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Reimagining land border ports

How to take the leap?

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The seamless flow of goods and people across land ports of entry has become indispensable for fostering economic growth, international collaboration, and cultural exchanges. As gateways to societies, communities, and countries, land border ports hold a pivotal role in facilitating this vital exchange.

However, maintaining a delicate balance between security, efficiency, and experience, has emerged as a paramount challenge that demands innovative solutions. In this context, the emergence of cognitive and next-generation smart ports heralds a new era in border management, where cutting-edge technologies and intelligent systems converge to redefine the very essence of these vital infrastructures.

Effectively designing these ports is not merely a matter of architectural aesthetics, but a strategic imperative to cultivate smart, user-focused, and future-ready gateways that harmonise with the evolving needs of our globalised world.

This paper focuses on the key contours and challenges that are impacting land ports, the correlation of infrastructure, traffic volume, and clearance time, the strategic pillars for designing next-gen land ports, design considerations and technology enablers for next-gen land border ports (LBPs), and how clients can successfully deliver highly personalised and futuristic LBPs.

Welcome to the land border port of the future

1

Open your device **camera** and **unsilent your phone**

2

Scan the **QR code**

3

Enjoy the **video!**

Scan the QR code to see our perspective on aspirations to establish the most secure and seamless land border crossings in the world, enabled by cutting edge technology*.

*This video is not for circulation. It is intended for demonstration purposes only and for the purposes of the proposal evaluation team to judge PwC's understanding of how to enhance land border security and management using emerging technologies, and to demonstrate our video animation capabilities. The video is not intended to showcase the any scope of work or deliverables, nor is it a true representation of physical or geographical borders. All characters portrayed in this production are fictional. No identification with actual persons (living or deceased), places, buildings, and products is intended or should be inferred.

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Introduction

In today's increasingly interconnected world, the importance of secure and efficient cross-border trade and travel cannot be overstated. Land Border Ports (LBPs) play a pivotal role for the flow of goods and people between countries. Yet, the conventional LBP model is facing a multitude of challenges due to the rapidly changing global environment.

This thought leadership paper aims to thoroughly explore and redefine the concept of LBPs. We set forth on a comprehensive exploration to rethink the existing paradigm of LBPs and pave the way for a new era in border management. Our ambitious vision revolves around the conception of next-generation land border ports. These modernised LBPs will embody the latest cutting-edge technologies, streamline operational processes, and create memorable experiences for border-crossers, forming a holistic and integrated approach to border control.

By envisioning a future where LBPs function with optimal efficiency and seamlessness, our goal is to stimulate economic growth, bolster security measures, and boost the overall experience for all stakeholders involved in the process. This paper will delve into each of these aspects, providing an in-depth analysis and our approach to expediting the transformation of traditional LBPs. Through this, we aim to not just respond to the evolving challenges but also shape the future of cross-border travel and trade, fostering an environment of prosperity and security.
It is time to take bold steps towards a more efficient, secure, and sustainable future for LBPs.

> **“Reimagining land border ports is the passport to a flourishing future for global trade and travel”**

Defining the stakeholder land border port ecosystem - Introducing LBP-ECO

Today, the increase of trade and travel necessities are rapidly evolving, and in order to provide an efficient and seamless border-crossing, there is a need for a comprehensive LBP-ECO. A number of stakeholders must come together to create a robust LBP-ECO. (Figure 1)

A robust LBP-ECO is expected to provide human-centric solutions, increase border security, and drive successful collaboration. This ecosystem will comprise multiple commercial, inter-governmental, and government agencies coming together to achieve a country's public safety vision.

