Here, there and everywhere

Digital Reinvention in travel

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Reimagining the enterprise

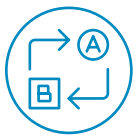
People feel deeply emotional about travel. While banking, shopping and similar experiences are important and personal, discussions about miles, suite upgrades and boarding privileges tend to strike a deeper cord. Over the past 20 years, the global travel industry has been at the vanguard of digital innovation. And it is also leading the way in terms of ecosystem evolution. But the industry's technological leadership has become a two-edged sword. By leading with experience, the industry has conditioned its customers to expect experience leadership. And customer expectations are destined to become more comprehensive and demanding. By embracing the philosophy of Digital Reinvention,™ the travel industry can work to sustain its momentum by meeting and eventually exceeding travelers' most personal aspirations and deepest desires.

New challenges, new opportunities

Whether due to the astounding success of customer affinity programs or, perhaps, because of something unique about the travel experience, people have deeply personal feelings about how they move from place to place. At the same time, since the commercialization of the Internet in the 1990s, the travel industry has been a clear leader in digital adoption and disruption. Through its drive to rapidly adopt technology for operations and processes, new products, services and experiences, and paradigm-shattering business models, the travel industry has led the way.

And the pace of change in global travel is only increasing. Innovation from across the technology spectrum continues to reshape the industry. For example, industry leaders such as Airbus have embraced 3D-printing technology to improve tooling, prototyping and part-making – initially for high-complexity, low-scale items, but increasingly for lower-complexity, higher-scale components.[1] Air France-KLM now provides a personal digital travel concierge, powered by artificial intelligence (AI), to select customers.[2] Global hotel chain Marriott is using virtual reality (VR) to help customers enjoy intimate travel stories about unique destinations around the world from the safety and comfort of their own homes.[3] And Japan-based Henn-Na Hotels now employs intelligent robots to carry luggage, staff luggage lockers and provide housekeeping services.[4]

Using cognitive computing and AI, global hotel chain Hilton is piloting a service named "Connie" to engage with guests about topics such as local tourist attractions, dining recommendations and hotel features.[5] And the Sydney Airport in Australia is employing predictive analytics to help reduce parking congestion, improve passenger lounge access and optimize flow-through in its duty-free shops.[6] Another Australian travel business, Webjet, is transforming the way hotel bookings are made using blockchain technologies, which can increase transparency, security and accuracy.[7] And Thomson, the UK's largest tour operator, is trialing a new chatbot tool using natural language processing (NLP) capabilities to engage with tourists in and around the travel experiences.[8]



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Half

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57 percent

of surveyed travel industry executives say that competition from new and unexpected sources is beginning to impact their businesses

This confluence of technological innovation is creating both new challenges and new opportunities for the travel industry. As with other industries, including retail, customers of travel services are demanding more comprehensive and consistent experiences.

The transaction-oriented travel solutions of the past are ceding to a model based on experience. And the travel industry is not alone in embracing this trend. In the automotive industry, for example, leading manufacturers such as Ford Motor Company are adapting their business models, shifting focus away from vehicle sales and toward anytime-anywhere mobility.[9] In the travel industry, companies such as Tui Travel in the UK are also aggressively advancing an experience-oriented business model, offering comprehensive travel experiences from transfers to meals to Tui-branded aircraft and accommodations.[10]

As customers grow accustomed to such individualized arrangements, they are becoming less tolerant of both inconsistency and imposition. Travel customers now expect streamlined processes, convenient self-service options and one-of-a-kind experiences. And they are willing to quickly shift buying behaviors and preferences if they do not get what they are seeking.[11]

Additional industry disruption remains a very real possibility and a lingering threat.[12] Indeed, new entrants continue to leapfrog established travel businesses by applying new digital technologies in innovative ways. Organizations like Onefinestay and Airbnb, for example, make it much easier to book someone's home instead of a traditional hotel room.[13] Lola, a new mobile travel service, combines chatbots and agents to help travelers book and troubleshoot trips, disintermediating Internet businesses that once disintermediated traditional agents.[14] And Rover, an online pet sitting and dog walking marketplace, efficiently links pet owners with nearby caregivers.[15]

