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Designing Business Models for Physical Internet Transit Centers

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Abstract: *The emergence of the holistic concept of the Physical Internet enables transforming the ways physical objects are designed, manufactured, and distributed. The Physical Internet provides a new open and interconnected structure to logistics networks, allowing to reconfigure business models and value creation patterns. As the Physical Internet is being further conceptualized and experimented, it becomes critical to rigorously investigate how its induced new generation of open logistics centers are to be designed and managed. The focus of this paper is to investigate a specific type of Physical Internet logistics centers, termed Transit Centers, from a business design and strategic management perspective. The emphasis is put on their potential business models, by bringing into play a business modeling canvas as a visual tool for envisioning their business operations. The proposed business models address the utility of deploying the Physical Internet to potential service providers of such nodes.*

Keywords: *Strategic Management; Canvas Business Model; Physical Internet; Transit Center; Business Model Design; Interconnected Logistics; Mobility Web*

1 Introduction

In today's modern world, logistics networks are yet deemed to be lacking in terms of both efficiency and sustainability from economic, environmental, and social aspects (Montreuil, 2011). The dominant dedication to either one user or one service provider, the emptiness of trucks and containers at departure, and the long travelling times of truck drivers, utterly result in poor asset utilization, low performance, reduced personal life for drivers, and low service levels. The Physical Internet (PI, π), as a solution to this grand challenge, is defined as a global open logistics system founded on physical, digital, and operational interconnectivity, through encapsulation, interfaces, and protocols (Montreuil et al. 2013). It enables the evolution towards interconnected logistics. Users are to exploit it through a Logistics Web, a network of open logistic networks, which can be conceptualized as having five constituents: Mobility Web, Distribution Web, Realization Web, Supply Web, and Service Web, respectively and synergistically devoted to moving, storing, realizing, supplying, and using physical objects.

This paper is to focus on the constituents responsible for good movements (i.e., the Mobility Web), and its open logistics nodes. In particular, our goal is to analyze how such nodes should be designed and managed from a strategic management point of view, in order to facilitate forthcoming Physical Internet deployment. Montreuil *et al.* (2010, 2014), Ballot *et al.* (2014) and Meller *et al.* (2014), have all addressed the physical and operational design of Physical Internet hubs and transit centers. Montreuil *et al.* (2012) have explored Physical Internet induced business model innovation.

To the best of our knowledge, there is no published study that focuses on Physical Internet logistic nodes and their management. So as to contribute toward filling this gap, we strategically study key strategic aspects such as what is to be their mission, how they are to add value, what are to be the services they are to commercialize, what are to be their revenue streams, how they are to insure service reliability and to deal with liability in cases of service disruptions, how they are to grow, and how they are to make profits and be viable in the long run.

The paper is structured as follows. We first describe the functional design of Physical-Internet Transit Centers, based on the pertinent literature. We next introduce the Business Modeling Canvas of Osterwalder and Pigneur (2010) and use it as a basis for defining the essence of business models for Physical Internet Transit Centers. Third, we address the potential growth strategies for Physical Internet Transit Centers. Finally we provide avenues for further research resulting from our exploratory research.

2   Physical Internet

The paradigm-breaking Physical Internet, conceptualized as a metaphor of the Digital Internet, enables the transmission of all products through encapsulation in world-standard, modular, re-usable, and smart π-containers, similarly as moving data through encapsulation in standard packets under TCP-IP protocols (Montreuil, 2011). This standardization allows any firm to handle any other firm's encapsulated products. The Physical Internet is to exploit a new generation of logistics facilities as π-nodes, including π-Hubs, π-Transit Centers, π-Warehouses, π-Distribution Centers, etc. These π-nodes are unique in design and managerial perspectives.

By focusing on π-Transit Centers, Figure 1 sourced from Montreuil (2011) shows significant results of exploiting these nodes, in comparison with the current approach: it allows reducing source-to-destination delivery time by 50% for a shipment from Québec City to Los Angeles, unlocking a potential for significant productivity gains for drivers, tractors and semi-trailers.

The following section will explain the process for interconnecting and operating these π-Transit Centers.

Figure 1: Illustration of an interconnected truckload transportation of trailers across a Mobility Web

2.1 Uni-Modal Physical Internet Transit Center Description

Π-transit centers are among the simplest nodes in the Physical Internet. They are used to transship trailers from one truck to another, in order to facilitate the delivery of trailers from their source to their destination. In particular, π-transit centers are to accommodate three main entities: tractors, semi-trailers, and drivers. Hereafter in this paper, we freely interchange the terms tractor and truck, semi-trailer and trailer, as well as driver and trucker. For a π-transit, a semi-trailer is treated as a single entity, indeed as a black box. It may contain a set of π-containers, but the π-transit will not deal explicitly with these. Each inbound and outbound semi-trailer has to be assigned to a tractor and a driver. All trailers must depart from their original source and reach their final destination within some specified time window. All trailer-truck-trucker (T³) triads depart from their current location (source, final destination or π-transit) and move toward their next destination (source, final destination or π-transit) according to an agreed upon delivery time window. Truckers' daily driving hour limitations are considered as well as their choices regarding their favorable destination at the end of their work day.

