EasyChair Preprint

№ 4189

The Viable System Model as an Instrument to Manage the Creation of Value in Smart Cities

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September 15, 2020

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Abstract

The tourism sector faces a new environment derived from rapid changes that affect its business dynamics. Moreover, 21st century tourists have a huge range of tourist and leisure offerings to choose from, and due to such a plethora of possibilities, catering to them can be quite demanding.

With the intensification of global competition, challenging markets and dynamic technologies, companies have recognized the need to differentiate themselves by innovating at an accelerated pace. Empowering consumers as co-creators of their experiences has become a central notion that companies strive to achieve.

This aspect has changed the sector's trends in response to the demands of a market that requires more personalized and flexible concepts of the tourism product or service. Consequently, to improve service management they need to develop strategies to gain a competitive advantage.

Therefore, the purpose of this document is to provide a cyber-systemic framework for addressing value creation processes through the Viable System Model (VSM) as a tool for understanding the interaction of current tourists and service providers to generate their value propositions created in the tourism system.

Keywords **–** Value creation, Viable System Model (VSM), Smart Cities

1. Introduction

In order to increase competitiveness in tourism markets, the organizations that make up the sector are actively seeking creative incentives to activate new service concepts that can meet the needs of tourists. One of the key factors leading to the explosion of a multitude of these new concepts is the advance of information-based technologies.

This has led the tourism industry to disintermediation in some markets, re-intermediation in others and a drastic increase in the transparency of the tourism market. This article therefore addresses how disruptive innovation has benefited services by changing the way value is created (values co-created jointly by service providers and customers), business models and work organization, making services intelligent.

Therefore, the first section comprises a literature review covering smart city, smart destination and value creation issues. Next, we address the systemic methodology to be used and its importance. Third, we present the management proposal for value creation processes in tourism experiences from the perspective of the VSM and the systemic structure of the tourism supply chain. And finally, we provide our conclusions.

2. Literature Review

A. Smart City and Smart Tourism Destination

The debate on smart cities and smart tourist destinations has been growing in the last decade, however, the work of conceptualizing and defining these terms can still be considered in progress. Although the term Smart City has its origin in the 1990s, the concept revolves around the synergy between technology and the social components of a city in order to improve the quality of life of citizens.

Picon (2015) coined the concept as a complex technological infrastructure integrated in urban areas to promote economic, social and environmental prosperity and thus obtain a sustainable competitive advantage and which requires a continuous process.

Authors such as Giffinger, et al. (2007); Cohen (2011) and Alvarez-Garcia, et al. (2016) agree that smart cities have six dimensions or categories: (1) smart governance; (2) smart

environment; (3) smart mobility; (4) smart economy; (5) smart people; and (6) smart life, strategic points that improve a city's competitiveness.

Thus, intelligent cities have become the seed for the development of tourist destinations by providing integrated systems that increase the quality of the tourist experience and some intelligent tourist destination concepts provide this:

López y Gracia (2015), defines it as an innovative area based on a territory and a state-of-the-art technological infrastructure. A territory committed to the environmental, cultural and socioeconomic factors of its habitat, equipped with an intelligence system that can obtain information in a legal way, that can analyze it and understand the events in real time in order to facilitate an interaction between the visitor and the environment, and a decision making of the destination managers, increasing their efficiency, and improving the quality of the tourist experiences.

López de Avila quoted by Gözdegül, et al. (2019) which is an innovative tourist destination, built on a state-of-the-art infrastructure that guarantees the sustainable development of tourist areas, accessible to all, which facilitates the interaction and integration of the visitor into his surroundings, increasing the quality of the experience in the destination and improving the quality of life of the residents.

Femeina (2018) defines it as a destination capable of encompassing cutting-edge technologies and the exploitation of large data to develop an interconnection between stakeholders, intelligent decision-making and, consequently, offer better experiences in increasingly competitive destinations.

Based on these concepts, tourism destination managers must understand the importance of contributing to value creation by collecting, exchanging and organizing data supported by the intelligent city infrastructure in order to provide an intelligent experience for tourists.

B. Tourism and Value creation

The tourism sector has undergone profound transformations due to social and political changes in various countries. These transformations have triggered new forms of tourism as the tastes and preferences of tourists, who are characterized by seeking new experiences, are constantly in flux.

Consequently, a strong pressure has been exerted on the organizations and tourist destinations in terms of differentiating their offer, trying to design and offer new products and / or tourist services capable of providing tourists with unique experiences.

However, to cope with competitive scenarios for scaling in terms of efficiency, effectiveness and business and social sustainability (Barile and Polese, 2010), the new business models of tourism organizations are built on a value proposition not only for owners and society but also for tourists.