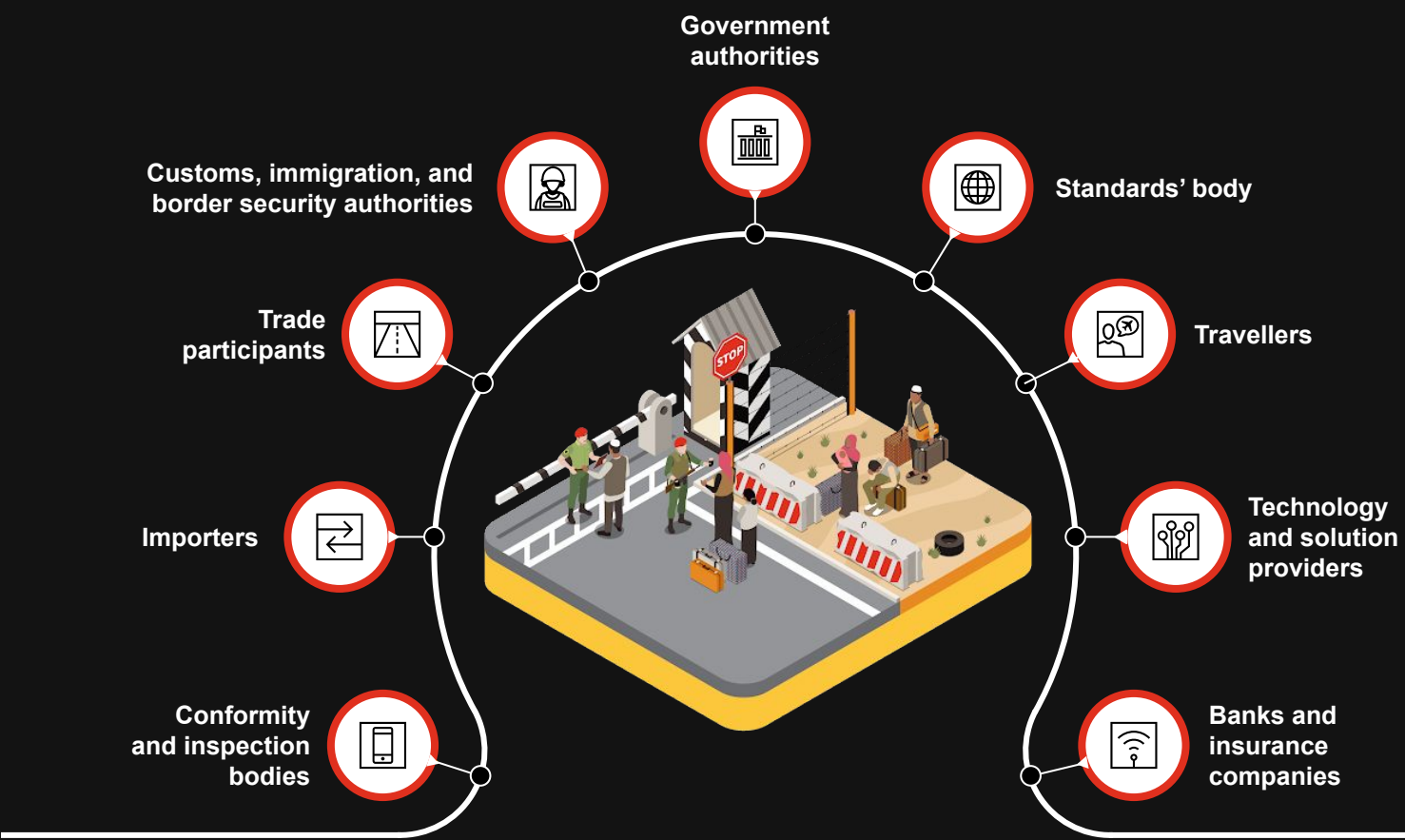


Figure 1: LBP-ECO

Let us take a look at the various stakeholders comprising the LBP-ECO and how they play their respective parts

Government authorities: Responsible for meeting country-wide public safety strategic objectives, providing funding, governing projects, and providing guidance and resources to official programs.

Customs, immigration, and border security authorities: Governmental officials responsible for enforcing customs, immigration, and border security laws and regulations at land borders and entry points.

Trade participants: Suppliers, exporters, shippers, manufacturers, retailers, wholesalers and other logistics providers that participate in the trade environment, enabling the manufacturing, transportation, and sale of goods crossing land borders.

Conformity and inspection bodies: Private or public entities that offer conformity assessment and inspection services including testing and calibration laboratories, inspection bodies, and certification bodies. Examples include the TUV and SGS who conduct inspections and testing of items such as drugs, food, animals, and plants to ensure import compliance.

Technology and solution providers: Specialised companies offering technological solutions and innovations used by land border officials, such as Non-intrusive (NII) scanning devices, e-Gates, License Plate Number Recognition (LPNR), Biometric scanners such as face, iris, and fingerprint scanners, facial recognition technology, cargo scanning equipment, vehicle and handheld radiation scanners, luggage, backscatter, and body x-rays.

Standards body: Provide the framework and guidelines that the LBP-ECO stakeholders need to conform to when designing, building, and operating land border ports. The World Customs Organization (WCO) and the World Trade Organization (WTO) are intergovernmental organisations that develop international standards such as the Revised Kyoto Convention. The Whole Building Design Guide in the US includes guidelines for designing and building land ports following regional and global building, sanitary, energy, and green building codes and frameworks (e.g. LEED, SITES or Net Zero Energy rating systems).

Travellers: These are individuals crossing the land border ranging from tourists, business travelers, and commuters. Tourists visiting another country for leisure, entertainment, or recreational purposes; business travelers who travel for purposes such as meetings, conferences, or trade negotiations;
and commuters who regularly cross the border for work or study.

Importers: Importers and clearing agents (C&F agents: clearing & forwarding agents), who are responsible for bringing goods and products into a country.

Banks and insurance agencies: Companies involved in the payment of goods, payment of taxes and duties, insurance of goods and vehicles during transport, and the deposit of guarantees and securities.

Designing, building and operating next-generation land border ports can deliver cross-border collaboration, but for an enhanced experience, strong border security, and flexibility, a comprehensive ecosystem is required.

Ensure optimum participation from all stakeholders to achieve maximum potential

Enable clear roles and responsibilities for all stakeholders

Adopt emerging technologies and trends across the ecosystem

Snapshot around the world: How countries have upgraded their land border ports

Investments in land border ports worldwide have increased, however, despite these substantial investments, some countries face challenges in efficiently utilising the technology and infrastructure available at their land ports. Below is a summary of how countries have upgraded their land border ports:

USA - Canada

Ambassador Bridge connects Detroit, Michigan to Windsor, Ontario. It is one of the busiest international crossings in North America, with an average of 10,000 trucks and 4,000 cars crossing every day with an average clearance time of **15 mins**.

Technology: Automated passport control kiosks, pre-clearance programs **(eManifest)** and **non-intrusive inspection systems**

USA - Mexico

The **Laredo Land Port of Entry** on the U.S.-Mexico border is one of the largest and most technologically advanced land border ports in the world with crossing traffic of about **2.3 million trucks per year** with clearance time of **10-15 mins**.

Technology: single window platform (ACE) , advanced **AI based imaging and scanning** technologies, **RFID technology** to track and monitor cargo in real-time.