Figure 2 sourced from Meller et al. (2012) shows the proposed functional design. Its unique and efficient design is readily observable.
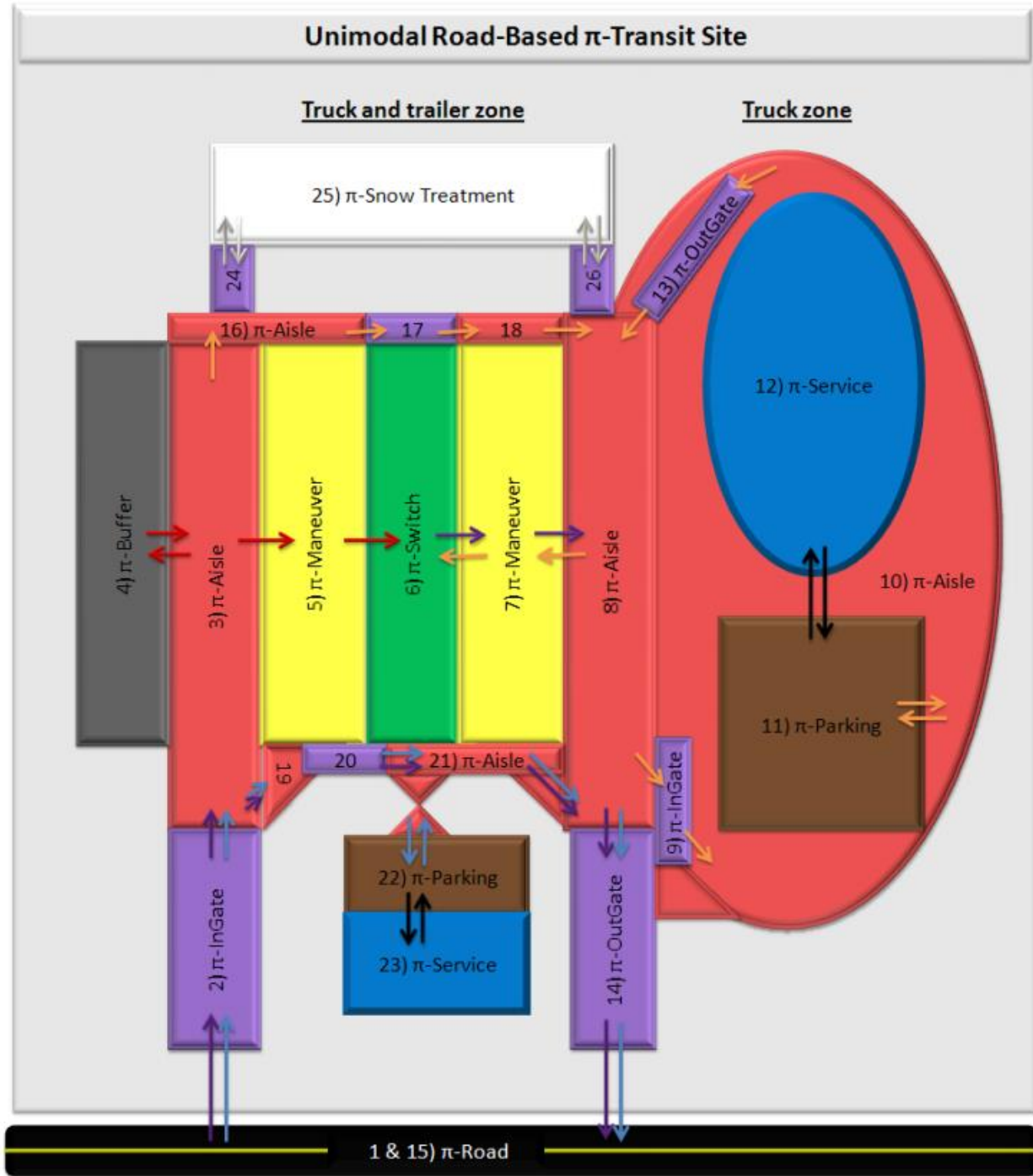
Figure 2: Block Layout for the proposed functional design

Π-transit centers are planned and managed using information from each entity involved. This information is recorded in databases, which are manageable by a negotiation protocol under what we call here the π-system. The π-system monitors movements in real time and knows the exact location and state of all trucks, trailers, and π-nodes at all times. The operational process which is guided through this π-system is as follows:

- A T^3 triad signals its intention to visit a π-Transit Center. This triad can arrive from various locations including another π-transit, trucker's home, local pick up or delivery point, or some other π-node.

- Before arrival, the π-system, through the provided information system and databases, gathers information about the capacity of the π-transit, current trailer-truck-driver triads inside the π-transit, potential T^3 triads likely to visit the facility, and their satisfactory routes. Based on this information, it finds the best match between distinct components of T^3 triads, and books a location in the π-transit for further tasks. The location for unhook-hook trailers-trucks is called π-switch.

- After arrival of the T^3 triad near the π-transit, it leaves the π-road and enters to the entrance gate of the π-transit, under the term π-InGate, for a rapid deep-security scan, entrance authorization, and getting a work order. Indeed, the π-system transfers a work order to the truck's dashboard computer. Each work order is obtained by optimizing algorithms to reduce traffic and time wasted. This work order shows every reachable area for the set of T^3 triad in the facility. After the driver acknowledges the work order and confirms its acceptance, the entrance authorization is issued and the blocking barrier is allowed to rise. The π-InGate counts the number of trailers, trucks, and drivers entering the facility. In the case that the π-transit is faced with high load of work, parking for trucks and services for drivers are considered next to the π-InGate to prevent a queue.

- After entrance of the T^3 triad in the π-transit, it moves through provided four-way roads, under the term π-Aisles, to find its booked π-switch bay as specified on its work order. Two scenarios might happen. If the π-switch is full, the set will be headed to the temporary waiting location, called a π-buffer. Otherwise, if the π-switch is free, it will go through a provided place between π-aisles and the π-switch, a space called a π-maneuver, and will enter to its booked π-switch bay. Π-maneuver in between π-aisles and the π-switch is provided to prevent potential traffics that might happen in π-aisles when a set wants to enter to the π-switch.