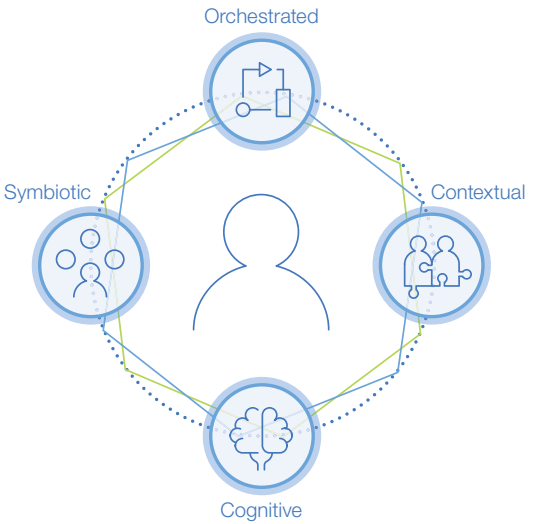
You, me and E2E

Travel executives recognize the continuing disruption and the impact it is having on the industry. In the 2016 IBM Institute for Business Value Global Ecosystem Survey of more than 2,000 cross-industry leaders, conducted in collaboration with the Economist Intelligence Unit, 63 percent of travel executives said that traditional value chains are being replaced with new value models. Half of the travel executives surveyed said that boundaries between the travel industry and other industries are blurring. And 57 percent said that competition from new and unexpected sources is beginning to affect their businesses.[16]

This disruptive environment in which travel executives and their customers find themselves can best be understood within the context of what we call the everyone-to-everyone (E2E) economy. The E2E economy has four distinct elements: It is *orchestrated*, based on business ecosystems that are both collaborative and seamless. It is *contextual*, in that customer and partner experiences are calibrated and relevant to their specific actions and needs. It is *symbiotic*, in that everyone and everything, including customers and businesses, are mutually interdependent. And it is *cognitive*, characterized by data-enabled self-supported learning and predictive capabilities (see Figure 1).

Figure 1

The everyone-to-everyone economy consists of four elements



Source: IBM Institute for Business Value analysis.

Korean Air employs cognitive computing to improve on-time performance and efficiency

Korean Air is using data analytics and cognitive computing to improve operational efficiency and on-time performance. Synthesizing both structured and unstructured data across multiple sources, Korean Air is able to identify and use previously hidden connections that help maintenance crews diagnose and solve problems faster and more accurately. Rather than spend hours diagnosing each issues, technicians can obtain near real-time analysis. Maintenance managers identify trends which can be shared with original equipment manufacturers (OEMs) to guide improvements. Cognitive-enabled initiatives have helped Korean Air successfully reduce maintenance defect lead times by up to 90 percent.[17]

The E2E business environment is deeply digital. And from the earliest days of computerization, with the development of the SABRE booking system in the 1950s, the travel industry has been at the center of digital innovation.[18]

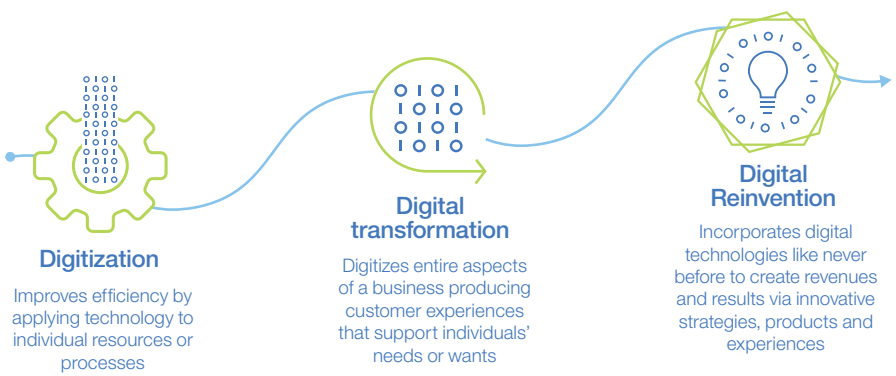
We can think of the travel industry as going through an evolving process in its embrace of digital – from digitization to digital transformation to Digital Reinvention. Within the context of travel, digitization involves setting up digital systems that support processes such as online ticketing – initially SABRE, for example, but evolving into online services in which customers might book directly rather than through traditional travel agents.