European Union

Schengen "Smart Borders" allow freedom of movement and checks at internal borders, with a **single set of rules for controls at external borders**. Significant learnings from establishing the Ireland/UK external border following Brexit and the continuing high tech/low intervention models including **robotics for the movement of cargo and people across borders**

Technology: EES, RTP, PNR, AI, Biometrics, SIS, NII

UAE

Dubai-Hatta Border crossing is equipped with advanced technologies to facilitate faster and more efficient processing of travelers. UAE and Oman have established a joint border management system, which enables the two countries to coordinate their border operations and share information in real-time

Technology: **Automated passport control systems, smart cameras and electronic gates**

South Korea

Incheon Port International Ferry Terminal is a vital gateway for land border trade between South Korea and China, handling significant volumes of cargo and passengers every year.

Technology: South Korea's Customs Service has implemented the **UNI-PASS system**, which provides a one-stop service for customs clearance and trade-related procedures

China

Manzhouli land port is a **free trade zone** which is responsible for **60% of imports and exports** from Eastern Europe to China.

Technology: China custom authorities are building technology driven user experience by implementing **AI+AR** enabled inspection system, **Blockchain enabled supply chain mgmt**.

Singapore

Woodlands Checkpoint is the most busiest land border checkpoint between Singapore and Malaysia capable of handling approx **200,000 - 300,000 travellers daily.**

Technology: Customs department has implemented **single window platform (TradeNet)** coupled with **Joint Inspection program** and **contactless clearance** system to reduce processing time

Australia

Although Australia has no land borders, there are significant learnings from Australia's current approach to **seamless trade and trave**l.

Technology: **Integrated Cargo System**, PNR and Smartgate, **Behavioural Risk Assessment**, Hi-Tech X Ray Inspection Facilities, Pre-arrival risk assessment and clearance, Exports Compliance Program and **Supply Chain accreditation**

Hong Kong

Luohu Port is the most busiest land border checkpoint between Shenzhen and Hong Kong capable of handling **30,000 passengers and 17,850 vehicles** per day with custom **clearance time of 10 mins**.

Technology: Port has introduce **One-stop clearance** smart border system which includes **FRS, electronic toll collection systems, joint inspection and quarantine center** to reduce processing time

Challenges faced by LBPs today

Land border ports face various challenges today, encompassing people, processes, technologies, infrastructure, and the overall border-crossers' experience. Below are some of the key challenges across these areas:

People

Insufficient manpower capacity, non-standardised training, and insufficient capacity building programs are common challenges in today's land border ports. Improving these challenges will help sufficiently accommodate all volumes of traffic and maintain the highest levels of efficiency and security.

Example: Language barriers can be a challenge between people in areas such as the US-Mexico border, where Spanish is the predominant language spoken by border-crossers.

Process

Inefficient, lengthy, and manual processes can affect a LBP's smooth operations. For instance; impeded traffic flow due to improper vehicle management processes, lack of cooperation between authorities, and lengthy clearance procedures are all considered issues that may interfere with achieving next-gen land ports. Re-engineering and digitising processes, such as adopting electronic manifests, will significantly help expedite today's processes.

Example: Canada has developed an eManifest Portal for the trade community to submit documents and personal information online for an easier and faster clearance process.

Technology

Many land border ports fail to incorporate new and advanced technologies and rely on legacy systems and manual operations. Continuing to solely utilise outdated x-ray scanning methods and other legacy systems defeats the purpose of innovating and modernising land border ports. This unfortunate practice is prevalent in today's ports, leading to a lack of verification, inspection, detection, monitoring, and communication technology in border-crossing areas. This can interfere with the port's day-to-day activities, causing delays and potential security risks.

Example: Singapore has installed biometric verification kiosks that have streamlined the immigration clearance process, taking roughly 24 seconds per traveller, compared to 45 seconds at manual counters.

Infrastructure

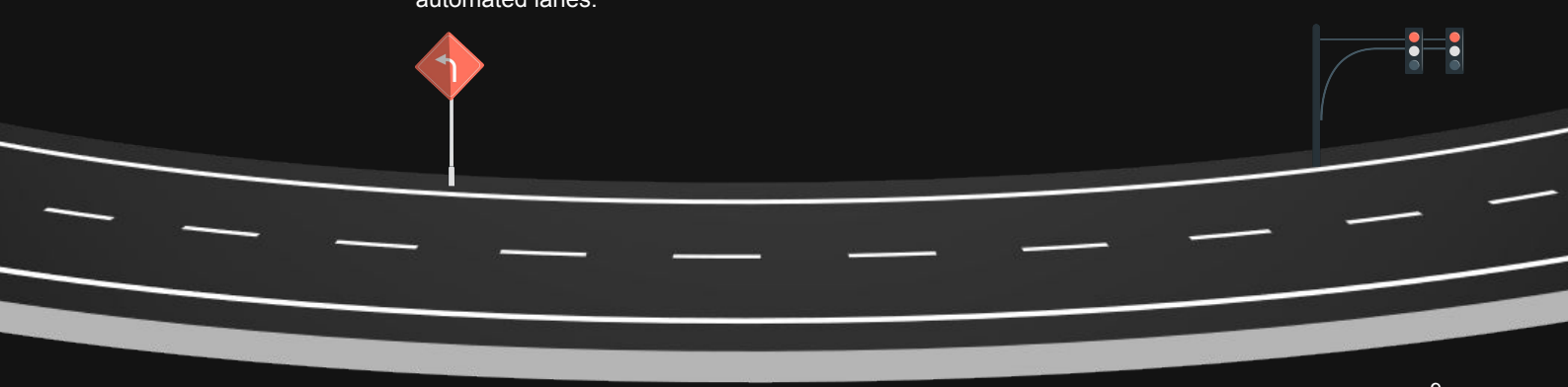
Land border ports often suffer from poor infrastructure, including inadequate facilities, equipment, and roads, leading to inefficiencies and delays. Maintaining such infrastructure can be challenging, especially in remote or harsh environments. Some challenges may include insufficient inspection facilities for outbound traffic, inadequate inspection areas, limited vehicle lanes, and the lack of traveller amenities like waiting areas, lounges, and restrooms.

