



# SEAMLESS TRAVELLER JOURNEY COST BENEFIT ANALYSIS

COST BENEFIT MODEL & TECHNICAL REPORT

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# CONTEXT

The WTTC's latest annual research, in conjunction with Oxford Economics, shows the Travel & Tourism sector experienced 3.5% growth in 2019, outpacing that of the global economy (2.5%) for the ninth consecutive year. Over the past five years, one in four new jobs were created by the sector, making Travel & Tourism the best partner for governments to generate employment.

WTTC Members have identified Security & Travel Facilitation as a top priority with the need for absolute requirements for security processes to be as robust as possible. A global, cross-industry solution which allows people to travel more securely is urgently required. WTTC is has been addressing this challenge through our Seamless Traveller Journey Programme (STJ) which is an ambitious initiative that brings together public and private sector stakeholders with technology providers to agree on models that will ultimately facilitate a seamless travel experience. The aim is to identify models which are globally interoperable, technology agnostic and cover the end-to-end journey from booking, through air travel and incorporating cruise, hotel, car rental and other non-air products where necessary.

Significant technological advances can help overcome the COVID-19 crisis. Contactless technologies, biometrics, faster clearance, among other solutions, may decrease the risk of pathogen transmission.

Transformations of the travel experience through technological advances, notably biometrics and the use of digital identity, show strong opportunities to enable a seamless and secure end-to-end traveller journey, while promoting sector-wide growth. Such a solution aligns with the World Travel & Tourism Council's (WTTC) consumer research undertaken in five European countries and in the United States, suggesting that, on average, 4 in 5 international and domestic travellers would be willing to share their photographs in advance of travel to speed up their journey. By capturing and uploading biometric and biographic data prior to travel, border and security agencies will be able to authenticate and pre-clear travellers in advance of arrival, thus reducing cumbersome checks and queues at ports and airports. This will in turn enhance security across the whole system, relieve pressure on infrastructure and capacity constraints, improve the traveller experience and ensure that the economic potential of Travel & Tourism to create jobs and drive economic growth can be fully realised.

From a traveller's perspective, this vision is exemplified by a journey during which the traveller no longer needs to present travel documents and boarding passes multiple times to a variety of stakeholders at different stages of their journey. Rather, travellers will be able to book transportation, check in, proceed through security, cross borders, board their aircraft, collect luggage, rent a car, check in and out of their hotel and other non-air services, and access myriad destination services, simply by confirming their identity and booking data.

WTTC has consulted with over 200 stakeholders to map existing initiatives and have begun to develop a roadmap to take this initiative forward. WTTC has identified potential future models which may deliver an end-to-end traveller journey and has also compiled over 80 existing initiatives within the Travel & Tourism sector that employ biometrics. What has become clear from our work so far is that there is no "one-size-fits-all" solution, and even more crucially, that a solution will only be achieved by working collaboratively across national boundaries and based on strong partnerships between both private companies and government entities.

The cost benefit analysis report was prepared by WTTC, Atkins, and in direct engagement with industry stakeholders over the period encompassing Q3 2019 to Q1 2020. As the impact of COVID-19 has spread globally, the aviation and tourism industries have been severely affected and thereby the numbers and figures associated with this report bear little comparison in actuality compared to the colossal impact of the global pandemic on the tourism sector.

Atkins calculated costs and benefits independently for each industry as there are no aggregated economic figures available that affect this. Qualitatively, and some of the benefits are unlocked wholly by the end to end process, but the attribution is linked back to the individual industry due to these figures being available for us to model against.

Whilst the effects of COVID-19 dwarf the proposed costs and benefits in financial terms, this report should be a roadmap articulating the potential of technology to support, accelerate, and help rejuvenate an industry that has suffered significantly.

Many of the initiatives and concepts behind the Seamless Traveller Journey theorised consideration of consumer choice when it came to potential benefits associated with issues such as contact-free access to hotel rooms and rental vehicles, or the opportunities enabled by better understanding of itineraries and how people were moving internationally between places of tourism interest. These transformed processes may be critical to enabling the economic restart of the global tourism industry, and while the numbers have changed, the concepts and benefits presented in this report may be of critical importance to the global tourism industry as it begins its recovery from the pandemic.





# EXECUTIVE SUMMARY

The World Travel and Tourism Council (WTTTC) Seamless Traveller Journey (STJ) Programme offers to align initiatives and technologies in such a way that the end-to-end passenger journey for air travel, hotel, cruise and car rental can be as seamless as possible in terms of security and identification. Given one in nine jobs will be in the tourism sector by 2029 and the projected doubling demand for air travel by 2037, new identity management and biometric technologies are required to replace and optimise existing processes.

A Cost-Benefit Analysis (CBA) has been undertaken to build a coherent and integrated narrative, that outlines the key assumptions of STJ Programme deployment, and their implications for the travel and tourism industry. The CBA was conducted to understand the scale, timeline and distribution of benefits and costs to the cruise, hotel and car rental sectors.

STJ comprises a range of identity management and biometric technologies, all of which aim to ensure a seamless end-to-end journey which enhances security and improves the traveller experience. It is recognised that these concepts are at various stages of implementation; a few are already emerging - e.g. Identity as a service (IDaaS), whilst others will require both technology and policy developments that may take many years. These barriers will vary by region and sector.

This assessment considers the impact of all the underlying concepts being deployed in an integrated manner. It presents one of many plausible scenarios to give indicative costs and benefits of STJ integration and the technologies themselves. Some assumptions are relaxed in the model under various scenarios used for sensitivity testing.

This analysis suggests the STJ concept is likely to be cost beneficial across all sectors and global regions. This does not change even under a more pessimistic scenario. Gross Present Value (PV) benefits over the period (2020-2050) across all sectors ranged from \$162 billion (North America) to \$38 billion (Middle East & Africa). Global benefits totalled \$459 billion across all sectors. Gross PV costs across all sectors ranged from \$-38 billion (North America) to \$-9.1 billion (Middle East & Africa). Global costs totalled to \$-110 billion across all sectors.

The global Net Present Value (NPV) of the STJ amounts to \$349 billion over the period. For all sectors, NPVs range from \$123 billion (North America) to \$29 billion for Middle East & Africa. On a sector basis, the cruise sector has the highest NPVs, followed by car rental and then hotels. However, in nominal terms the hotels sector derives the greatest overall benefit, although this is largely a function of the scale of the sector in contrast to cruise and car rental. From a regional context, North America and Europe will experience the greatest aggregate benefits from the STJ.

During stakeholder interviews and workshops there was considerable uncertainty regarding the tangible benefits that may be attained from the STJ and their quantification. It is equally unclear how the cost of deploying the STJ concept may also vary over time. For instance, the role of IDaaS type revenue models may change considerably and this is likely to impact the STJ concept. We have attempted to account for such uncertainty in our estimates through both sensitivity testing in the model and a conservative approach to benefit and cost estimation.

Further work is needed to consider how the industry and Government might exploit these opportunities. Without a central, coordinated vision, the benefits detailed here may not be realised at scale. The ability to make processes more seamless is not necessarily constrained by identity solutions, but by a non-uniform regulatory landscape that varies by region and sector. Identifying these 'blockers' is an important first step towards leveraging investment. It will be critical to understand ownership within the broader STJ Programme and the role of Governments in facilitating this vision.

# 1. INTRODUCTION

## 1.1. Overview

The World Travel and Tourism Council (WTTTC) represents the global Travel and Tourism private sector. WTTTC works to raise awareness of Travel and Tourism as one of the world's largest economic sectors. With Security & Travel Facilitation as one of their key priorities, WTTTC's Seamless Traveller Journey (STJ) Programme offers to align initiatives and technologies in such a way that the end-to-end passenger journey for air travel, hotel, cruise and car rental can be as seamless as possible in terms of security and identification. Given one in nine jobs will be in the tourism sector by 2029 and the projected doubling demand for air travel by 2037, new identity management and biometric technologies are required to replace and optimise existing processes.

## 1.2. Seamless Traveller Journey (STJ) Programme

The STJ Programme aims to develop a common vision to enhance the end-to-end travel experience, guide industry investment, and increase government buy in to improve the regulatory landscape. STJ offers distinct opportunities for both travel operators and travellers. The implementation of identity management and biometric technologies offers the opportunity to enhance security, improve operational processes and drive economic growth.

From the traveller's perspective, by simply confirming their identity and booking data, they no longer need to present documents multiple times to various stakeholders and the speed and ease of travel improves. Additional benefits associated with the STJ concept include reducing pressure on infrastructure, reducing and avoiding costs to industry and government and integrating all touchpoints of a traveller's journey enabled by improved technology.

## 1.3. Cost-Benefit Analysis of the STJ Programme

The STJ Programme is an ambitious initiative to bring together public and private sectors with technology providers to agree on models which are globally interoperable, technology agnostic and cover the end-to-end journey. A Cost-Benefit Analysis (CBA) was commissioned by WTTTC to help understand the scale, timeline and distribution of benefits to the cruise, hospitality and car rental sectors and across regions. The goal of this CBA was to identify the potential costs and benefits associated with the STJ concept for the cruise, hotel and car rental sectors over the next 30 years.

A joint team of economists, technology specialists and industry subject matter experts engaged via interview and workshop engagement with 16 representatives from 12 member organisations across the three sectors in scope. The result of this collaboration is laid out in the present technical report which covers:

- the methodology;
- the benefits realised by stakeholders<sup>1</sup>; and
- the costs assumed to deliver the STJ.

The cost benefit analysis report was prepared by WTTTC, Atkins, and in direct engagement with industry stakeholders over the period encompassing Q3 2019 to Q1 2020. As the impact of COVID-19 has spread globally, the aviation and tourism industries have been severely affected and thereby the numbers and figures associated with this report bear little comparison in actuality compared to the colossal impact of the global pandemic on the tourism sector.

Whilst the effects of COVID-19 dwarf the proposed costs and benefits in financial terms, this report should be seen as a roadmap articulating the potential of technology to support, accelerate, and help rejuvenate an industry that has suffered significantly. Many of the initiatives and concepts behind the Seamless Traveller Journey theorised consideration of consumer choice when it came to potential benefits associated with issues such as contact-free access to hotel rooms and rental vehicles, or the opportunities enabled by better understanding of itineraries and how people were moving internationally between places of tourism interest. These nice to haves may be critical to enabling the economic restart of the global tourism industry, and while the numbers have changed, the concepts and benefits presented in this report may be of critical importance to the global tourism industry as it begins its recovery from the pandemic.

<sup>1</sup>The WTTTC would like to thank all stakeholders for their involvement in the STJ stakeholder interviews and workshops related to this project



## 1.4. Structure of the report

This report concludes the development of the CBA for the STJ Programme and presents the assessment methodology and main findings. The report is accompanied by the CBA model in Excel format which includes all calculations and detailed assumptions.

The report is organised as follows:

- Chapter 1: *Introduction* provides an overview of the STJ Programme and the justification for the Cost Benefit Analysis.
- Chapter 2: *Methodology* presents the overarching approach to developing the CBA assessment, including its technology and economic components.
- Chapter 3: *Impact Identification and Analysis* identifies the impact of STJ technology functions, describes the benefit matrix and sets out the deployment scenarios of the technology functions.
- Chapter 4: *Economic Impact Assessment* presents the results of the economic impact assessment, outlining the baseline scenario and the economic benefits associated with STJ.
- Chapter 5: *Net Economic Effects of STJ Implementation* presents a capital balance sheet, reporting the overall results from the CBA under the most likely benefit scenario.
- Chapter 6: *Sensitivity Analysis* shows how the results of the CBA vary with different input variables in different benefit scenarios.
- Chapter 7: *Cross-Cutting Aviation* explores complimentary benefits associated with the aviation sector.
- Chapter 8: *Conclusions and Recommendations* summarises the key findings of the CBA and provides recommendations.



## 2. METHODOLOGY

### 2.1. Overview

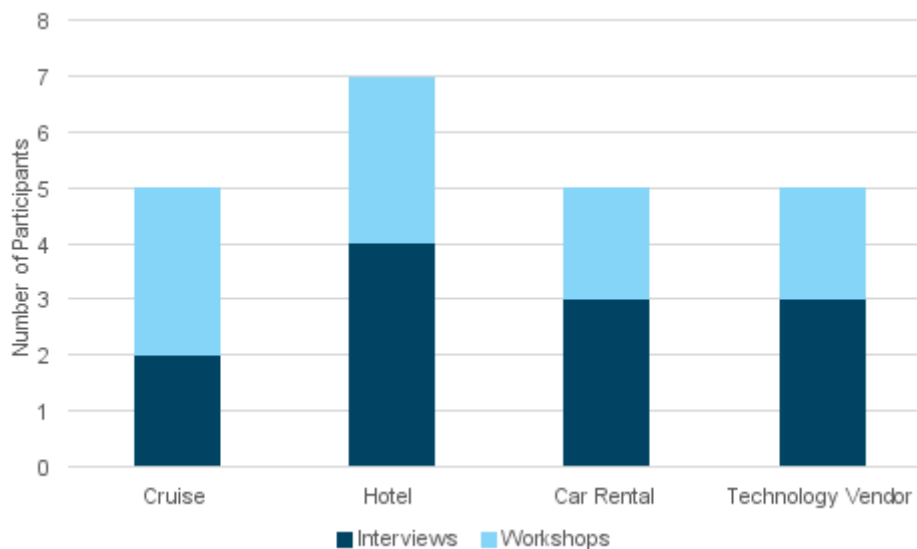
To account for the potential benefits of the STJ a structured methodological framework was used to cover the full spectrum of technology impacts and economic effects for each industry sector (i.e. hotels, cruises and car rental). The overarching methodology used a three-step approach to ensure relevant technology impacts were captured, analysed and evaluated (Figure 1). This approach is defined below.



**Figure 1: A three-step approach to technology impact assessment**

- Impact identification** was conducted to list all the potential impact areas and consider the perspectives of a range of stakeholders. We used a hybrid Delphi method by integrating elements of interviews, workshops using Nominal Group Technique (NGT) and the traditional Delphi techniques so that all methods complement each other and allow for comprehensive understanding of the sectors, impact areas and stakeholders' views.

The Atkins team facilitated 12 interviews and 3 workshops with representatives of the member organisations including key stakeholders from major hoteliers, car rental chains and cruise operators as well as vendors of some of the key technology platforms to glean intelligence on the size, scale, structure, segmentation and service models prevailing in the sectors (Figure 2). The final list of impacts is reported in Appendix 8.2.A.2.



**Figure 2: Interview and workshop participation by sector**

- Impact analysis** was performed to define the STJ functionalities, map their quantitative impacts on the industry sectors and identify opportunities for process optimisation, resource management improvements and potential increase of revenue generation. We utilised diverse methods of collecting experts' opinion (such as interviews and expert panels) to inform this stage of the study. To provide a focused input into the economic impact assessment, the impact analysis was broken down into three elements:

<sup>1</sup> The Delphi method is a structured communication technique which relies on a panel of experts, usually with multiple rounds of review, to construct a final list of parameter estimates. The approach is particularly powerful where existing data is unavailable.

<sup>2</sup> The Nominal Group Technique is a group process involving problem identification, solution generation, and decision making.



- o **Defining the technology functions.** Technology functions define the alternative functional roles of the biometrics technology. The different functions account for different aspects of costs and benefits that may be incurred from the deployment of biometrics. These are described in Table 1.
- o **Constructing the benefits matrix.** The benefits matrix delineates benefits across cruise, hotel and car rental from STJ. The quantification of impacts uses simple multiplication to define the final monetary impact of a change in various parameters related to process, consumer appetite and risk. A consolidated version of the benefits matrix is provided in Appendix 8.2.A.3.
- o **Constructing the deployment curves.** Deployment curves for each global region define the pace of deployment of STJ enabling technologies. The deployment curves are developed based on various assumptions regarding consumer readiness; consumer, government and business adoption and regulatory landscape.
- **Economic impact assessment** was performed by attributing monetary values to the impacts identified and analysed in the previous steps. Both benefits and costs were considered:
  - o **Defining the industry baseline.** Industry baselines are a do-nothing scenario (without STJ). The industry baseline takes variables used in the benefits matrix and produces a value estimate (either a function of sector revenues or cost) for each variable in the matrix.
  - o **STJ benefits forecast.** Benefit forecast of cruise, hotel and car rental sectors with deployment of biometrics to enable the STJ. The forecast uses both an 'impact' parameter and a 'magnitude' parameter to forecast the benefits. The benefits are always a function of sector revenues or costs.
  - o **STJ cost forecast.** Cost forecast of cruise, hotel and car rental sectors with deployment of biometrics to enable STJ. The forecast uses parameter estimates of IT infrastructure in an average hotel and extrapolates these values to all sectors with some scaling factors. The values are reported as a proportion of annual or periodic sector cost.
  - o **Calculating net economic effects.** Gross Present Values (PV)<sup>4</sup> were calculated for both benefits and costs for each industry sector and global region. These were then netted off to derive the Net Present Value (NPV) estimate for the STJ. In addition, a series of benefit to cost ratios were also calculated, that express the proportion of benefits per dollar investment.

A central scenario was used for reporting the overall cost and benefit results. The central scenario is the most likely outcome regarding the future impact of the STJ concept. A further two alternative scenarios (pessimistic and optimistic scenarios) were used for sensitivity testing of the model. A detailed overview of the methodology is provided in Appendix 8.2.A.4.

## 2.2. General assumptions

Multiple assumptions for the CBA were defined regarding the basic parameters of the assessment. The following assumptions feature in the model:

- Deployment scenarios and the baseline scenario were developed for 30 years (2020-2050). 2020 is assumed as the base year.
- Deployment scenarios assume the rate at which technologies can be deployed for each region. The actual rate of deployment may vary from this hypothetical potential.
- The deployment scenarios were fixed across sectors, although in practice this may exhibit some variation.
- Hotel, cruise and car rental sectors include all business types and sizes. The definition is broad to avoid market segmentation which would add considerable complexity to the model.
- A discount rate of 7% was adopted, based on the literature and the nature of STJ vision<sup>5</sup>.
- The deployment of STJ technology is not assumed to vary by sector, only by global region.
- The cost of STJ-enabling technology will fall at an average rate of 10% per 5-year period up to 2050. This reflects a maturing technology market.
- The number of beneficiaries of the STJ is a direct function of the deployment rate.
- Since the STJ is an integrated concept, it is assumed factors exogenous to the model (e.g. deployment of biometrics within the aviation context) are complimentary to the rates of deployment in the model.
- A scale factor for estimating costs assumes an economies of scale effect when deploying technologies in larger

<sup>4</sup> Present Values are a series of future cash flows discounted to account for the time value of money.