Digital transformation in travel goes further, involving integration of digital functions or processes across the enterprise. By combining a set of digital systems and processes, digitally transformed travel businesses can offer their customers both individualized and omni-channel experiences. An example of increasing importance is the ability of travel providers to combine data collected through travel booking sites and personal social media channels to formulate and deliver highly customized vacations.

Digital Reinvention of travel goes even further. Digitally reinvented travel involves a fundamental reimagining of the way an organization operates and engages with customers and other stakeholders with the aid of digital technologies. Digital Reinvention at its most fundamental level reconceives the travel enterprise from a customer-first or customer-centric perspective. Forming or redesigning an enterprise around an ability to most effectively deliver a compellingly unique customer experience, for example, reflects a Digital Reinvention philosophy (see Figure 2).

Figure 2

Digital Reinvention follows a path that starts with digitization and progresses through digital transformation



Source: IBM Institute for Business Value analysis.

There is no box

Digital Reinvention combines multiple digital technologies – including cloud, blockchain, mobile and the Internet of Things (IoT) – to reconceive customer and partner relationships. It involves creation or orchestration of unique, compelling experiences for customers and other stakeholders by way of emergent business ecosystems. And often the most successful digitally reinvented businesses establish a platform of engagement for their customers, acting as enablers, conduits and partners.[19]

Digitally conceived organizations often have an advantage as they undertake Digital Reinvention. Untethered by legacy technologies and a legacy organization, they frequently already possess Digital Reinvention attributes. And many digitally born startups are establishing footholds in traditional markets, putting new competitive pressures on traditional industry leaders.

For example, Koniku, a technology company based in California that specializes in visual processing and data recognition, is building neuron-based computer chips, which may soon find their way into airline and airport security systems to more quickly and confidently identify possible threats. Koniku also plans to employ its neuron-based chips inside drones to improve safety and efficiency.[20]

Winding Tree, one of the first blockchain companies established specifically within the travel industry, is building a decentralized and autonomous marketplace for travel. Winding Tree's open-source protocols for data exchange run on a blockchain and enable open access to a central repository of that data within a shared and distributed ledger system. The company's goal is to reduce the number of travel intermediaries, thereby reducing cost. Winding Tree is already being successfully deployed on several public blockchains.[21]

Massachusetts-based automotive startup NuTonomy makes software that support self-driving cars and autonomous mobile robots. The company launched an autonomous taxi service in Singapore in 2016, where pre-selected members of the public could hail rides using their smartphones. NuTonomy plans to establish a fully self-driving taxi fleet in Singapore by 2018, and has also partnered with the ride-service company Lyft to launch a self-driving car service in Boston in 2017.[22]

And Virginia-based MAG Aerospace, owned by the French firm Zodiac Aerospace, provides state-of-the-art airborne intelligence, surveillance and reconnaissance services. After extensive research and development, MAG Aerospace created an automated sensor system using ultraviolet organic LED (UV OLED) disinfection lights to kill germs in the air and on surfaces within aircraft. The company's automated system is said to kill nearly 99 percent of bacteria, viruses and airborne-based illnesses, lowering passengers' risks of contracting illness while also reducing aircraft cabin cleaning costs.[23]

Royal Caribbean reimagines cruising through digital

Global cruise company Royal Caribbean is transforming into an innovative, high-tech travel industry pioneer. Advancing a wide range of new technology solutions, Royal Caribbean is rapidly building capabilities and expertise around IoT, AI, VR, machine learning, big data and robotics. The company is introducing a range of new features, such as an intelligent personal assistant for passengers, facial recognition for portside check-in, automated security features, robotic bartenders to mix and serve drinks, as well as virtual reality to more efficiently design new ships. Royal Caribbean's WOWband, an NFC-enabled wristband, is already enabling guests to be identified as they check-in before boarding a cruise vessel, track luggage, pay for drinks, book meals and entertainment and move through ships.[24]

Figure 3

The Digital Reinvention operating environment revolves around new experiences

Source: IBM Institute for Business Value analysis.

Readying for reinvention

For successful Digital Reinvention, organizations need to pursue a new strategic focus, build new expertise and establish new ways of working (see Figure 3).

