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100 Innovations That Transformed Tourism

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Abstract

This article provides a systematized and analytically concise collection of 100 innovations that were not specifically invented for tourism but nevertheless affected tourism to a significant extent. The article is a contribution to tourism history, and it introduces a new facet of tourism innovation research. Scientific and technological progress facilitates the development of tourism, but often with some delay. The trickling down depends on institutional changes and absorptive capacity in the tourism sector. The impacts contributed mainly to the social and physical efficacy of tourists, including reduction of risks and improved mobility and accessibility. Innovations also laid the ground for entirely new touristic experiences. Numerous innovations were implemented to increase the productivity and performance of tourism enterprises. The article provides examples of innovations that led to the opening of new destinations. Institutional and informational innovations proliferated into critical modernization. A deeper comprehension of dissemination patterns can be useful toward future tourism innovation policies.

Keywords

history of tourism, innovation dissemination, product innovation, process innovation, institutional change

Introduction

This article attempts to expand the comprehension of important driving forces in the development of tourism. The aim is to map and categorize innovations that basically happened outside the tourist sector but nevertheless had decisive impacts in tourism. Accordingly, the article addresses the derived developments that take place *in* tourism as a consequence of scientific, technological, institutional and other innovations *outside* the tourism sector.

The history of science and technology relates to the invention of methods, tools, and techniques, and it investigates how emerging knowledge has enabled people to create new things and systems (McNeil 1990; Bijker, Hughes, and Pinch 2012). Further, the history of science and technology examines how humanity's understanding of the natural world (science) and ability to manipulate it (technology) have changed over time. As an academic discipline, it also addresses the cultural, economic, and political impacts of scientific inventions and innovations. The study of science and technology and their impacts in terms of the transformation of tourism is a potentially enormous topic with many aspects. For example, portraits of legendary tourism developers, such as Thomas Cook, address the underlying technological inventions, such as the steam engine and the expanded rail services (Brendon 1991; Butler and Russell 2010; Withey 1997). Likewise, Towner (1988, 1995) and Towner and Wall (1991) bring up the quite significant historical interest in spa resorts and the social life connected hereto, and to the related innovations in terms of technology to heat and transport water. Similarly, the history of mobility is a popular theme in historical tourism writing, and the development of technology and infrastructure materializes as vital for the emerging new forms of vacationing, such as described by Armstrong (2005) and Coons and Varias (2003) in the case of steamboats, and in a later period in history, car travel and road systems (Featherstone, Thrift, and Urry 2005; Havlick 2002). Reich (1999) illustrates the development of snowmobiling, and he describes it as a mechanization of snow. Science and technology also influence the experience field, for example, the Disney Corporation, which very systematically lets the advanced progress in film production spill over to the theme parks—and vice versa (Weinstein 1992). Stipanuk (1993) and Löfgren (1999) come to the conclusion that theme parks, in more recent decades, are driven by the rapid technological developments in electronics and photography.

An encompassing analysis of tourism and technologies was provided by Stipanuk in 1993. He claimed that contemporary tourism researchers have blinkered themselves by only being concerned with the impacts of information

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technology. This observation still seems to be valid. Overall, the history of science and technology has received limited dedicated and recent attention in tourism research.

Obviously, a brief article cannot comprehensively deliver a full account of all aspects of scientific and technological development and how it has affected tourism. The aim is to offer a general idea of which innovations transformed tourism significantly over time. One hundred specific innovations were selected to illustrate this general idea. These are innovations that eventually, perhaps through a chain of transformations, interpretations, and social adaptions, make tourists happier, safer, healthier, and that create new experiences and pleasures for them. These are also innovations that make tourist businesses and organizations more advanced, recognized, and profitable (Stipanuk 1993) and that link the tourism actors together in new networks and systems. Accordingly, the assumption is that science and technology is the cause of progress and improvements. There may also be downsides, but the negative impacts and side effects will be given limited attention in this article.

The selection of innovations in this presentation is hardly all-comprising. Most of the innovations are more recent and introduced within the past century, and they attempt to direct attention to, on the whole, fairly disregarded aspects of how innovations disseminate into tourism. It is hoped that this exercise will raise the general awareness on the science and technology history aspect of tourism and travel and inspire researchers to undertake further research in the numerous "missing links." In addition, the article may also reveal influential development interdependencies between tourism and other sectors in the economy (Hjalager 2002, 2010) and stimulate policy makers' attention to the area (Hjalager 2012).

Sources and Diffusion of Innovations

Generally, new technical and scientific knowledge is often regarded as the prime source of innovation. In his seminal writings on innovation, Von Hippel (1988) emphasized research and development (R&D) as a principal driver of innovation. R&D includes not only enterprises' own research and development but also R&D mediated and stimulated through universities and public research units, military spending, etc, which leads to the significant discoveries that may eventually result in successful commercialization. Over the years, innovation studies have increasingly included other sources of ideas and inspiration for innovation, thus recognizing that many firms are innovative in spite of the fact that they do not invest in formalized R&D. A point raised by Leonard-Barton (1995) is that some categories of core knowledge capacities are essential to have inside the companies, while less critical resources can be insourced when needed. In her view, sustaining the sources of innovation is a strategic process of great importance, and creative knowledge is not confined to specified departments and dedicated employees but rather is widespread.

Von Hippel and Leonard-Barton recognize that what we comprehend to be new products, processes, methods, and procedures might not necessarily have been invented in the enterprises and sectors where they were implemented. Innovations travel in time and space. The dissemination of scientific and technological knowledge and the outcomes hereof have occupied innovation researchers for a number of decades. Rogers (1995) systematically introduces the concept of diffusion of innovations. He distinguishes between early and late adapters of innovation, and he confirms that there might be advantages of being both a first mover and a latecomer. He also determines that the rate and speed of dissemination, apart from economic and market factors, depend on social structures, systems and norms, opinion leadership, etc. The diffusion of innovation implies organizational, cognitive, and institutional boundary crossing through more or less permeable boundaries and with more or less rigid gatekeepers (Ancona and Caldwell 1992; Marrone 2010; Tushman 1977). Further, imitation and adaptation is essential to the diffusion process for enterprises not able or willing to innovate themselves (Nelson & Winter 1982). No single company can afford to be first in everything in its field, and any organization will be obliged to, for some aspects of operations, copy others.

Imitation is not necessarily a noncreative process. Along the way, the enterprises may come up with fresh combinations and reinventions that appear to be new to the company or to the customers. A reinvention will take place along the path of dissemination and implementation (Rogers, 1995; Wejnert 2002), and this leads to incremental developments that have significant influence on the individual enterprises as well as on entire industries.

Utterback (1974) distinguishes between technology push and demand pull in innovation processes. He recognizes that industry sectors at different levels of maturity, and in different situations of competition, innovate and utilize external knowledge in different ways. It is relevant for some categories of enterprises to have a strong focus on what technology suppliers can deliver so as to change the product and process in the next step in the value chain. On the contrary, in other industries, consumer needs are the prime source of inspiration, and innovation in the service industries is often regarded as governed mainly by a demand pull (Malerba 2004).