<sup>5</sup> US Office of Management and Budget guidance, 2018; UK Treasury, Central Government Guidance on Appraisal and Evaluation, 2018

premises. The inverse of this operation is also true. This adjustment effects the unit price of deployment.

- The future growth of each sector in the industry baseline is assumed to lie between current CAGR forecasts and long-run GDP forecasts.
- The CBA assumes a constant deployment rate across industry sectors and fixed internally for global regions. This allows a segment of the market (that has deployed biometrics) to be valued in conjunction with the STJ concept.
- All impact functions of the STJ concept can be valued through either change to aggregate sector revenues or costs. In practice, some elements of the concept may have indirect effects.
- The costs and benefits derived from the STJ concept is underpinned by the deployment of biometric technology.





## 3. IMPACT IDENTIFICATION AND ANALYSIS

### 3.1. Impact identification

STJ impacts were identified using a hybrid Delphi method integrating elements of interviews and workshops to elicit stakeholders' views regarding technology functions and associated benefits. Approximately 22 stakeholders were engaged across all the industry sectors.

Initially, impacts were identified as a function of the STJ concept. The quantitative impacts of these functions were then estimated and validated by a literature review. The magnitude of the effect of the impacts was also estimated, based on expert judgement and literature review. A description of impacts is provided in Appendix 8.2.A.2.

### 3.2. Defining the technology functions

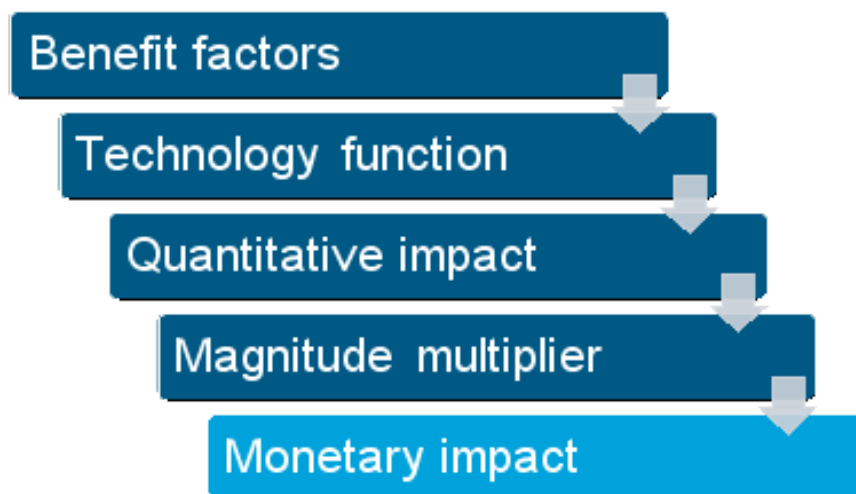
We have segmented the STJ vision against three core emergent technology functions (see Table 1). The costs and benefits associated with the STJ are differentiated according to the technology functions.

**Table 1: Technology functions associated with the STJ**

Technology function	Description	Benefit
Identification	Proof of identity linked to the user through a service platform. Identity may include multiple facets including driver licence; passport; etc.	Rapid processing of customers due to pre-verified payment and identity checks.
Real time data sharing	Real time data sharing as users pass various touch points (for example check-in at airports).	Operational changes that can be optimised to reflect customer travel updates.
Consumer preferences	Sharing of user preferences through the identity service provider. Such data may include historical bookings; travel history; consumptive patters; etc.	Upselling and cross selling opportunities where products can be matched to user preferences.

### 3.3. Constructing the benefits matrix

A benefits matrix was constructed based on the benefit factors developed in the impact identification phase. It provides a consistent approach to link the technology functions with a range of monetised impacts for each sector and is described in Figure 3.



**Figure 3: Methodology of the benefit matrix construction**

Five factors were defined to enable transparent monetisation:

- **Benefit factor:** The variable that could be optimised as a result of the STJ concept. For example, lower payroll costs as a result of operational streamlining within a sector.
- **Technology function:** The functional role of the technology that incurs a series of costs and benefits. For instance, identification services.
- **Quantitative impact:** The quantified impact of the benefit factor. For instance, the percentage change in annual payroll for a sector facilitating the STJ.
- **Magnitude multiplier:** The share of the benefit factor in overall balance sheet (e.g. annual payroll of staff as a proportion of total operating cost of the sector).
- **Monetary impact:** The quantitative impact multiplied by the magnitude multiplier to derive a % change in either sector cost or revenues.

The benefit factors, their quantification impact and magnitude multipliers were constructed based on a literature review and consultations with experts and stakeholders (see Figure 4). The output is a series of factors that express the breakdown of benefits for each sector. The colour coding of values within the matrix reveals uncertainty in value estimation which is accounted for by a scaling factor in the model.

Technology function	Benefit Factor	Quantitative Impact	
		Value	Metric
Identification		3.0%	Reduced annual payroll on staff
Identification		3.0%	Increase in customer bookings
Consumer preferences		10.0%	Increase in cross-selling or up-selling conversions
Identification		3.0%	Increase in customer bookings
Identification		90.0%	Reduction in incurrance of credit card fees
Identification		90.0%	Reduction in issuance of key cards
Identification		90.0%	Reduction in credit card fraud
Identification		3.0%	Reduced payroll (based on front & back office staff)
Real time data sharing		0.1%	Increase in room occupancy rate
Consumer preferences		10.0%	Increase in cross-selling or up-selling conversions
Identification		3.0%	Increase in customer bookings
Identification		90.0%	Reduction of car theft
Real time data sharing		3.0%	Reduced annual payroll on staff
Real time data sharing		0.5%	Increase in asset utilisation rate
Real time data sharing		20.0%	Cost reduction for vehicle storage off-site
Consumer preferences		10.0%	Increase in cross-selling or up-selling conversions

Key: Green = high certainty in value estimate; Orange = moderate certainty in value estimate.

**Figure 4: Quantitative impacts of technology functions by sectors**

Less uncertainty is typically associated with quantitative impacts that were recognised by stakeholders and where such values can be validated through the literature. More uncertainty is associated with values that cannot be validated in the literature. A full version of the benefits matrix is reported in Appendix 8.2.A.3.

### 3.4. Constructing the deployment scenarios

#### 3.4.1. Deployment scenarios definition and assumptions

Deployment scenarios forecast the potential rate at which STJ-enabling technologies can be deployed and the concept can be realised. A deployment curve is constructed for each global region and are used in the model to scale the future costs and benefits likely to be incurred as a result of the STJ concept. The deployment scenarios were formulated based on expert assumptions and a review of literature (reported in the following sub sections). They were constructed for three aspects:

- **Technology Readiness:** The readiness of underlying technology infrastructure necessary to support the STJ concept (e.g. underlying telecoms infrastructure).
- **Regulatory Landscape:** Regulatory agreements will be necessary to enable service providers to process travellers’ personal data. This factor considers how regulatory acceptance may vary across regions over time.
- **Consumer, Business, and Government Adoption:** The pace of technology adoption is likely to vary across regions and depends on consumer, business and government appetite. This factor depicts how this appetite may change over time and by region.

These three factors are used to construct an overall adoption curve for each global region (Europe, North America, South America, Asia Pacific, and Middle East & Africa). A scaling factor was used to ensure the overall adoption score never exceeded the regulatory landscape score, since regulatory and legal agreements will be fundamental to implementing technologies. The deployment of technology was held constant across each sector although in practice this may exhibit some variation.

The deployment curves reflect that not every concept of STJ is appropriate or viable in every location. Complete deployment is considered unfeasible and so only incomplete deployment (capped at 99%) is considered viable. Some exceptions to deployment are likely to centre around rural vs urban, developed vs developing countries and sub-regional variation in the marginal propensity to adopt new technology.

#### 3.4.2. Deployment scenarios for overall adoption

More developed areas of the world including North America and Europe currently have the highest levels of potential adoption readiness (see Figure 5). Based on trends, it is these two global regions that will see the greatest adoption levels with both predicted to have the highest potential adoption rate by 2050.

South America and Middle East & Africa currently have the lowest levels of potential STJ adoption. Over the period both regions are will likely see high uptake in STJ adoption by 2050. This will likely be spurred on by growth in technology readiness and the regulatory landscape. The main constraint in these areas will be in the potential consumer, business and government adoption rate.

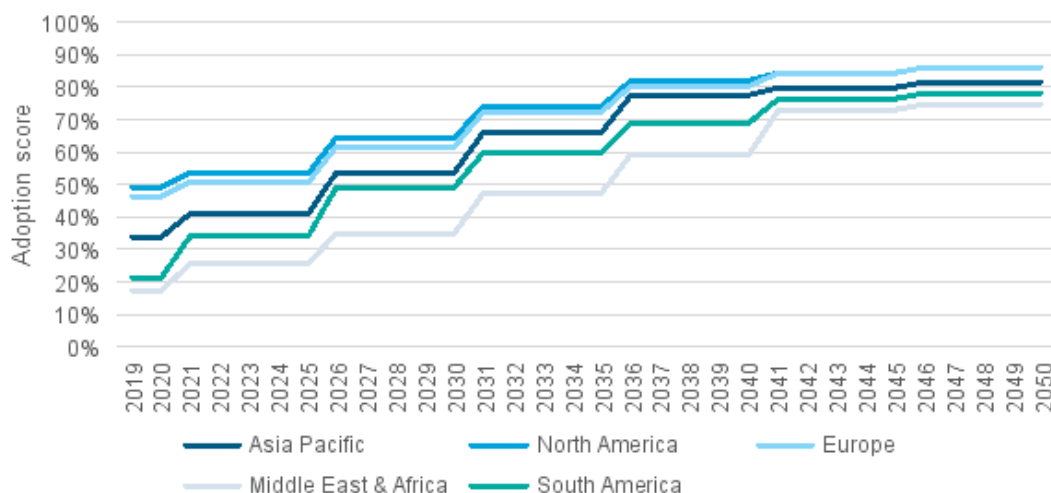


Figure 5: Deployment scenarios for overall STJ adoption



### 3.4.3. Deployment scenarios for consumer, business and government adoption

By 2050, consumer, business and government adoption will be greatest in North America, Europe and the Asia Pacific region (see Figure 6). The Asia Pacific region is generally a rapid adopter of technology. China, Singapore and South Korea are all high adopters characterised by growing long-term GDP and a population with a rising middle class. Companies, particularly in North America, are using tech adoption to build new customer relationships and strengthen existing ones. Technology adoption by all parties in the North America region is high, spurred by a booming technology sector. According to Forrester Research, some 81% of US online adults say they are comfortable with retailers using information like purchase history or even in-store location to personalise shopping experiences<sup>6</sup>. Similarly, the rate of technology adoption in Europe is likely to be relatively rapid across all sectors. EU countries perform above the average in the integration of digital technology and governments are also promoting market based approaches to digital identity management<sup>7</sup>.

South America and Middle East & Africa will likely see a slower rate of consumer, business and government adoption. South America's markets have a proven appetite for technology adoption. Brazil, Mexico and Argentina are among the highest-ranked markets worldwide for total hours per week spent on the internet, much of it on mobile devices, but industry-specific taxes on telecommunication services and devices are also a barrier to adoption. While consumer desire to adopt technology will be high, government (and to a lesser extent business) is likely to be more conservative<sup>8</sup>. The Middle East & Africa is adopting digital technologies rapidly. Consumer enthusiasm for digital suggests strong growth potential for user-ID platforms in the near future. However, this adoption may be hindered by slower government and business uptake. Digitization is uneven from country to country, and businesses and governments across the board have struggled to keep up<sup>9</sup>.

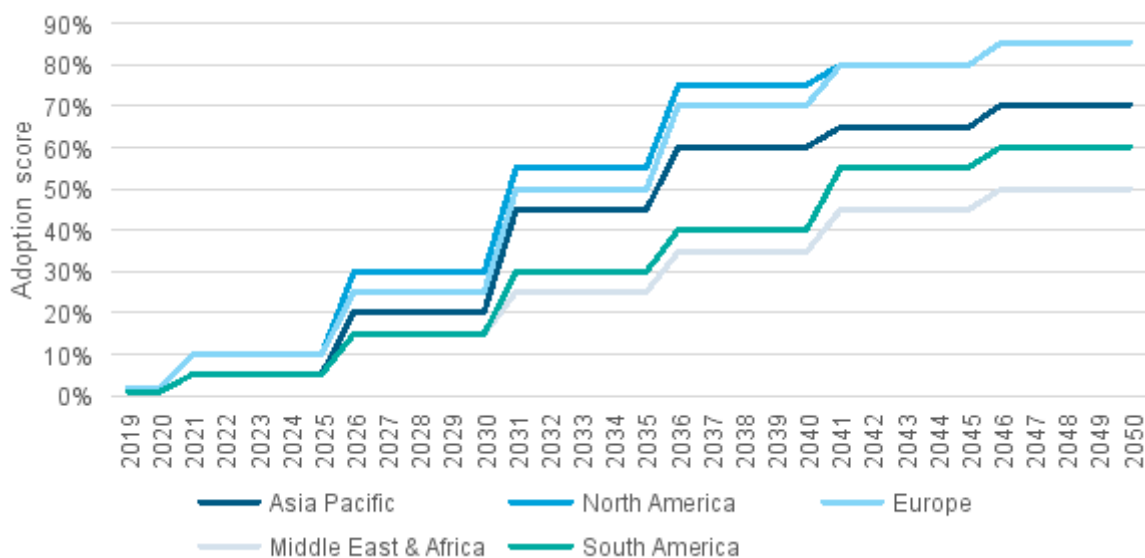


Figure 6: Deployment scenarios for consumer, business and government adoption

### 3.4.4. Deployment scenarios for technology readiness

In developed countries, almost everyone has a reliable form of official identification, and biometric technology has traditionally been employed mainly for security and forensics. Conversely, many developing countries suffer from an identity gap, whereby millions of people lack the official forms of identification including birth certificates, national ID cards and voter cards, that would allow them to access basic rights and services.

Closing this gap has been increasingly recognised as a goal of development<sup>10</sup>. In the way that mobile phones have allowed poorer countries to leapfrog past landlines, biometrics have the potential to help solve their identification woes while

<sup>6</sup> McQuivey, L. and Fleming, G. 2018. "Our 2018 US Benchmark Data Overview Reveals the Four Forces of Adoption"; available at: [https://na.eventscloud.com/file\\_uploads/d58536118d5821db5f6555f04e0f8dd2\\_The\\_Consumer\\_Tech\\_Stack\\_.pd](https://na.eventscloud.com/file_uploads/d58536118d5821db5f6555f04e0f8dd2_The_Consumer_Tech_Stack_.pd)

<sup>7</sup> European Commission, 2018. "Eu businesses go digital: Opportunities, outcomes and uptake"; available at: <https://ec.europa.eu/easme/en/news/are-eu-companies-adopting-digital-technologies>

<sup>8</sup> Price, J. 2017. "Latin America braces for an era of technology-led disruption"; available at: <https://theglobalamericans.org/2017/06/latin-america-braces-era-technology-led-disruption/>

<sup>9</sup> McKinsey & Company, October 2016. "Digital Middle East: Transforming the region into a leading digital economy"; available at: <https://www.mckinsey.com/featured-insights/middle-east-and-africa/digital-middle-east-transforming-the-region-into-a-leading-digital-economy>

bypassing paper-based systems. Higher overall readiness will lead to greater intent to adopt biometric authentication<sup>11</sup>.

Despite currently being significantly behind other global regions in terms of STJ deployment, by 2040 it is expected that South America and Middle East & Africa will have the same levels of STJ deployment as the rest of the world (see Figure 7). Significant advancements in telecoms infrastructure and the telecoms sector generally, as well as 4G and 5G technology adoption, largely driven by increased demand for mobile data, will allow for the wide-scale deployment of biometrics across global regions.

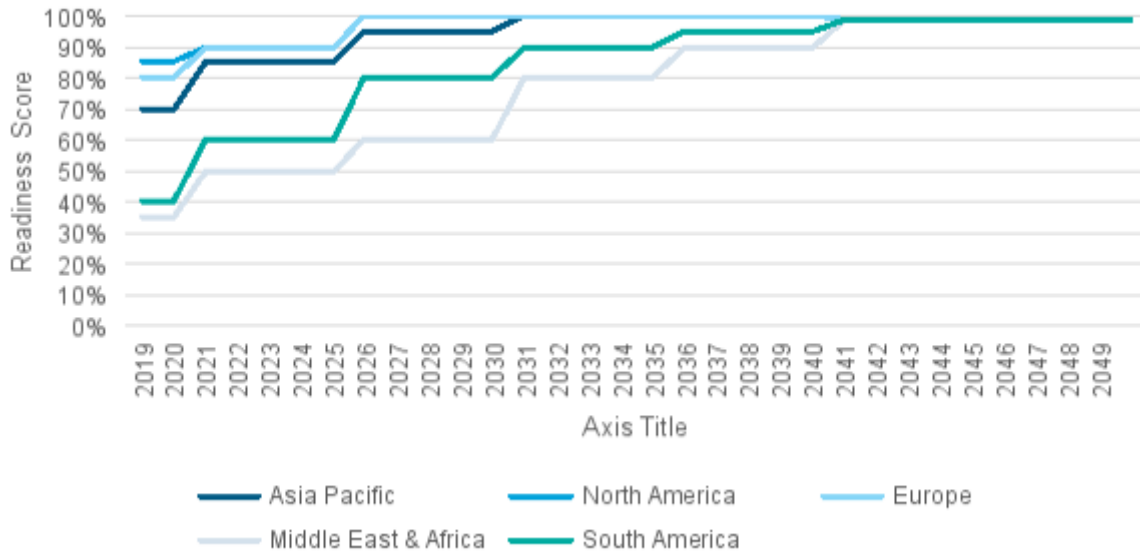


Figure 7: Deployment scenarios for technology readiness

### 3.4.5. Deployment scenarios for regulatory landscape

The regulatory landscape varies greatly by region for both enabling and limiting the implementation of STJ. Both domestic regulations and international agreements are necessary to enable fully seamless journey. Some residual areas may not be compatible with the STJ from a regulatory perspective, hence a global maxim of 99% is attained.