Pursue a new focus

Travel businesses need to continue developing new ways of creating experiences, building ecosystems and monetizing value. Initiatives might include spawning new business models, tapping new forms of financing and developing better, more holistic ways of conducting risk assessments. Leaders will also need to create deep, contextual capabilities.

Build new expertise

Travel firms also should continue digitizing products, services and processes that help merge the physical world with the digital. They can augment initiatives with ever-better predictive analytics, AI and cognitive computing, along with IoT and new forms of automation, to create fully integrated, flexible and agile operating environments that support the individualized experiences expected.

Establish new ways of working

Travel businesses need to identify, assemble and retain the talent necessary to create and sustain a highly digital organization. It will be essential to create and perpetuate innovation-infused cultures that incorporate design thinking, agile working and fearless experimentation.

Adopt a self-funding approach

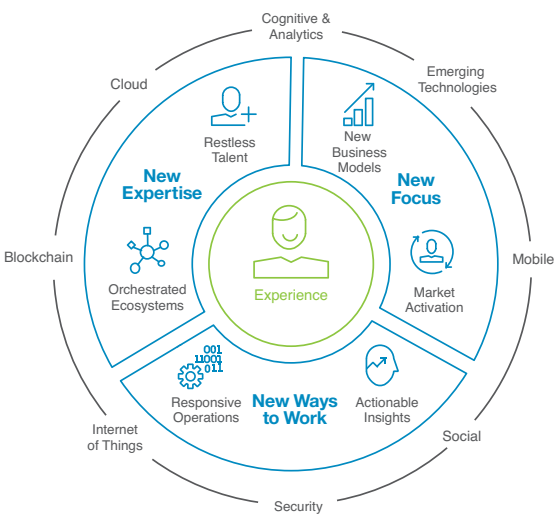
Travel firms should deploy new technologies quickly and in ways that support scalable growth and market share. They will need to use digital tools to optimize existing operations, increasing earnings that can, in turn, be used to fund further innovation and growth. Some have termed this approach “radical cost reduction and efficiency.”

Embrace digital drivers

Travel businesses need to become ever-more proficient in digital technologies. Indeed, they need to become digital leaders. Technology will underpin the creation of any reinvented organization that can build the deep customers experiences required. Rather than incrementalism, Digital Reinvention can provide a path for the most visionary firms to adopt an "experience-first" planning approach, employing the strengths of both ecosystem partners and themselves (see Figure 4).

Figure 4

The Digital Reinvention framework combines the strengths of ecosystem partners



Source: IBM Institute for Business Value analysis.

Tesla conceives new modes of travel with fully autonomous vehicles

Tesla is expanding from car manufacturing into travel solutions. Preparing for a future in which customers will be able to summon cars from anywhere at any time, Tesla is building expertise around AI, IoT and augmented reality, which combines with world-leading expertise in electric vehicles and software design, to produce cars that are redefining how people travel. With minimal to no human intervention, Tesla's autonomous cars, with the aid of cognitive computing, are expected to redefine the very nature of mobility in which Tesla owners will not only see their vehicles as a means of transport, but treat them as profit centers by adding their vehicles to shared fleets.[25]

Surfing the digital wave

To set out on the path toward Digital Reinvention, travel industry leaders can take four initial steps: Envision possibilities, create pilots, deepen capabilities and orchestrate environments.

Step 1: Envision possibilities

Conduct envisioning sessions based on design thinking to produce a definitive reinvention blueprint. For example, through deep conversations and in-depth marketing analysis, develop a better understanding of customer needs, aspirations and desires; brainstorm new ideas to enhance engagement; and visualize unexpected customer scenarios. Incorporate external stakeholders in these sessions, including customers, to encourage thinking that goes beyond business-as-usual.

Step 2: Create pilots

Develop prototypes using agile development, test them with customers and get them to market quickly to promote feedback and iteration. Establish communities of interest to create safe environments to beta test innovations, and incorporate them as a central part of design and development processes.

Step 3: Deepen capabilities

Augment digital capabilities with strategic initiatives, and continue to build and deploy necessary applications aligned to the target Digital Reinvention operating model and ecosystem strategy. As pilots evolve, impediments around development will emerge, highlighting limitations in existing capabilities. Adopt a continuous, iterative strategy to address limitations by building new or extending existing capabilities.