Example: The Sarpi Border Checkpoint between Georgia and Turkey has functional and aesthetically pleasing infrastructure, which integrates customs facilities with a café, staff rooms and conference rooms.

Experience

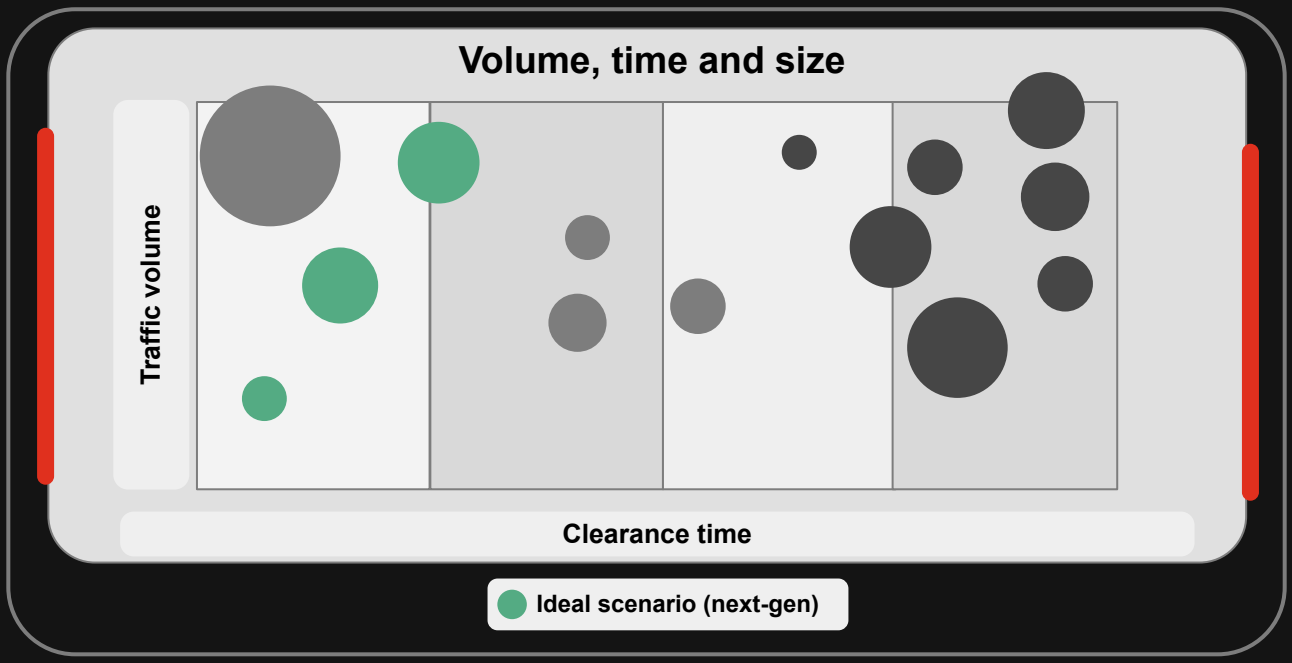
A border-crosser experience differs in every land port, and they typically may face several barriers resulting in frustration and dissatisfaction. Some challenges include long wait times, slow queues, manual submission of documents and declarations, and undergoing a complicated overall inspection journey.

Example: The US, Singapore and Hong Kong operate trusted traveler programs for frequent travelers, which provides expedited clearance and enhances their experience through dedicated fast or fully automated lanes.



Understanding the correlation between key levers for designing the LBP

Identification of appropriate facility infrastructure size is a very crucial and challenging task for global LBPs. An optimal synergy needs to be derived between LBP size, traffic volume, and clearance efficiency. A well-sized facility will accommodate traffic flow conveniently, reducing congestion and enabling swift clearance. The following chart depicts depicts correlation of traffic volume (vertical-axis), clearance time (horizontal-axis) and infrastructure size (bubble-size) of global LBPs.



The ideal scenario, which any LBP will thrive to achieve, is moderate facility size to cater to highest traffic volume at the same time providing shortest clearance time (represented via green circles in the above chart).

Following are the scenario based correlation for the varying volumes of incoming traffic to LBPs"

Scenario with high traffic volume -

Traffic	Size	Clearance
↑	↑	↓

Balancing a larger LBP infrastructure with swift clearance times is crucial in managing high traffic volume effectively and maintaining a positive border-crossing experience for all users.

Infrastructure size: A larger LBP infrastructure is essential to handle the influx of high traffic volume effectively. Separate areas for vehicle queues, dedicated lanes for different types of traffic, and ample space for inspection facilities are necessary to prevent congestion and ensure a smooth flow.

Clearance time: To accommodate the increased traffic, clearance processes need to be optimised for efficiency. Advanced technology such as pre-arrival risk screening, automated document scanning, biometric identification, and streamlined customs procedures become critical.

Scenario with moderate traffic volume -

Traffic	Size	Clearance
↑	↑	↓

In this scenario, a well-proportioned LBP infrastructure and optimised clearance procedures provide an effective and user-friendly experience for medium traffic volumes.

Infrastructure size: A moderately sized LBP infrastructure should be designed to efficiently handle the expected traffic volume. Adequate lanes for different types of traffic, well-organised queuing areas, and streamlined inspection facilities are important to prevent congestion while utilising space effectively.