- After entrance to the appropriate π-switch bay, the trailer is unhooked from the truck-driver dyad. The unhooked trailer will wait for its next assigned truck-driver dyad, while the available empty truck-driver dyad will leave the π-switch, passing the π-maneuver and, based on its work order, move through π-aisles to find the next determined π-switch to hook the next planned trailer. In the case a T^3 triad enters a wrong π-switch, an alarming system on the truck's dashboard computer announces it and guides the driver to find the accurate one.

- The empty truck-driver dyad next enters a new π-switch and waits until its next trailer is hooked to it. It might take time for the π-system to find the best match between the unhooked trailer and an empty truck-driver dyad with the same intended destination. If the best match is not available, the unhooked trailer is transferred by an employee to the temporary waiting bay, π-buffer, while the empty truck-driver dyad is guided toward the truck zone which provides the π-service and the π-parking. The truck zone has a π-InGate and a π-OutGate to check the sets and count them to inform its free capacity. The π-parking provides places for keeping trucks while π-service provides washroom, restaurant, a small park containing trees, benches, picnic tables, etc., for serving drivers. The empty truck-driver enters to this zone through the π-InGate, passes π-aisle, and enters to the considered π-parking; it will wait in this truck zone until an appropriate trailer will be found by the π-system. When a match is found with a trailer the truck-

driver leaves the π-parking, enters to the π-aisle, moves toward the π-OutGate of truck zone, enters to π-aisles of truck and trailer zone, and moves toward the π-switch where the trailer is waiting.

- When a set is matched and the process is done, the new T^3 triad leaves the π-switch, passing the π-maneuver, and moves through π-aisles. Now the new T^3 triad can leave the π-transit through the π-OutGate directly or use truck zone services before leaving. In the case it wants to leave, the T^3 triad will enter to π-OutGate, a security check will be done, the authorization will be issued, the barrier will rise, and the T^3 triad will leave the π-transit. After a T^3 triad leaves the π-transit, the π-system updates its information and databases.

Figure 3 sourced from Meller et al. (2014) presents an overview of the flow of trucks and trailers in a π-transit. Explanations are related to the process inside π-switches.
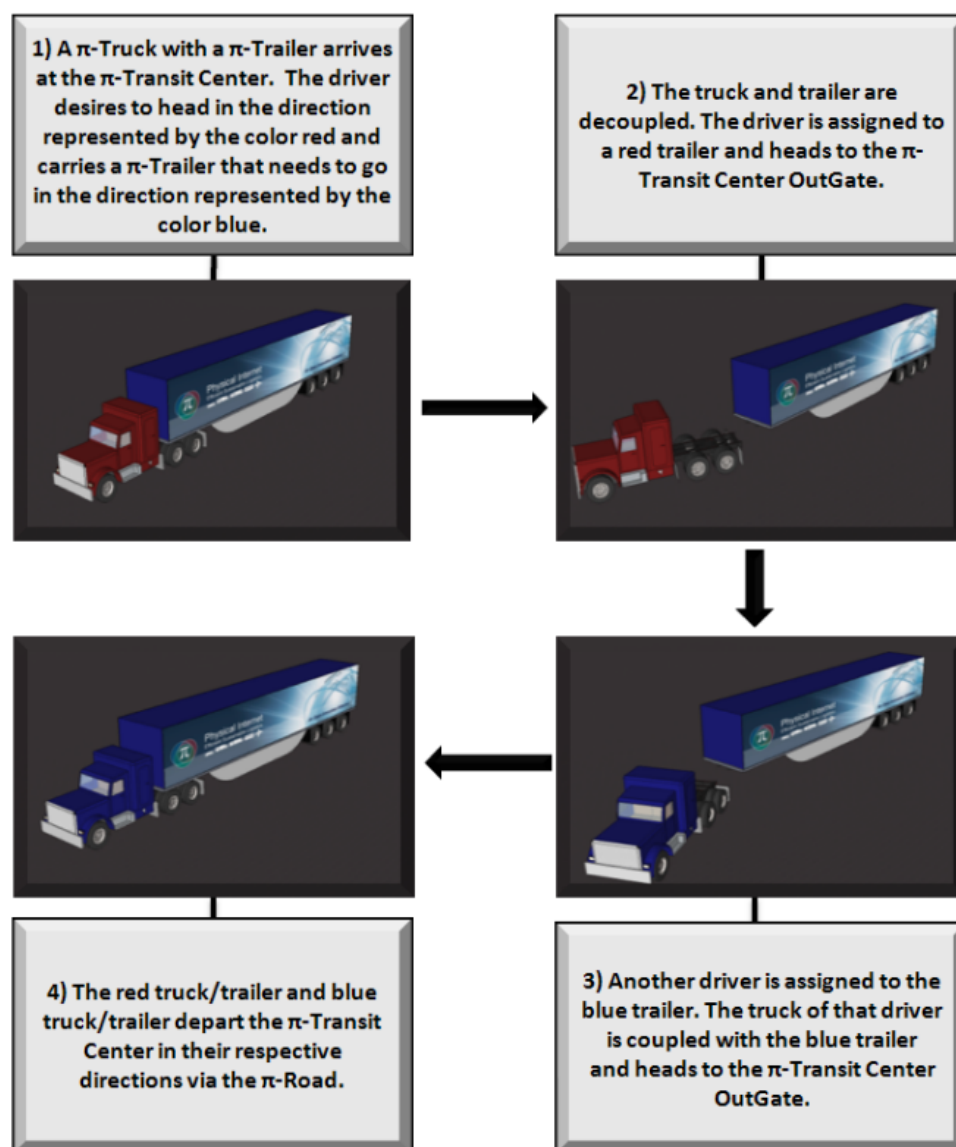