Step 4: Orchestrate ecosystems

Embrace a strategy based on holistic reinvention rather than a series of point solutions, maintaining a clear focus on deep needs, aspirations or desires of customers, clients (such as partners) and colleagues (such as service providers). Focus on ecosystems to expand and align a broader set of capabilities, and to help create and deliver on customer promises.

Key questions

- How can you make your digital strategy more ambitious to face disruption head-on?
- In what ways can your organization become more agile, so it is better equipped to respond to unexpected challenges and opportunities?
- What steps can you take to make your workforce open and flexible?
- How can you help your leadership become more visionary, conceiving what customers want before they know it themselves?

Related reports

Berman, Saul J., Peter J. Korsten and Anthony Marshall. "Digital reinvention in action: What to do and how to make it happen." IBM Institute for Business Value. May 2016. https://www-935.ibm.com/services/us/gbs/thoughtleadership/draction/

Berman, Saul J., Nadia Leonelli and Anthony Marshall. "Digital reinvention: Preparing for a very different tomorrow." IBM Institute for Business Value. December 2013. https://www-935.ibm.com/services/us/gbs/thoughtleadership/digitalreinvention/

Peterson, Steve J. and Raimon Christiani. "Travel loyalty: Cognitive connections Enhancing loyalty programs to connect with all travelers, not just million-mile mavens." IBM Institute for Business Value. May 2016. https://www-935.ibm.com/services/us/gbs/thoughtleadership/travelloyalty/index.html

Peterson, Steve J. and Raimon Christiani. "Beyond bots and robots: Exploring the unrealized potential of cognitive computing in the travel industry." IBM Institute for Business Value. November 2016. https://www-935.ibm.com/services/us/gbs/thought-leadership/beyondbots/

Authors

Greg Land is the IBM Global Segment leader for Hospitality and Travel Related Services. Greg has dedicated his entire 25-year career to the travel industry, where he has served as a strategy consultant, advisor and executive. His work with global airlines, travel technology providers and hospitality companies have informed his views on digital transformation. Greg is based in New York, and can be reached at greg.land@us.ibm.com.

Anthony Marshall is Research Director at the IBM Institute for Business Value. Anthony has consulted extensively with U.S. and global clients, working with numerous top-tier organizations in innovation management, digital strategy, transformation and organizational culture. Anthony can be reached on LinkedIn at www.linkedin.com/in/anthonyejmarshall, Twitter at @aejmarshall and by email at anthony2@us.ibm.com.

Brian O'Rourke is the IBM Global Segment leader for Airlines. Brian has been a respected advisor to industry executives for over a decade. Previously, Brian enjoyed a career as an airline executive for Delta Air Lines. Brian is based in Atlanta, and can be reached at beorourk@us.ibm.com.

Steve Peterson is the global Travel and Transportation lead for the IBM Institute for Business Value. Steve is the author of numerous industry studies, and has served as a strategy consultant to the industry since 1998. His work has been embraced by IBM clients around the globe and widely praised in the industry and popular press. Steve is based in Denver, and can be reached at steve.peterson@us.ibm.com.

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Notes and sources

1 Plastics Today staff. “Airbus employs 3D printed parts extensively in A350 XWB.” *Plastics Today*. May 7, 2015. https://www.plasticstoday.com/content/airbus-employs-3d-printed-parts-extensively-a350-xwb/13981426222188; “A printed smile.” *The Economist.* April 28, 2016. https://www.economist.com/news/science-and-technology/21697802-3d-printing-coming-age-manufacturing-technique-printed-smile

2 “Air France-KLM’s ‘customer intimacy’ strategy: new technologies, human interaction and innovation.” *Future Travel Experience.* February 2017. http://www.futuretravelexperience.com/2017/02/air-france-klms-customer-intimacy-strategy/

3 “Marriott’s Virtual Reality Transports Guests ‘Around the World.’” *eMarketer*. December 31, 2015. https://www.emarketer.com/Article/Marriotts-Virtual-Reality-Transports-Guests-Around-World/1013409

