increasingly piqued the interest of the business research community. Nevertheless, there remains a substantial need for a deeper comprehension of the business and economic aspects within this domain. This is primarily because the majority of published papers have been predominantly technically oriented, with limited attention given to entrepreneurial initiatives and business prospects related to GNSS-based services. Consequently, there is ample opportunity for research that delves into these aspects through a business-oriented lens. Some avenues for further studies are presented below.

Based on the existing literature on LBS, it becomes evident that there exists a significant variance in customer requirements concerning these services (Khurri & Luukkainen, 2009; Uphaus et al., 2021). This challenge is underscored by Khurri and Luukkainen (2009, p. 206), who note, "It is not clear how to develop business models that will take

into account the interests of different players in the LBS value network ranging from content owners and device vendors to end-users.” In order to effectively thrive in markets with such diverse customer needs, there is a compelling necessity for a business model that can be replicated across various use cases, industries, and market segments (Winter & Szulanski, 2001). As such, there is a clear demand for further research to delve into the innovation and development of business models (Karami et al., 2022) within the context of LBS. These studies should explore how to create a versatile business model that is easily customized, while also considering the diverse demands of customers and the specific regulations of different countries.

Prior research underscores the utility of various positioning-based services in data collection and the examination of visitor mobility, encompassing their underlying patterns and structures (Hallo et al., 2012; Sugimoto et al., 2019). Leveraging such data, diverse service types have been developed, including smart-city services for municipal authorities and tracking services for consumers aiming to circumvent traffic congestion, among others. Nonetheless, a noticeable gap exists in linking the development of these services to entrepreneurial aspects that could explore how entrepreneurs innovate novel services using available positioning technologies. An equally intriguing realm lies in indoor positioning, which presents unique challenges due to the limitations of GPS within interior spaces and the need for multifaceted technology solutions (Dedes & Dempster, 2005). Exploring this area would expand positioning-based studies and business prospects from outdoor to indoor settings (Ojala et al., 2024).

We have observed that the existing literature emphasizes networking with partners and other market actors (see Balland, 2012; Zervos & Siegel, 2008). In future research endeavors, we propose a more comprehensive application of network theories to yield in-depth insights into the dynamics of networking and ecosystem initiation among diverse stakeholders in GNSS-based services. For instance, exploring the formation of both weak and strong ties, as outlined by Granovetter (1973), can shed light on how these various types of connections contribute to the creation of a successful business ecosystem (Tiwana, 2015). Furthermore, given the international nature of GNSS-based businesses, there is a compelling need to investigate the establishment of different types of cross-border networks (Ojala, 2009). This research should aim to identify the necessary actions and strategies for integrating the potential requirements of

foreign partners and addressing possible bottlenecks in the market into the service (Fraccastoro et al., 2023).

## 5 CONCLUSIONS

In this chapter, we have provided a comprehensive literature review that contributes to the advancement of our understanding regarding the commercial application of navigation satellite systems. Our review indicates the main themes and key findings derived from an analysis of 32 studies within this domain. The outcomes of this systematic literature review reveal that despite its importance, business-related research on the application of navigation satellite systems remains relatively scarce. While the technical features of GNSS have attracted a lot of interest, the commercial side of this market is only emerging. However, there seems to be growing interest in business research related to GNSS. Notably, a substantial portion of the existing business literature concerning GNSS and LBS emerged in the early 2010s, indicating a pressing need for contemporary research that examines the current market dynamics of GNSS and LBS.

In light of these findings, this study provides the following contributions that future research endeavors should focus on in more detail. Firstly, especially in the LBS market, there are diverse customer needs that should be addressed by developing flexible and replicable business models. Secondly, the literature highlights different services and technologies for position-based data collection, but it does not focus on how these services are created and commercialized. Thirdly, we observed that although the industry is highly networked, these networks and how they are formed have not been studied in detail.

It is essential to acknowledge the limitations of this literature review. While it aims to provide an overview of the current literature concerning navigation satellite systems with a focus on commercial aspects, it is important to note that the review is based on a modest sample size of 32 publications. We also acknowledge that some publications might be missing if they are not published within the databases applied or did not include the search words employed. Furthermore, there is always a possibility of mistakes, and the authors are responsible for any potential errors. We also acknowledge that the findings and implications of this study cannot be extrapolated beyond its specific scope. However, the

study provides valuable insights into the existing literature within its specified themes and offers new perspectives for further business research on this topic.