Thus, organizations have begun to understand the importance of including tourists as active actors, who interact and participate in the design of tourism products or services so that they can customize them according to their demands, profile and requirements (Sigala, 2006). The end goal is to develop strategies of co-creating value in their own tourism experiences and ensuring connections and interaction between all parties involved in the exchange of services, within the complex tourism market. This is also the interactive function of systems on the VSM (Beer, 1985).

A tourist co-creator of experiences must be part of the organization's value proposition (Ng, *et al*., 2010); however, co-creation does not mean that all the tourist's needs will be met during the process of delivering the tourist service. Therefore, it must be seen from a process-based perspective (Chathoth, *et al*., 2013).

Furthermore, the value in tourism products and/or services is determined by the tourist at the moment of receiving the service in three different phases: the period before, during and after the trip (because tourism products and/or services cannot be examined before purchase), which is no more than their tourist experience when interacting with multiple and heterogeneous organizations operating within the tourism system.

Payne, *et al*., (2008) define three main components that are at the crossroads of the process-based value creation framework: (1) customer value creation processes, (2) supplier value creation processes, and (3) the interaction between the two.

For its part, Sigala (2006) observes that customer value is a focal concept that has been examined in multiple disciplines, emphasizing it in the discipline of economics, with roots in foundations in exchange, utility, labor value theories, marketing, among others. In addition, recent value conceptualizations demand greater attention, as they emphasize functional (extrinsic) and experiential (intrinsic) or emotional aspects.

On the other hand, Hindley and Font, (2015); Sigala, (2010); Kyoungjin Kim and Brown, (2012) support the notion that values and motivations are two variables that determine the tourist´s satisfaction: i.e., the tourist determines their satisfaction through the perceived value between the preferred expectation of a destination and the perceived experience at that same destination (if they can imagine themselves there).

Additional, Yoon and Uysal (2005) argue that tourists may have varying degrees of satisfaction and standards due to the heterogeneous nature of tourism markets and their different types of motivations and reactions to various destination attributes.

Thus, the tourism sector is increasingly relying on the experience of tourists and, as such, suppliers and consumers interact more closely at all stages of their relationship (Shaw and Bailey, 2011). Moreover, when value creation requires joint efforts, value depends on the characteristics of the supplier-client relationship (Moller and Torronen, 2003).

Furthermore, a vendor provides value to its customers in several ways. In its simplest form, this value is reflected in the market price, however, the price is not the core value, when a vendor aligns its strategies to meet a need, it appears with a new role, that of value creator.

As a result of these changes, Prahalad and Ramaswamy (2000 and 2004) introduce the concept of co-creation of value to refer to consumer participation in value creation (the term “value creation” and the expression “value creation process” are used only for the creation of value in use by the customer)(Gronroos, 2011) jointly with organizations.

Subsequently, the works of Vargo and Lusch (2004, 2006, and 2008), argue that historically value has always been co-produced, but only recently have the coproduction processes consciously integrated within the management of the service been identified. They propose the new paradigm of Dominant Service Logic, where the concept of co-creation maintains a central position.

According to these authors, the value is always co-created by integrating resources from organizations, suppliers, users, and strategic partners. On the other hand, Polese and Carrubo (2008) interpret that the processes of value creation in the tourism sector are influenced by numerous aspects of the systemic vision.

Specifically, this involves interaction between different entities represented by various tourist services systems and by the desire to achieve collective mutual satisfaction, in which active contribution is multiple, integration is maximal, and complementarity is fundamental to integrate in their environment and for value to be an adaptive and complex system (Spohrer and Maglio, 2008).

Therefore, in order to create value, broad integration between these processes is required. Additionally, it is critical that tourism organizations properly understand actual and potential tourists in order to prioritize and ensure compliance with the tourism services. This requires a demand of real time and suggests that knowledge management involves different behavioral processes that collectively facilitate the capture and use of market information to create innovative value propositions for tourists (Esper *et al*., 2010).

In addition, studies including Srivastava, Shervani and Fahey (1999) have identified supply chain management as a key process for co-creating value.

C. Viable System Model

The exchange of services and value creation should be considered complex phenomena due to the fact that, as outlined above, relationships between tourism providers and tourists characterize the co-creation of values (Wieland, Polese and Lusch, 2012) with levels of variability that lead us to use a holistic vision, such as systems science, as it is a suitable

discipline to diagnose integrated systems for people whose activities cannot be easily controlled by predictable processes.

Hence, the systemic methodology to be used is Stafford Beer's Viable System Model (VSM), which can provide an effective perspective for understanding the interaction mechanisms between tourists and the organizations that make up the tourism supply chain. Thus, the value of tourism experiences can be co-created and supported in a dynamic environment.