4 “World Economic Forum Digital Transformation Initiative - Aviation, Travel And Tourism Industry.” *World Economic Forum.* January 2017. http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-aviation-travel-and-tourism-industry-slideshare-updated.pdf

5 “Hilton and IBM Pilot ‘Connie,’ the World’s First Watson-Enabled Hotel Concierge.” Hotel Online. March 9, 2016. http://www.italian.francia.hotel-online.com/press_releases/release/hilton-and-ibm-pilot-connie-the-worlds-first-watson-enabled-hotel-concierge; Gaudin, Sharon. “Meet Connie, Hilton’s smart robot concierge.” *Computer World*. March 9, 2016. http://www.computerworld.com/article/3042401/robotics/meet-connie-hilton-s-smart-robot-concierge.html

6 Price, Daniel. “How Big Data Is Changing Air Travel.” *Cloud Tweaks.* April 2014. https://cloudtweaks.com/2014/04/big-data-changing-air-travel/; Braue, David. “Analytics helping ‘smart’ Sydney Airport get off the ground.” ZD Net. August 8, 2013. http://www.zdnet.com/article/analytics-helping-smart-sydney-airport-get-off-the-ground/

7 del Castillo, Michael. “Webjet Ethereum Pilot Targets Hotel Industry’s ‘Dirty Secret.’” *Coin Desk*. May 10, 2017. http://www.coindesk.com/webjet-ethereum-pilot-aims-at-hotel-industrys-dirty-little-secret/

8 Finnegan, Matthew. “Thomson creates travel search chatbot with IBM Watson.” *Computer World UK*. November 2016. http://www.computerworlduk.com/data/thomsons-creates-travel-inspiration-chat-bot-with-ibm-watson-3649635/ ; Bridgwater, Adrian. “Come Fly With AI, IBM Cloud Builds ‘Chatbot’ Virtual Travel Agent.” *Forbes*. November 22, 2016. https://www.forbes.com/sites/adrianbridgwater/2016/11/22/come-fly-with-ai-ibm-cloud-builds-chatbot-virtual-travel-agent/#57a4a3134813

9 White, Joseph. “Ford sets up new mobility services unit.” *Thomson Reuters*. March 11, 2016. http://www.reuters.com/article/us-ford-mobility-idUSKCN0WD1NL

10 “One ‘power-brand’ for tour operators and airlines.” FVW.com. May 13, 2015. http://www.fvw.com/tui-one-power-brand-for-tour-operators-and-airlines/393/143463/11245

11 Edelman, David, and Marc Singer. “Competing on Customer Journeys.” *Harvard Business Review*. November 2015. https://hbr.org/2015/11/competing-on-customer-journeys

12 Floater, Graham, and Lisa Mackie. “Travel distribution: The end of travel as we know it?” LSE Consulting. October 2016. http://www.lse.ac.uk/businessAndConsultancy/LSEConsulting/pdf/Amadeus-The-Future-of-Travel-Distribution.pdf

13 Lagorio-Chafkin, Christine. “It’s Like Airbnb, Minus the Regulatory Troubles.” *Inc*. July 2014. https://www.inc.com/christine-lagorio/home-rental-unhotel-onefinestay.html; Birkner, Christine. “Here’s How Airbnb Disrupted the Travel Industry.” *Ad Week.* May 26, 2016. http://www.adweek.com/brand-marketing/heres-how-airbnb-disrupted-travel-industry-171699/

14 Sheivachman, Andrew. “Lola’s Booking Experiment Mixing Artificial Intelligence and Travel Agents Is Live.” *Skift.* May 12, 2016. https://skift.com/2016/05/12/lolas-booking-experiment-mixing-artificial-intelligence-and-travel-agents-is-live/

15 Radnovich, Connor. “Dog owners go online to find alternatives to kennels.” *The Seattle Times*. July 10, 2012. http://old.seattletimes.com/html/businesstechnology/2018653253_dogsinhome11.html

16 IBM Institute for Business Value Global Ecosystem Survey in collaboration the Economist Intelligence Unit. 2016.

17 Canaday, Henry. “Beyond Predictions: Watson On The Line.” MRO Network. May 16, 2017. http://www.mro-network.com/airlines/beyond-predictions-watson-line; “Less time on maintenance issues means more time getting you places on time.” https://www.ibm.com/watson/stories/airlines-with-watson.html