Clearance time: With moderate traffic, clearance processes can be optimised for a balance between efficiency and thoroughness. Incorporating adequate technology such as automated document checks and electronic payment systems can expedite processing and ensures inspections are conducted promptly, maintaining reasonable clearance times for travelers and cargo.

Scenario with low traffic volume -

Traffic	Size	Clearance
↓	↓	↓

In this scenario, optimising the LBP infrastructure for efficiency and prioritising thorough clearance processes maintains an effective balance between the needs of low traffic volume and the LBP's potential for growth.

Infrastructure size: For low traffic volumes, a more compact LBP infrastructure is appropriate. While maintaining essential lanes for various traffic types, the emphasis should be on efficient space utilisation. The LBP can be designed to accommodate potential growth without excessive capacity that might go underutilized.

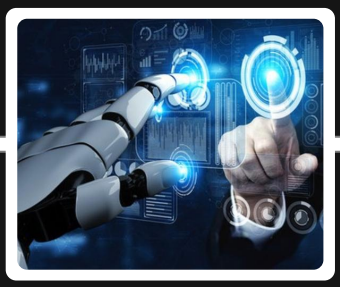
Clearance time: By embracing technological innovations, LBPs can provide swift and efficient clearance processes, enhancing the overall border-crossing experience.

Strategic pillars to move towards the next-gen land border ports

Next-generation land border ports are driven by three strategic pillars i.e. High impact minimum footprint design, enriching user experience, and a tech-driven minimum intervention facilities.

Minimum footprint based design

Creating a land border port that optimises space utilisation and minimises environmental impact, following the SMART* Border concept. Strategies such as compact infrastructure layouts, intelligent traffic management systems, and streamlined processes can be implemented to reduce the overall footprint of the port, promote sustainability, and effectively manage resources.



Enriching user experience

Implementing **user-centric design principles**, seamless processes, and modern amenities to provide a hassle-free and positive experience for all port users. It includes initiatives such as trusted-travelers programs, digital wayfinding systems, clear signage, comfortable waiting areas, modern customs and immigration facilities, and expedited clearance procedures.

Emerging technologies

Aligning the design with the **SMART* Border concept** which identifies **technology as a key enabler** for delivering world class **border management.** This involves incorporating innovative and cutting-edge technologies into the design and operations of the land border port such as AI Behaviour Profiling, Cognitive Targeting Systems, VR based luggage search, and AR Inspection Systems.

National standards and regulations

- The following standards and guidelines become pivotal in defining the operating model parameters for global LBPs:

Environmental Standards

- All benchmarks follow certain **national environmental standards** as well as try to gain **international certifications** for land border crossings.
- These cover a range of areas, including **water management, waste management, air quality, and wildlife protection** to ensure that the environmental impact of the port throughout its lifecycle is minimized.

Infrastructure Standards

- The US has various mandatory standards and guidelines that govern the design and construction of **physical infrastructure**, facilities and equipment, as well as the operational requirements expected of this infrastructure.
- Turkey follows a **quality-based approach** to ensuring the infrastructure of land border crossings is sufficient to sustain traffic volumes and meet passenger requirements.

Operational Standards

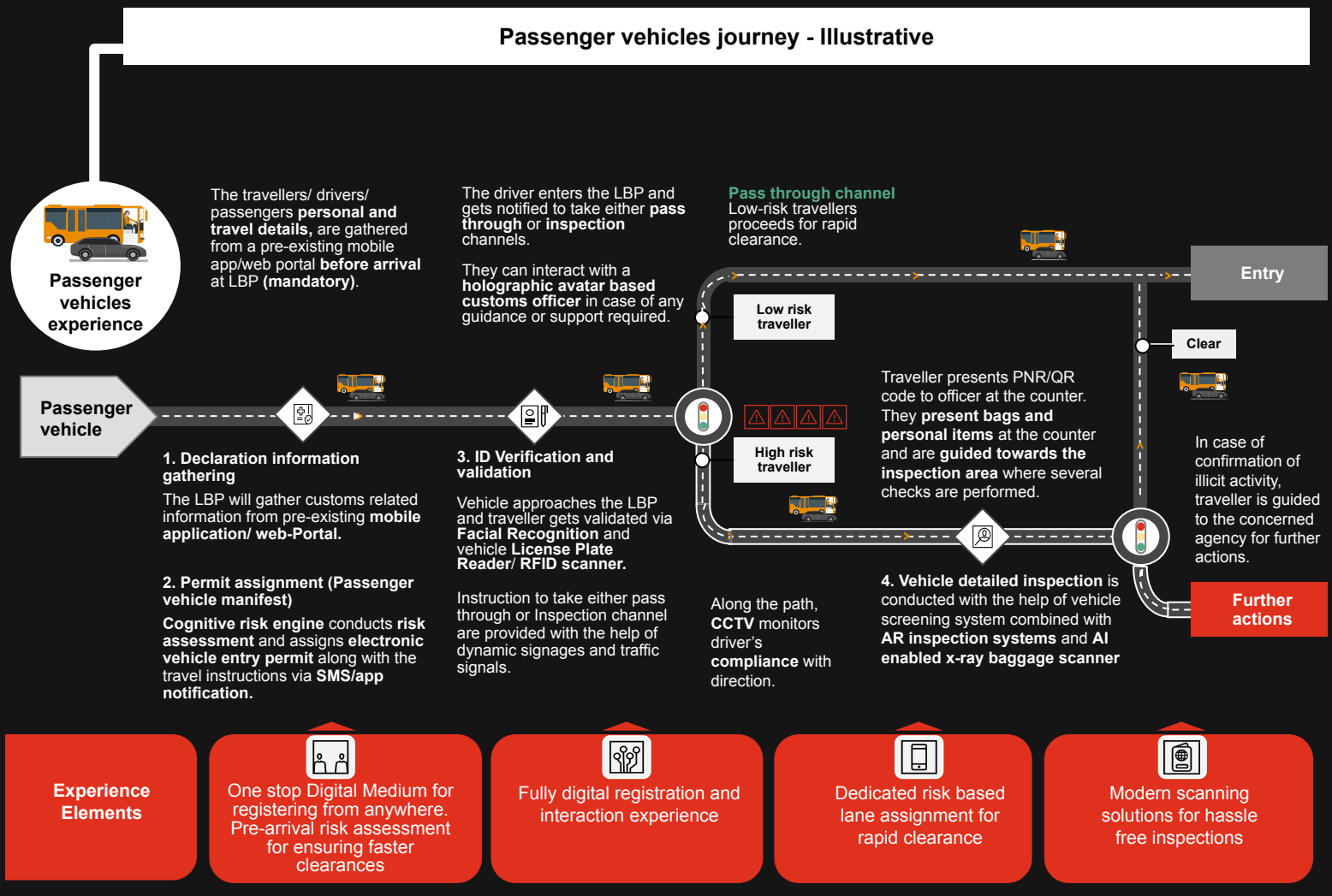
- Turkey's Ministry Of Agriculture And Forestry has in place a set of standards that govern the **technical procedures and ethical conduct principles to be followed by agricultural inspectors** at land border crossings to ensure a methodical and standardized approach to inspections.