Abernathy and Clark (1985) envisage that groundbreaking inventions can change the production logics and the business models for larger segments of an industry. Some innovations are of a "destructive" nature, where enterprises that stick to old products and procedures will eventually have to close down. Christensen and Raynor (2003) provide examples from consumer electronics, such as video-recorders, where new technology paradigms tend to wipe out prior formats from the market. However, the adoption of new knowledge and technologies happens gradually, sometimes with significant delays. There are barriers for innovation, for example, in the form of sunken costs combined with policy rigidities and protective measures, and in addition,

the structure and absorptive capacity of the industry have determining impacts on adaptation (Teece 1992; Cohen and Levinthal 1990).

The mentioned scholarly approaches have only been modestly applied to the tourism sector, and investigations of innovations in the tourism business often come up with very bleak results. Many studies conclude that tourism accommodation businesses, restaurants, and transportation companies are not particularly innovative (Carmison and Monfort-Mir 2012; Abreu et al. 2010; Evangelista 2000; Miles 2008). Even the largest corporations seldom employ people in dedicated R&D departments, and innovations mainly consist of small changes, mostly aimed at obtaining higher productivity and cost savings. Attractions and travel agencies are found to be slightly more innovative. Fuglsang, Sundbo, and Sørensen (2011), who in their studies include a wider experience economy, for example, festivals and events, find a more favorable innovative performance in these types of organizations.

More than in other sectors of the economy, innovations in tourism occur in relationships and under external inspiration. Hall and Williams (2009) also state that new ideas do not easily penetrate existing organizations and that innovation therefore tends to happen in conjunction with entrepreneurship. Rønningen (2010) verifies an innovative capacity in microenterprises, but the possibility to scale up depends on the extent of external alliances. He also suggests that new products and services, to quite an extent, trickle down from suppliers instead of being self-invented. The search for, and the discovery, experimentation and development of new products and services take place in newly started enterprises or in enterprises for which the tourism aspect is fresh (Ateljevic and Dorne 2000).

To conclude, for many years, the scholarly innovation literature has emphasized the importance of science and technology and recognized the complex and dynamic processes of diffusion. Scholars refer to the structural, social, and economic circumstances and the importance of changed demand patterns. While tourism enterprises may not be first movers in the invention and in the core of science and technology, they may well rapidly utilize the outcome of new ideas and knowledge. The power of technology and science on tourism is what will be illustrated below.

Methodology

The process of bringing together 100 innovations that have transformed tourism took several years. It has been a side activity of the other tourism research projects I have performed over the years. Inspiration has also emerged from other studies and from literature reviews undertaken in that connection. Additionally, I have consulted research texts and popular writings about science and technology history, which delivered many clues to the list and to its categorization. I have paid visits to science and cultural history museums and made observations at a range of tourism facilities. I have asked colleagues for ideas, and nontourism researchers and lay persons have been particularly helpful with comments. During the long period, material and references have been systematized, and this process was intensified in connection with the writing of this article.

The selection of innovations was guided by the aim to efficiently illustrate how innovations transform tourism with at least some comprehensiveness. The 100 innovations were taken from most areas of science and technology so as to be illustrative and diverse (Seawright and Gerring 2008). In order to become specific, the selection of examples should also address transformations that can be claimed to fall into at least one of the following impact categories:

1. Changing the properties and varieties of the goods and services as they are experienced by the tourists
2. Increasing the social and physical efficacy, for eample, the power for the tourists to produce the benefits for themselves
3. Increasing the productivity and efficacy in tourism enterprises and restructuring the input factors such as energy, labor, capital, and land
4. Forming new destinations
5. Enhancing mobility to and within destinations
6. Altering the way of passing information within and across organizational boundaries
7. Changing the institutional logic and the power relations.

Accordingly, this list of impacts is an unorthodox reinterpretation of categories of innovations suggested by Schumpeter (1942) and elaborated in relation to tourism by, for example, Carmison and Monfort-Mir (2012), Fuglsang, Sundbo, and Sørensen (2011), and Hjalager (2002, 2010). Stipanuk (1993) chooses to organize technology impacts on tourism with some similar features.

A main exercise in the process has been confined to speculations about how to deliver a sound and analytical categorization of the 100 innovations. Will it be possible to structure the cases in a beautiful framework: the "Linnaeus of innovations that transformed tourism"? The history of science and technology does offer ways to categorize, but it is governed by a disciplinary approach or by timelines (Bunch and Hellemans 1993). McNeil (1990), for example, applies two approaches. First, seven ages of technology. And second a disciplinary approach, where the development within each of them can be described chronologically. The disciplines include materials, power and engineering, transport, communication and calculation, and technology and society, which take into account agriculture, textiles, building and construction, domestic technology, public utilities, and weapons. I first attempted to organize the list of innovations from a disciplinary model, but that turned out to not be feasible, as transformations in tourism were far too ambiguous. Under the circumstances, I found that the best model was to organize the list chronologically. The merit of this is the illustration of advancements in how tourism has benefited from

innovations. However, the dating of innovation can also be very ambiguous, as knowledge may be embedded in prehistoric practice, or in nonmatured ideas. I have chosen to indicate, where possible, the year where the innovation first takes the form of becoming functional and implementable.

All suggested innovations were assessed carefully. Information was collected from a variety of sources, factual information mainly from encyclopedias and Wikipedia. Information is also acquired from handbooks and the Internet to ensure appropriate explanations for the likely impacts on tourism. Where possible, the information has been cross-checked. In the text, I have not made references to the specific sources in the description of the innovations as this would result in a very extensive literature list.

The concise evidence on the impact of scientific and technical innovations on tourism is more often than not lacking, and thus, a more thorough study of the dissemination of scientific discovery into tourism is not found. In terms of assessing the likely impact on tourism, evidence is often very scarce, and the text is, admittedly, sometimes speculative. In this sense, the main point of the article is to offer a mode of reflection and exemplification and a push for further research.

An Overview

Table 1 provides the overview of the innovations with the indicated types of transformations.

The Innovations

Passport. There is evidence of passage documents far back in time, but the formal and regulated issuing of passports originates from King Henry V in 1414. The passports are a means of mobility for travelers, but authorities can also increase control of "unwanted" travelers. Thus, over time, passports have not only caused barriers for travelers, but also and importantly created opportunities due to easy legitimization. Passport standardization came about in 1980, and since 2006, many countries have started to supply them with chips. Biometric evidence for passports includes fingerprints or iris recognition.

Taxicab. Formalized horse-drawn taxi services range back to 1640. However, taxicab companies came to flourish around the world in the early 20th century after the introduction of the automobile. The taximeter was invented in the late 1940s, at the same time that two-way radios facilitated the operation of taxi services and combined the individual taxicab into cooperated units with the advantage of being able to communicate with and serve customers more efficiently. The next major innovation occurred in the 1980s with electronic communication and payment systems. The officially recognized and certified taxi services improved not only the mobility for tourists, but also provided reliable and safe transportation.