Figure 3: Overview of the flow of trucks and trailers in a Physical Internet Transit Center

Figure 4 sourced from Meller et al. (2014) shows the final 3D layout of a proposed design (front aerial view). It gives a perspective of the truck zone, the truck and trailer zone, and the π-gates, which leads to a better realization of the efficiency in the design of the π-transit.
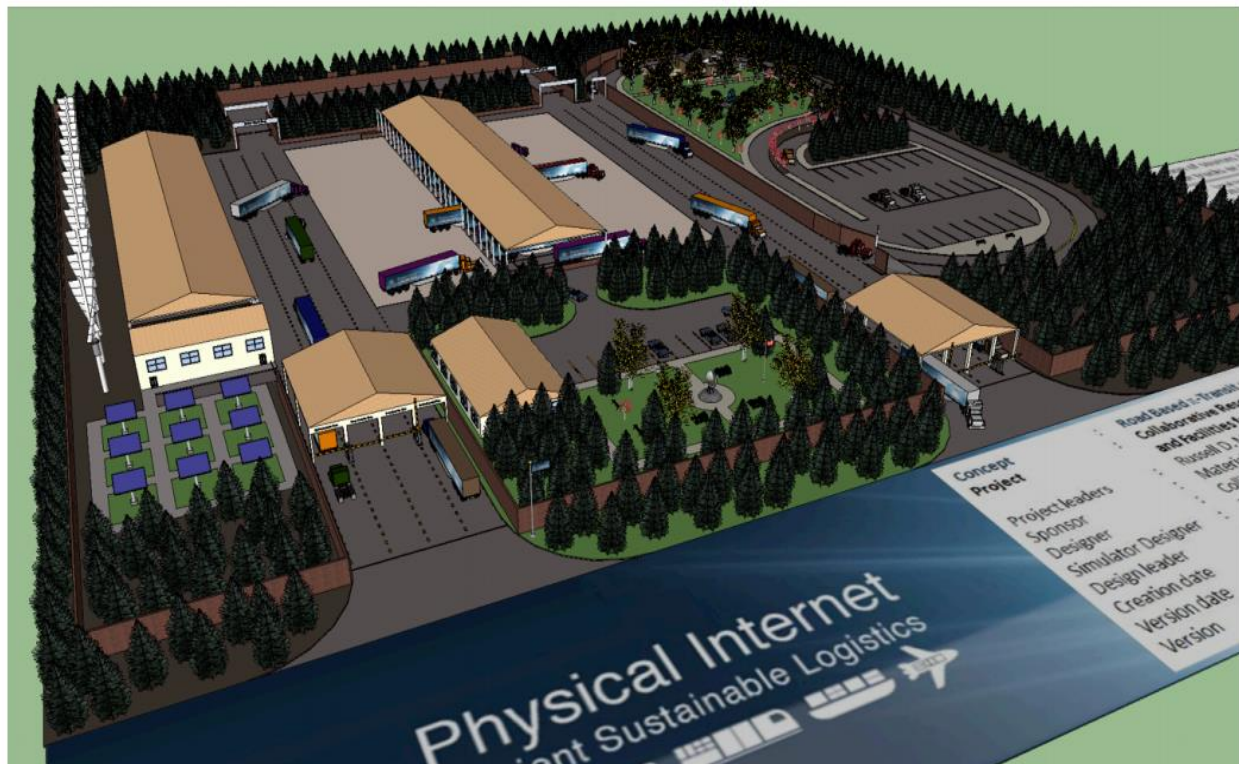

Figure 4: Final layout of a proposed design (front aerial view)

The π-transit has two key sets of stakeholders with distinct goals and expectations: its customers and its owners/operators. Customers include transportation service providers (Truck-Driver), transport service brokers (Truck-Driver), and shippers (Trailer). These customers will evaluate the performance of the π-transit based on key potential factors such as:

1) Average processing time inside the π-transit (Trailer-Truck-Driver);
2) Average percentage of departures in preferred or satisfactory direction (Truck-Driver);
3) Average percentage a π-Transit Center is able to manage rushed situations successfully (Trailer).

Π-transit owners/operators are interested in gaining competitive advantage through increasing the π-transit center capacity, attracting new customers, and keeping their current profitable customers through unique services. From a center design perspective, important factors for these stakeholders are:

1) Area of π-transit center;
2) Number of π-gates (In/Out);
3) Number of π-switches;
4) Number of π-parkings for trucks and trailers;
5) Average percentage of time the capacity of π-transit is full and Trucks/Trailers are rejected from entering (Meller *et al.*, 2012).

A better understanding of the functional design of the π-transit center raises the necessity to explore its managerial aspects and to define its innovative business model. The next sections introduce such concepts.