North America and Europe currently have the highest levels of adoption from a regulatory perspective (see Figure 8). Privacy and data sharing laws in North America are relatively relaxed and little evolution of the regulatory landscape is necessary to facilitate deployment of biometric technology and user-ID platforms<sup>12</sup>. The European region has faced stricter regulation policies, although there are now indications the environment here is starting to improve. The recent General Data Protection Regulation (GDPR) is potentially challenging for how user data is managed and shared. Some regulations will need to be relaxed for biometric and user-ID platforms to be fully compatible<sup>13</sup>.

Asia Pacific, South America and Middle East & Africa have a much stricter regulatory landscape, particularly regarding sharing of data with international regions. Regulation around data sharing and telecoms has been slow to evolve, weighted strongly to privacy laws in some countries (e.g. the case of China and social networking sites). Regulation in the near-term will likely inhibit the deployment of biometrics and user-ID platforms. This is likely to evolve in the Asia Pacific region, but regulatory reform is necessary in South America to reduce the cost of wireless infrastructure deployment and improve coverage of 4G. In the Middle East & Africa the regulatory landscape in the region requires further development for deployment of biometrics and user-ID platforms .

<sup>10</sup> Center For Global Development, "Biometrics FAQs", available at: <https://www.cgdev.org/page/biometrics-faqs>

<sup>11</sup> Laux et al., 2011. "Adoption of Biometric Authentication Systems: Implications for Research and Practice in the Deployment of End-User Security Systems", Journal of Organizational Computing and Electronic Commerce

<sup>12</sup> The National Academies, 2010. "Biometric Recognition, Challenges and Opportunities", available at: [https://www.ncbi.nlm.nih.gov/books/NBK219896/pdf/Bookshelf\\_NBK219896.pdf](https://www.ncbi.nlm.nih.gov/books/NBK219896/pdf/Bookshelf_NBK219896.pdf)

<sup>13</sup> European Commission, February 2020. "A European strategy for data", available at: [https://ec.europa.eu/info/sites/info/files/communication-european-strategy-data-19feb2020\\_en.pdf](https://ec.europa.eu/info/sites/info/files/communication-european-strategy-data-19feb2020_en.pdf)

<sup>14</sup> GSMA, June 2019. "Data Privacy Frameworks in MENA, Emerging approaches and common principles", available at: <https://www.gsma.com/mena/wp-content/uploads/2019/07/GSMA-Data-Privacy-in-MENA-Exec-Summary.pdf>

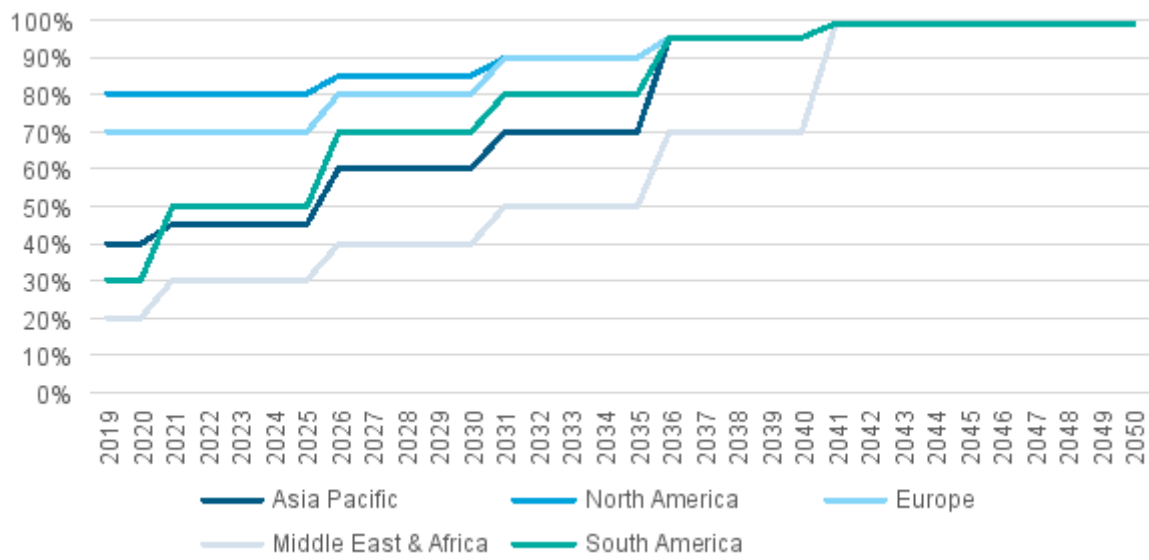
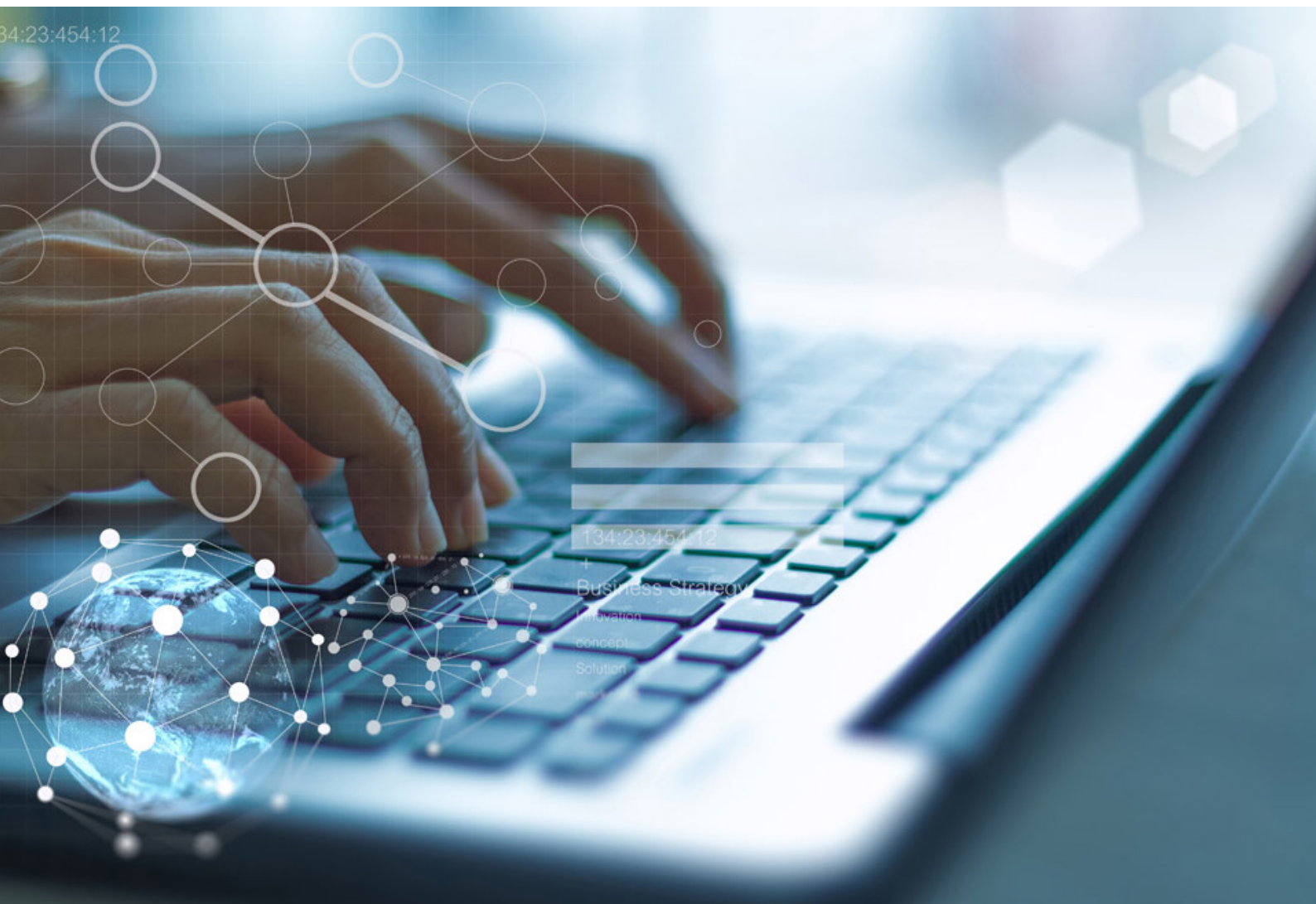


Figure 8: Deployment scenarios for regulatory landscape





## 4. ECONOMIC IMPACT ASSESSMENT

### 4.1. Baseline (do-nothing) scenario

#### 4.1.1. Approach to baseline scenario definition

The baseline scenario constituted a reference base on which the benefits of STJ were calculated. This scenario was designed based on a 'do nothing' situation, when the components of STJ are not implemented, and technology-driven solutions are not introduced in the relevant sectors.

The baseline scenario was generated by collating core industry data, analysis and trends relating to the supply and demand for travel and tourism for the next 30 years. Data collected covered cruise, hospitality and car rental.

The baseline scenario provides a robust foundation upon which the CBA was built, and includes the following components:

- Cruise-specific data, including forecasts on revenues, operational costs and revenues, global deployment capacity, revenue per passenger and number of passengers.
- Hotel sector-specific data, including forecasts of revenues, operational costs, Revenue per Available Room (RevPAR), number of rooms, number of hotels, average daily rates, occupancy rate and number of users.
- Car rental-specific data, including forecasts of revenues, operational costs, total users and average revenue per user.

Various sources were used to collate the baseline industry data that underpins the cost and benefits forecast. The regional data included annual sector revenues, costs, customer base estimates, asset base estimates and various other industry metrics. Several company annual reports were reviewed to identify proportions of costs and revenues that are typical of each sector. These data were subsequently used to generate a baseline industry forecast for each sector to 2050 for revenues and costs. To collate these analyses, Atkins engaged with representatives of each industry via a programme of one-to-one interviews and facilitated three collaborative workshops in Miami and London with participants from the various sectors and technology vendors.

The baseline was forecast following a literature review of CAGR (%) forecasts for each sector and region, up to 2023. These forecasts were then extended to year 2050 by taking an average of the CAGR forecast and GDP forecast for the region, up to 2050. This approach assumes future growth of each sector will fall somewhere between short-run forecast growth and future GDP growth. This aligns with long-term growth patterns reported in the literature and ensures the forecast provides relatively conservative estimates.

#### 4.1.2. Global trends

The forecast for global trends is based on long-run assumptions regarding the future state of regional economies, extending to 2050. The forecast does not seek to explicitly consider peaks and troughs (fluctuations) in economic growth, but rather capture the general long-running trend. Given the extent of the forecast, considerable uncertainty underlies these longer-term estimates.

GDP per capita reflects the relative wealth of society and the strength of the macro economy (see Figure 9). Positive economic growth is forecasted for all world regions, with particularly strong growth forecast for North Asia over the period, largely reflecting the strength of the Chinese economy. Europe, North America and North Asia all have per capita GDP that exceeds the global average. Purchasing trends in the hospitality and travel sectors tend to be correlated with changes to GDP.

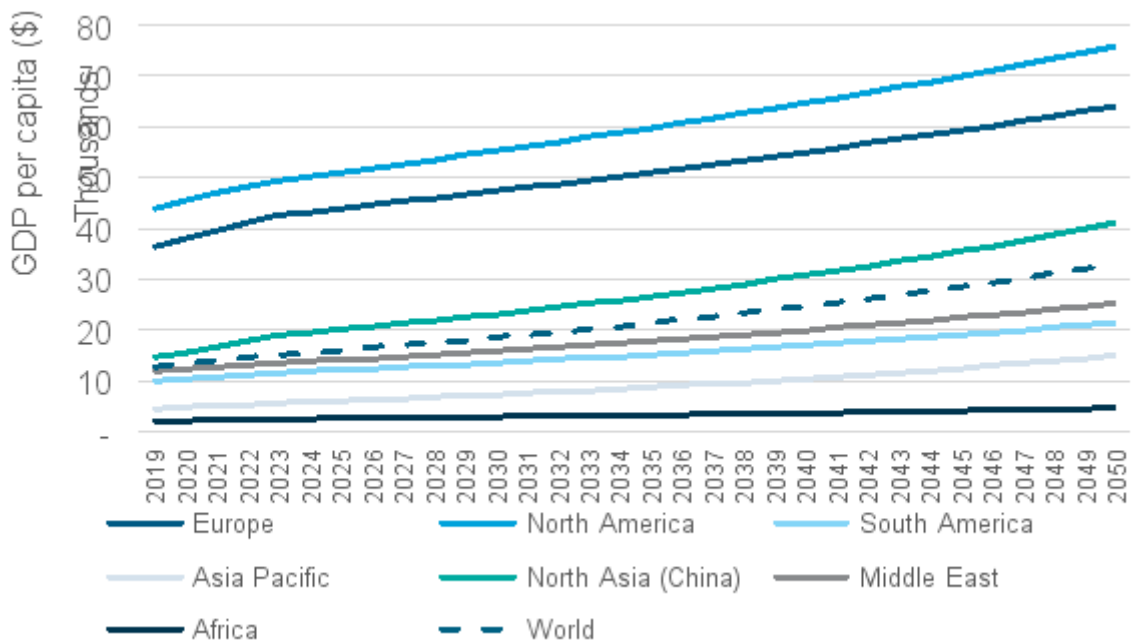


Figure 9: GDP per capita forecast by region (2020-2050) <sup>15</sup>

4.1.3. Baseline scenario for cruise sector

Revenue forecasts for the cruise sector suggest strong global growth. Market volume (passenger numbers) is expected to grow strongly with the demand for high-end trips increasing rapidly, especially in Asia<sup>16</sup>. The number of cruise goers is expected to reach 31 million by 2023. Revenues are expected to be particularly strong in the Asia Pacific and North America regions (see Figure 10). In the case of Asia Pacific region, this growth is the product of a growing economy and a rising middle class in the region, particularly in China and India<sup>17</sup>.

Most revenue will be generated in the United States, owing to a strong economy and a GDP per capita that exceeds all other regions<sup>18</sup>. Forecasts for CAGR in the sector (period 2020-2023) range from 5.7% (Asia Pacific)<sup>19</sup> to 1.4% (Europe)<sup>20</sup>. Globally, the sector is growing at a rate of CAGR of 4.2% (2020-2025). **Total sector revenues in 2050 are forecast to be ~\$107 billion**, compared to \$43 billion in 2020.

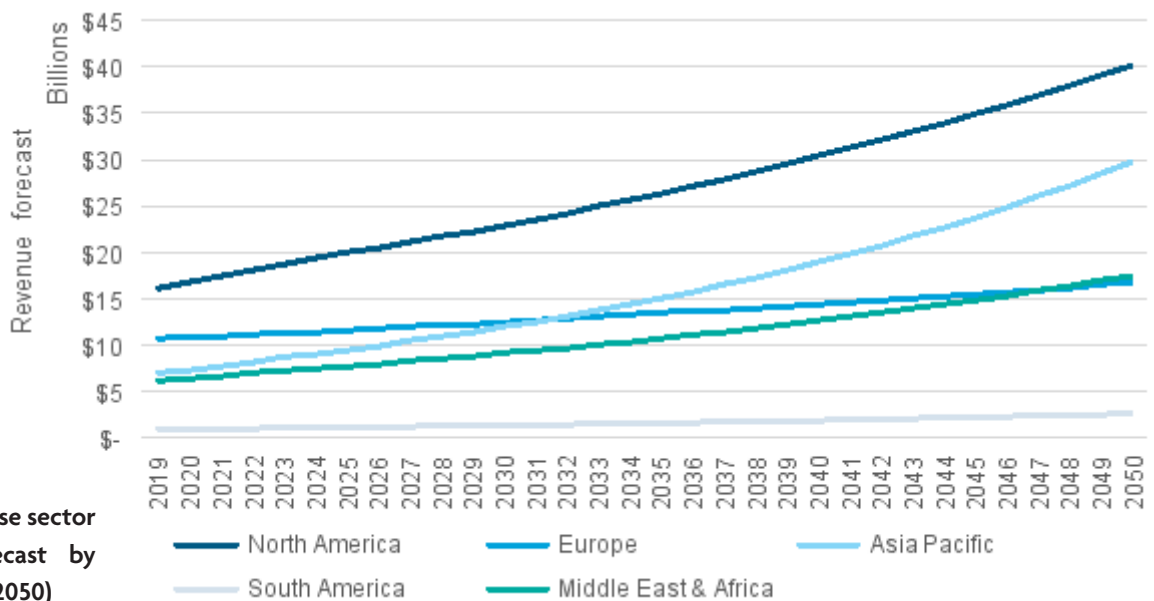


Figure 10: Cruise sector revenue forecast by region (2020-2050)

<sup>15</sup> Source data derived from Oxford Economics (2019)

<sup>16</sup> <https://www.researchnester.com/press-details/global-cruise-ships-market/2190>

<sup>17</sup> <https://www.marketwatch.com/press-release/global-cruise-market-2020-with-top-countries-data-industry-size-growth-factor-key-drivers-segments-share-and-demand-analysis-and-2026-forecast-research-report-2020-02-04>

<sup>18</sup> <https://www.statista.com/outlook/450/613/cruises/north-america>

<sup>19</sup> <https://www.statista.com/outlook/450/101/cruises/asia>

<sup>20</sup> <https://www.statista.com/outlook/450/102/cruises/europe>

#### 4.1.4. Baseline scenario for hotel sector

Revenue forecasts for the hotel sector also suggest strong global growth, with the sector growing at a CAGR of 3.6% (2020-2025). The number of guests is expected to reach 1.2 billion by the year 2023. Revenues are expected to grow strongly in the Asia Pacific and North America regions (see Figure 11). In Europe, growth is slower leading to it being succeeded by Asia Pacific as the second most lucrative region after North America<sup>21</sup>.