Barometer. The first publicized working barometer dates back to 1643. A barometer is a meteorological instrument that measures the atmospheric pressure, and in the late 19th century it became essential for the forecasting of weather changes. The barometer was of importance for safe sea travel, and it serves as a guide for the planning of touristic activities. Nowadays, electronic barometers are used, for example, by recreational anglers who want to predict fish behavior and optimize their catches.

Museum. Private collections of objects range back to prehistoric times. The first known collection open to the public was established in Oxford in 1683: the Ashmolean Museum. A legislative initiative came in 1753, prior to the founding of the British Museum. This initiative institutionalized the concept of preservation, research, and interpretation for visitors. Museums developed into "reasons to go" for travelers, and they became essential elements of the tourism infrastructure.

Thermometer. In 1714, Fahrenheit invented the first modern thermometer with a standardized scale. As weather has a considerable impact on holiday pleasures, temperature is a matter of great importance. The provision and analysis of data on historical temperature developments is crucial in tourism price calculation, campaigning and marketing.

Traveler's check. Traveler's checks were generally used in place of cash, as many businesses used to accept them as currency. If lost or stolen, they could be replaced by the issuing financial institution. Traveler's checks were first issued in 1772 for use in ninety European cities. American Extree was the first company to develop a large-scale traveler's check system in 1891, and the checks also became part of Thomas Cook's package to the customer. Their use has been in decline since the 1990s as more convenient alternatives have become more widely available for travelers.

Battery. The exploitation of electricity has been the target of scientific endeavor for centuries. The battery was invented in 1800. The discovery of electromagnetism led to a swarm of subsequent innovations that would revolutionize life throughout society. The first batteries were very bulky, but since the introduction of the modern-day battery in the 1950s, they have become essential for modern tourists who want to bring gadgets of all kinds and use them, for example, outdoors and while in motion.

Lifebelt. The lifebelt was said to be invented in 1804 and was given the nickname "Seaman's Friend." Over time, a range of personal floatation devices have emerged: lifejackets, life preservers, Mae Wests, life vests, life savers, cork jackets, buoyancy aids, flotation suits. The lifebelt has increased the safety of a number of marine activities, and it most certainly introduced the pleasures of the sea to children and families

Table 1. 100 Innovations That Transformed Tourism, by Year and with Indication of Transformations.

		Types of Transformations						
	Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Passport	1414		X			X	X	X
Taxicab	1640		X			X		
Barometer	1643		X	X				
Museum	1683	X			X			X
Thermometer	1714		X	X				
Travelers' check	1772		X	X			X	X
Battery	1800		X			X		
Lifebelt	1804		X					
Ocean liner	1818	X	X	X	X	X		
Quinine	1820		X		X			
Bus	1820		X	X	X	X		
Railway	1825	X	X	X	X	X		X
National park	1832	X			X			X
Sleeping car	1837		X	X	X	X		X
Indoor swimming pool	1837	X	X					
Bicycle	1839	X	X			X		
Telegraph	1844		X	X		X	X	
National weather service	1847		X	X			X	X
Ski technology	1850	X	X		X			
Elevator	1854		X	X				
Luggage	1854		X		X	X		
Travel insurance	1864		X		X	X		X
Medical emergency service	1865		X					X
Suez Canal	1869		X	X	X	X		
Electric street light	1873		X	X				
Automobile	1875	X	X	X	X	X		X
Telephone	1877		X	X			X	X
Restaurant car	Approx. 1880	X	X	X		X		
Glass fiber	1893	X	X	X		X		
Discount coupon	1895			X	X		X	X
Escalator	1896		X	X				
Zeppelin	1900	X				X		
Michelin guide	1900	X	X		X		X	X
Gliding	Approx. 1900	X				X		
Air conditioning	1902		X	X	X			
Caravan	1907	X	X		X	X		
Passenger aircraft	1914	X	X	X	X	X		X
Snowmobile	1916	X	X		X	X		
Instant food	1916	X	X	X				
Air traffic association	1919		X	X		X	X	X
Highway	1922		X	X	X	X		
Sunglasses	1929		X					
Air hostess	1930		X	X				
Paid holiday	1936		X					X
Shopping cart	1936		X	X		X		
Credit card	1938		X	X			X	X
Air bed	Approx. 1940	X	X					
Sunscreen	1944		X					
Bivouac	???	X	X			X		
Computer reservation system	1946		X	X		X	X	X
Microwave oven	1947	X	X	X				

(continued)

Table 1. (continued)

		Types of Transformations						
	Year	1	2	3	4	5	6	7
Electric sauna stove	Approx. 1950	X		X				
Minibus	1950	X	X	X	X	X		
Snow canon	1950	X		X				
Immunization program	Approx. 1950		X		X		X	X
Backpack	1951	X	X			X		
Kettle grill	1952	X	X	X				
Solar cells	1954		X	X		X		
Shopping mall	1956	X	X	X	X			
Carbon fiber	1958	X				X		
Automatic teller machine (ATM)	1959		X				X	X
Automatic door	1960		X	X		X		
Family dome tent	Approx. 1960	X	X			X		
Dry ski slope	Approx. 1960	X		X	X			
Recreational drug	Approx. 1960	X	X					
Instamatic pocket camera	1963	X						
Inflatable life raft	1963			X				
Snowboarding	1965	X						
Barcode	1966		X	X		X	X	X
Pool-cleaning robot	1967			X				
Computer tablet	1968	X	X	X		X	X	
Scents technology	Approx. 1970	X						
Loyalty program	1972	X	X	X			X	X
Lonely Planet	1972	X	X		X		X	X
RFID	1973		X	X		X	X	
Sous-vide	1974	X		X				
Mini-bar	1974	X	X	X				
Gore-Tex	1976	X	X			X		
Airline deregulation	1978		X	X	X	X		X
Camcorder	1983	X						
Mobile phone	1983	X	X	X		X	X	
Rolling luggage	1987		X	X		X		
Robotic lawn mover	1989			X				
World Wide Web	1989	X	X	X	X	X	X	X
Consumer protection	1990		X				X	X
Online maps	1993	X	X		X	X	X	X
E-ticketing	1994		X	X			X	X
QR code	1994	X	X	X		X	X	X
Schengen Agreement	1995		X		X	X		X
Social media	1997	X	X	X	X		X	X
Blogging	1997	X	X		X		X	
Viagra	1998	X	X					
Common currency—euro	1999		X	X		X	X	X
Augmented reality	1999	X			X		X	
GPS	2000	X	X	X	X	X	X	
Genetically modified golf turf	2003	X		X				
Micro-blogging	2006	X	X	X	X		X	
Body scanning	2007			X			X	
Artificial weather	2008	X	X	X				
Avatar—embodied agent	2012		X	X		X		

and less sportive people. Indirectly, it boosted the services and experiences at marine destinations. Over time, the equipment has shrunken in size and has become more convenient to wear without compromising safety.

Ocean liner. The first regular passenger service on an ocean steamship was offered in 1818 from England to the United States. In the following decades, ocean traffic increased dramatically, coinciding with the immigration streams from Europe to the new world. From the late 1800s, the ocean liners became symbols of technological advances, and many of them developed into luxurious floating palaces. Traffic and popularity declined with the emerging passenger airlines, but the idea of large floating facilities survives in the cruise ship industry.