3 Business Modelling

A business model is a heuristic logic a firm will use to create value in a competitive environment. Osterwalder and Pigneur (2010) define business models as: *"The rationale of how an organization creates, delivers, and captures value"*. Companies that have already designed their business model should also consider the dynamic environment and improve their business model, involving modifications in their value creation patterns (Montreuil et al., 2012). To help managers in defining their business model, Osterwalder and Pigneur (2010) have developed a business model canvas, a powerful visual and intuitive tool that gives a better perspective of company's businesses. The key components embedded by the authors in their canvas include customer segments, value proposition, customer relationships, channels, key resources, key partners, key activities, revenue streams, and cost structure:

- Customer Segments: Profitable customers are centers of attention of businesses and their strategies. Companies will categorize their customers and serve them through various strategies and distinct products and services. Categories of customers are based on their mutual needs, expected behavior, and other attributes. This block therefore addresses various categories of customers, especially the profitable segments a firm wants to focus on.

- Value Proposition: it is the aggregation or bundle of benefits a firm offers to its customers. Proposed value of a firm can be an innovative value, representing a disruptive offer, or the same value in the existing market with significant added attributes. Value proposition are classified into two categories including qualitative and quantitative values. Qualitative values address customer service and newness, while quantitative values address price, performance, and speed of services. Customers, based on their expectations, give various weights to these values. This block notably addresses the services or products a firm provides.

- Channels**:** they address the tools and approaches a firm uses to reach its customers and deliver its value to the market. They include sales forces, websites, networking, etc. Firms can reach their customers through their own channels, partners' channels, or a combination of both.

- Customer Relationships: they address various methods a firm uses to contact its customers. Goals out of making these relationships are customer acquisition, customer retention, and sales enhances. A firm might choose multiple types of relationships, from collaboration to automated services, for various segments.

- Revenue Streams: they address cash inflows a firm generates. It can also encompass any new, novel, undiscovered, potentially lucrative, innovative, and creative tools for income generation or a potential exploitation. Revenues can be made in transactional or recurring types. Transactional revenues address incomes from one time customer's payments, while recurring revenues correspond to incomes resulting from customer's ongoing payments.

- Cost Structure: it addresses all expenses a firm must take into account to provide a service or a product. Cost structure can be used in cost-based pricing strategies. Business models can be classified into two categories: value-driven approaches and cost-driven approaches. Cost-driven approaches focus on minimizing costs, while value-driven approaches focus on maximizing delivered values to customers. The spectrum of costs can be classified as strategic, tactical, and operational costs, while another classification can be fixed costs at one end and variable costs at the other end of the spectrum.

- Key Resources: they address any resource a firm uses to operate its business processes and make profit. They can be human resources, tangible resources (e.g., plant, machineries), intangible resources (e.g., knowledge, brand image), and financial resources. Key resources can be owned or leased from strategic partners.

- Key Partners: partnership is a successful approach to establish business operations between two or more firms, share management and profits, and access to more resources. Through partnerships, firms not only can gain access to various resources, but can also focus on their capabilities and propose unique products or services. This block is to address key partners a firm will choose to work with based on their capabilities;

- Key Activities: they address all the economic, environmental, and social activities a firm carries out to create value for its stakeholders. Activities are to be in line with the mission of the firm and its value proposition.

4   Π Transit Center and Business Modelling

Based on Osterwalder and Pigneur's Canvas Business Model (2010), the various business design facets of π-transits will be highlighted and classified into distinct blocks. It will therefore facilitate the analysis of various essential aspects of this type of logistics center, a necessity for superior strategic planning.

4.1   Π-Transit Center Customer Segments

A primary classification for the π-transit center customers segregates them into three key segments: transportation service providers (truck-driver providers), transport service brokers (truck-driver providers), and shippers (trailer provider). It is also applicable to categorize these three segments in a secondary classification, based on their usage of π-transit center services over a time span. Such a classification can for example exploit four distinctive segments: elite customers, strategic customers, regular customers, and transactional customers. More specifically:
- Elite customers are the most valuable segment of customers. In a determined time span, for example one month, not only their number of usages is salient, but also they use the π-transit continuously, so they are important loyal customers for the π-transit center. They are strong contributors to profit for a π-Transit Center and its owner/operator should plan for significant retention and prioritization strategies to keep them as satisfied customers;
- Strategic customers are the segment with a continuous yet lower usage frequency of the π-transit center over a time span. Their contribution to the profitability of the π-transit center is individually lower than elite customers, but they are loyal to facility and jointly they provide a sure source of profit. As a result, it is essential for the owners/operators to plan for strategies to keep them, especially as they could become future elite customers;

- Regular customers are the segment with the highest collective number of usages but with the lowest individual continuity of usage over a time span. These customers ensure a high load of work, insuring a steady inbound cash flow, so the π-transit center owners/operators should invest on attracting and retaining them;
- Transactional customers correspond to the segment with the lowest number of usages as well as the lowest continuity of usage over a time span. The owners/operators of a π-transit might hesitate to plan for strategies on attracting or keeping them for further work, since they have low share in profitability of the π-transit center; yet these customers can be potential regular, strategic, or elite customers and planning for them may be essential both for profitability and for PI openness integrity. Figure 5 illustrates this secondary classification of customers.
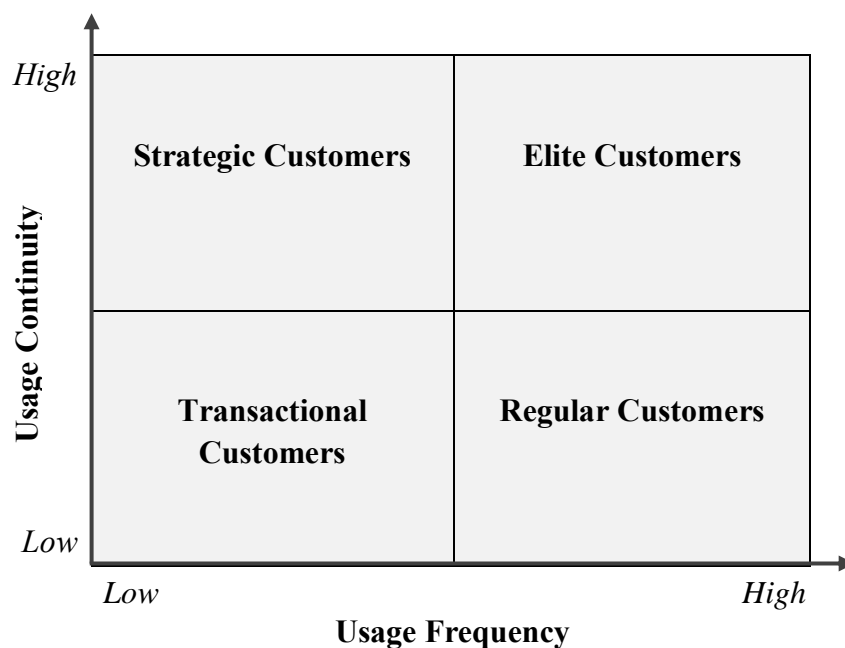