## REFERENCES

Sources marked with an asterisk (\*) are included in the material of the literature review.

- \*Balland, P.-A. (2012). Proximity and the Evolution of Collaboration Networks: Evidence from Research and Development Projects within the Global Navigation Satellite System (GNSS) Industry. *Regional Studies*, 46(6), 741–756. <https://doi.org/10.1080/00343404.2010.529121>
- \*Balland, P.-A., Suire, R., & Vicente, J. (2013). Structural and Geographical Patterns of Knowledge Networks in Emerging Technological Standards: Evidence from the European GNSS Industry. *Economics of Innovation and New Technology*, 22(1), 47–72. <https://doi.org/10.1080/10438599.2012.699773>
- \*Breeman, M. P., Grillo, F., & Van de Kaa, G. (2022). Battles in space: De-facto Standardization of Global Navigation Satellite Systems. *Journal of Engineering and Technology Management*, 65. <https://doi.org/10.1016/j.jenotecman.2022.101693>
- \*Bucovetchi, O., Georgescu, A., Badea, D., & Stanciu, R. D. (2019). Agent-Based Modeling (ABM): Support for Emphasizing the Air Transport Infrastructure Dependence of Space Systems. *Sustainability*, 11(19), 5331. <https://doi.org/10.3390/su11195331>
- \*Cobanoglu, C., Ciccarelli, S., Nelson, R. R., & DeMicco, F. J. (2010). Using Global Positioning Systems as a Marketing Tool: An Analysis of U.S. Consumers' Use and Perceptions. *Journal of Hospitality Marketing & Management*, 19(6), 556–574. <https://doi.org/10.1080/19368623.2010.493069>
- \*Conger, S., Pratt, J. H., & Loch, K. D. (2013). Personal Information Privacy and Emerging Technologies. *Information Systems Journal*, 23, 401–417. <https://doi.org/10.1111/j.1365-2575.2012.00402.x>
- Davidian, K. (2021). What Makes Space Activities Commercial? *Acta Astronautica*, 182, 547–558.
- Dedes, G., & Dempster, A.G. (2005). *Indoor GPS Positioning-Challenges and Opportunities*. IEEE 62nd Vehicular Technology Conference, 1, pp. 412–415.
- \*Dempster, A. G., & Cetin, E. (2016). Interference Localization for Satellite Navigation Systems. *Proceedings of the IEEE*, 104(6), 1318–1326. <https://doi.org/10.1109/JPROC.2016.2530814>

- \*De Reuver, M., Skournetou, D., & Lohan, E. S. (2013). Impact of Galileo Commercial Service on Location-Based Service Providers: Business Model Analysis and Policy Implications. *Journal of Location Based Services*, 7(2), 67–78. <https://doi.org/10.1080/17489725.2012.750018>
- EU Agency for the Space Programme. (2022). *EUSPA EO and GNSS Market Report* (Issue 1). Publications Office of the European Union. <https://doi.org/10.2878/94903>
- \*Falletti, E., Margaria, D., Marucco, G., Motella, B., Nicola, M., & Pini, M. (2019). Synchronization of Critical Infrastructures Dependent upon GNSS: Current Vulnerabilities and Protection Provided by New Signals. *EEE Systems Journal*, 13(3), 2118–2129. <https://doi.org/10.1109/JSYST.2018.2883752>
- Fraccastoro, S., Ojala, A., & Gabrielsson, M. (2023). *Technical, Strategic, and Cultural Bottlenecks of Born-Global-Digital Firms*. Proceedings of the 56th Hawaii International Conference on System Sciences.
- George, K. W. (2019). The Economic Impacts of the Commercial Space Industry. *Space Policy*, 47, 181–186.
- \*Gibson, C., Brennan-Horley, C., & Warren, A. (2010). Geographic Information Technologies for Cultural Research: Cultural Mapping and the Prospects of Colliding Epistemologies. *Cultural Trends*, 19(4), 325–348. <https://doi.org/10.1080/09548963.2010.515006>
- Granovetter, M. S. (1973). The Strength of Weak Ties. *American Journal of Sociology*, 78(6), 1360–1380.
- Gurtuna, O. (2013). *Fundamentals of Space Business and Economics*. Springer.
- \*Hallo, J. C., Beeco, J. A., Goetcheus, C., McGee, J., McGehee, N. G., & Norman, W. C. (2012). GPS as a Method for Assessing Spatial and Temporal Use Distributions of Nature-Based Tourists. *Journal of Travel Research*, 51(5), 591–606. <https://doi.org/10.1177/0047287511431325>
- \*Hausler, G., & Collier, P. (2013). National Positioning Infrastructure: Identifying and Evaluating High Accuracy GNSS Service Coverage Across Australia. *Journal of Spatial Science*, 58(2), 191–214. <https://doi.org/10.1080/14498596.2013.812025>
- \*Higgins, M. B. (2008). An Organisational Model for a Unified GNSS Reference Station Network for Australia. *Journal of Spatial Science*, 53(2), 81–95. <https://doi.org/10.1080/14498596.2008.9635151>
- Huang, H., Gartner, G., Krisp, J. M., Raubal, M., & Van, N. (2018). Location Based Services: Ongoing Evolution and Research Agenda. *Journal of Location Based Services*, 12(2), 63–93. <https://doi.org/10.1080/17489725.2018.1508763>
- \*Isaacson, M., & Shoval, N. (2006). Application of Tracking Technologies to the Study of Pedestrian Spatial Behavior. *The Professional Geographer*, 58(2), 172–183. <https://doi.org/10.1111/j.1467-9272.2006.00524.x>