Quinine. Quinine has been known since the 17th century, and from 1850 it became a most common part of the colonialists' and the travelers' prophylactic self-medication against malaria. The substance was cumbersomely extracted from the cinchona tree. In 1944, the chemical composition was discovered, and from then, a synthetic version could be produced much more economically. Later, new ingredients emerged and replaced quinine. The possibility to protect against malaria increased the range of "safe" travel destinations and expanded the interest for tourist experiences in swamps, jungles etc. The development augmented the possibilities for Third World counties to develop tourism.

The bus. The first stable horse-drawn buses were introduced around 1820 in major cities. Over the next decades, buses became important for the mobility of larger groups of people. However, for many years, public passenger transportation was combined with postal services and not at all comfortable. The buses gradually gained importance, for example with the legendary services of the U.S. Greyhound Corporation. After World War II, buses were part of packaged tours, and chartered buses brought guests to new destinations. Modern buses are designed to accommodate special needs, for example skiers and sports groups.

Railway. The invention of the railway in 1825 and the expansion of the rail network were of groundbreaking importance for tourism. It dramatically increased mobility and accessibility as well as the speed of transportation. In 1841, Thomas Cook chartered a train for a group of 540 antialcoholism campaigners. Instantaneously, the tour became very popular, and Cook decided to arrange a number of excursions for a broader audience to destinations in the United Kingdom—including seaside resorts, which made a difference to the travelers' normal everyday lives. The first international Cook tour was offered in 1855. The company expanded further under the management of Thomas Cook's two sons. From the very beginning, package tours were extremely important for the introduction of the pleasures of travel.

National park. The first governmental initiative to set aside land for the protection of its natural qualities was launched in the United States in 1832. However, institutional and regulatory structures were not established until 1872. The first national park in Europe was established in 1909 in Sweden. The national parks became popular places to visit and provided a reason for people to go. The national parks spurred the interest in nature experiences and nature protection, and this was the root of a wide range of organized categories of tourism.

Sleeping car. Sleeping on the train was introduced in 1839, but it was not until 1865 that Pullman organized the operations of sleeping cars in a professional organization, separate from the railways. The travelers could save time and on the costs of hotels. With Pullman, the standards and comfort rose. Sleeping cars became part of the tourist experience, such as the Trans Siberian Railway. The extension of sleeping cars grew over nearly a century, but declined again with the expansion of air traffic and the appearance of low-cost airlines.

Indoor swimming pool. Swimming and water pleasures are not new tourism pastimes, and they were an essential installation in ancient spas. The first indoor swimming pool opened in London in 1837 in an era where swimming became a popular sport and where new categories of swimming styles were also invented. The King of Bavaria supplied his indoor pool with artificial waves and heated water. That was in 1879. The ideas of pools soon traveled to the hotel industry, and in 1907, the first ocean steamer could offer passengers access to a pool. The pools were substitutes for nature, and there are many examples of designs that imitate natural elements. Increasingly, pools have also developed to become attractions in their own right, such as seen in the large water parks, which were initiated in late 1940s.

Bicycle. The first mechanical bicycle is claimed to be introduced in 1839, and in the decades after, recreational bicycling became popular, particularly after the invention of the "safety bicycles" in 1896. The first bicycle touring club was formed in 1878, at a time when bicycling offered new flexibility and accessibility. Cars led to a decline in bicycle touring, but it was reintroduced with a health, experience, and nature agenda in the 1960s. Many destinations have developed and institutionalized bicycle tourism and ensured safe and convenient infrastructures for that purpose.

Telegraph. The electromagnetic telegraph was invented in 1844, and instigated an era of telecommunication of great significance for tourists and tourist operators and enterprises. In 1861, the first transcontinental line was established. The telegraph allowed for more rapid communication than postal services, which is of importance, for example, in the case of bookings and emergency messages. The use of telegraph

declined after the introduction of the competing technology, the telephone, in 1877.

National weather service. The first meteorological institute was established by the Smithsonian in 1847. From that point, volunteers were recruited to make systematic observations of temperature, barometric pressure, humidity, wind and cloud conditions, and precipitation amounts. They also reported the occurrence of thunderstorms, hurricanes, tornadoes, earthquakes, meteors, and auroras. The data became important for the development of reliable weather forecasts.

Ski technology. Skiing has been around since prehistoric times, but the breakthrough of modern and recreational skiing took place around 1850, supported greatly by the invention of the Norheim binding. Norheim's binding included a leather toe strap that was fastened tightly with a buckle, and a heel strap made from thin shoots of birch roots. The strap had to be flexible and elastic in order to allow it to keep tension on the heel as the skier strode forward and the heel lifted from the ski. Norheim and other Norwegians also worked with the shape of the ski, and they introduced the curved slalom ski. Additionally, they were pioneers in organizing institutional frameworks, competitions etc., which meant a rapid dissemination of recreational skiing.

Elevator. Various elevation techniques have been known since prehistoric times, but the first modern steam-driven person elevator was introduced in 1854. The Brighton Hotel was the first to install an elevator in 1865, and other hotels followed soon after. The elevator radically changed the possibility of hotels to profitably rent rooms at floors above the ground level and the first floor. Elevators also became important in, for example, transportation systems, such as in subway stations.

Luggage. In 1854, the legendary Louis Vuitton started to produce travel luggage in new formats after seeing the business possibilities related to the railways. He flattened the lids of the trunks and started to use lighter materials while offering sophisticated and practical interiors of the trunks and suitcases and personalized key systems. He produced luggage adapted to the space-constrained ocean steamer cabins. Louis Vuitton's products have affected the social interpretation of travel accessories.

Travel insurance. The first private company selling travel insurance was established in 1864. Mainly wealthy travelers could afford to protect themselves from the consequences of theft and other travel circumstances. In the 20th century, health insurance coverage was added as an option under many insurance packages. Later, the insurance was adapted to target losses due to missed hotel reservations, canceled flights, and other travel-specific events. These types of developments coincided with the fact that airplanes became a more popular form of travel. Travel insurance has led to a reduction of the perceived risk of traveling, particularly in unfamiliar destinations.

Medical emergency service. Civilian ambulances were introduced in the United States in 1865, but the fully integrated systems with coordination with hospitals and medical providers did not happen until the 1950s. The first telephone system with a direct three-digit emergency number came in 1937. With extended emergency services, it became less risky to travel.

Suez Canal. The Suez Canal connected the Mediterranean and the Red Sea, and it opened in 1869. The canal transformed shipping lines between Europe and Asia, cutting off 9,300 km of travel distance. Suez was particularly important for trade and military purposes, but also enhanced (leisure) migration in colonial times. The Canal serviced several ocean liners from Europe. The Suez Canal was closed during political unrest in 1967–1975. By that time, long-haul tourism had shifted to air traffic. Other canal projects also facilitated tourism, but the Suez was significant.

Electric street light. Street lights first became a reality after 1873. Better-lit public areas increased accessibility as well as safety for travelers and for the tourism businesses. The electricity propelled many other infrastructural innovations in the transportation and other categories of infrastructure.