Global Standards

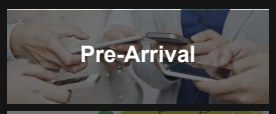
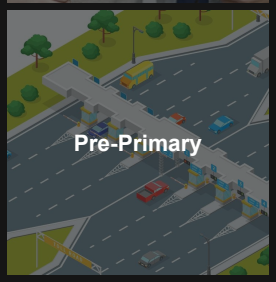
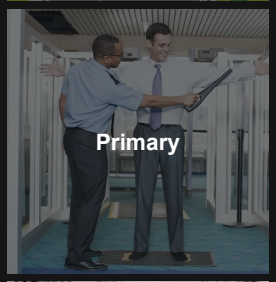
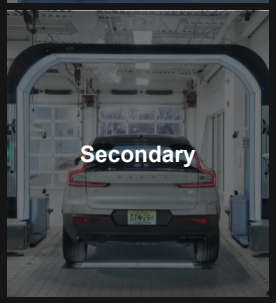
- Countries across the globe follow standards and guidelines set out by major international conventions administered by the **World Customs Organization.**
- These primarily include the **Revised Kyoto Convention** and the **SAFE Framework of Standards**, which provide best practices with an aim to promote harmonization of customs procedures, facilitate trade, enhance border security, and encourage international cooperation.

*Secure, Measurable, Automated, Risk Management-based and Technology-driven

Enabled by state-of-the-art and futuristic technologies and focusing on an automated and integrated one-stop screening approach



LBP technologies and Infrastructure (non-exhaustive list)

Screening Stages	Cutting-Edge Technologies and Infrastructure	
 Pre-Arrival	Mobile App/Web Portal	Remote Inspections
 Pre-Primary	License Plate Reader	Thermal & Radiation Scanner
	Retail & food complex	Crash rated Boom barriers
	RFID reader/Access control	Face recognition
 Primary	Millimetre wave body scanner	Handheld Narcotics & Explosives Scanner
	Luggage X-ray	Under vehicle imaging system
	CCTV with Video analytics	Muon Tomography Scanning System
 Secondary	Satellite vehicle tracking system	Mobile X-ray Station
	Vehicle X-Ray Machine	Backscatter X-rays
	Entertainment & Fitness Zone	Mechanical Sniffer Dogs
	Behavioural Analytics	5G/6G Communication