The VSM based on the work of Wiener (1948) and Ashby (1956), combines cybernetics and the study of biological systems using metaphors of machines, organisms and brains to apply these principles to the study of organizations, generating a cybernetic business model. It is also based on three fundamental cyber-principles: feasibility (which implies that an organization must react to internal and external disturbances in an appropriate way to maintain its existence, i. e., achieve "required variety", where the system seeks to control and reduce such variety), recursiveness (structuring organizational systems in a identical way as a main invariant characteristic of VSM) (Thomas, 2006), and autonomy (a system can act independently as long as it is consistent with the rules of its meta-system).

Accordingly, Beer (1985) argues that in a viable system, management functions must be broken down into five systems (Table 1) to maintain an independent identity with other organizations within a complex environment.

System	**Description**
System 1 (S1)- Operation	This is the operational function performed by the members of the organization. Manages and performs system tasks. In a complex tourism system, each one attends a specific process. For example: food and beverage, hotels service, transportations, etc.
System 2 (S2) - Coordination	Comprising a metasystem of Systems 1 there are, damping oscillations effects, including budget distribution, human resources, etc., in the tourism enterprise. System 2 is responsible for the coordination and vertical communication between S1 and S3 and horizontal communication between the operational units of S1.

System 3 (S3) – General Management System 3* (S3*) - Audit and Monitoring Channel (sporadic)	Concerned with the general coordination and coherence between S1 and S2. Responsible for monitoring and control at all levels of the organization also provides an interface with the S4 and S5.
System 4 (S4) – Strategic Management	Responds to the need to cope with a large environment and an unknown future. System that interacts and investigates the environment and develops strategies and future plans factoring in the internal capacities of the organization.
System 5 (S5) Council Board and Policy	Must contain general S3 and S4 models in order to be able to regular through general management, according to the Law of Requisite Variety. For example: touristic stakeholders like owners, investors, creditors etc. to cope unexpected external variety: government regulation, national economic changes, etc. It is the system that makes policy decisions, controls the organization as a whole and balances time and resources dedicated to planning and development necessary for the organization.

Table 1. Systems of the Viable System Model (Beer, 1979, 1981).

Each of these systems represents an interactive, cyber systemic function that acts as a filter between the environment and the organization's leadership to connect management and communication processes. Beer associates Ashby's Variety Required Law with this to indicate that the organization can remain a viable system and survive a potentially hostile environment (Ng, Parry, Smith and Maul, 2010; Badillo, Tejeida, Morales and Flores, 2011; Mckelvey, Lichtenstein and Andriani, 2012, Badillo, Tejeida, Morales and Briones, 2015), involving amplification techniques, where the organization attempts to match variety; or attenuation techniques, where the organization seeks to control and reduce such variety.

However, despite the fact that the VSM provides a tool for diagnosing or designing organizations and understanding how they operate as a whole, there has been criticism of Beer's work. For example, Rivett (1977) argues that his work is not supported by empirical

evidence. However, Rivet's, assumptions regarding the theories that underpin the model are unfounded, as laid out in Checkland (1980, 1986).

Puche, (2015); Puche, Ponte, Costas, Pino and De la Fuente (2016), takes up again the critique of Flood and Jackson (1988) concerning the socio-cybernetic theory of the VSM, for its theoretical design and abstract nature, the questionable analogy between the human brain and the organizations and its hierarchical disposition and lack of flexibility.

Beer (1985) acknowledges that the data contained in the case study work he presents were not academic exercises but are the result of paid consulting and due to his having spent very little time working with organizations on their long-term viability and few applications of VSM within the small business sector. On the contrary, most of the examples he used to illustrate his work are from large companies in the steel industry, steel supply chain, education and government.

However, some studies, including Espejo, Bowling and Hoverstadt (1999) differentiate the two ways of using VSM (design and diagnosis in the case of VIPLAN software) and emphasizes that VSM generates the same processes and controls for large and small organizations. Hetzler (2008) adds that the application of the VSM to a large number of organizations in all types of sectors and sizes has helped to reveal specific patterns of structural deficiencies.

This is shown in Schwaninger's work (2006) where he presents five cases located in different contexts where the VSM is applied as a conceptual tool for diagnosis (case 1-Transformation of a company; case 2 - redesign of a goal-system; case 3 - improve cohesion; case 4 - develop strategies and case 5 - examine the corporate ethos).

Other works have also contributed to provide guidance on the dissemination and application of the VSM in different disciplines, such as Preece, Shaw and Hayashi (2013) to structure information on major disasters; Chronéer and Mirijamdotter (2009) in supply chain management; and Briones-Juarez, Tejeida-Padilla and Badillo-Piña (2012) used the Viable System Model to understand the complexity of sustainable tourism activities.