Figure 5: π-Transit Center Secondary Customer Segments

4.2   Π-Transit Center Value Proposition

The potential portfolio of services offered by a π-transit includes access services, matching services, parking services, resting services and short-term storage services.

- Access service, which is provided by the π-InGate and the π-OutGate of the truck zone and the truck and trailer zone is to address the entrance and exit security checking. It encompasses the initial entrance and final exit authorization, as well as the work order delivering for each set of trailer-truck-driver.
- Matching service is to address finding the best match for sets of trailer-truck-driver through the π-system and performing the physical matching process provided by locations, equipment, and administrative employees.
- Parking service is to address the embedded locations inside a π-Transit Center for trucks according to their needs.

- Resting service is to address embedded washroom, cafeteria/restaurant, and pleasant environment for drivers during their sojourn inside the π-transit center.
- Buffering service is to provide locations (π-buffer) inside the π-transit center, for those trailers waiting to have a well matched truck, for example for up to a few hours. In this case, the trailer would be transferred to a π-buffer by an employee and wait there.
- Storage service is to provide trailer or truck storage space for agreed upon durations, upon explicit customer request.

A π-transit can gain from insuring the quality and reliability of its services, notably through a service guarantee engagement.

4.3   Π-Transit Center Channels

A π-transit can reach its customers based on two main channels: indirect services via platforms and direct services via personalized contacts. On one hand, all essential information is provided through a platform and customers from every segment can exploit it. On the other hand, the π-transit might serve more profitable customers through personalized direct contacts, like elite customers who are power poles for the firm or strategic customers who are loyal and provide a stable profit.

In some cases, we can imagine a customer service manager sent to these customers to propose or validate some services. Customers might also not be interested in more formal relationships. However, depending upon on the management philosophy of a specific π-transit center, all four customer segments can be served by both channels.

4.4   Π-Transit Center Customer Relationships

A π-transit can exploit various strategies for its relationships with customers. Based on the importance of customer segments, distinct approaches may be used.

For example, elite customers and strategic customers can be served through collaborative relationships. Collaboration in the π-transit center is conceptualized as direct, person-to-person tight relationships, leading to a well-established mutual recognition, more information exchange, and more coherency between proposed services and their needs. It may result in customized services proposition, higher service level, more loyalty, customer satisfaction, and customer retention in the long-term.

Transactional customers and regular customers could be served through cooperative relationships. Cooperation in the π-transit is defined as one discrete relationship with customers, the latter being served through a platform or via direct relationships on request. It means that the π-transit operator serves these customers through its current superior services, made public on the PI Mobility Web platform, without customizing services for them. Also these segments might not be interested to have more relationships with the π-transit center.

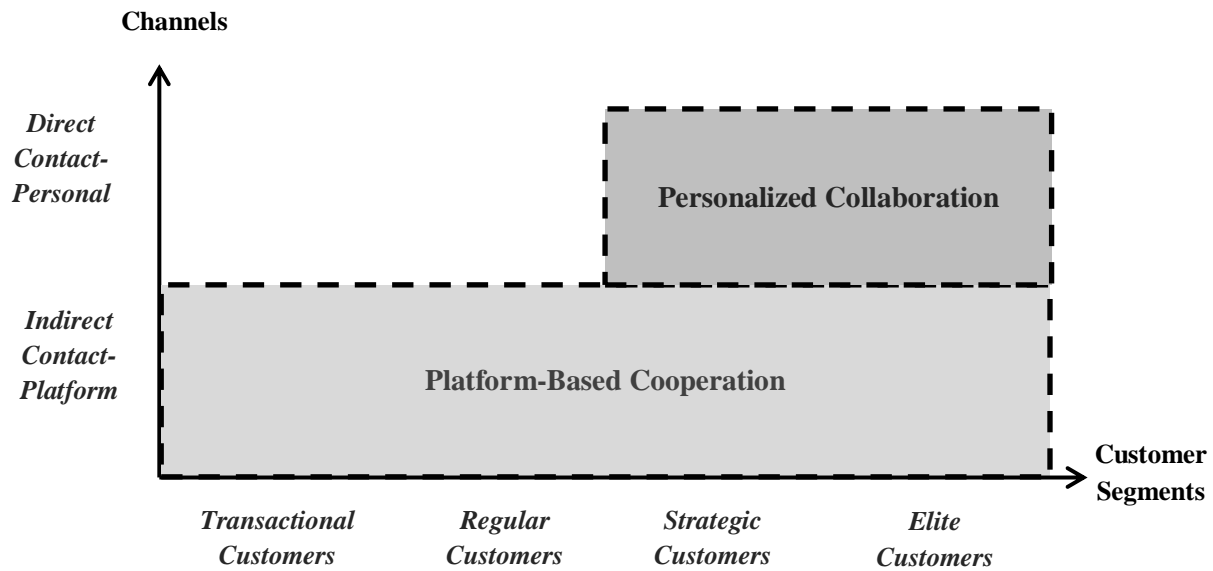Figure 6 shows the summary of potential customer relationships based on channels and customer segments.