Forecasts for CAGR in the sector (period 2020-2023) range from 4.9% (Asia Pacific) to 2.4% (Europe)<sup>22</sup>. **Total sector revenues in 2050 are forecast to be ~\$1,446 billion**, compared to \$562 billion in 2020. In North America, total sector revenues in 2050 are forecast to be ~\$464 billion, compared to \$172 billion in 2020. Currently, the North American region accounts for around 31% of the global market.

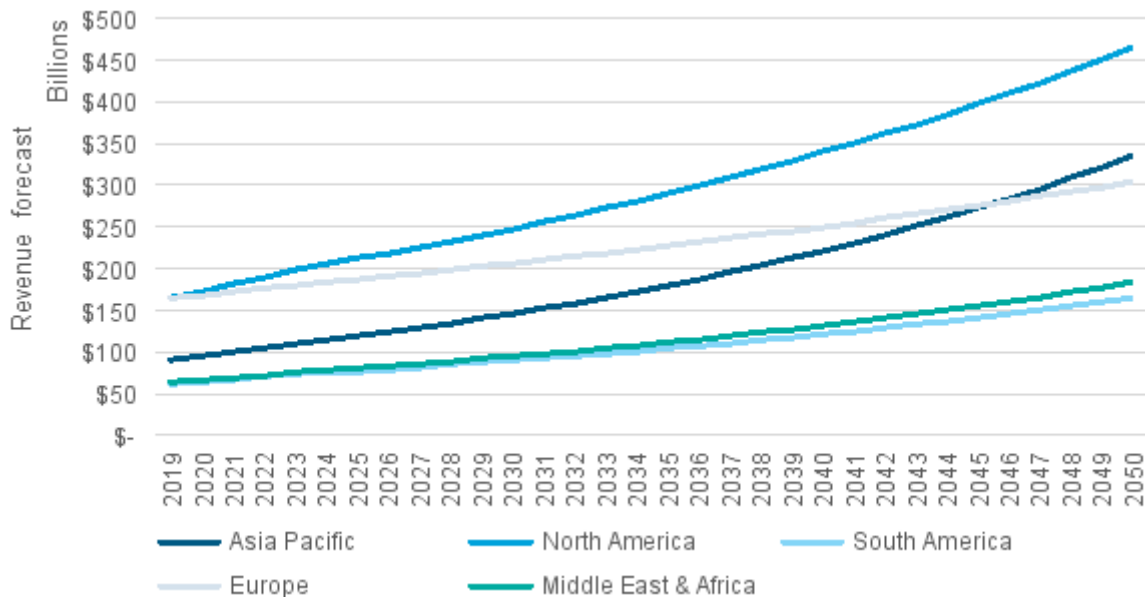


Figure 11: Hotel sector revenue forecast by region (2020-2050)

#### 4.1.5. Baseline scenario for car rental sector

Global revenue in the car rental market amounts to \$138 billion in 2020 and is expected to show an annual growth rate (CAGR 2020-2025) of 8%, resulting in a projected global market volume of \$216 billion by 2025. Expansion and progression of worldwide travel and tourism industry, incorporation of advanced digital technologies in car rental services and investment by global funds opting for aggregator-based business models are accelerating this market<sup>23</sup>. Strong global growth is largely the product of rapid growth in the Asia Pacific and Middle East & Africa regions.

Worldwide growth in travel and tourism sector, as well as increase in the global number of flights taken, will likely lead to an increase in the global market for car rentals. The number of users is expected to reach 843 million by 2023, up from 793 million in 2020. Revenues are expected to grow strongly in the Asia Pacific and Middle East & Africa regions (see Figure 12), growing at a CAGR (2020-2023) of 7.5% in Asia Pacific and 5.5% in Middle East & Africa. In Europe, growth is the least of all regions, rising at a CAGR of 2.7% over the same period<sup>24</sup>.

<sup>21</sup> <https://www.globenewswire.com/news-release/2019/03/08/1750501/0/en/Global-Hotels-Market-Expected-To-Reach-USD-211-54-Billion-By-2025-Zion-Market-Research.html>

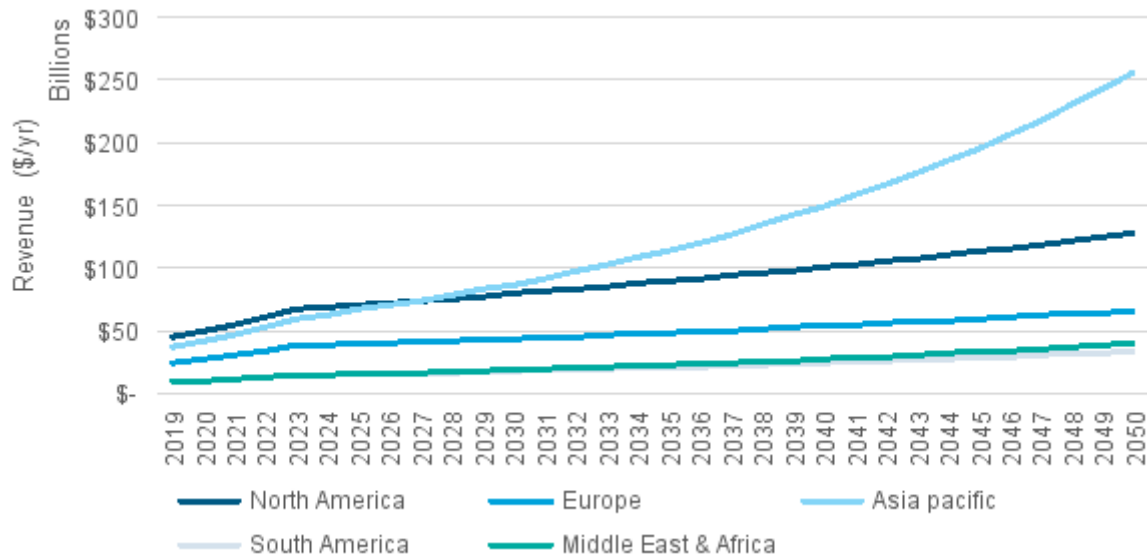
<sup>22</sup> <https://www.statista.com/outlook/267/101/hotels/asia>

<sup>23</sup> <https://www.alliedmarketresearch.com/car-rental-market>

<sup>24</sup> <https://www.statista.com/outlook/270/102/car-rentals/europe>

Emerging countries such as India and China are witnessing significant growth in car rental due to increases in the per-capita income, change in lifestyle of people, the rise in middle-class population and generally higher standards of living<sup>25</sup>. In the Middle East, improved economic conditions, a high proportion of expatriate population, growth of tourism and investment in travel infrastructure has led to significant growth in Middle East car rental industry over the last 10 years and this trend is expected to keep growing<sup>26</sup>.

Total sector revenues in 2050 are forecast to be ~\$521 billion, compared to \$205 billion in 2020. Most revenue will be generated in Asia Pacific region, where total sector revenues in 2050 are forecast to be ~\$256 billion, compared to \$41 billion in 2020. Currently, the Asia Pacific region accounts for around 30% of the global market.



**Figure 12: Car rental sector revenue forecast by region (2020-2050)**

**4.1.6. Overview of the baseline scenario for industry metrics**

The baseline trends for the relevant industry metrics were calculated to determine the long-run changes for the sectors in the absence of the STJ concept (see Table 2). All estimates are either a function of revenue or operating cost change. This is advantageous since uncertainty in the baseline forecast is constrained to just three parameters (uncertainty in the revenue forecasts; uncertainty in the cost forecasts and uncertainty in the magnitude metrics).

A negative value in Table 2 indicates an operational cost while a positive value is a change in revenue. Costs for each sector will never exceed revenues, since the differential is margin. The estimates were forecast over the period 2020-2050 and to report present values were discounted in the central scenario using a 7% discount rate.

The present value estimates for the period range from \$ -2.3 billion (total annual cost attributed to stolen vehicles) to \$ 8,616 billion (volume of customer bookings in annual sales revenues) over the period. The total of the metrics (in absolute terms) summed to \$607 billion for the cruise sector; \$19,000 billion for hotels and \$6,567 billion for car rental. The largest potential gains arising from the STJ concept are likely to accrue in the hotel sector. Over the period, these potential gains are likely to grow in line with the CAGR rates attributed in the sector revenue and cost forecasting (see preceding sections).

<sup>26</sup> <https://www.alliedmarketresearch.com/car-rental-market>

<sup>27</sup> [http://storyoffuture.com/business/car-rentalmarket/?\\_sm\\_au\\_=iVvFvNWTsZV5sPWfHFv7kKtp0KcGj](http://storyoffuture.com/business/car-rentalmarket/?_sm_au_=iVvFvNWTsZV5sPWfHFv7kKtp0KcGj)



**Table 2: Baseline (do nothing) forecast for monetary metrics used in the CBA model**

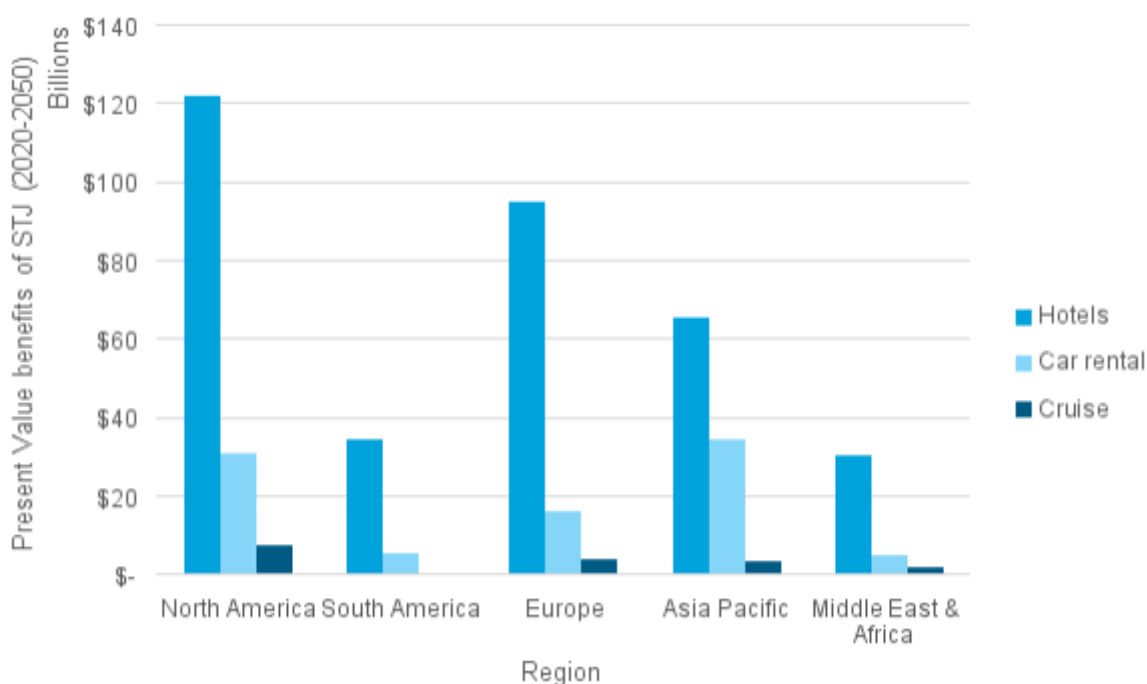
Sector	Monetary metric	2020	2030	2040	2050	PV Total
		\$(m)	\$(m)	\$(m)	\$(m)	\$(m)
Cruise	Payroll in total annual costs	\$-4,690	\$-6,425	\$-8,687	\$-11,870	\$-88,798
	Volume of customer bookings in annual sales revenues	\$25,004	\$33,795	\$45,286	\$61,571	\$466,753
	Cross-selling and up-selling in annual sales revenues	\$2,768	\$3,738	\$5,006	\$6,804	\$51,625
Hotel	Volume of customer bookings in annual sales revenues	\$449,884	\$623,925	\$847,152	\$1,156,775	\$8,615,593
	Total cost is incurred due to card transaction fees	\$-3,147	\$-4,270	\$-5,702	\$-7,712	\$-58,869
	Spend on key cards in annual costs	\$-226	\$-307	\$-410	\$-554	\$-4,230
	Lost total revenue as a result of card fraud	\$1,125	\$1,560	\$2,118	\$2,892	\$21,539
	Payroll in total annual costs	\$-38,243	\$-51,886	\$-69,289	\$-93,712	\$-715,336
	Impact of occupancy rate on annual revenues	\$449,884	\$623,925	\$847,152	\$1,156,775	\$8,615,593
	Cross-selling and up-selling in annual sales revenues	\$50,612	\$70,192	\$95,305	\$130,137	\$969,254
	Volume of customer bookings in annual sales revenues	\$110,305	\$204,969	\$322,656	\$531,581	\$2,933,727
Car rental	Total annual cost attributed to stolen vehicles	\$-88	\$-162	\$-254	\$-424	\$-2,320
	Payroll in total annual costs	\$-13,127	\$-23,996	\$-37,733	\$-62,927	\$-344,689
	Impact of utilisation rate on annual revenues	\$110,305	\$204,969	\$322,656	\$531,581	\$2,933,727
	Vehicle storage costs in annual costs	\$-884	\$-1,615	\$-2,540	\$-4,236	\$-23,200
	Cross-selling and up-selling in annual sales revenues	\$12,409	\$23,059	\$36,299	\$59,803	\$330,044
	<b>Absolute total</b>	<b>\$1,272,703</b>	<b>\$1,878,791</b>	<b>\$2,648,243</b>	<b>\$3,819,352</b>	<b>\$26,175,299</b>

Note: A negative value indicates an operational cost while a positive value is a change in revenue

## 4.2. Economic benefits of STJ

### 4.2.1. Overview of STJ benefits

Most of the benefits accrue in the Hotel sector, distributed across all regions. Total PV benefits for hotels sum to \$349 billion over the period 2020-2050, while for car rental the total PV benefits are \$93 billion and for cruise the PV benefits are \$17 billion (see Figure 13). Disaggregating the benefits by region shows most benefits accrue in North America for hotels. For car rental, the highest benefits accrue in the Asia Pacific region. Lastly, for cruise most benefits accrue in the North American region. These differences largely reflect regional variability in revenue forecasts and CAGR for the sectors, in addition to differences in regional deployment curves.



**Figure 13: PV benefits according to each sector and region for the STJ concept**

A final breakdown of all benefits reported by benefit function and sector is illustrated in Figure 14. The proportions on the chart demonstrate the share of benefit attributed to each function and sector, with 'more customer bookings' accounting for the highest overall share of benefit. The breakdown of these benefits across the different sectors and benefit functions are discussed further in the following sub-sections.

Global benefit to revenue ratios shows the hotels sector has the highest proportion of benefits to revenue (0.032), suggesting \$1 dollar of benefit is generated for every \$31 in revenue. For car rental, the ratio is slightly lower (0.028) and suggests \$1 dollar of benefit is generated for every \$34 in revenue. For cruise this ratio is 0.022, suggesting \$1 dollar of benefit is generated for every \$45 in revenue.



Figure 14: Breakdown of benefits by benefit factor and sector 4.2.2. Benefits for hotels

The hotels sector is the largest sector analysed in the CBA model and accounts for some 76% of combined revenues from all sectors in 2020. The following key findings have emerged from the hotel's benefits matrix:

- The hotels sector can expect to see more returning customers due to greater satisfaction linked with streamlined check-in and check-out. The identity validation component of check-in can cause queues, but by offering online or early check-in using trusted identity data pre-arrival, it is possible that the average check-in time of 5 minutes can be reduced to between 0-3 minutes. Time saved at these two touchpoints will result in a more seamless experience for customers which we suggest may result in an increase to total customer bookings. A best estimate suggests there is potential for a 3% rise in customer bookings from improved customer satisfaction. The former is assumed to result in a 2.4% increase in annual revenues, since both the volume of bookings and associated rates impact revenues<sup>27</sup>.
- With the potential for less reliance on credit cards for holding room deposits, with improved certainty that bookings are made legitimately, hotels could expect to see a 100% reduction in incurrence of credit card holding fees (transaction charges usually amount to 1-3% charge for each payment). The 100% reduction in credit card holding fees will be mitigated with a transaction by an ID service provider. The implementation of biometric authentication has the potential to reduce the number of fraudulent payments from credit cards by 0.7%. This could reduce credit card fraud for the hospitality sector from 1.1% to a tourism industry average of 0.4%.
- Real time data sharing has the potential to allow for better knowledge of customer estimated time of arrival, reducing underutilised capacity and optimising overall estate management. However, since most hotels on average do not operate at full occupancy, there is only likely to be a minor increase to occupancy (-0.1%) at certain times during peak season where occupancy is high.
- As expected, there is some overlap of benefits between the sectors. Similarly to cruises, hotels are predicted to see a 10% increase in cross selling or up-selling from personalisation and customisation leading to a 1% increase in total annual revenue. Similarly, the operational saving on front and back office staff, through initiatives such as 'Seamless Check-in' and the implementation of kiosks in some properties to reduce staffing costs, will result in a 3% reduction to payroll leading to a 0.4% increase in annual revenue.
- Biometric access control has the potential to reduce the requirement for purchasing replacement key cards for room access. Initiatives are underway looking to use smartphone capability to replace these physical tokens, around 25% of which are lost in-stay. By replacing key cards with biometrics, hotels can eliminate key card spend and thus will see a 100% reduction in issuance of key cards. However, since key cards account for 0.1% of annual costs, the overall benefit is minimal.