18 Joyce, Stephen. “A brief history of travel technology – from its evolution to looking at the future.” Tnooz.com. September 12, 2013. https://www.tnooz.com/article/a-brief-history-of-travel-technology-from-its-evolution-to-looking-at-the-future/

19 Berman, Saul J., Peter J. Korsten and Anthony Marshall. “Digital reinvention in action: What to do and how to make it happen.” IBM Institute for Business Value. December 2016. https://www-935.ibm.com/services/us/gbs/thoughtleadership/draction/; Berman, Saul J., Nadia Leonelli, Anthony Marshall. “Digital reinvention: Preparing for a very different tomorrow.” IBM Institute for Business Value. December 2013. https://www-935.ibm.com/services/us/gbs/thoughtleadership/digitalreinvention/

20 Guerrini, Federico. “Neuron-Based Chips Will Soon Become Commonplace, This Startup Founder Says.” *Forbes*. May 22, 2016. https://www.forbes.com/sites/federicoguerrini/2016/05/22/neuron-based-chips-will-soon-become-commonplace-this-startup-founder-says/#50fddab36ad3; McShane, Sveta. “This Amazing Computer Chip Is Made of Live Brain Cells.” *Singularity Hub*. March 17, 2016. https://singularityhub.com/2016/03/17/this-amazing-computer-chip-is-made-of-live-brain-cells/

21 Izmaylov, Maksim. “Travel Industry’s Invisible Battle.” Winding Tree Blog. December 28, 2016. https://blog.windingtree.com/travel-industrys-invisible-battle-93603e986bbf; Bjorøy, Trond Vidar. “Blockchain startup Winding Tree could upend the travel industry.” *Venture Beat*. Aug 2017. https://venturebeat.com/2017/08/23/blockchain-startup-winding-tree-could-upend-the-travel-industry/

22 Liang, Annabelle, and Dee-Ann Durbin. “World’s First Self-Driving Taxis Debut in Singapore.” *Bloomberg*. August 24, 2016. https://www.bloomberg.com/news/articles/2016-08-25/world-s-first-self-driving-taxis-debut-in-singapore; Etherington, Darrell. “Lyft and Nutonomy partner to bring first self-driving Lyft service to Boston.” T*ech Crunch*. June 6, 2017. https://techcrunch.com/2017/06/06/lyft-and-nutonomy-partner-to-bring-first-self-driving-lyft-service-to-boston/

23 Kitching, Chris. “The aeroplane cabin that cleans ITSELF: Automated system uses ultraviolet lights to kill harmful bacteria on dirty surfaces.” Mail Online. April 12, 2016. http://www.dailymail.co.uk/travel/travel_news/article-3536059/MAG-Aerospace-Industries-files-patent-self-cleaning-plane-cabin.html

24 Maddox, Teena. “Royal Caribbean steps up the high-tech battle on the high seas.” *Tech Republic*. March 15, 2017. http://www.techrepublic.com/article/royal-caribbean-steps-up-the-high-tech-battle-on-the-high-seas/

25 Lambert, Fred. “Elon Musk clarifies Tesla’s plan for level 5 fully autonomous driving: 2 years away from sleeping in the car.” *Electrek*. April 29, 2017. https://electrek.co/2017/04/29/elon-musk-tesla-plan-level-5-full-autonomous-driving/; Stewart, Jack. “Tesla’s New ‘Autopilot’ Is Just the Start of a Critical Reboot.” *Wired*. January 2017. https://www.wired.com/2017/01/teslas-new-autopilot-may-seem-lame-critical-reboot/; Ryan, Kevin J. “Tesla Explains How A.I. Is Making Its Self-Driving Cars Smarter.” Inc. https://www.inc.com/kevin-j-ryan/how-tesla-is-using-ai-to-make-self-driving-cars-smarter.html; Andersen, Michelle, Thomas Dauner, Nikolaus Lang, and Thomas Palme. “What Automakers Can Learn from the Tesla Phenomenon.” *BCG Perspective.* May 2016. https://www.bcgperspectives.com/content/articles/automotive-what-automakers-can-learn-from-tesla-phenomenon/

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