3. Methodology

In order to focus on the role of tourism services in value creation as an interconnected activity system, Figure 1 is presented below for depicting the interface between value creation and service processes.

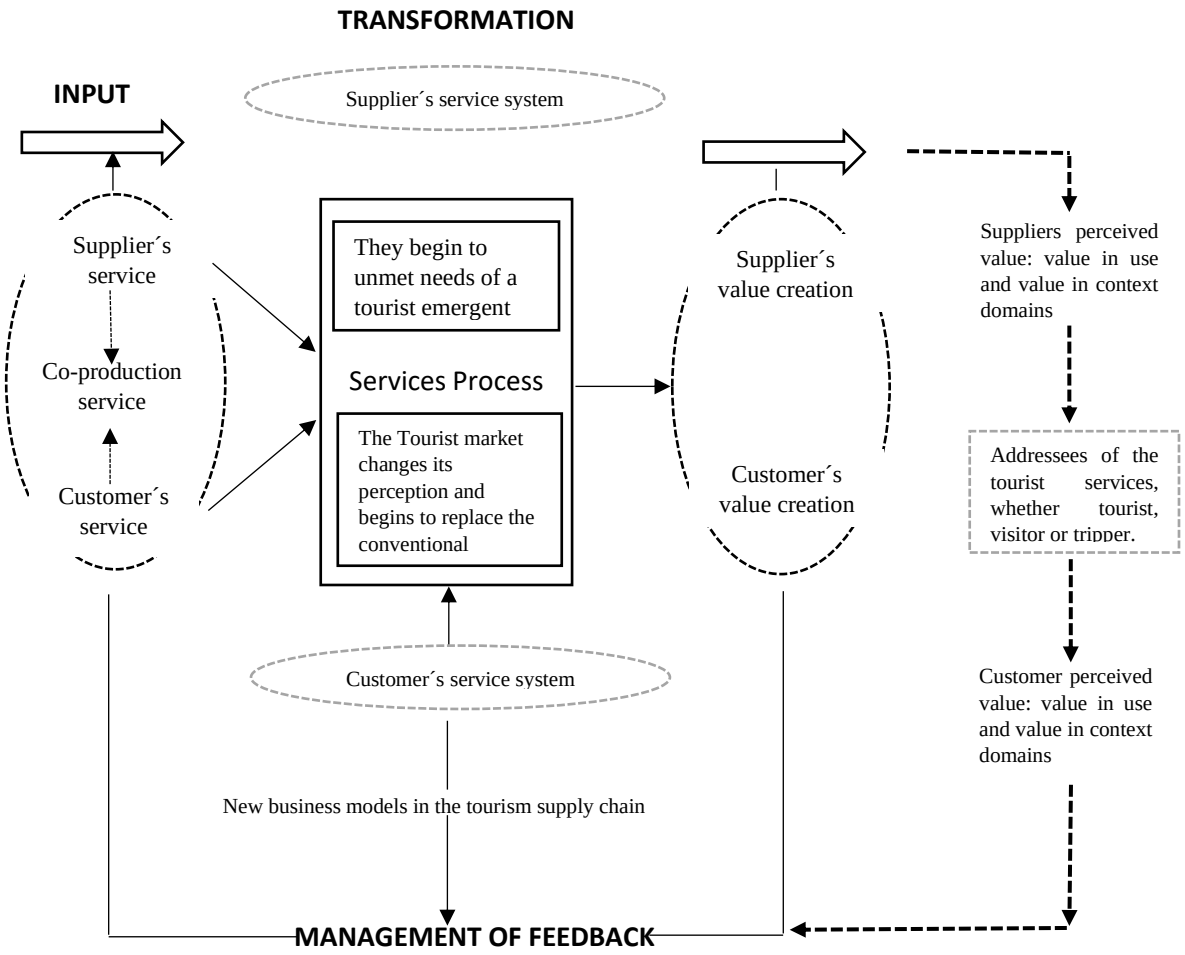


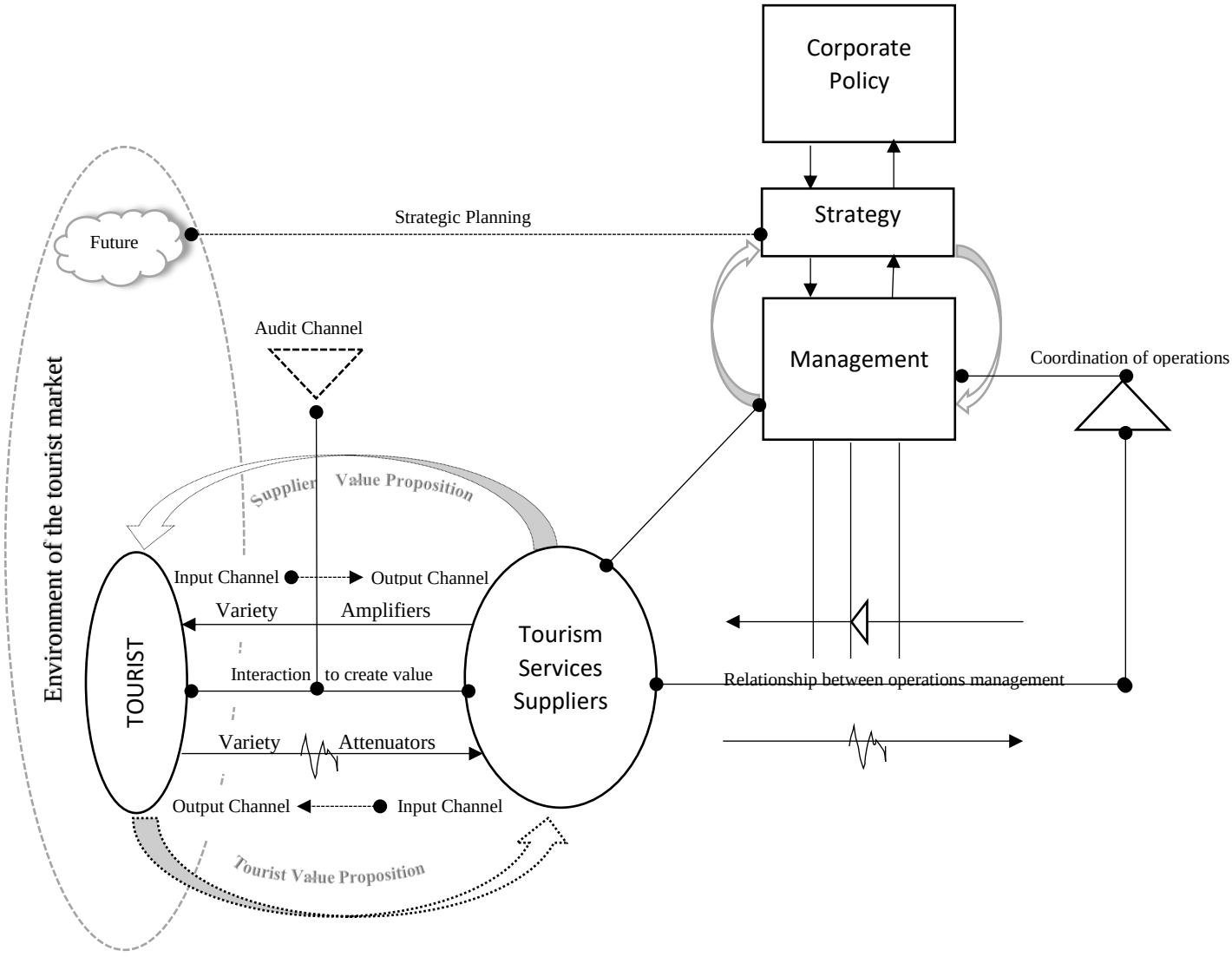
Figure 1. Value creation interface

Bearing in mind that entry is represented by the service skills of tourism providers to provide the necessary actions and structures for the provision of customer service, there are also tourists or consumers who demand their own service practices. However, the provider has its own plan regarding the process it will follow to provide the service, and the client has his own idea of what he is willing to pay for the service and this interaction between the two leads them to make their own value propositions.

This means that in the process of transformation both the provider and the tourist have their own systems to create value and use the service as an instrument to satisfy their own needs and benefits. Moreover, this interaction must result in balance between the internal resources of the organizations and tourists in terms of variety of experience and expectation. In the end, upon departure, both the tourist and the provider, should have made value propositions with benefits for both parties.

On the other hand, there should be feedback on perceptions of value in order to know if the interactions had a degree of synergy or if it is necessary redo the process to improve the tourist experience by increasing the viability and stability of the system.

In addition, in order to better manage the process of co-creating value in tourism experiences, it is proposed to approach it from the perspective of the VSM and its five systems as shown in figure 2, and the procedure to be followed is divided into three stages.