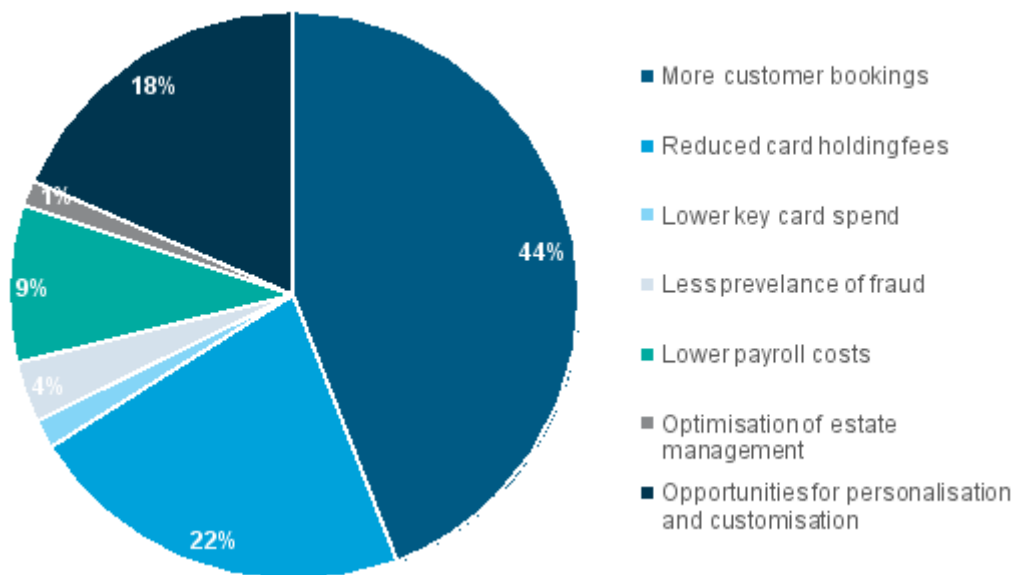


Figure 15: Global PV benefits for hotel sector according to benefit function

<sup>27</sup> Estimates regarding the booking volume of 3% and revenue factor of 2.4% are held consistent across all three sectors.

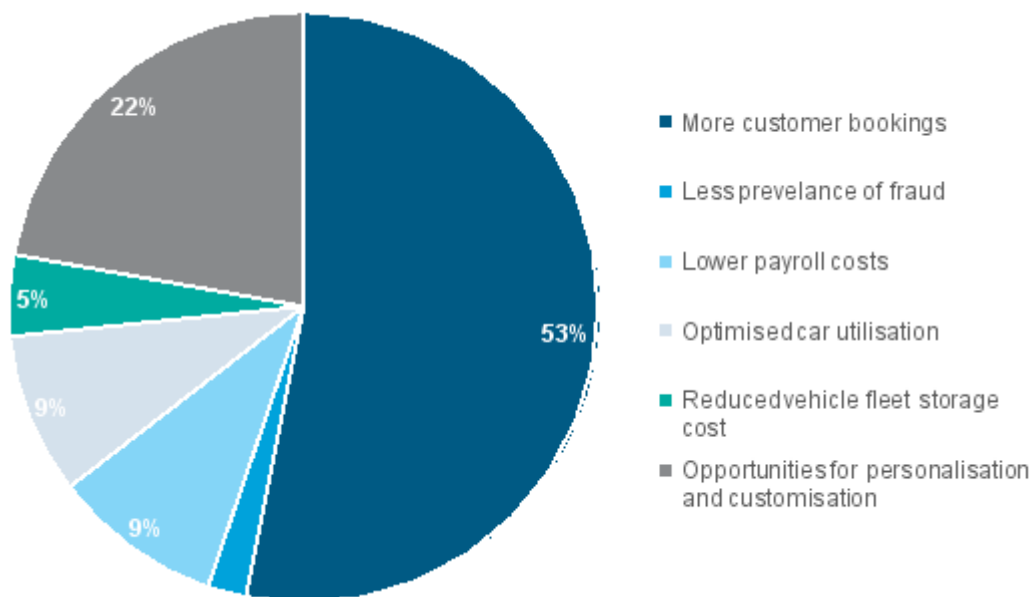


Figure 15 reports distribution of benefits according to each benefit function. An increase in customer bookings will likely result in the highest proportion (44%) of benefits, yielding some \$151 billion of benefits. The lowest provision of benefits are associated with optimisation of estate management, yielding some 1% of overall benefit (a minor increase in annual revenues of \$5 billion). Total PV benefits accrued to the sector are \$348 billion over the period.

**4.2.3. Benefits for car rental**

The car rental sector accounts for approximately 19% of combined revenues from all sectors in 2020. Car rental benefits considered in this assessment mainly relate to real time data sharing and identification. Six core benefits have been identified:

- Improved identification capability could result in reduced cost attributed to vehicle theft through fraudulent rentals. Thus, improved security and authentication via the use of biometrics has the potential to reduce car theft by up to 95%, since the possibility of car rental with fraudulent documents would become increasingly difficult. However, the magnitude is likely to be low given the total annual cost attributed to stolen vehicles is estimated at 0.1%.
- Real time data sharing will improve knowledge of customer ETA and optimise utilisation of car rental assets by 0.5%. Since there is little in-hire fleet tracking, rental companies often do not know the whereabouts of their vehicles. However, the change to total annual revenue is anticipated to be minimal at 0.4%, and since most car rental companies on average do not operate at full utilisation (~85%) any increase in utilisation will likely be during peak seasons when utilisation is higher.
- Better knowledge of customer ETA also means vehicle storage can be optimised. With parking, particularly at airports, urban retail and railway stations expensive for car rental companies, real time data sharing (particularly between airlines and car rental companies) could lead to a 20% cost reduction from storing more vehicles off-site/ at car rental premises.
- Car rental companies can also expect to see a 3% increase in customers due to greater satisfaction linked with streamlined operations (e.g. pick-up) resulting in a 2.4% uplift in total annual revenue. Since corporate business accounts for a third of car rental business, and these customers significantly value their time and convenience, they are likely to choose rental companies which have embraced STJ technologies/initiatives.
- A reduction in operational spend (on front and back office staff) is possible with real time data sharing and identification. By lowering staffing cost due to operations streamlining organisations can expect to see a 3% reduction in annual payroll on staff.
- As with cruise and hospitality, appealing to customer preferences through personalisation and customisation should lead to the generation of additional revenue (1% growth in total annual revenue) from more up-selling and cross-selling conversions driven by richer data about which customers value which features. Most up-selling takes place at pick-up, and with additional customer information, rental companies can tailor this (e.g. better suited vehicle class, insurance, sat-nav).



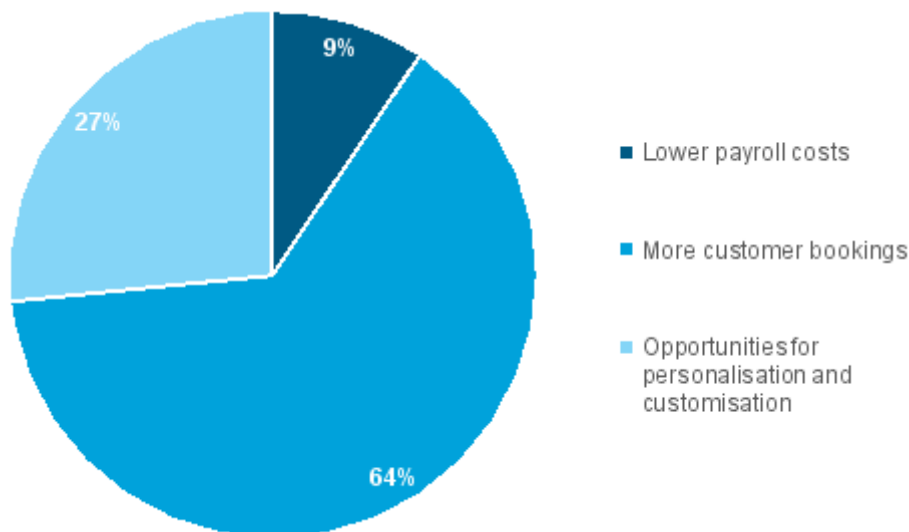
**Figure 16: Global PV benefits for car rental sector according to benefit function**

Figure 16 reports distribution of benefits according to each benefit function. Under the central scenario, the PV benefits forecast for car rental similarly shows an increase in customer bookings will likely result in the highest proportion (53%) of benefits, yielding some \$49 billion of benefits over the period. The lowest provision of benefits is associated with reduced vehicle fleet storage cost (a minor reduction in annual cost), accounting for 2% of overall benefit from the STJ concept and yielding some 2% in cost savings for the sector. Total PV benefits accrued to the sector are \$93 billion over the period.

**4.2.4. Benefits for cruise**

The cruise sector is the smallest sector analysed in the CBA model, accounting for just 6% of the combined revenues from all sectors in 2020. Three core benefit of STJ have been identified:

- STJ will have the greatest impact on the generation of additional revenue through greater personalisation and customisation. With a better understanding of consumer preferences at the booking and sales stage, cruise companies could experience a 10% increase in sales of non-core services (e.g. tours, upgrades and additional services) which represents a 1% uplift in annual sales revenue.
- Biometrically-enabled facilitation is working to great effect for some operators already in the United States, reducing boarding and turnaround times. Implementing biometrics has the potential to reduce cruise embarkation and particularly disembarkation time from ~2.5 hours to ~20 minutes. Check-in will be largely conducted on an automated basis, reducing queues associated with identification and security screening checks. A demand-side response (increase in customer bookings) is expected due to greater satisfaction linked with streamlined security operations. This could result in a 3% rise in customer bookings, which equates to a 2.4% increase in annual sales revenue.
- Operations streamlining as a result of STJ technologies could result in a 3% reduction to annual payroll (via lower staffing costs). This is based on the assumption that 10% of payroll is dedicated to check-in/out and security staff, and a potential 30% reduction in those staff due to STJ implementation. Check-in in particular can be labour intensive given the number of manual transactions that take place (e.g. ~40 check-in staff and c.30 other staff for a 5,500-capacity ship).



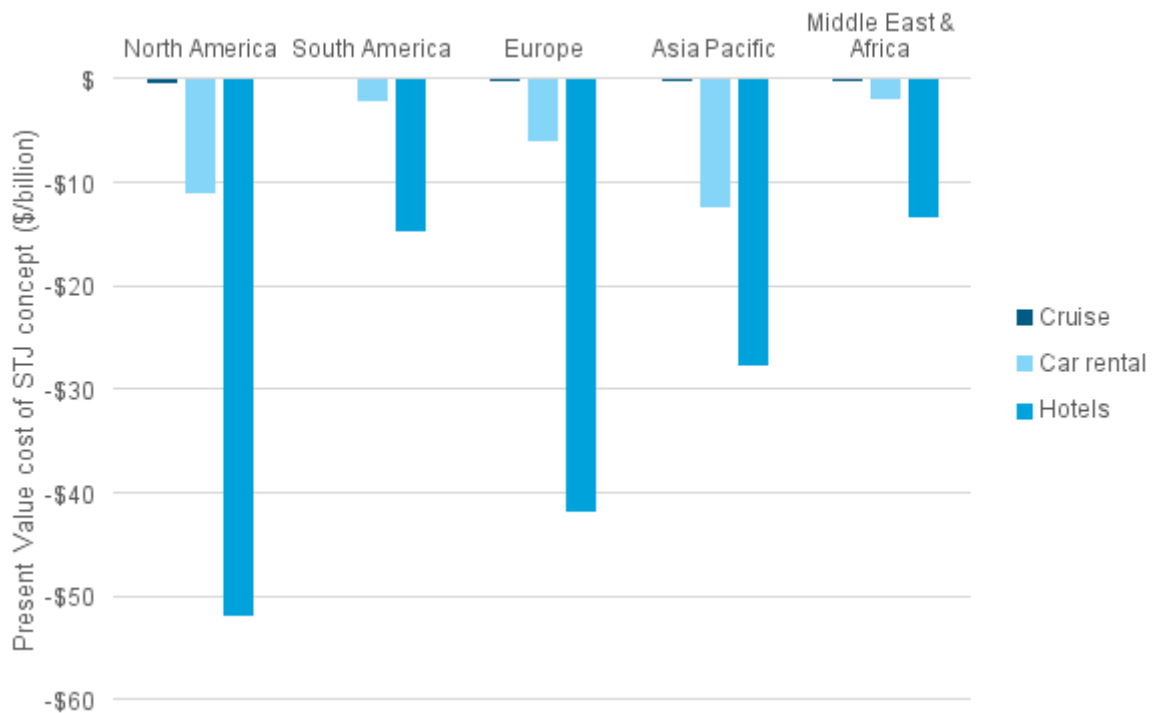
**Figure 17: Global PV benefits for cruise sector according to benefit function.**

Figure 17 reports distribution of benefits according to each benefit function. For cruise, the portfolio of benefits is the smallest of any industry sector and occurs via three core benefit functions. Under the central scenario, the PV benefits forecast for cruise also suggests an increase in customer bookings will likely result in the highest proportion of benefits (64%) and the most of any sector. This is likely to yield some \$11 billion of benefits over the period. The lowest provision of benefits are associated with payroll savings, accounting for 10% of overall benefits and a cost saving of \$1.7 billion over the period. Total PV benefits accrued to the sector are \$18 billion over the period.

### 4.3. STJ implementation costs

Costs associated with STJ were allocated to one of the three technology functions ('Identification', 'Real time data sharing' and 'Consumer preferences'). Every technology function incurs all or some of the cost metrics including initial CAPEX, recurring CAPEX, OPEX and transaction cost. A maturity factor was applied to adjust the rate of technological maturity, resulting in a reduction of the capital cost of biometric deployment. The default scenario introduces a cost reduction of 10% for the 5 years following 2025, with an increment of 10% applied every 5 years. For a more detailed overview of cost estimation, please refer to Appendix 8.2.A.4.

Results from the cost forecast are provided in Figure 18 for the default scenario. Total PV costs for hotels sum to \$90 billion over the period 2020-2050, while for car rental the total PV costs are \$20 billion and for cruise are \$645 million. Disaggregating the cost by region shows that most costs arise in North America for hotels and cruise. For car rental, the Asia Pacific region preconsises the highest cost. These differences largely reflect regional variability in cost forecasts, in addition to differences in regional deployment curves.



**Figure 18: Global Present Value cost by sector (2020-2050)**

The breakdown of the costs across the different sectors and technology functions is presented Appendix 8.2.A.4. For all three sectors, the identification function of biometrics incurs the highest cost, since the deployment of the identification function plays the core role of biometric technologies and requires a series of hardware and software costs. The marginal cost for additional technology functions is low, because most costs are incurred at the 'identification' phase. The distribution of costs across CAPEX and OPEX is similar across all sectors and regions, though these vary in absolute terms.

## 5. NET ECONOMIC EFFECTS OF STJ IMPLEMENTATION

A capital balance sheet reports the overall results from the CBA under the central scenario – the most likely benefit scenario (see Table 3). The global NPV of the STJ across all sectors and regions amounts to \$349 billion over the period. Regionally, the NPVs range from \$123 billion (North America) to \$29 billion for Middle East & Africa.

Gross PV benefits across all sectors range from \$162 billion (North America) to \$38 billion (Middle East & Africa). Global benefits totalled \$459 billion across all sectors. Gross PV costs across all sectors ranged from \$-38 billion (North America) to \$-9.1 billion (Middle East & Africa). Global costs amounted to \$-110 billion across all sectors.

Benefit to cost ratios are also reported in Table 3, which reveals the dollar benefit per \$1-dollar cost. The ratios are fairly similar across all regions. The highest benefit to cost ratio was attained for Asia Pacific (4.32), demonstrating \$4.32 of benefit per \$1 cost, while the lowest ratios were attained for South America (3.99).

The NPVs by region are reported in Figure 19 for the period. They show the highest NPVs are associated with North America and European region for hotels. For car rental, the NPVs are greatest for the Asia Pacific and North American region. Lastly, for cruise the highest NPVs are associated with North America and Europe.

Benefit to cost ratios also vary by sector. Cruise has the highest benefit to cost ratio of all sectors, amounting to 27.7 globally. This is largely derived from the lower marginal cost of technology deployment in the cruise sector. For car rental, the benefit to cost ratio is 4.6 globally while for hotels it is 3.9. This suggests while hotels account for the highest overall NPV benefits, the ratio of benefits to costs is in fact the lowest of all sectors analysed (though still a positive outlook).