Figure 6: π-Transit Center Customer Relationships based on Channels and Customer Segments

4.5 Π-Transit Center Revenue Streams

The main revenue streams for a π-transit are through its provided services including access services, matching services, parking services, resting services and buffering services; while subsidiary revenue streams are renting extra capacity and proposing storage services.

The π-transit, based on its goals, objectives, and mission, might exploit various strategies for its services, including pricing strategies. For now, Physical Internet Webs are new and may provide unique non-competitive services, as they are at the first stage of the business life cycle. Nevertheless, when competitors will have their own π-transit, various pricing strategies based on differentiation or cost leadership strategies will become necessary. Table 1 positions strategic goals versus these potential pricing strategies. Complementarily, Table 2 clarifies concepts of various potential strategic goals and pricing strategies.

Table 1: Matching Potential Goals and Pricing Strategies for a π-Transit Center

Potential Objective	Potential Strategies									
	Multiple Pricing	Service Line Pricing	Skimming Pricing	Good, Better, Best Pricing	Optional Service Pricing	Penetration Pricing	Premium Pricing	Service Bundle Pricing	Loss Leader Pricing	Competitive Pricing
Profit Maximization	✓	✓	✓							
Revenue Maximization			✓	✓	✓	✓		✓		
Quantity Maximization	✓			✓		✓		✓	✓	
Profit-Margin Maximization			✓				✓			
Quality Leadership		✓			✓		✓	✓		
Partial Cost Recovery								✓	✓	

			✓	✓	✓
Survival			✓	✓	✓
Status Que					✓

Table 2: Concepts Underlying Potential Goals and Pricing Strategies for a π-Transit Center

Goal	Concept	Strategy	Concept
Profit Maximization	Maximize facility's returns	**Competitive Pricing**	Pricing in the line with competitors for same services
Revenue Maximization	Maximizing revenue from the sale of services	**Good/Better/Best Pricing**	Offering same services with various price levels
Quantity Maximization	Maximizing the number of sold services to follow economies of scale	**Loss Leadership**	Providing one service with low prices Attracting customers for other services and future purchases
Profit Margin Maximization	Maximizing the per unit profit margin of selling a service	**Multiple Pricing**	Pricing per service-usage in the line with prices for more serving Motivating customers to use for greater number
Quality Leadership	Signaling the high quality of service, by a high price	**Optional Service Pricing**	Charging low extra money for optional services
Partial Cost Recovery	Selling services through the lowest cost Exploiting other sources of income for compensating costs	**Penetration Pricing**	Proposing the lowest price for services Attracting/Growing the market share while gaining minimal profit
Survival	Pricing just to stay in business and recover essential costs	**Premium Pricing**	Selling unique/high quality services for buyers less sensitive to prices
Status Quo	Pricing in the line with competitors Maintaining stable levels of profit	**Product/Service Bundle pricing**	Proposing a group of services at a discounted price
-	-	**Product/Service Line pricing**	Selling a range of complementary services together
-	-	**Skimming Pricing**	Setting highest price the same as premium pricing Setting lowest price when competitors enter Setting highest price when no competitor available Increasing prices when demand enhanced Reducing prices

4.6   Π-Transit Center Cost Structure

The cost spectrum of π-transits encompasses three main types of expenses as synthesized in Figure 7. The top of the spectrum concerns the strategic costs which address initial and less iterative expenses such as initial investments, land costs, sites costs, fixed employee salary costs, fixed management costs, services costs, etc. At the bottom of the spectrum, we can find the operational costs which address highly iterative day-by-day costs, such as throughput costs and resource utilization costs. In the middle of the spectrum lie tactical costs. They correspond to expenses dependent on π-transit workload such as extra employee hiring costs, extra services costs, extra administrative cost, and extra management costs. In seasons with high workload, a higher number of operators and managers are needed.
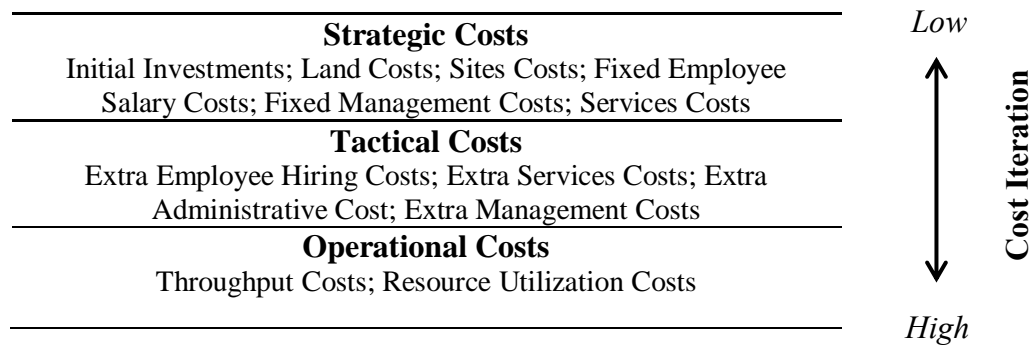
Strategic Costs Initial Investments; Land Costs; Sites Costs; Fixed Employee Salary Costs; Fixed Management Costs; Services Costs	*Low*
Tactical Costs Extra Employee Hiring Costs; Extra Services Costs; Extra Administrative Cost; Extra Management Costs	Cost Iteration
Operational Costs Throughput Costs; Resource Utilization Costs	*High*

Figure 7: π-Transit Center Cost Spectrum

4.7   Π-Transit Center Key Resources

In order to exploit a π-transit, a wide range of resources are essential including physical, technological, and technical assets as well as human and financial resources, as was outlines in section 2. A π-transit can thus use various strategies for managing these resources such as partnerships in which companies provide these resources as their exclusive services.