Automobile. The first automobile with a combustion motor is said to be the work of Siegfried Marcus in 1885, although Henry Ford was responsible for the radical change of the whole concept of person transportation after his introduction of the T-model in 1903. The automobile led to new independence and flexibility for travelers, and mass production made it possible for larger numbers of consumers to acquire a car. The car transformed holiday habits and behaviors dramatically. New areas, not well served by railways, became accessible. Door-to-door transportation also altered luggage and holiday equipment and increased the amount of luggage that could be transported. Many types of special cars have been developed for tourist purposes, for example, golf cars.

Telephone. A functional telephone system was first installed in 1877. The telephone itself was indeed a significant invention, but the telephone exchange, which allowed any telephone to be connected with any other telephone, was even more essential. The telephone became an indispensable tool for tourists prior to and during travel. After the introduction of the cellular phone, communication on the move increased. Self-evidently, the telephone allowed tourism operators and businesses to raise productivity and efficiency.

Restaurant car. The first dining car or train restaurant was introduced around 1880. Up until then, passengers had to

bring food or buy it from small stalls at the water stops. Such poor conditions discouraged many from making the journey. In addition, lengthy stops prolonged the trips at an inconvenience for passengers as well as for the railway companies. In this respect, the restaurant car represented a new organization not only of provision, but also of the organization of time. Later the restaurant car concepts developed and for many railways, the quality of this particular facility became an important sales argument.

Glass fiber. Glass fiber consists of glass extruded into many fibers of small diameters suitable for textiles and other materials. The technique was invented in 1893, but was not used in commercialized formats until 1938. The material is cheap, flexible, and does not break easily. There is a variety of tourism-related products reinforced by fine glass fibers. Tent poles in glass fibers, for example, replaced earlier heavier metals. Boat hulls of glass fibers made boats cheaper and required less maintenance, and this boosted the popularity of yachting. Equipment for many other sports have benefited from glass fiber, such as surfing, angling, shooting, etc.

Discount coupon. The origin of the discount coupon in tourism and travel is uncertain, but the idea and practice of offering something for free as part of a marketing and promotional effort was launched in 1895 by the inventor of Coca-Cola. For decades, coupons have been a way to bundle tourism offers and thereby stimulate additional demand and to pioneer new or less recognized offers to tourists. Discount coupons, and their later versions as destination cards, have been of importance for destination building and collaboration between tourism providers.

Escalator and moving sidewalk. An escalator is a moving staircase. The first installation took place in 1886 in connection with a pier. Escalators soon became important in transportation facilities, for example, the subways. In the same period, the world of retailing changed. The emerging department store owners (first in 1872) saw them as a good opportunity to ensure traffic and trade on the upper floors. The escalators offered convenience for customers. A more rapid flow of people brought benefits to the service providers as well.

Zeppelin. The zeppelin was the first powered rigid-body airship, and it rose from the ground for the first time in 1900. Passenger pleasure trips were launched in 1909, and in 1928 a zeppelin for transatlantic passenger transportation was tested. There were many safety difficulties, and the era of the zeppelins stopped dramatically in 1937, when *Hindenburg* burst into flames, killing 35. Zeppelins were reintroduced in 2001 in safer designs, and they are increasingly used for sightseeing tours. A comeback of large luxury air cruisers is scheduled for 2015.

Michelin guidebook. In 1900, two Michelin brothers started offering dining guidebooks free of charge to motorists traveling around France. The Michelin company sold tires for vehicles. It was at the time when there were only 3,500 cars in France. The guidebook included information about how to inflate the tires and where to purchase gasoline, and there were indications of where to eat and sleep. Over time, the guides became authoritative in terms of classy eating. In particular, the innovation of Michelin was the creative co-branding of tourism sites and motorized transportation.

Gliding. The idea of flying has always fascinated mankind. Experiments around 1900 led to the aviation pioneering of small, one-man hang gliders. However, gliding did not become a recreational sport until the 1950s, when paragliding was developed. In the 1990s new materials improved the performance and safety of the gliders. During the past decades, the technology was implemented in skiing and water sports. Paragliding increases business during the low summer season in some mountainous winter sports regions.

Air conditioning. Techniques for heating and cooling have been known since prehistoric times, but the first large-scale electromechanical air conditioning machine was invented and came into use in 1902. Air conditioning became crucial for the development of tourism in hot as well as cold climates. Tourists benefit in terms of comfort, and they get more energy to experience and enjoy their trip. Air conditioning can also increase staff members' productivity by providing pleasant work temperatures.

Caravan. Caravans and caravanning have been known in the Gypsy population since 1850 and onwards, but a change took place in 1907 when the first caravan club was created, and other segments discovered the pleasures of being "on the road." In the subsequent years, caravan technology shifted quite dramatically away from the traditional wooden designs, and caravans became aerodynamic and adapted to cars. The first steel-bodied caravan came in 1938. Caravan development coincides with the emerging camping and outdoor movement.

Passenger aircraft. The first scheduled passenger flight was launched in Florida in 1914, and the plane carried only one passenger. The development of aircraft technology took speed in the late 1920s, and planes rapidly became bigger and safer. Thus, flying as a means of transportation, also intercontinentally, increased. In the United States, Congress passed an Air Commerce Act of 1926, which initiated the designation of air routes, development of air navigation systems, licensure of pilots and aircraft, and investigation of accidents, all of importance to the development of commercial aviation. In 1933, Boeing built what is generally considered the first modern passenger airliner: the Boeing Model 247.The first jet-plane was introduced in 1939. Travel packages got a tremendous boost in 1950, when air chartering started with the introduction of the jet engine. Travel

packaging symbolized a new era, also for the providers of accommodation, catering, and experiences at the destinations, and in that sense, the aircraft became a cornerstone in mass tourism.

Snowmobile. The snowmobile is a powered sled. The first model was designed in 1915. For a time, snowmobiles were critical for rural mail delivery. Some decades later, snowmobiles ensured the opening of new winter sport resorts in remote areas. Spectacular tours and experiences could be organized on the snowmobiles. Bombardier's Ski-dog was successfully introduced in 1959, and it set the scene for intensified recreational use, which led to new ways of socially organizing experiences in the winter landscapes. The development was followed up with dedicated trails and the construction of supportive facilities.

Instant food. Techniques for food preservation have been used since prehistoric times. Freeze-drying food items was first introduced in 1919, but did not come into more comprehensive industrial use until the 1960s, for example, for instant coffee, soups, dressings, etc. Dried foods have features of importance for touristic expeditions to places with an insufficient local food supply, for example, in the wilderness, arctic areas, and in connection with sea travel. It is lighter to carry than food that contains liquid substances. Drying does not violently heat food, and therefore it saves many of the nutrients. Dried foods can be reconstituted by adding water or can often simply be consumed dry.

Air traffic association. The International Air Traffic Association was founded in 1919, and its much more powerful successor, IATA, constituted an important institutional innovation, founded in 1945. Members included airlines from all over the globe, and it was the prime vehicle for interairline cooperation in promoting safe, reliable, secure, and economical air services. IATA developed standards, practices and procedures. One of the key services of IATA is the clearing function that renders the massive economic transactions between airlines and with travel partners and passengers efficient and seamless.