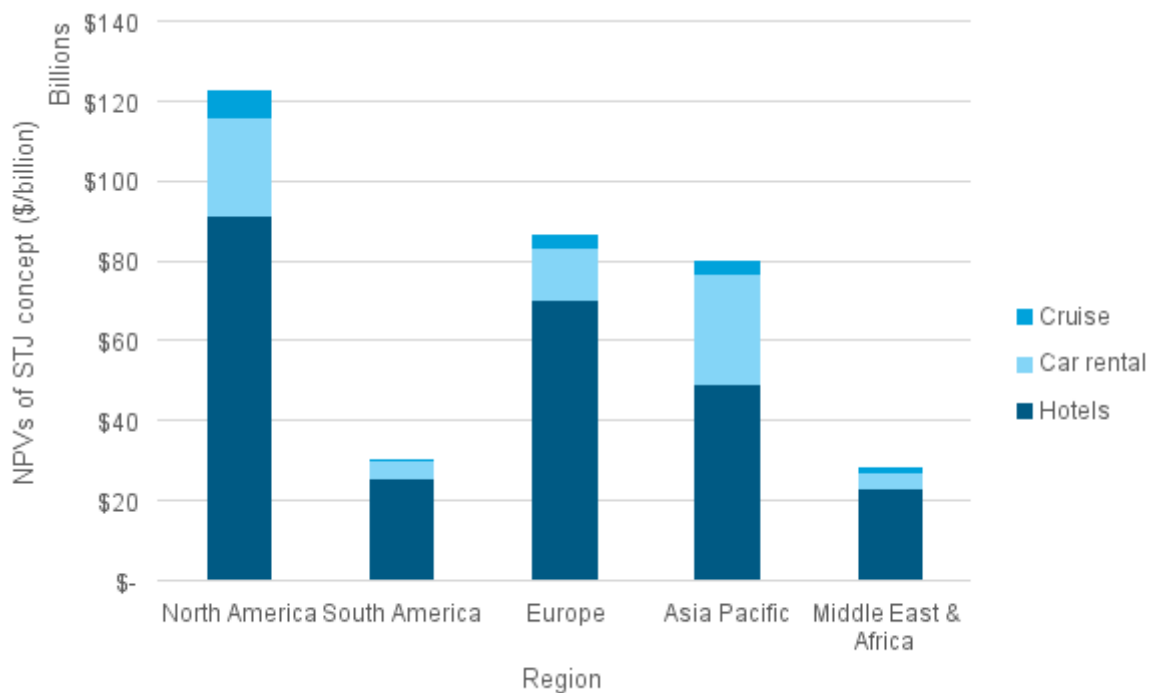
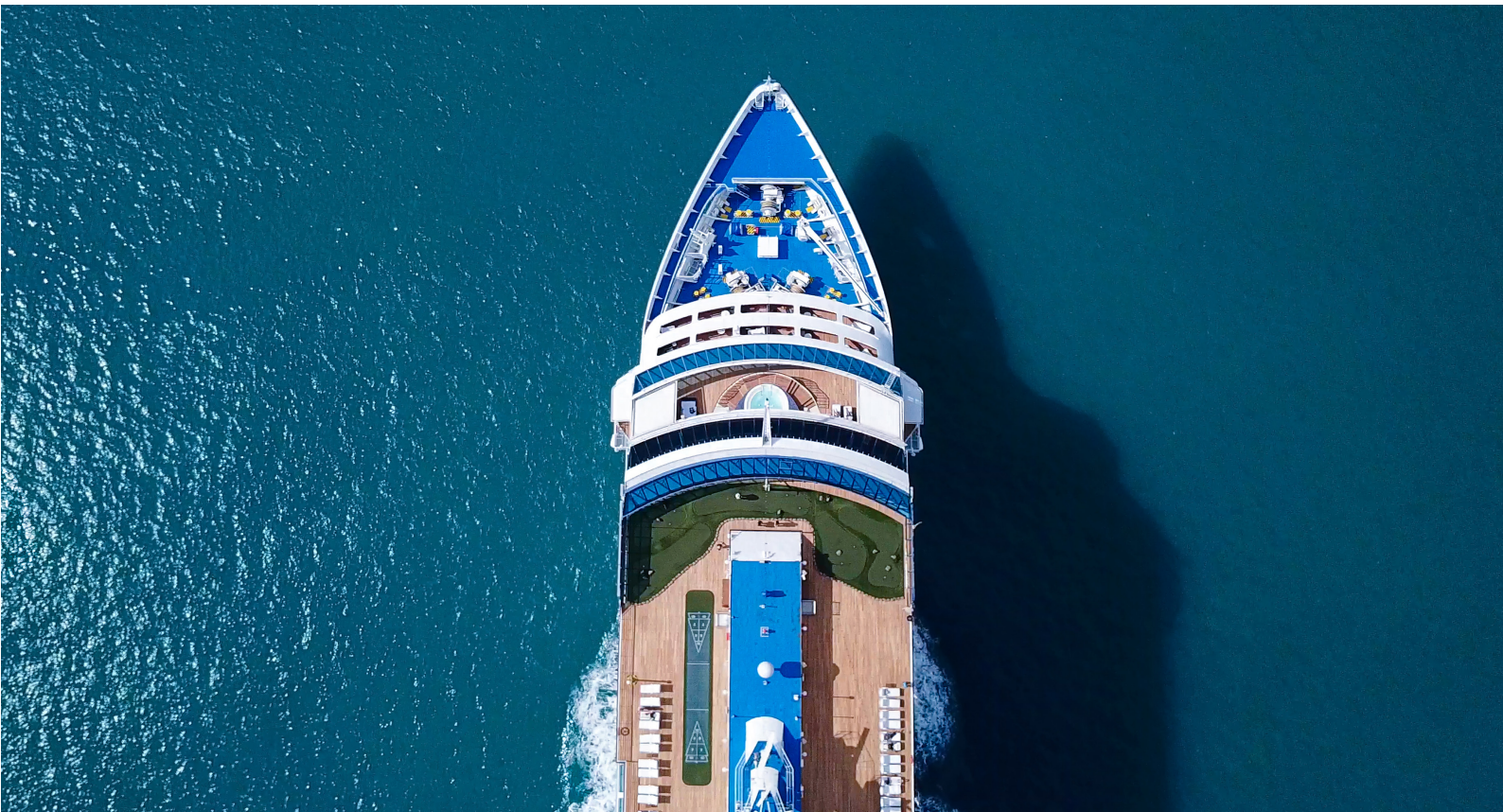


Figure 19: Net Present Values (NPVs) of STJ concept by sector and region



Table 3: Capital balance sheet summarising costs and benefits for STJ

Capital Balance Sheet - TOTAL		Period 2020 to 2050					
		North America	South America	Europe	Asia Pacific	Middle East & Africa	Global
		\$ (M)	\$ (M)	\$ (M)	\$ (M)	\$ (M)	\$ (M)
<b>Benefits</b>							
1	Baseline value	\$ 8,597,189	\$ 2,826,468	\$ 6,405,166	\$ 6,340,187	\$ 3,077,776	\$ 27,246,785
2	Cruise benefits	\$ 7,718	\$ 372	\$ 3,941	\$ 3,808	\$ 2,043	\$ 17,882
3	Hotel benefits	\$ 122,301	\$ 34,428	\$ 95,238	\$ 65,765	\$ 30,778	\$ 348,510
4	Car rental benefits	\$ 31,169	\$ 5,606	\$ 16,402	\$ 34,739	\$ 5,095	\$ 93,011
	<b>Gross PV benefit</b>	\$ 161,188	\$ 40,406	\$ 115,580	\$ 104,312	\$ 37,916	\$ 459,402
<b>Liabilities</b>							
6	Cruise costs	\$ -273	\$ -13	\$ -151	\$ -131	\$ -76	\$ 645
7	Hotel costs	\$ -31,159	\$ -8,861	\$ -25,052	\$ 16,607	\$ -7,978	\$ -89,657
8	Car rental costs	\$ -6,687	\$ -1,244	\$ -3,580	\$ -7,426	\$ -1,144	\$ 20,080
	<b>Gross PV cost</b>	\$ -38,119	\$ -10,118	\$ -28,783	\$ 24,164	\$ -9,198	\$ -110,382
<b>Net Present Value (NPV)</b>		\$ 123,069	\$ 30,288	\$ 86,798	\$ 80,147	\$ 28,718	\$ 349,020
<b>CBA Ratio</b>		4.23	3.99	4.02	4.32	4.12	4.16



## 6. SENSITIVITY ANALYSIS

Three scenarios have been constructed in the model to conduct sensitivity testing. The parameters used in the scenarios are denoted in Table 4, according to:

- **Central scenario.** This is the most likely scenario regarding the deployment of biometrics and associated costs and benefits incurred for each sector. All results reported in this report reflect the central scenario.
- **Optimistic scenario.** A more optimistic consideration (upper-bound) of the potential benefits and costs incurred from the STJ concept for each sector.
- **Pessimistic scenario.** A more conservative scenario considers the lower-bound of benefits and upper-bound of costs for each sector.

**Table 4: Scenarios used for sensitivity testing**

Variable	Parameter	Pessimistic scenario	Central scenario	Optimistic scenario
Technology cost	Low		Selected	Selected
	High	Selected		
Technology benefit	Low	Selected		
	Central		Selected	
	High			Selected
	Low			
Discount rate	Central	Selected	Selected	Selected
	High			
Deployment rate	Low	Selected		
	Central		Selected	
	High			Selected
	Low		Selected	Selected
Uncertainty scoring	High	Selected		
	Low		Selected	Selected
Maturity factor	Low		Selected	
	Central	Selected	Selected	Selected
	High			

The analysis suggests the model is not overly sensitive to any single input parameter, though a change of all parameters in any one direction will have a considerable effect on the final results. The results of both the optimistic and pessimistic scenario are reported in Table 5. Under all scenarios, the benefit to cost ratios always exceed one which means implementation of the STJ concept is always considered cost effective.

The pessimistic scenario considers that the overall benefits from the STJ might be lower and the costs of implementation higher. The optimistic scenario is converse to this. Under the pessimistic scenario, the CBA ratios range from 10.4 for cruise to 1.6 for hotels globally. Regionally across all sectors, they range from 1.8 to 2.1. Under the optimistic scenario, the CBA ratios range from 33.6 for cruise to 4.8 for hotels globally. Regionally and across all sectors, they range from 5.2 to 6.1.

Table 5: CBA ratios from the sensitivity analysis

		Sensitivity analysis – CBA ratios					
		Period 2020 to 2050					
		North America	South America	Europe	Asia Pacific	Middle East & Africa	Global
		Ratio	Ratio	Ratio	Ratio	Ratio	Ratio
<b>Pessimistic Scenario</b>							
1	Cruise	10.8	10.4	9.7	11.1	9.9	10.4
2	Hotels	1.7	1.6	1.6	1.7	1.6	1.6
3	Car rental	2.9	2.7	2.8	2.9	2.7	2.8
	<b>Aggregated</b>	1.9	1.8	1.8	2.1	1.8	1.9
<b>Central Scenario</b>							
4	Cruise	28.2	28.1	26.2	29.0	26.8	27.7
5	Hotels	3.9	3.9	3.8	4.0	3.9	3.9
6	Car rental	4.7	4.5	4.6	4.7	4.5	4.6
	<b>Aggregated</b>	4.2	4.0	4.0	4.3	4.1	4.2
<b>Optimistic Scenario</b>							
7	Cruise	34.2	34.0	31.7	35.2	32.4	33.6
8	Hotels	4.8	4.8	4.7	4.9	4.7	4.8
9	Car rental	8.4	8.1	8.2	8.4	8.0	8.3
	<b>Aggregated</b>	5.7	5.2	5.3	6.1	5.4	5.6





## 7. CROSS-CUTTING AVIATION

Given the interconnectivity between the sectors within the scope of this report, we discuss our findings with reference to a previous CBA focused on the economic impacts of the STJ in the aviation context. The key findings of the economic analysis Atkins conducted for IATA's One ID initiative is therefore incorporated within this report. It presents:

- the potential scale of the case across all major travel sectors;
- contextualises the comparative opportunity for stakeholders in cruise, hospitality and car rental; and
- highlights the ongoing need for all sectors to collaborate to drive research and testing of solutions, progress towards data standards and to lobby government to legislate and invest themselves in the interest of all stakeholders.

### 7.1. Cross-Cutting Results

The two models' 30-year forecasts for implementing STJ (One ID and STJ) suggest a combined NPV of \$967 billion to the main traveller processing stakeholders across the travel sector. In all sectors the greatest benefit values come from improvement to traveller experience, as a result of time saved or as manifested in increased bookings.

The NPV within aviation calculated was nearly two-thirds of the total at \$618 billion compared to the \$349 billion NPV across car, hotel and cruise sectors for STJ adoption. A significantly larger absolute NPV in aviation may suggest a stronger case for airlines and airports to drive investment in the solutions which underpin One ID.

The global annual sectors' revenues baselined in the first year within the respective models show incomes of:

- Aviation (airline and airports): ~\$1.1 trillion per annum
- Car rental, Hotel and Cruise: ~\$0.7 trillion per annum

The relative sector sizes show that aviation constitutes 61% of the total modelled sectors' revenues and receives 64% of the total net benefit from investment in One ID/STJ suggesting an almost equally strong case for investment by hotel, cruise and car rental companies.

However, further analysis of the sectors benefit cost ratios shows that investment returns \$15.4 for every \$1 in cost in aviation and 'just' \$4.16 per \$1 spent in the other sectors.

This gulf in Return on Investment could be down to:

- Identity transactions are believed to drive a larger proportion of costs in an aviation context than others so benefits here may outstrip those attainable in the other sectors.
- Benefits within the IATA One ID CBA were calculated using a different approach (see Section 7.1) which has attributed a greater value.
- Costs are much greater in the STJ model than the One ID model. The cost of implementing in the aviation sphere could be lower because:
  - o The existing physical and technology infrastructure in place in airports and airlines is more adaptable to identification and similar functions than in hotels, car rental drop-offs and cruise ships and terminals
  - o The number and variety of types of properties across car rental and hotels is significantly greater than for aviation. Although the unit price of implementation per property would likely be higher at most airports, there will be fewer overheads.
  - o Standards are already in place to facilitate cross-organisational data sharing in an aviation context, whereas the STJ sectors are characterised by proprietary solutions which are difficult to change at scale. The economic modelling helped IATA to pinpoint the importance of standardisation through semantics, data models and open API approaches – a big shift from the operating models and degrees of collaboration that car rentals and hoteliers are used to. Cruise operators have more in common with airlines in this sense so are expected to have comparatively lower costs of implementation.
  - o Aviation organisations had already spent significantly by the time the CBA for One ID was conducted, generally this is not the case for cruise, car or hotel organisations.

o Progress within aviation deployments in the intervening 15 months may have tempered optimism around costs associated with STJ implementation.

## 7.2. Limitations and Caveats

The models have some difference which should be considered when comparing and, especially, compounding the two sets of results.

- Time has passed since the construction of the IATA model. Economic outlook data contributing to the baselines will have changed in the period between the IATA work and this modelling for WTTC.
- Benefits in the One ID model were attributed to both the operating organisations (airports and airlines), but also to passengers through time saving which was economically quantified. 69% of the benefit was said to sit with the passenger, so is likely to be an impactful point of difference
- This STJ model quantifies the benefits to organisational entities only, with the benefit in time savings and other experiential improvements associated with an assumed higher propensity to book more trips or stays. The approach taken with IATA would therefore have generated higher benefit value as the traveller will receive the benefit from every second of time saving whereas an organisation could only hope to convert a proportion of time saved into further revenue
- Both models make various assumptions regarding the model parameters (e.g. deployment rate of technology, likely benefits, discount rate, etc.). While some of these assumptions are fixed across both models (e.g. discount rate) most vary due to different context.





## 8. CONCLUSIONS AND RECOMMENDATIONS

### 8.1. Conclusions

The analysis identified clear benefits across all sectors which could be effectively evaluated in future stages of work. A significant benefit will be accrued directly by travellers themselves (through time savings, improved travel experience, and improved access to services and additional products and functionality). On the demand side, this report has focused on how benefits directly accrued to travellers may result in improved revenues for firms. On the supply side, we have explored how stakeholders may reduce their operational costs through the STJ concept.

The headline conclusions are:

- The STJ concept is likely to be cost beneficial across all sectors and global regions. This does not change even under a more pessimistic forecast scenario.
- The highest proportion of benefits derived from the STJ are associated with improved and more rapid identification functions. Broadly this benefit can be quantified across sectors as an improvement to customer satisfaction (that results in more or repeated bookings) and an operational cost saving (e.g. reduced staff payroll).
- The cruise sector has the highest NPVs, followed by car rental and then hotels. However, in nominal terms the hotels sector derives the greatest overall benefit.
- From a regional context, North America and Europe will experience the greatest aggregate benefits from the STJ.
- The marginal cost of additional technology functions (real time data sharing and consumer preferences) are considerably lower than for identification. This is largely a result of the cost of core infrastructure associated with the STJ deriving from the identification stage.
- The cost of deploying biometric technology is likely to decrease over time with an increase in demand. Equally, the benefits are likely to be more pronounced with a coordinated deployment effort across sectors.
- Identifying travellers using biometrics and sharing itinerary data across institutions are the most important components underpinning the STJ.

During stakeholder interviews and workshops there was considerable uncertainty regarding the tangible benefits that may be attained from the STJ and their quantification. It is equally unclear how the cost of deploying the STJ concept may also vary over time. For instance, the role of IDaaS (Identity as a service) type revenue models may change considerably over time and this is likely to impact the STJ concept. We have attempted to account for such uncertainty in our estimates through both sensitivity testing in the model and a conservative approach to benefit and cost estimation. Results in this report therefore represent the lower-bound range of the reporting spectrum.

Within the model, various assumptions are made (see Section 2.2) regarding the costs and benefits associated with the STJ. These assumptions relax some real-world complexity and factors external to the model that would likely impact the STJ. For instance, the assumed role of the aviation sector in the STJ. These assumptions should be considered when interpreting our estimates.

The model has been constructed so it can be updated in the future with revised input data (e.g. updated sector cost and revenue forecasts) and parameter estimates (e.g. a refined benefits matrix). Such updates should be relatively simple to incorporate into the model architecture. Given the long-run forecasting period, future updates would provide further validity to the findings and reflect changes to long term outlooks.

### 8.2. Next steps

**Continued support of the Programme:** Given the positive outcome from the economic analysis, the WTTC should continue to support the travel and tourism sector as a whole in its efforts to adopt the innovative technologies and ways of working which enable the STJ.

**Benefits to travellers and governments should be quantified:** Net benefits calculated in this analysis sit with the industry operators. Further consideration of the advantages of Seamless Traveller Journey to travellers themselves and governments

which set the legislative agenda necessitating much of the identity-related processing of travellers should support the WTTC and industry in its attempts to encourage adaptation of regulation to unlock the value identified in this analysis.

**WTTC will continue engage governments and promote the introduction of a consistent regulatory landscape:** Governmental engagement is critical due to the regulatory attitude towards digital identity and data privacy across sectors. The ability to make processes more seamless is not necessarily constrained by identity solutions, but by a non-uniform regulatory landscape that varies by region and sector.

**WTTC will encourage the adoption of solutions and standards which are interoperable for all stakeholders:** Data standards and collaboration are essential enablers to unlocking additional benefits (in the form of a cross-travel modality seamless experience) not captured in this economic analysis. IATA has made gradual progress towards setting standards for identity management in an aviation context but has a more formal remit and history of collaborative behavior amongst its members than in the sectors subject to this analysis.