- \*Kaasinen, E. (2003). User Needs for Location-Aware Mobile Services. *Personal and Ubiquitous Computing*, 7, 70–79. <https://doi.org/10.1007/s00779-002-0214-7>
- Karami, M., Baber, W. W., & Ojala, A. (2022). The Effectual Process of Business Model Innovation for Seizing Opportunities in Frontier Markets. *Technovation*, 117, 102595.
- \*Khurri, A., & Luukkainen, S. (2009). Identification of Preconditions for an Emerging Mobile LBS Market. *Journal of Location Based Services*, 3(3), 188–209. <https://doi.org/10.1080/17489720903362306>
- \*Lee, J., Kim, I., Kim, H., & Kang, J. (2021). SWOT-AHP Analysis of the Korean Satellite and Space Industry: Strategy Recommendations for Development. *Technological Forecasting and Social Change*, 164, 1–14. <https://doi.org/10.1016/j.techfore.2020.120515>
- \*Lubojemski, A. M. (2019). Satellites and the Security Dilemma. *Astropolitics*, 17(2), 127–140. <https://doi.org/10.1080/14777622.2019.1641689>
- \*Luo, X., Andrews, M., Fang, Z., & Phang, C. W. (2014). Mobile Targeting. *Management Science*, 60(7), 1738–1756. <https://doi.org/10.1287/mnsc.2013.1836>
- \*Manulis, M., Bridges, C. P., Harrison, R., Sekar, V., & Davis, A. (2021). Cyber Security in New Space. *International Journal of Information Security*, 20, 287–311. <https://doi.org/10.1007/s10207-020-00503-w>
- \*Millonig, A., & Gartner, G. (2011). Identifying Motion and Interest Patterns of Shoppers for Developing Personalised Wayfinding Tools. *Journal of Location Based Services*, 5(1), 3–21. <https://doi.org/10.1080/17489725.2010.535029>
- \*Mörth, U. (2009). The Market Turn in EU Governance—The Emergence of Public-Private Collaboration. *Governance*, 22(1), 99–120. <https://doi.org/10.1111/j.1468-0491.2008.01423.x>
- \*Ng-Kruelle, G., Swatman, P. A., Rebne, D. S., & Hampe, J. F. (2002). The Price of Convenience: Privacy and Mobile Commerce. *Quarterly Journal of Electronic Commerce*, 3, 273–285.
- OECD. (2022). *OECD Handbook on Measuring the Space Economy* (2nd ed.). OECD Publishing. <https://doi.org/10.1787/8bfef437-en>
- Ojala, A. (2009). Internationalization of Knowledge-Intensive SMEs: The Role of Network Relationships in the Entry to a Psychically Distant Market. *International Business Review*, 18(1), 50–59.
- Ojala, A., Fraccastoro, S., & Gabrielsson, M. (2024). *Internationalization of Indoor Positioning Platform Firms: Insights from Loose Coupling Theory*. Proceedings of the Annual Hawaii International Conference on System Sciences.