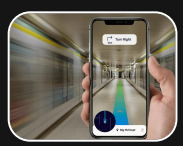
Future technologies

AI Behaviour Profiling

Cognitive Targeting System

Holographic Avatar Based Customs Officer

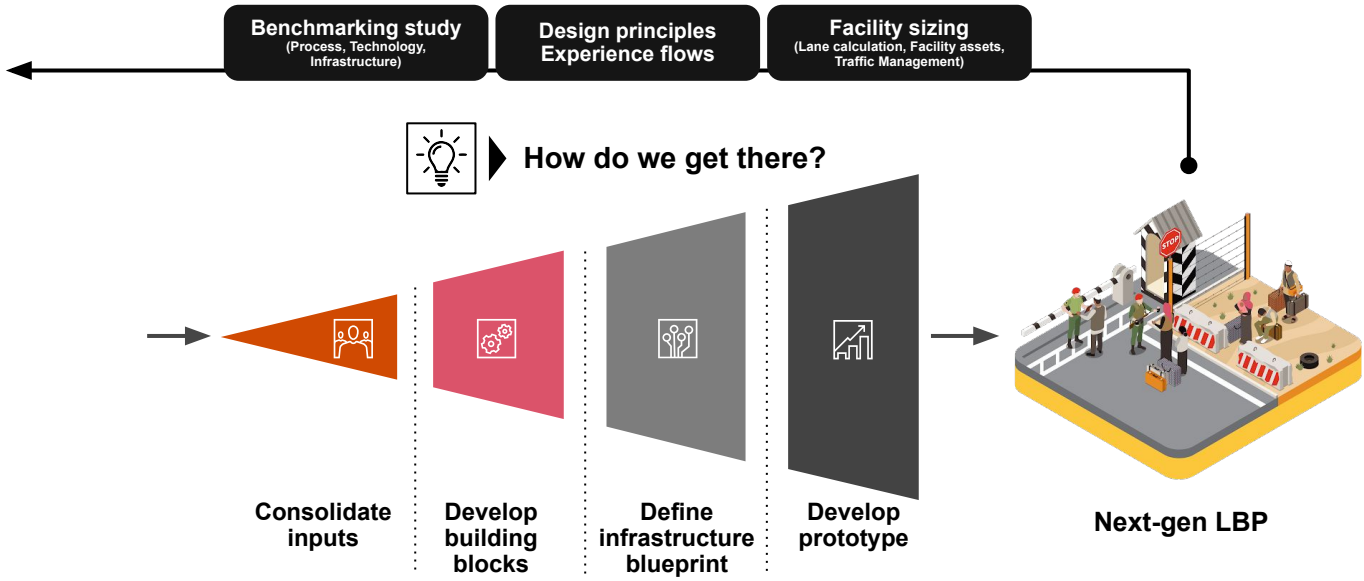
VR based luggage search



AR Inspection System

Unlocking next-gen land border ports: A cognitive framework for transformation

Highlighted below is a cognitive framework aimed at revolutionising land border ports. The framework encompasses key steps, including consolidating inputs, developing building blocks, defining an infrastructure blueprint, and creating prototypes. By adopting this framework, land ports can pave the way for next-generation advancements and achieve transformative outcomes.



Consolidate inputs

- Inputs
- Leading practices (Process, technology, infrastructure)
- Regulations and guidelines (global)
- Key risks applicable

Develop building blocks

- Define design principles
- Define experience flows
- Options for land border port operations
- Define infrastructure contours as per leading practices

Define infrastructure blueprint

- Overall blueprint
- Lane calculation and Facility detailing
- Facility sizing

Develop prototype

- Traffic management
- Technologies
- Facility Assets
- BoQ

Embracing the above framework enables the realisation of cutting-edge advancements and sets the stage for a new era of efficient and innovative land border operations.

Conclusion

The vision of Next-Generation LBPs represents a commitment to shaping the future of cross-border travel and trade, fostering an environment of efficiency and security between societies. Creating synergies between the land port's size, traffic volume, and clearance efficiency will lead to a harmonious balance between infrastructure and border operations. Further, incorporating cutting-edge technologies and modern infrastructure will leave behind positive and memorable experiences for all people crossing borders. In a nutshell, this summarises what we reimagine next-Generation LBPs should achieve in our increasingly interconnected world.

All partners in the Cognitive LBP ecosystem must now move faster to ensure full adoption of next-generation and human-centric ports, by leveraging new ways of operating and utilising emerging technologies. This will require a collective effort of the whole ecosystem working together.

The journey continues. PwC will be there every step of the way to help you reach the promised land of 'cognitive' operations that will enable a smarter, self-optimised, adaptive and user-focused version of the built world.

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- https://www.gsa.gov/about-us/regions/welcome-to-the-pacific-rim-region-9/land-ports-of-entry/otay-mesa-land-port-of-entry
- https://www.gsa.gov/cdnstatic/Otay%20Mesa%20Fact%20Sheet%20April%202022_E.pdf
- https://www.usatoday.com/border-wall/us-mexico-interactive-border-map/
- https://mx.usembassy.gov/gsa-cbp-celebrate-otay-mesa-port-commercial-processing-improvements/
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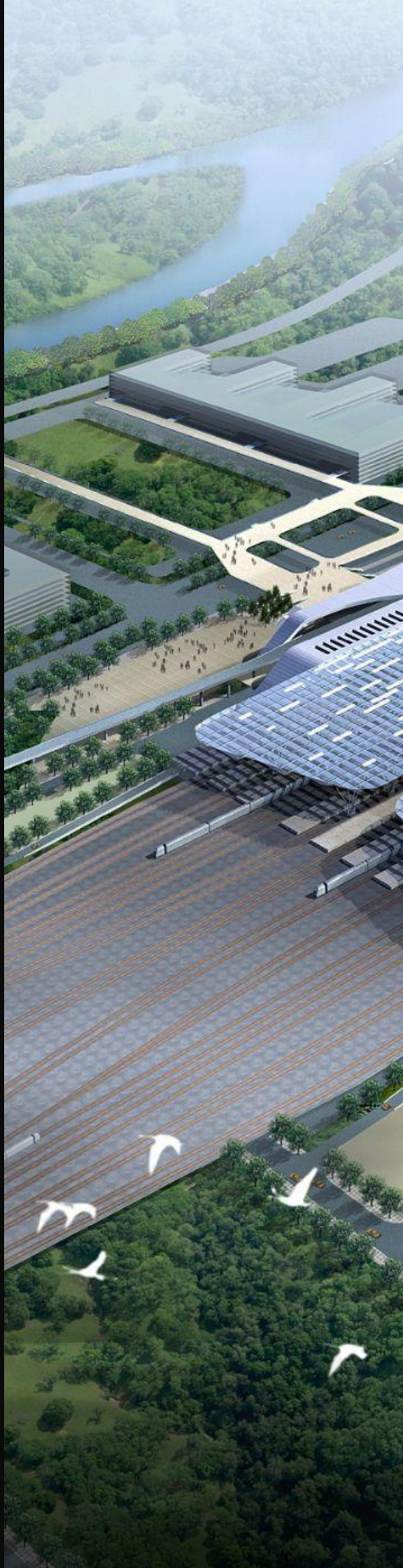
- https://www.yusen-logistics.com/sg_en/resources/press-and-media/69712



How can we help?