Highway. A highway is a planned and geographically extensive road system connecting larger cities, and with a controlled access. The first highway appeared in Italy in 1922. Highways increased the mobility essentially. The highway pull-ins with petrol stations and cafes were subsequent innovations that supported the mobility of tourists and boosted travel distances.

Sunglasses. Inventors had experimented with tinted glass very early in history, but sunglasses were not produced for the market until 1929. They were adopted by consumers very rapidly. In 1936, the versions with polarized lenses appeared. Sunglasses replaced or supplemented hats with large shades and allowed tourists to experience attractions in sunny and snowy environments, undisturbed by sharp light.

Air hostess. The job description as an air hostess was invented by the American airline Boeing Air Transit (BAT). In 1939, BAT declined a woman, Ellen Church, the opportunity to become a pilot and instead offered her a job to attend to the passengers' comfort and safety. Ellen Church was trained as a nurse, a relevant background at the time. The air hostess position rapidly became institutionalized and a part of every airline's service and safety system.

Paid holiday. Until the early 20th century, paid vacations of one or two weeks per year were generally limited to the professional middle classes, and formalized leisure did not include the large numbers of manual workers. Between the two world wars, political pressures led to the acceptance of the principle of paid holidays in many countries in Europe. Paid holidays have fueled the growth in tourism in general, but the principle also changed the nature of tourism as there was a need to accommodate for new, and typically less wealthy, customers.

Shopping cart. The shopping cart was invented in 1936 for use in supermarkets. The shoppers needed no longer to carry heavy baskets. Shopping carts stimulated the development of self-service shopping, and the principle of putting wheels under the luggage was imported to a range of other types of commercial outlets, airports, museums etc.

Credit card. After a period of some decades with single-company credit devices, several companies started to accept one another's cards in 1938. At first, the card was a metal plate embossed with information about the customer's identity. In recording a purchase, the plate was laid into a recess in the imprinter, with a paper "charge slip" positioned on top of it. American Express, established in 1958, was first in creating a worldwide credit system. It became of immense importance for travelers, who no longer needed to carry large amounts of cash, and the dependence on banking hours also diminished. The electronic credit systems created gigantic opportunities to build up CRS (Customer Relation Systems) which link bank and nonbank information and communication together for marketing and customer market intelligence and other purposes.

Air bed. Air beds or inflatable mattresses are usually made of PVC or other rubbers or plastics. They can be deflated and rolled up or folded and carried easily. They play a role in camping and backpacking, and for this purpose, thinner and lighter versions of sleeping pads were developed. The air beds have also become popular as pool and beach equipment, where they are used for rest, sunbathing, and play. Airbeds were introduced in the 1940s, and they have continually contributed to the mobility of tourists. The airbed

made it possible to enjoy some comfort in overnight stays in open air.

Sunscreen. Sunscreens or sunblocks are lotions, gels, or sprays that absorb or reflect some of the sun's ultraviolet radiation. The first product was on the market in 1944, and helped protect against sunburn. Sun Factor System was introduced in 1962, which has become a worldwide standard for measuring the effectiveness of sunscreens. Sunscreens have been of significant importance for sand–sea holidays, as well as for yachting, skiing, hiking, and other outdoor forms of holidays. Sunscreens have contributed to a variety of beach and pool habits and cultures, for example, in relation to the body and sun exposure. Sunny places have become safer playgrounds, and the tourist industry has exploited this by providing a range of beach animations and beach facilities.

Bivouac. Bivouacs are improvised tents and shelters used in connection with scouting and mountain climbing. There are military origins to the bivouacs, and the year of introduction for recreational purposes is not known. Bivouac technology has developed in recent times. To a great extent, they support outdoor experiences and lengthen the amount of time people can stay in nature. Furthermore, they allow more remote locations to be reached. Many types of bivouacs have been patented since the 1980s, including for example isolated polar sleeping bivouacs and textiles that could be transformed from raincoats to shelters and vice-versa.

Computer reservation system. In 1946, American Airlines installed the first automated electromechanical booking system on an experimental basis. Newer machines, with temporary storage based on magnetic drums, followed soon after. The systems proved successful and were soon being used by several airlines. However, they were seriously hampered by the need for local human operators to do the actual lookups, and ticketing agents had to make calls to the booking office. In 1953, remote terminals were invented, but the first joint system was not launched until 1959: SABRE. In the following years, several competing systems came about, and in 1976, travel agencies were given access to the systems. CRS increased the transparency dramatically for the customers. The most recent development gives customers access to book reservations themselves, a development that has led to a dramatic decline in travel agencies.

Microwave oven. Microwaves are used for many purposes, among others for heating food. The process of heating food includes bombarding it with electromagnetic radiation. The first microwave ovens were introduced in 1947, and they were very large and used mainly for industrial-military purposes. However, they were quickly integrated into restaurant kitchens, where they contributed to increased flexibility and efficiency. Microwaving has also had an important impact on the development of a variety of fast-food products. Some self-service food outlets have installed microwave ovens for customers to heat their own food and drinks, and they have also become a standard amenity in some hotel rooms.

Electric sauna stove. The Finnish sauna is part of a very ancient tradition. The first saunas were dug into embankments, and they were heated with firewood in order to create hot and/or humid baths. Later, log cabins were used for this purpose. In the 1950s, electric sauna ovens were invented, and the sauna tradition traveled to other environments and countries. The sauna became part of the international spa package and an offer alongside other categories of hot and cold baths.

Minibus. Volkswagen was an early developer of small buses. The Type 2, introduced in 1950, became immensely popular. It—and succeeding and competing versions of the minibus—contributed to the entire change of the idea of safaris, from old-fashioned rough hunting tours to photo safaris. The buses carried smaller groups of tourists, and they offered an opportunity to get closer to the animals.

Snow cannon. Artificial snow is produced by forcing water and pressurized air through a snow cannon. The technique was invented in 1950, and was commercialized widely in the 1970s. Snow cannons are used at ski resorts to supplement the natural snow. This allows ski resorts to improve the reliability of their snow cover and to extend their ski seasons and ensure customer satisfaction. Artificial snowmaking postpones the likely effects for tourism of climate change.

Immunization program. Systematic vaccination programs started in the U.S. and European countries around 1900. After the Second World War, traveling to exotic, tropical places became increasingly popular and feasible. The medical system was adapted to cater for appropriate immunization and counseling. The programs set off comprehensive institutional innovations that included a number of medical bodies and specialists. They were meant to reduce risks for travelers, but equally important, the risks of spreading infectious diseases across borders. The link between immunization and forefront medical research and international accreditation is considered very imperative for the provision of the best possible protection for travelers.

Backpack. There is nothing new in carrying heavy loads on the back rather than in the hands, and backpacking has been practiced across all times and cultures. Military versions of the backpack affected leisure for decades. However, the modern concept of a backpack is claimed to originate from Dick Kelty, who correctly assumed in 1951 that is was convenient to shift the heavy load from the shoulders to the hips. The first version spurred a long series of incremental improvements and developments to accommodate for any

particular travel need. The development coincided with both the increased interest in hiking and other outdoor activities, and the inclination of youths to travel "on the rough."