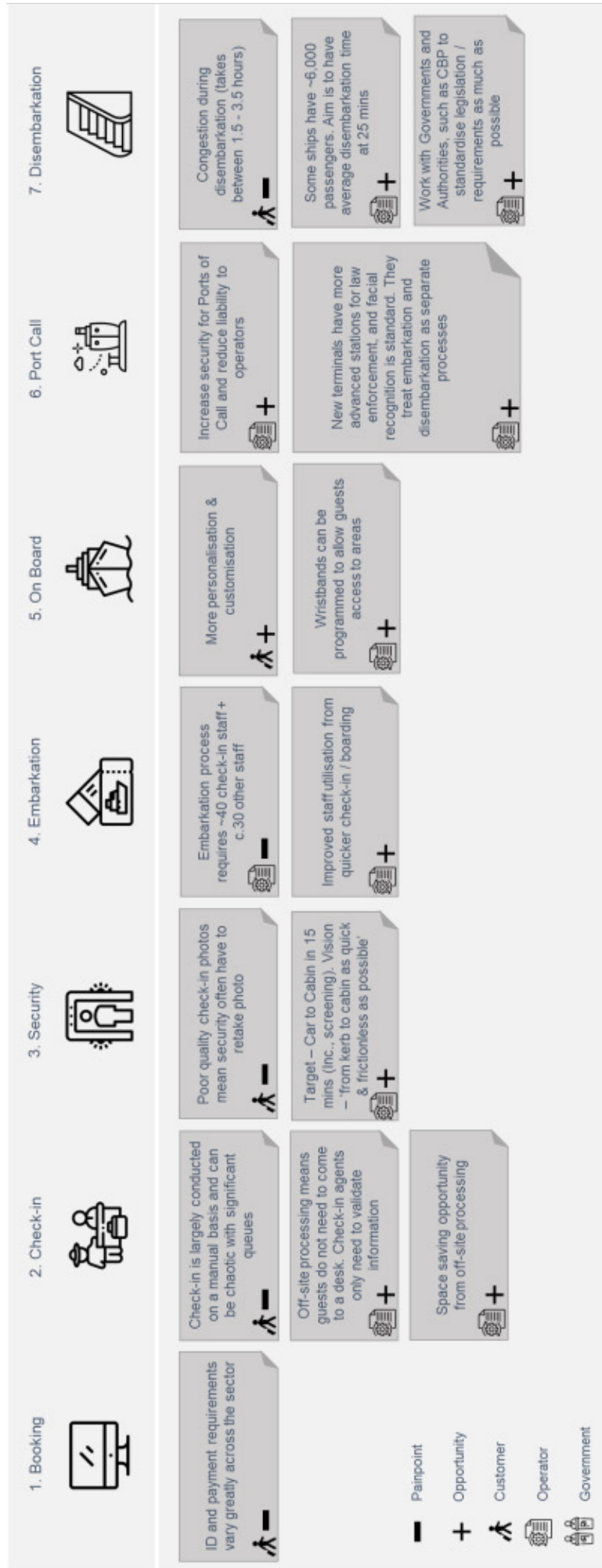
**WTTC will facilitate the introduction of trials to demonstrate potential technologies and prove the costs and benefits identified in this CBA:** A lesson learned from the aviation sector's early progress in One ID has been the use of trials and technology demonstrators involving passengers. Moving forward, some trials will be necessary to demonstrate the actual costs and benefits to sectors from adopting the STJ concept. This could consist of integrated deployment of biometric technology and other enablers across pilot sites for the cruise, car rental and hotel sectors. A pilot programme would yield further insights in terms of the actual costs of deployment, realistic deployment rates and the likely benefits of a scaled-up approach. The pilot will help validate some of the assumptions taken within the model, including the benefits matrix.



# APPENDICES

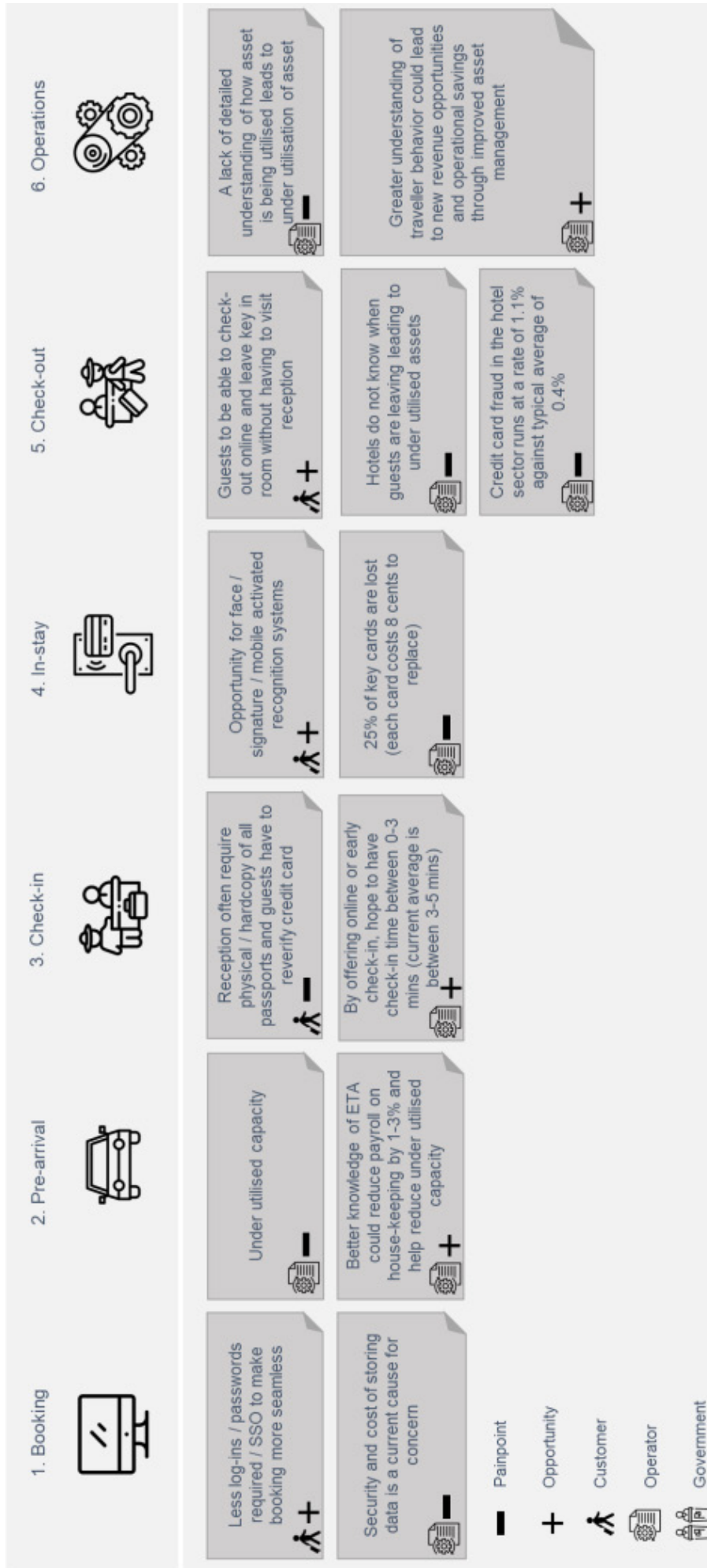
## A.1. PROCESS MAPS

### CRUISE

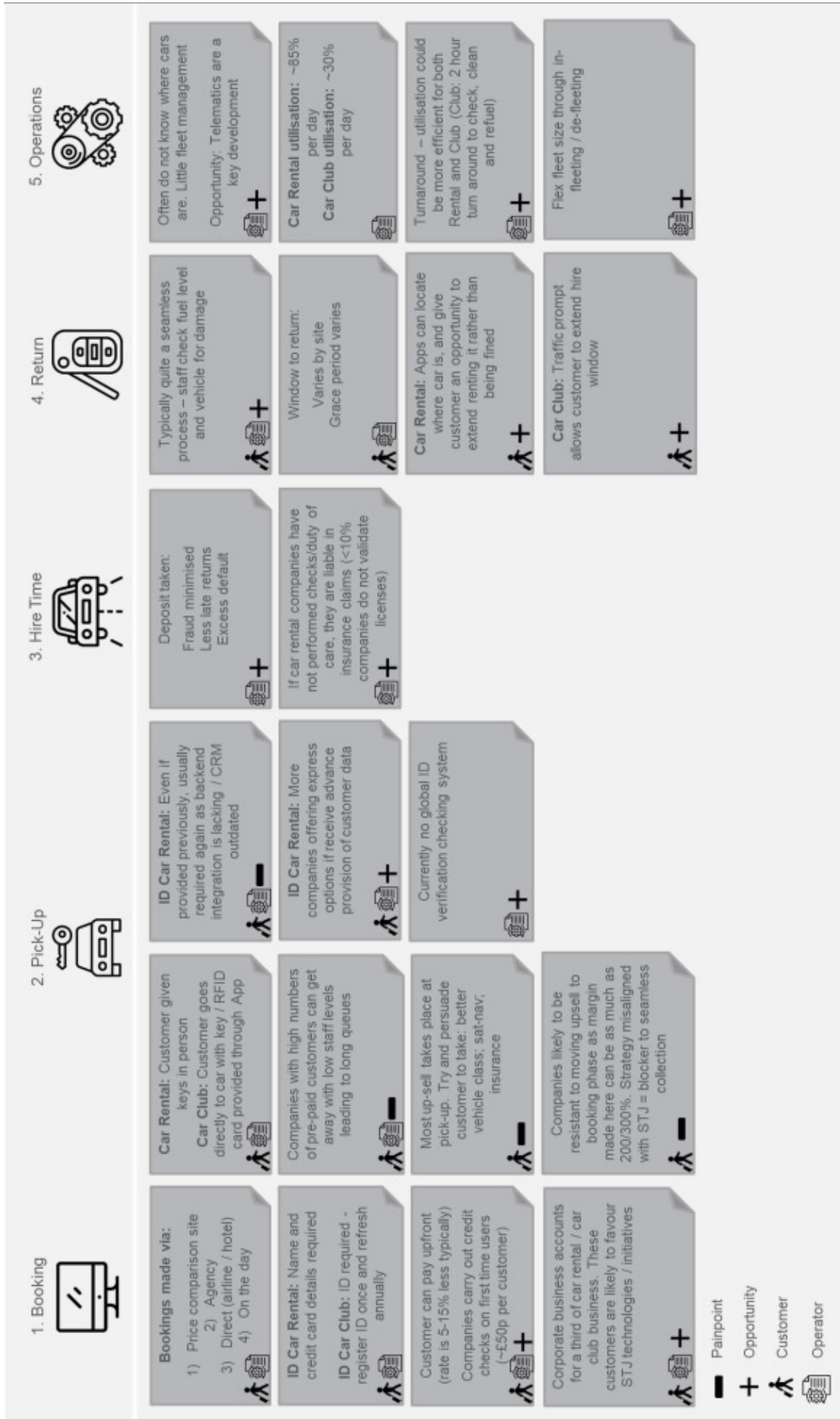




HOTELS

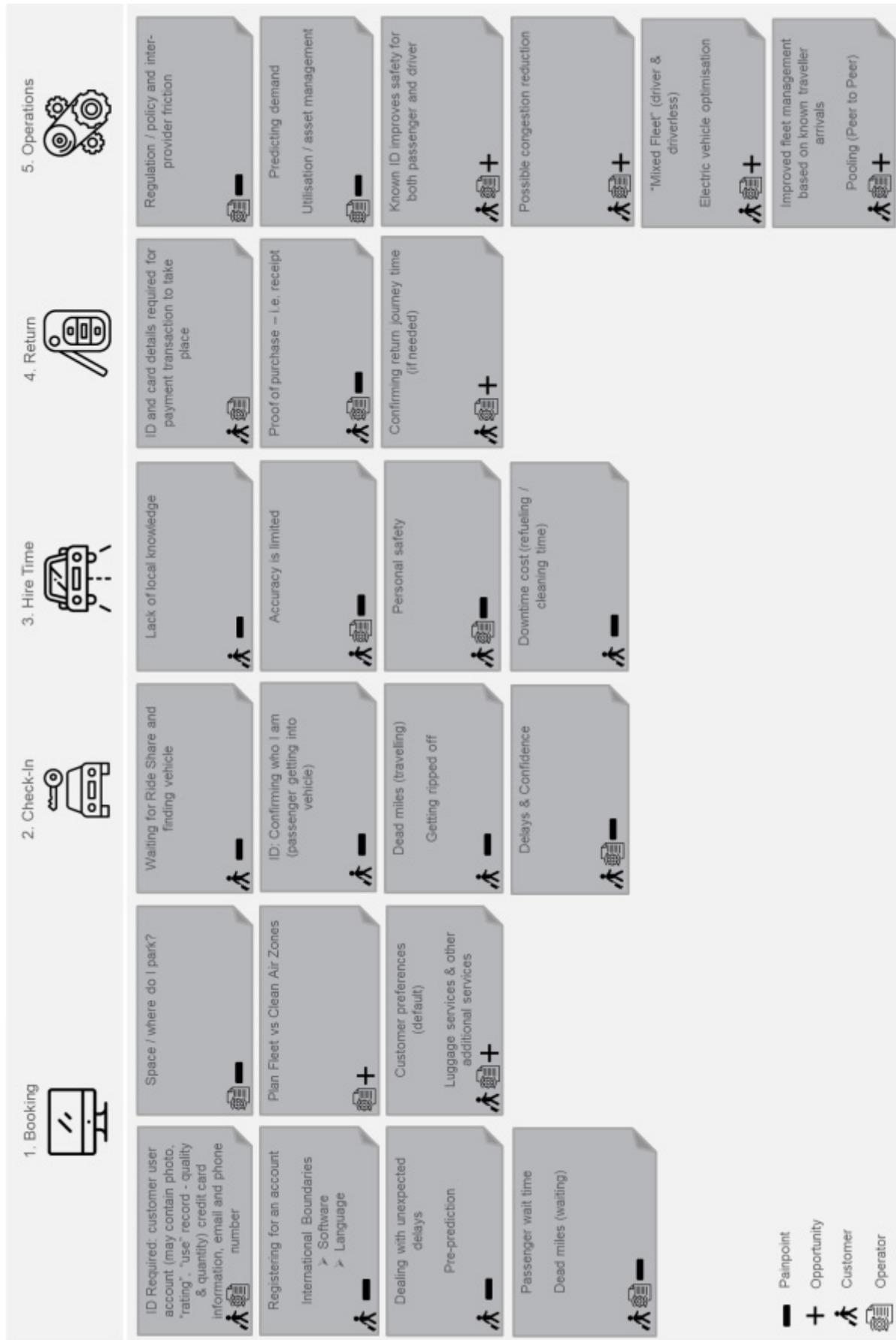


CAR RENTAL / CAR CLUB





RIDE SHARE/RIDE HAIL



## A.2. DETAILED LIST OF SECTOR BENEFITS

Sector	Impact	Benefit factor
Cruise	Lower staffing cost due to operations streamlining as a result of biometrics.	Lower payroll costs.
	Disembarkation time is reduced from 2.5 hours to 20 minutes due to biometrics. More returning customers due to greater satisfaction linked with streamlined operations	More customer bookings.
	Generation of additional revenue due to more up-selling and cross-selling conversions.	Opportunities for personalisation and customisation.
Hotel	More returning customers due to greater satisfaction linked with streamlined check-in and check-out.	More customer bookings.
	Less reliance on credit cards for holding room deposits.	Reduced card holding fees.
	Reduction in requirement for purchasing replacement key cards for room access.	Lower room key card spend.
	Reduced number of fraudulent payments from credit cards due to biometric authentication.	Less prevalence of fraud.
	Lower staffing cost due to operations streamlining (e.g. seamless check-in).	Lower payroll costs.
	Better knowledge of customer ETA could reduce under utilised capacity.	Optimisation of estate management.
	Generation of additional revenue due to more up-selling and cross-selling conversions.	Opportunities for personalisation and customisation.
Car Rental	More returning customers due to greater satisfaction linked with streamlined operations (e.g. check-in).	More customer bookings.
	Improved identification powers associated with biometrics results in reduced cost attributed to vehicle theft through fraudulent rentals.	Less prevalence of fraud.
	Lower staffing cost due to operations streamlining (e.g. seamless check-in).	Lower payroll costs.
	Better knowledge of customer ETA could optimise utilisation of rental assets.	Optimised car utilisation.
	Better knowledge of customer ETA means allocation of vehicle storage can be optimised.	Reduced fleet storage cost.
	Generation of additional revenue due to more up-selling and cross-selling conversions.	Opportunities for personalisation and customisation.