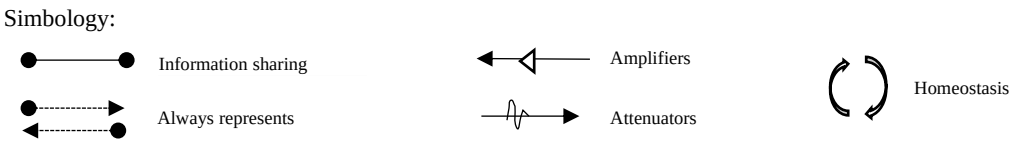


Figure 2. VSM and variety operators

STAGE 1. To choose a set of products or tourist services elaborated and associated for satisfying the necessities, requirements or desires of a consumer aka “tourist”; to strategically position the organization within a tourist market.

This management is carried out in systems 4 and 5 of the VSM and is, related to corporate strategy and policy, given that it is a decision that will define the value proposition that it wants and/or can offer to the tourism market and, from which the rest of the strategic variables must be constructed.

These systems must identify the market segments to which they will target the tourist offer. Once this study has been carried out, the valuation of the product must be established from the perspective that the value-benefit offered by the product must be equal to the value-benefit sought by the tourist. However, the value proposition in the case of tourism products has a high component of intangibility and, therefore, subjectivity. The tourist's own perception is the one that will determine if the tourist product succeeds in becoming a magnificent and once in a lifetime tourist experience, ensuring better positioning in the market.

In turn, these interactions between the tourist and the organizations that provide tourism products or services must be regulated by the operators of varieties (amplifiers and attenuators), as illustrated in figure 2; and those that will be addressed later.

STAGE 2. It consists of transmitting the value of the product, connecting supply with tourism demand.

Value creation involves ongoing communication between tourists and tourism service providers within the markets, these communications must be largely self-organized and driven by the connections between the S1 and the relevant tourism market environment, but

must also be guided by institutional policies and regulations, so that, at this stage systems 3, 3* and 2 play a major role as channels of coordination between the present represented by S3 and the future as S4.

Through this homeostat, the tourism service provider can develop stability in its internal environment in response to tourist requirements and environmental turbulence, so that market relations are more effective.

STAGE 3. The co-creation of value is generated by the value propositions of the tourist and the provider of tourism products or services.

The main objective of this stage is to observe the operations of system 1 where the value proposition, elaborated by the other systems of the VSM changes, i.e., a new value relation, is provided. In fact, one of the phenomena that have most characterized the behaviour of tourists in recent years is that many like to change and learn about new tourist experiences through different products and services, although their level of satisfaction has been positive on previous occasions.

Thus, the stability of S1 depends on the resources deployed by the other systems to achieve homeostasis and improve the viability of tourism products. Therefore, this system needs to address the variety introduced by tourists in a different way as shown in Figure 2; by supporting market variety operators (attenuators and amplifiers); by attenuating the variety of tourists to make demand more meaningful and manageable; and by expanding their variety.

Tourism service suppliers manage the variety that comes from customer outlets that summarize the customer's value proposition to generate their own value propositions, subsequently becoming a cycle of inputs and outputs. This implies that suppliers' processes must be aligned with the tourist buying process, making S1 the first homeostat and VSM management axiom a stabilizing force in operations with their markets.

In addition, the value creation proposal does not work in a linear and isolated way, since it depends on the type of organization that provides the service (hotel, restaurant, airline, car Rental Company, among others). It is not always the case that organizations have the same resources to achieve the proper positioning in the market of a tourism system for its value

proposition. Therefore, they must consider being part of a network of tourism organizations that provide, distribute, and market the products and/or services.

4. Findings

The correct process in the tourism sector is very different from that of other sectors, as it does not need physical inventories either, logistical support to take the product from the point of manufacture to the distribution, as tourism is an intangible, heterogeneous product and each tourism provider has its own market structure, information is the only thing on which potential tourists can base their purchasing decision.

For this reason, it is important to first determine which system you want to model and what its limits are. This is known as the system in focus. (Beer, 1985), for which three levels of modeling is recommended: the system or organization in focus, the environment in which it is immersed, and the subsystems included in the system or organization.

For this reason, new ways of understanding the process of value creation not only of tourism suppliers, but also of a tourist destination as a global and inclusive strategy are needed, which is why we propose that the supply chain should be constituted as a systemic structure through Beer's VSM as shown in Figure 4.

One important characteristic is observed; the model is recursive, meaning that it is a structure made of components similar to the unit that integrates them (like Russian dolls). Given that, each supplier of the S1 combines the S2, S3, S4 and S5, with these systems, it is possible to synthesize the main strategies that every supply chain must have and its distribution and commercialization (administered by intermediaries that act as amplifiers of variety for distribution and commercialization.