The kettle grill. The Weber kettle grill was invented in 1952, and it revolutionized not only the cooking in people's backyards, but it also influenced restaurants' cooking practices, including opening up grilling procedures for guests to observe. The kettle grill became a popular instrument at parties and picnics, and smaller versions of the grill became standard equipment in camping and caravanning. The grill was essential for the emerging outdoor cooking as a leisure activity.

Solar cell. A solar cell converts the energy in light into electrical energy through the photovoltaic process. A device with a silicon solar cell to exploit the solar energy in this way was invented in 1954. Solar energy has previously been important for tourism, for example, for the provision of hot water for washing and pools. However, solar cells have appeared to have a wider range of use, for example powering mobile phones, navigation equipment, and other travel devices.

Shopping mall. The first enclosed, indoor shopping mall was opened in 1956, and the trend spread rapidly. In 1981, the West Edmonton Mall set new standards, partly because of its enormous size, and partly because it also included a hotel, amusement facilities, a miniature golf course, a water amusement park, and a zoo. The malls no longer just served a local need, but became attractions in their own right.

Carbon fiber. Carbon fibers have been known for decades, but the industrialization boomed after 1958, the year of the invention of high tensile fiber. The material, which is ultralight, became an ingredient in many products of importance for tourism leisure, for example, cars and aircraft. The material is also used widely in sports goods, for example, bicycles, tennis rackets, hockey sticks, surfboard, kayaks, fishing rods, etc.

Automatic teller machine. The first ATM was launched in 1959. The system was limited in use, as it was confined to a single bank. The networked versions came into use in 1969, and by 1972, the "cash point" technology was developed to become a comprehensive standard. Gradually, the safety was increased, and the network meant that currency was available at most locations. For the tourists, ATMs decreased the needs for travelers' checks and currency exchange services, and they increased flexibility and decreased the risks of carrying cash while traveling.

Automatic door. The first automatic sliding door was produced in 1960. It provided easy and inviting access to stores, airports, hotels, restaurants, etc. The automatic doors were convenient for travelers with their hands full of luggage. Quite some bellboys lost their job, as tourists could serve themselves.

Family dome tent. Tents are sheets of fabric draped over poles. The old-fashioned model—sometimes leftover military equipment—of a camping tent was standard for many decades. From 1960 and onwards, new technologies for the frames were launched, importantly the aluminum frame. After the frames became stronger and more portable, inventors began to revolutionize the cover. Manufacturers began to make the covers out of new materials, such as nylon and polyester. As a result, life on a camping site could increasingly resemble a summerhouse, convenient for the whole family, with the additional built-in freedom of mobility.

Dry ski slope. Skiing is normally seasonally constrained, but with artificial slopes it became an all-year indoor and outdoor activity. The slopes, established on natural hillsides or on ramps, were covered with a plastic material, dendix, which is a by-product of brush manufacturing. The development of newer materials has made it possible to organize skiing slopes as pop-up installations at events etc. Dry skiing has developed since the early 1960s, mainly in areas with no natural preconditions for winter sports.

Recreational drug. The term "recreational drug," or "party drug," is used for a range of different products that people take with the intention of creating or enhancing the recreational experience. The so-called holiday tablets were introduced in the 1960s, and the ingredient was amphetamine. The substance for Ecstasy was already developed in 1912. Party drugs could help to keep energy levels up, and, when taken, less sleep was needed, and the users became more sociable and courageous. In spite of attempts of regulation for the protection against disastrous health effects and addiction, there is a continuous (sometimes illegal) development of new types of drugs. Some tourist destinations and resorts have built up a reputation for clubbing and nightlife, and it is likely that the business is indirectly affected by the tourists' use of recreational drugs.

Instamatic pocket camera. The first automatic camera went on sale in early 1963. These cameras were inexpensive and very easy to operate, and they introduced a large new audience to photography. Pocket versions were quickly added to the market by Kodak and Minolta, and the cameras became a travel accessory for tourists, who could document their holiday experiences.

Inflatable life raft. Lifeboat services operating from land have been known for many centuries, and solid lifeboats attached to the side of the ships and hoisted down in case of an emergency were also notorious pieces of lifesaving equipment on ocean liners. Inflatable life rafts were introduced in 1963. They were made from durable materials and they had

canisters attached to attract attention. The design was intended to ensure that the rafts could inflate quickly. Generally, the rafts increased safety, and they saved space on the ships. As anyone can inflate the equipment, the need for crew and training of crew and related costs are reduced.

Snowboarding. Modern snowboarding originated in 1965, when an engineer came up with an efficient design that allowed the user to surf downhill with some control of the board. The board was put into production, and the increase in popularity and dissemination took place after the organization of competitions. After being recognized as an official sport, winter sports destinations gradually, although with some resistance from traditional skiers, organized terrain parks suitable for snowboarders.

Barcode. Barcodes are product identification tags that can be read by optical scanners. The system was invented in 1966, and soon after, it was introduced as a universal standard. Barcodes have been used in supermarkets since 1974 and are widely used in tourism, for example, in connection with the handling of luggage in airports, in ticketing systems, in fast-food chains, etc. They have increased the speed of operation and are essential elements in queue and crowd management.

Pool cleaning robot. The first robotic pool cleaner that used electricity was launched in 1967. Already before, there had been electric devices to perform the cumbersome cleaning work, but the robots truly offer a major advance in labor savings and quality.

Computer tablet. The first prototype of a tablet was introduced in 1968, and it was designed as an entertainment device for children. It had a hard keyboard, and it became inspiration for later extensive laptop computing. The critical and comprehensive benefit in this invention was that users of computers could choose to be more mobile. Mobile computing has influenced travelers' behavior extensively, for example, in the possibility of bringing along work or entertainment on holiday. Mobile computing also influenced the operations of tourism enterprises, as administrative and managerial functions can be done more flexibly in terms of time and space.

Scents technology. Aromas have been important for human beings for millenniums. Chanel is claimed to be the first to go into aroma marketing by requiring sales assistants to spray themselves with the famous Chanel No. 5. However, the modern systematic and scientifically based development of scents did not surface until the 1970s, where a method was invented to analyze and re-create smells of all kinds. Scents have been included in modern spa products, for example, in aromatherapies. Scents—including unpleasant ones—are used for interpretation in museums.

Loyalty program. The first frequent-flyer program was established by United Airlines in 1972. Loyalty programs were known already in the 1930s from the retail sector. Customers were encouraged to show continued patronage by being offered rewards; in the case of tourism, free trips or access to hotels and rental cars. Loyalty programs allow companies to gather important data for market analyses, which is considered decisive. Loyalty programs succeeded in affecting travel behaviors, and they created new and enhanced old business alliances in the sector.

Lonely Planet. Lonely Planet is the product of two adventurous travelers who, in 1972, created the idea of a guidebook system for people who wanted to travel on a low budget. They hit the true spirit of rebellious youth at the time, and they published millions of books that were based on their own experiences of living on a shoestring. The innovative elements came in as they increasingly incorporated feedback from their readers, and their books became more and more "crowd sourced." The website was launched in 1994, and it allowed an intensification of the communication between readers.