### A.3. CONSOLIDATED BENEFITS MATRIX

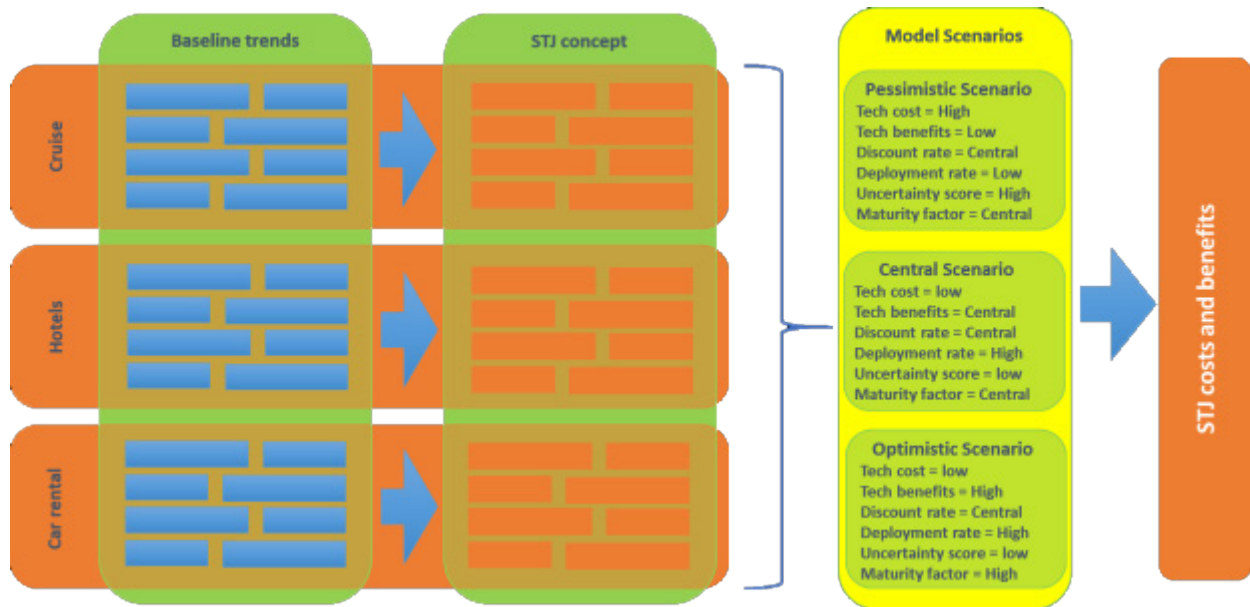
Tech function	Benefit factor	Impact		Magnitude		Monetary impact	
		Value	Metric	Value	Metric conversion	Value	Monetary metric
Identification		3.3%	Reduced annual payroll on staff	10%	Payroll in total annual costs	0.6%	% change in total annual costs
Identification		3.3%	Increase in customer bookings	88%	Customer bookings in annual sales revenues	2.9%	% change in total annual revenue
Consumer preferences		11.6%	Increase in cross-selling or up-selling conversions	11%	Cross-selling and up-selling in annual sales revenues	1.2%	% change in total annual revenue
Identification		3.3%	Increase in customer bookings	88%	Customer bookings in annual sales revenues	2.9%	% change in total annual revenue
Identification		99.6%	Reduction in incurrence of credit card fees	2.0%	Total cost is incurred due to card transaction fees	2.0%	% change in total annual costs
Identification		99.6%	Reduction in issuance of key cards	0.3%	Spend on key cards in annual costs	0.3%	% change in total annual costs
Identification		99.6%	Reduction in credit card fraud	0.2%	Lost total revenue as a result of card fraud	0.2%	% change in total annual revenue
Identification		3.3%	Reduced payroll (based on front & back office staff)	2.6%	Payroll in total annual costs	0.8%	% change in total annual costs
Real time data sharing		0.1%	Increase in room occupancy rate	88%	Impact of occupancy rate on annual revenues	0.1%	% change in total annual revenue
Consumer preferences		11.6%	Increase in cross-selling or up-selling conversions	11%	Cross-selling and up-selling in annual sales revenues	1.2%	% change in total annual revenue
Identification		3.3%	Increase in customer bookings	88%	Customer bookings in annual sales revenues	2.9%	% change in total annual revenue
Identification		99.6%	Reduction of car theft	0.1%	Total annual cost attributed to stolen vehicles	0.1%	% change in total annual costs
Real time data sharing		3.3%	Reduced annual payroll on staff	88%	Payroll in total annual costs	2.9%	% change in total annual costs
Real time data sharing		0.6%	Increase in asset utilisation rate	88%	Impact of utilisation rate on annual revenues	0.5%	% change in total annual revenue
Real time data sharing		22.6%	Cost reduction for vehicle storage off-site	1.1%	Vehicle storage costs in annual costs	0.2%	% change in total annual costs
Consumer preferences		12.6%	Increase in cross-selling or up-selling conversions	11%	Cross-selling and up-selling in annual sales revenues	1.3%	% change in total annual revenue

Note: Colour coding reflects uncertainty in parameter estimates

## A.4. DETAILED ECONOMIC METHODOLOGY

### Estimating benefits

The benefits model was constructed according to the estimation of a sector baseline (based on revenues and costs) and alternative scenario featuring the STJ concept. In this approach (see Figure 20), the STJ concept is adopted for each sector though the application of a benefits matrix. The model can be adjusted according to three scenarios (pessimistic, optimistic and central). In these scenarios, some model assumptions are either relaxed or constrained. The final reporting of the provides a regional breakdown of Present Value (PV) costs and benefits and Net Present Values (NPVs).



**Figure 20: Overarching approach taken to model the STJ concept**

The benefits of the STJ were forecast for each region and sector. The forecast uses sector-specific revenues and costs and combines them with the monetary impact parameters from the benefits matrix to project a stream of future benefit cash flows from 2020 (base year) to 2050. Future cash flows were discounted using a fixed discount rate of 7% over the period in the central scenario<sup>28</sup>. Here, the discount rate represents the Weighted Average Cost of Capital (WACC) for each sector that would likely be used by the companies when budgeting for a new investment.

Note - the monetisation of benefits considers the economic value of time savings through an increase in customer satisfaction. The model does not directly value time savings since such savings result in an indirect benefit to the sector. The benefit to a customer through a time saving is only advantageous for the sector when it results in increased revenues (i.e. additional bookings). A benefits matrix was developed to capture and record the benefits of STJ for each of its stakeholders, elements and categories. The process maps compliment the construction of the benefits matrix, with the various pain points and opportunities for process optimisation mapped across the touchpoints for each sector. Identified benefit was allocated to one of three technology functions' ('Identification', 'Real time data sharing', 'Consumer preferences').

Benefits assigned to the 'Identification' function of biometrics are the most likely to be realised, since this is the core role of biometric technologies. This is driven by emergence of novel identity as a service business model<sup>29</sup>. Ancillary functions associated with the technology include benefits assigned to 'Real time data sharing' and 'Consumer Preferences'. Both facets are less likely to be realised since the legalities and regulations around data sharing and particularly customer data make the benefits more challenging to attain.

<sup>28</sup> The discount rate is the interest rate used to determine the present value of future cash flows in standard discounted cash flow analysis.

<sup>29</sup> Slamanig, D., Stranacher, K. and Zwattendorfer, B., 2014. User-centric identity as a service-architecture for eIDs with selective attribute disclosure. In Proceedings of the 19th ACM symposium on Access control models and technologies (pp. 153-164).

Benefits were linked to six processes common to each sector (Booking and Sales, Check-in/embarkation, Consumption/use, Check-out/disembarkation, Operations and security). The benefits forecast can therefore be reported according to each benefit factor, technology function and process. As the sectors develop, this matrix can be further refined, whether adjusting some of the parameter estimates (such as the accruing of benefits across processes) or refining the input data used for the analysis (such as alternative revenue and cost forecasts).

Sensitivity testing functionality was embedded in the model. A dashboard was constructed for user interaction and reporting the results. The dashboard features a range of parameters that can be toggled for sensitivity testing of the model. A description of the toggles is provided in Table 6. A capital balance sheet is reported for the final results for all sectors and regions. In addition, a series of sub-tables are also constructed for alternative results reporting alongside accompanying graphical visualisation.

**Table 6: Parameters used in the model for sensitivity testing**

Variable	Toggle	Description
Technology cost	Low	The technology cost is estimated according to either a 'low' or 'high' scenario. A low scenario is a least cost approach to deployment of biometrics, where the technology will be deployed in central areas only (e.g. lobby and reception areas). A high scenario assumes wider scale deployment of biometrics according to each individual asset (e.g. cameras on hotel room doors, cruise cabins and rental cars).
	High	
Technology benefit	Low	The technology benefit estimates used in the benefits matrix are adjusted according to either a 'low', 'central' or 'high' benefit scenario. An adjustment is made in the benefits matrix to account for changes in the technology impacts. The low and high scenarios are a +/- 10% change in benefit streams.
	Central	
	High	
Discount rate	Low	The rate of discount rate is adjusted using scalars according to either a 'low', 'central' or 'high' scenario. The rate ranges from 5%, 7% and 9% according to the scenarios.
	Central	
	High	
Deployment rate	Low	The rate of deployment is adjusted using scalars according to either a 'low', 'central' or 'high' scenario. The scaling is adjusted by +/- 10% according to the low and high scenario.
	Central	
	High	
Uncertainty scoring	Low	An uncertainty score of 'low' and 'high' can be applied to the benefits matrix to account for uncertainty in the estimation of input parameters used in the matrix. A 'low' score scales the benefits estimates by 10% while a 'high' score scales the benefits by 20% and provides a more conservative estimate.
	High	
Maturity factor	Low	A maturity factor adjusts the rate of technological maturity that reduces the capital cost of biometric deployment. A 'low' or 'high' maturity factor changes the rate of market maturity by +/- 5%. A 'high' maturity factor assumes the technology matures more rapidly which reduces deployment cost.
	Central	
	High	

### Estimating costs

To evaluate the proportion of the total annual cost spent on the identification technology function, we considered two approaches – an average based cost approach (used in the model) and a unit-based cost approach (as a sense check). Here, we report the approach used for estimating cost using the average based approach.

Two cost scenarios, low and high, were created to consider uncertainty surrounding how the costs associated with identification tech function will transpire over time. The scenarios are described below:

- 1. Low scenario.** Biometrics deployed in reception / lobby areas.
- 2. High scenario.** Biometrics deployed in reception/lobby areas and on all assets (hotel rooms, cruise cabins and rental cars).

Cost estimations for an average hotel were extrapolated to cruise and car rental sectors based on cost estimates described in (Ramkhelawan, 2015) for hotel IT infrastructure<sup>30</sup>. The various components of the IT cost, including both hardware and software, are provided in this study for a typical five-star hotel with 220 rooms. The cost for each approach is broken down into CAPEX, OPEX and a transaction cost. The CAPEX and OPEX estimates are expressed in the model as a function of overall sector cost.



The average hotel cost values from the paper serve as the overarching evidence base for calculating the annual cost associated with the identification technology function. These costs are extrapolated to the cruise and car rental sectors. It was assumed that any capital investment has an asset life of 5 years<sup>31</sup>, and a recurring CAPEX equal to a third of the respective initial CAPEX will be incurred to renew assets. The four-cost metrics and their payment periods are presented in Table 7.

**Table 7: Cost metrics and payment periods**

Cost metric	Payment period
Initial CAPEX	Initial investment – pay once
Recurring CAPEX	Every 5 years
OPEX	Annually
Transaction cost	Cost per transaction

In the low-cost scenario, for each cost metric, the identification cost per room was calculated by deriving a unit cost per room for an average hotel, using the assumption that a hotel room, a cabin in a cruise ship and a rental car are equivalent units for the purpose of cost estimation.

To account for variation in the cost of installation and maintenance of solutions a scale factor was applied to the cost estimate to reflect the potential change in unit cost according to the size of asset hotel, branch or cruise ship. The scale factor essentially adjusts for economies of scale. An assumption was made that a 10% change in the number of units (rooms/cabins/cars) in a hotel property/cruise ship/car rental branch results in a 1% change in the unit cost for all CAPEX and OPEX<sup>32</sup>. The scale factor was capped at 20%.

For the hotel sector, an average hotel size of 220 rooms was assumed; therefore a scale factor of 0% was applied to the cost per room (since this is the base case). For the cruise sector, it was assumed that each cruise ship has 1500 cabins, and a scale factor was applied to reduce the cost of implementation per ship by 20% (capped). For the car rental sector, a fleet size of 65 rental vehicles was assumed, which gives a scale factor that raises the cost of implementation per branch by 7.05%. CAPEX and OPEX estimates were calculated in absolute terms and as a proportion of company cost from the annual report analysis. In the high-cost scenario another cost element, biometric identification device per cabin, is added to the unit cost.

The total CAPEX of the identification function for a typical hotel with 220 rooms is \$120,540, giving a CAPEX per room of \$548. Results suggest the proportion of the total annual cost spent on the identification-related infrastructure varies significantly across the sectors. The identification cost occupies a much smaller percentage of the total annual cost in the cruise sector than for other sectors, reflecting higher operational costs in the sector (e.g. fuel). The costs of other two technology functions, real-time data sharing and consumer preferences, were determined using the assumptions set out in Table 8.

**Table 8: Cost metrics and calculation assumptions for real time data sharing and consumer preferences**

Tech function	Metric	Calculation
Real time data sharing	CAPEX	Assumes an additional 5% cost beyond Identification CAPEX.
Real time data sharing	OPEX	Assumes an additional 5% cost beyond Identification OPEX.
Real time data sharing	Transaction	Assumes an additional 25% transaction cost beyond Identification transaction cost.
Consumer preferences	CAPEX	Assumes an additional 5% cost beyond Identification CAPEX.
Consumer preferences	OPEX	Assumes no additional OPEX.
Consumer preferences	Transaction	Assumes an additional 25% transaction cost beyond Identification transaction cost.

<sup>30</sup> Ramkhelawan, S., Cadarsaib, Z. and Gobin, B., 2015. Cloud Computing as an Alternative for on-Premise Software for Mauritian Hotels. Lecture Notes on Software Engineering, 3(2), pp.113-119.

<sup>31</sup> Assumption based on biometric technology assets lifecycle

<sup>32</sup> This assumption is evidenced by the review of global trends in digital market and consultations with domain experts

### A.5. Detailed economic costs

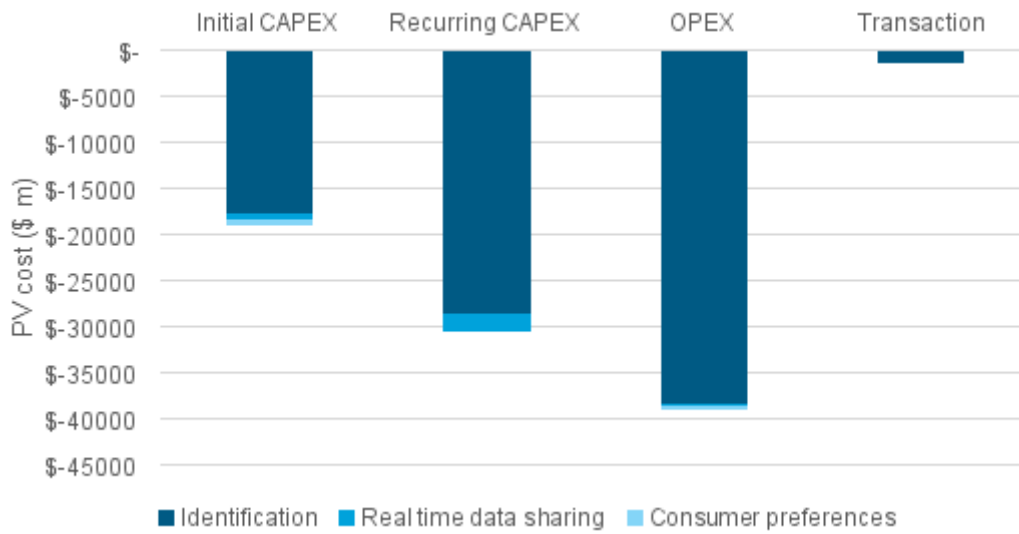


Figure 21: Global PV cost for the cruise sector

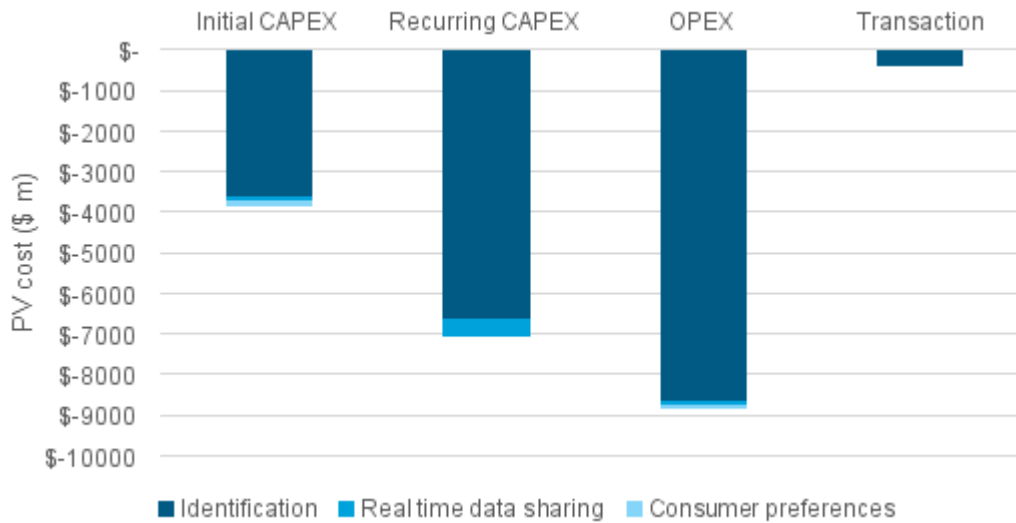


Figure 22: Global PV cost for the car rental sector

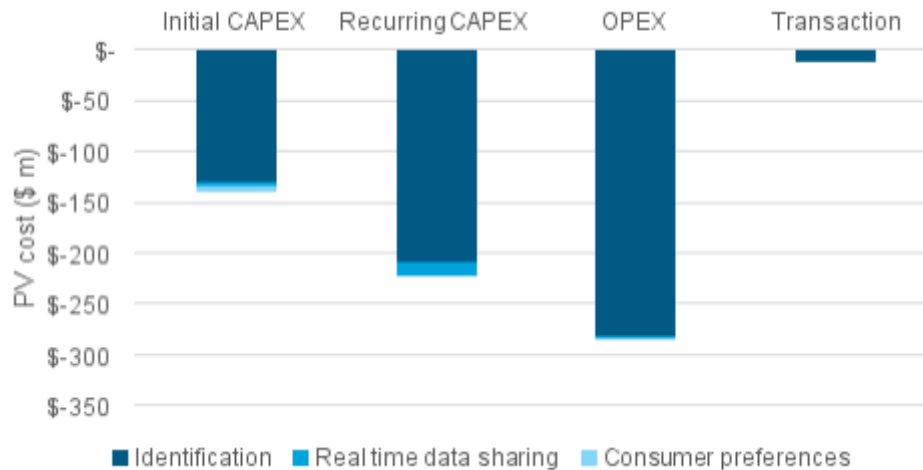


Figure 23: Global PV cost for the cruise sector

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