4.8   Π-Transit Center Key Partners

The potential partners of a π-Transit Center can notably be technology providers for supplying technological needs; routing service providers for supplying trailers, trucks and drivers; governments for supporting various facilities or investments; other π-nodes for supplying extra capacity in season with high workload; or other problem solving supports inside Webs. Key customers such as transport service providers and transport service brokers can also be considered as partners as previously explained.

4.9   Π-Transit Center Key Activities

The π-transit center is involved with various tasks necessary for providing expected services, with the core activities described in section 2. In particular, based on π-transit center design and goals, these tasks involve accessing services of the π-InGate and the π-OutGate of truck and truck-trailer zones; providing matching services including administrative and managerial tasks;

providing parking, resting services, and short-term storage including administrative tasks; monitoring, controlling, and evaluating the π-transit center profitability through cost and performance assessment; and finally motivating human resources toward better performance.

4.10 Π-Transit Center Business Model Canvas Overview

Figure 8 shows an overview of key components of the business model canvas of π-transit centers.

Key Partners	Key Activities	Value Proposition	Customer Relationships	Customer Segments
Technology Providers Transport Service Providers Transport Service Brokers Routing Service Providers Other π-Nodes Government	Access Tasks Matching Tasks Parking Tasks Resting Tasks Short-term Storage Tasks Controlling Tasks **Key Resources** Physical Assets Technological Assets Technical Assets Human Resources Financial Resources	Access Services Matching Services Parking Services Resting Services Short-term Storage Services	Collaboration Cooperation **Channels** Direct Contact-Personal Indirect Contact-Platform	Transportation Service Providers Transportation Service Brokers Shippers Elite Customers Strategic Customers Regular Customers Transactional Customers

Cost Structure	Revenue Streams	
Strategic Costs Tactical Costs Operational Costs	Access Services Matching Services Parking Services	Resting Services Short-term Storage Services Renting Extra Capacity

Figure 8: π-Transit Center Business Model Canvas

5 Π-Transit Center Growth Strategy

It is essential for π-transit owners/operators to think about growth strategies, whether for a new startup business or an established one, to ensure continuous efficiency and profitability in the long-term.

In general, companies should exploit their opportunities, alleviate their threats, empowering their strength, and obviate their weaknesses. There are various growth strategies available, including market penetration, service development, market development and diversification (e.g. Ansoff,

1965). Market penetration strategy aims to push existing services to their current market segments while market development strategy tries to develop new markets for the current services. Service development strategy aims to develop new products for existing markets while with diversification strategy, new services are developed for new markets.

As mentioned previously, the Physical Internet paradigm is a unique and creative concept. So in the early phases of PI implementation, the exploitation of π-transits may be non-competitive in local markets. Nevertheless, in the long run, as PI implementation builds momentum, they will have to face competitors with similar services. Consequently, in order to keep or grow their market share, they will have to exploit distinct growth strategies. A π-transit center could thus exploit growth strategies as highlighted above.

For example, new services such as π-crossdocking services, π-warehousing services, and π-distribution center services, could be provided, resulting in the attraction of new customers in the current geographical markets. The π-transit center could also enlarge its network or increase its capacity to cover larger geographical markets. Through innovative ideas, up-to-date technologies, greater synchronization with more π-nodes, strategic partnerships and intensive knowledge transfer, π-transit centers could finally ensure their sustainability in the long term.

6 Conclusion

As stated at the outset, this paper has aimed to design a comprehensive business model framework for Physical-Internet enabled transit centers. The goal of such a business modeling framework is to address how π-transits should be managed from a service provider's perspective to facilitate their further exploitation.

Using the Business Model Canvas of Osterwalder and Pigneur (2010), various dimensions of these logistics centers have been conceptualized, including their mission, services, customer segments, channels, customer relationships, revenue streams, costs, key resources, key partners, and key activities.

While these π-transit centers are not commercialized yet, their growth strategies have also been investigated since they are another concerning issue. The significant point is that based on the dynamic nature of business environment, these business models should be continuously assessed and modified to bring more value added to their networks.

Limitations of this research are as follows. First, the proposed business model canvas is limited to π-transit centers and their services, while a π-transit center might provide other services to other π-nodes such as π-crossdocking services and π-warehousing services. Second, the π-transit centers can have various business models based on their location. The nature of their locations will lead to demand differentiation, distinct missions, different customer segments, different costs, different resources, different partners, and different revenue streams which affect their competitive advantages and strategies.

Further research is needed to investigate the intricate relationship between the potential business model and the location of a π-transit center. There is also a need for assess the efficiency of business model variants in dynamic competitive environments through a simulation based assessment. Finally, this research has explored business modeling for one of the simplest types of Physical Internet logistics centers, a π-transit, opening the way for the investigation of more complex centers such as Physical Internet crossdocking hubs and open distribution centers.

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