Assessment

LBP ecosystem assessment

- Current state assessment (assessment of the existing LBP) in 3 aspects i.e.
  - People
  - Process
  - Technology
- Leading practice study for alignment and best practice

Design and develop

Operating model

- Define department vision and mandate
- Design user journeys
- Organisational structure and people requirements
- Define governance structure (including KPIs, decision rights, RACI matrices)
- Develop a business continuity plan
- Perform technology impact analysis and identify recovery objectives for IT applications/services

Facility infrastructure

- Develop and prioritise infrastructure facilities
- Create strategic roadmap
- Identify list of key OEMs
- Design conceptual prototypes

Technology

- IT infrastructure and network design
- Design LBP ecosystem architecture including integration requirements
- Integrate artificial intelligence (AI) and machine learning into both new and existing security and scanning technologies to enhance safety, efficiency, and user satisfaction, thereby optimizing future BCPs.

Implement

RFP and supplier evaluation

- RFP preparation including pre-qualification, technical evaluation, scope of work, technical/functional specifications
- Define service-level agreement parameters for different components
- Support on pre-bid meeting and clarification response
- Vendor response analysis (technical and commercial)

Go live

Project management

- Project management activities including risk mitigation and daily project coordination to meet project milestones
- Supply installation testing (use case testing) and go live monitoring
- SLA monitoring for the edge devices, applications and IT infrastructure
- Evaluation of change requests across project life cycle

Next Gen LBP Outline

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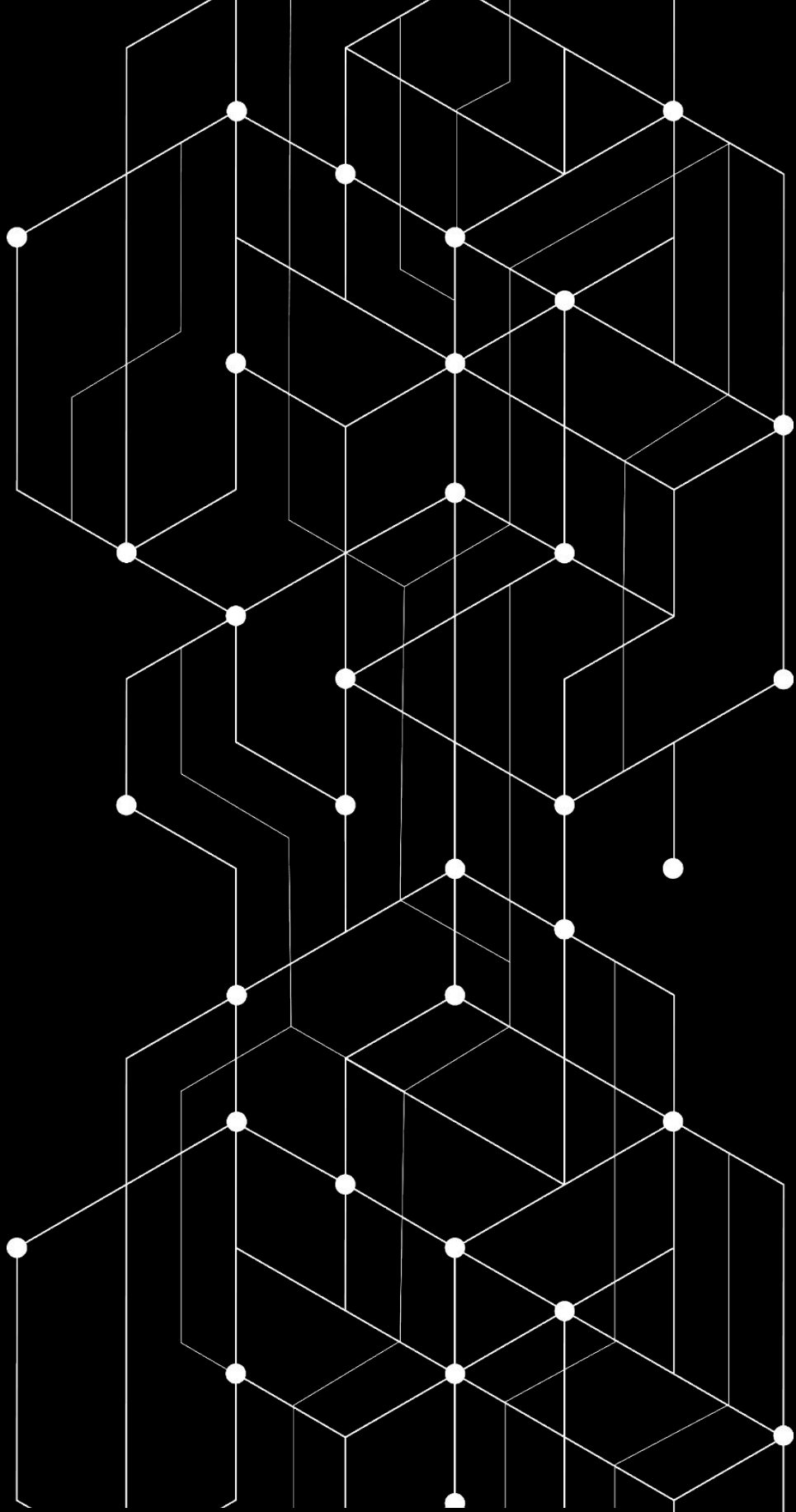

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