In the systemic structure of the tourism supply chain projected from the Viable System Model, system 1 (Operation) is integrated by tourism service providers as the central actors of the TSC. These service providers such as hotels, transportation companies, food and beverage companies, car rental companies, among others, are in contact with tourists through the provision of services, and therefore the satisfaction of tourists depends on the performance of these service suppliers.

Another key role in the S1 is that of intermediaries (travel agencies or tour operators) as assemblers of products when packaging and selling the services provided by tourist providers to tourists, and thus are considered as external logistics service suppliers. Other factors include the tourism sector, service suppliers meeting incoming demand, and the demand for collaboration with intermediaries throughout their distribution channel.

As a result, a horizontal collaboration relationship emerges, where the exchange of information in systemic terms takes place between the system (S1) and the relevant environment (which is the environment of the tourism market, made up of political, economic, socio-cultural, technological, competition, governance and tourists themselves) and it is in this information exchange, where the variety and complexity of the S1 is introduced, complicating its value proposition.

Some short comings identified on VSM by Jackson (1998, 2000) are being reduced, for example using software facilities presented by Perez-Ríos (2008). Additionally, McClelland (2003, pp.16) recommends a set of collaboration strategies to gain alignment among value chain partners via supply chain synchronization activities. He proposes the metaphor of a finely tuned orchestra, *"the conductor as the costumer and the first violinist as the supply chain host".*

According to McClelland (2003, pp. 107) "*The ideal supply-chain management system has the following characteristics:*

- *The ideal supply chain will be or appear to be seamless.*
- *The ideal supply chain will have appropriate security measures.*
- *The ideal supply chain will be agile, able to respond to changes in demand in shortest possible to time"*