- Paravano, A., Loctelli, G., & Trucco, P. (2023). What Is Value in the New Space Economy? The End-Users' Perspective on Satellite Data and Solutions. *Acta Astronautica*, 210, 554–563.
- \*Parent, C., Spaccapietra, S., Renso, C., Andrienko, G., et al. (2013). Semantic Trajectories Modeling and Analysis. *ACM Computing Surveys*, 45(4), 1–32. <https://doi.org/10.1145/2501654.2501656>
- \*Petrova, K., & Wang, B. (2011). Location-Based Services Deployment and Demand: A Roadmap Model. *Electronic Commerce Research*, 11, 5–29. <https://doi.org/10.1007/s10660-010-9068-7>
- Prol, F. S., Morales Ferre, R., Saleem, Z., Välisuo, P., Pinell, C., Lohan, E. S., Elsanhoury, M., Elmusrati, M., Islam, S., Çelikbilek, K., Selvan, K., Yliaho, J., Rutledge, K., Ojala, A., Ferranti, L., Praks, J., Bhuiyan, M. Z. M., Kaasalainen, S., & Kuusniemi, H. (2022). Position, Navigation, and Timing (PNT) Through Low Earth Orbit (LEO) Satellites: A Survey on Current Status, Challenges, and Opportunities. *IEEE Access*, 10, 83971–84002.
- \*Rouyre, A., & Fernandez, A.-S. (2019). Managing Knowledge Sharing—Protecting Tensions in Coupled Innovation Projects Among Several Competitors. *California Management Review*, 62(1), 95–120. <https://doi.org/10.1177/00081256198851512>
- \*Sugimoto, K., Ota, K., & Suzuki, S. (2019). Visitor Mobility and Spatial Structure in a Local Urban Tourism Destination: GPS Tracking and Network Analysis. *Sustainability*, 11(3), 919. <https://doi.org/10.3390/su11030919>
- Tiwana, A. (2015). Evolutionary Competition in Platform Ecosystems. *Information Systems Research*, 26(2), 266–281.
- \*Uphaus, P., Beringer, B., Siemens, K., Ehlers, A., & Rau, H. (2021). Location-Based Services—The Market: Success Factors and Emerging Trends from an Exploratory Approach. *Journal of Location Based Services*, 15(1), 1–26. <https://doi.org/10.1080/17489725.2020.1868587>
- \*Vicente, J., Balland, P. A., & Brossard, O. (2011). Getting into Networks and Clusters: Evidence from the Midi-Pyrenean Global Navigation Satellite Systems (GNSS) Collaboration Network. *Regional Studies*, 45(8), 1059–1078. <https://doi.org/10.1080/00343401003713340>
- \*Wang, Y.-Y., Lin, H.-H., Wang, Y.-S., Shih, Y.-W., & Wang, S.-T. (2018). What Drives Users' Intentions to Purchase a GPS Navigation App: The Moderating Role of Perceived Availability of Free Substitutes. *Internet Research*, 28(1), 251–274. <https://doi.org/10.1108/IntR-11-2016-0348>
- Winter, S. C., & Szulanski, G. (2001). Replication as Strategy. *Organization Science*, 12(6), 730–743.
- Xue, Y., Li, Y., Guang, J., Zhang, X., & Guo, J. (2008). Small Satellite Remote Sensing and Applications—History, Current and Future. *International Journal of Remote Sensing*, 29(15), 4339–4372. <https://doi.org/10.1080/01431160801914945>

- \*Zervos, V., & Siegel, D. S. (2005). The Importance of Co-ordination in National Technology Policy: Evidence from the Galileo Project. *Prometheus*, 23(2), 167–180. <https://doi.org/10.1080/08109020500085593>
- \*Zervos, V., & Siegel, D. S. (2008). Technology, Security, and Policy Implications of Future Transatlantic Partnerships in Space: Lessons from Galileo. *Research Policy*, 37(9), 1630–1642. <https://doi.org/10.1016/j.respol.2008.06.008>

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