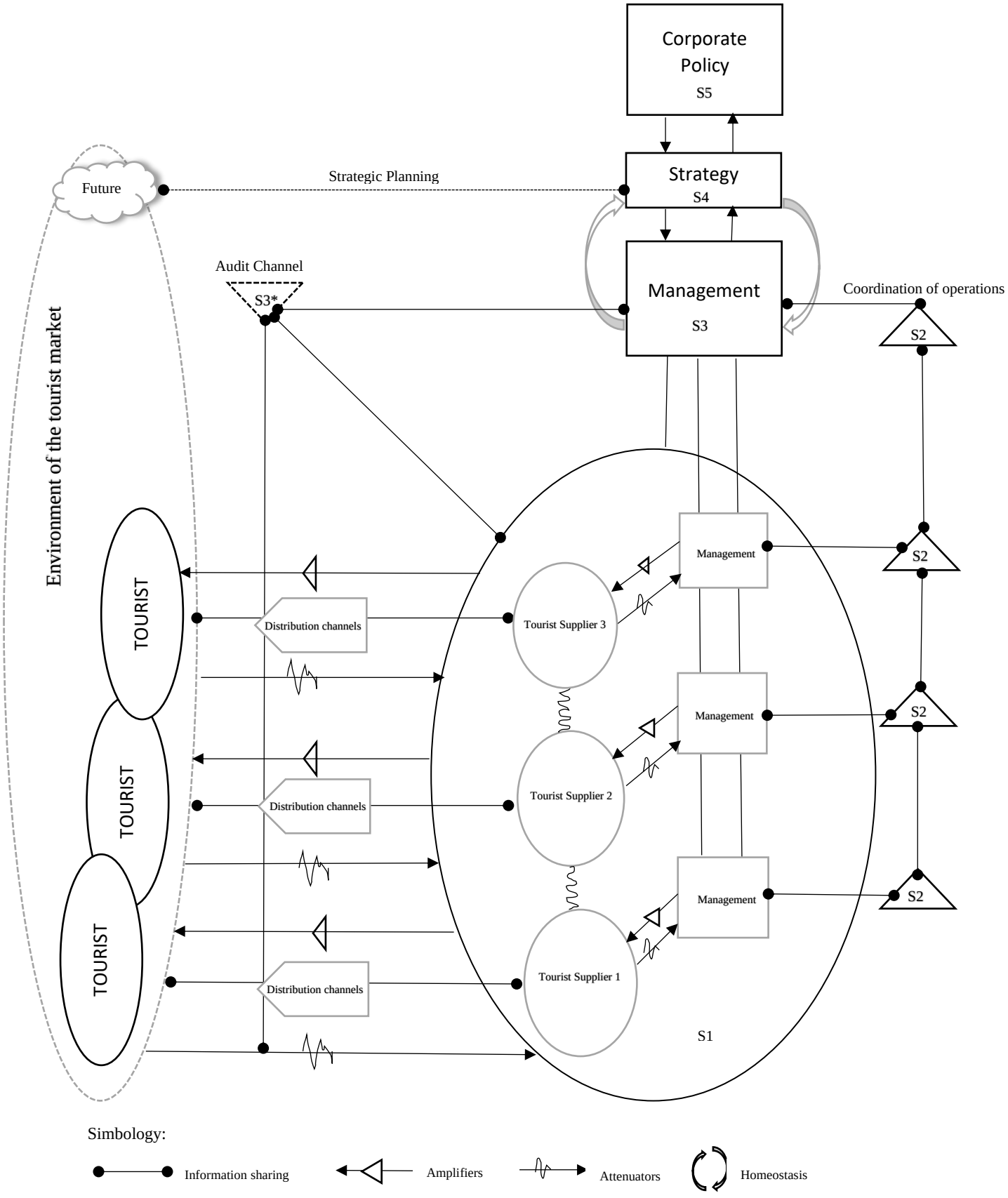


Figure 4. VSM of the system in focus

One example of variety introduced by the relevant environment to S1, is the economic situation faced by a country or region, which can lead to a drop in the discretionary spending of tourists, thus affecting tourism suppliers. Another example is the change in laws that regulate tourism activity, which can have an effect on the way tourism providers run their businesses (a change in tax laws can raise the price of tourism services by impacting the final costs to the tourist). Additionally, tourism suppliers are affected by technological changes (smart devices, Big Data, artificial intelligence), as new technologies become available, and they are forced to adapt to these changes. Finally, demographic changes and trends in the tastes and motivations of tourists themselves should not be overlooked.

Therefore, to address this variety of influencing factors, Ashby's Variety Law required is used through variety attenuators and amplifiers. Therefore, those that can be used in the tourism supply chain to carry out value creation depend on each tourism supplier and its market environment. The following list presents exemplary situations:

- Variety attenuators to carry out the value creation process in the systemic structure of the tourism supply chain:
- Change the traditional segmentation approach and establish different levels of service. Tourists may be delighted if the perceived quality of service exceeds their expectations.
- To have a "focused" service strategy to serve a narrow target market more effectively and/or efficiently.
- To direct tourists to assume the role of service supplier, so that their communication no longer depends on the traditional channels of intermediation.
- Use information systems proactively to collect and analyze customers' purchasing behavior.
- Training of the staff in digital skills to acquire customer interaction skills and waiting times as well as increase the capacity to respond to their needs.
- Cloud services can stimulate openness and collaboration between different stakeholders in tourism.

- Variety amplifiers to carry out the value creation process in the systemic structure of the tourism supply chain:

- Use Big Data's information technology and analytics to understand each customer's profile and establish the type of service (self-service, direct service, pre-service, combined service and physical service) to be fully aligned with each customer's needs.
- Developing an application designed for tourists that, aid tourist destinations and service providers in communicating directly with their customers, gather information about their behavior, and generate cross-selling, offering new products and services that increase their tourist spending.
- Capture customer feedback in order to improve services.
- Standardize organizational processes so that service provision is different between competitors.
- To manage service capacity and facilitate tourist demand, service providers can use a range of preventive strategies, such as price differentials to encourage demand.
- Increase the level of automation to shorten waiting times.

And in order to make it easier for each of the tourism service providers to manage the variety and carry out the process of value creation, it is necessary for them to collaborate with each other to combine services and put them into operation together, this vertical dimension will allow the exchange of information between S1 (Operation) and the meta-system (S3, S4 and S5) regulated by S2 and S3*.

Systems S3, S4 and S5 can be represented in the supply chain by associations and government agencies that coordinate the objectives and goals of a particular tourist destination or the sector as a whole. At the tourism supplier level, the S3, S4 and S5 will be represented by their own management and operational team.

5. Conclusions

The creation of value in tourist experiences can be seen from different perspectives. Moreover, the systemic interpretation that was addressed for the creation of value recognizes

that there is not a single route for the generation of it, rather it is an interactive and multidisciplinary phenomenon.

In addition, the relationship of the Viable System Model with Required Variety Theory provides a clearer idea of the systemic interactions that allow better and more effective management and implementation of value creation by doing the following:

- Creating a framework for the creation of values based on second-order cybernetics,

- Establishing within the tourism supply chain, co-creation of value-in-experience tourism services as a dynamic process of interaction loops,

- Providing, through a variety balancing method, a framework to manage and improve the quality of the co-creation processes, and

- Fostering collaboration strategies, modeling creative relationships as homeostatic loops supported and managed by variety.

It is in these ways that the VSM differs radically from the traditional strategy model, as it is designed to respond to these turbulent changes, while the traditional model presupposes stability.

It is recommended as a future improvement of current system to implement the functions of S2, S3, s4, and S5 according to attributes of VSM.

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