RFID. The first radiofrequency identification systems can be traced back to military use during the Second World War. In 1973, the first operational wireless noncontact system that used radio-frequency electromagnetic fields to transfer data was patented. The RFID is attached to an object, which may then automatically be identified and tracked. RFID became widely used in connection with tourism, for example, in access control for customers and staff. Airports use the tags to follow luggage flows or to plan and control the location of equipment. Museums tag their valuable objects in order to prevent theft. Amusement parks provide children with RFID for their parents to follow their movements.

Sous-vide. Sous-vide is a method of cooking food sealed in airtight vacuum plastic bags in a water bath for longer than normal cooking times: up to 72 hours under strict control. The intention is to allow the item to cook evenly, and thereby ensure a juicier food. These precooked food items—often in portions sizes—are reheated in special containers. The sous-vide method has been in industrial operation since the 1960s and was introduced to restaurants in 1974. The advantage for restaurants and hotels is that they can operate a large menu with limited numbers of trained staff. There is lower waste, and the quality is considered to be at a fully acceptable level.

Mini-bar. The mini-bar is a small, private refrigerator containing snacks and beverages, and it is found in upscale Western-style hotel rooms. Typically, it is stocked with a precise inventory, from which the room's guests can take what they please at any time during their stay. The mini-bar was first introduced in Hong Kong Hilton Hotel in 1974. With the mini-bars, hotel guests became less dependent on

room service. For the hotel, the availability of snacks and drinks is likely to increase sales and revenues, and there are potential savings in staff otherwise allocated for room service.

Gore-Tex. Gore-Tex is a waterproof and breathable fabric of a layered construction invented in 1976. The fabric is used for outdoor clothing and shoes. The protective features, and the fact that it is easy to clean and wash, popularized equipment based on Gore-Tex across many categories of tourists, particularly hikers and backpackers. Gore-Tex, and all the other fabrics that emerged after the patent expired, led to increased comfort and opportunity for outdoor life. It became possible to plan longer trips, endure tougher weather conditions, and to carry lighter loads. Simultaneously, the extension of hiking routes and the popularity of outdoor leisure and travel have increased.

Airline deregulation. Deregulation is part of an institutional principle that, in this context, can be regarded as an institutional innovation. The stated rationale for deregulation is often a plea for a raised level of competition, resulting in higher productivity, more efficiency, and lower prices overall. The United States started a deregulation process of airlines in 1978, and the European Union implemented a similar process in 1993. Deregulation led to a restructuring of the airline business and was an important factor in the emerging low-cost airlines. Overall, airborne tourism transportation has increased, and passengers have experienced a favorable development in prices. In addition, the competition has led to the opening of new routes and destinations.

Camcorder. The first handheld video recorder was released by Sony in 1983. Sony continued to develop the compact types of video cameras that became popular for use on holidays. Tapeless formats came in 2004, and from 2009 camcorders came in pocket sizes and were integrated in mobile phones for instant sharing of holiday memories.

Mobile phone. The concepts of mobile phones had been around for several decades, but the first ones available to the general public were marketed in 1983. Mobile phones enhanced mobility, and they have changed tourists' communication behaviors. Text messages, which were introduced in 1987 by Nokia's letter keyboard, contributed to transnational communications and were an advantage for travelers who wanted to communicate cheaply. Likewise, text messages became integrated in various facilities, including ticketing, information, and marketing. Smartphones, introduced in 1999, combined the functionalities of the computer with the convenience of a mobile phone, and the phone thus became a principal guide to traveling, and not only a means of communication.

Rolling luggage. A Northwest Airlines pilot, Bob Plath, needed an easy way to transport his bags through busy airports. After some experimentation in his garage, he invented a rolling suitcase. Before, all luggage was oriented horizontally with handles on top. With the vertical format, important ergonomic advantages were reached. In 1989, when passengers began asking airline personnel where they could buy rolling suitcases, the pilot started production. Airport security procedures and equipment were standardized to accommodate the popular rolling carry-on. Over time, airlines reconfigured their fleets with overhead storage bins that could hold the new carry-ons. The tourism industry also received a boost, as travel was simplified for everyone, regardless of their physical limitations.

Robotic lawn mower. Effective equipment for the up-keep of lawns is essential for the maintenance of sports fields, golf courses, public green spaces, and areas in connection with hotels and resorts. Mechanical and electronic devices have been available for decades. The first generation of robotic mowers was introduced in 1989. The robotic era in maintenance is a step toward the saving of labor resources. A typical lawn mower requires the user to set up a border wire around the lawn that defines the area to be mowed. Robotic lawn mowers are becoming increasingly sophisticated, are self-docking and some contain rain sensors if necessary, nearly eliminating the need for human interaction.

World Wide Web. The WWW has been one of the most groundbreaking inventions for tourism, transforming a range of information dissemination and retrieval processes radically. From 1989 and onwards, the web has replaced many paper-based information sources and documents. Travelers experienced increased transparency of tourism products and prices, and a possibility to amplify flexibility in travel planning. Eventually, the interactive facilities empowered travelers and created entirely new categories of travel communities. For travel enterprises and destinations, the WWW revolutionized marketing methods and changed the collaborative structures in tourism business. Data processing has sped up and become automatic, with considerable labor savings for enterprises. The WWW led to a decline in the number and operations of traditional travel agencies, visitor centers, etc.

Consumer protection. The origin of consumer protection goes back a century, but the inclusion of travel came much later, after radical "consumer movements" in the 1960s and 1970s. Another circumstance was the blossoming package travel markets. In Europe, The Package Travel Directive was passed in 1990. The directive included regulations of the provision of information by tour operators, financial protection and repatriation in the event of company failure, and a specific regime for contractual liability in terms of package holidays. Warranty funds with payments from the tour operation ensured that customers could reclaim expenses in case of bankruptcy.

Online maps. Xerox introduced the first map server in 1993, and shortly after, in 1995, interactive maps emerged. Google Earth was launched in 2005. Online mapping had significance in several ways for tourism. Web versions provided frequently updated maps and cheaper distribution. It is possible to generate personalized map content, for example tracking tours. The maps can be shared with others. Most important for the travelers are maps displayed on mobile phones, smart phones, PDAs, and GPS.

E-ticketing. United Airlines was the first airline to issue electronic tickets in 1994. The development went fairly slowly, but a new standard in 2004 by IATA sped up the development, and e-ticketing was fully implemented in 2008. Airlines and other types of transportation achieve savings in terms of the issuing and handling of tickets. Customers have come to accept e-ticketing, especially as business models with discounts for self-service have emerged.

QR code. The QR codes were developed in 1994 for identification purposes in the automobile industry. QR code systems moved rapidly into tourism and other service sectors because of its fast readability and greater storage capacity compared to its predecessor, the bar code. The importance of the QR code increased with the dissemination of smart phones with scanning abilities. The QR code shifts the mode of travel information and introduces new formats of instantaneous and site-sensitive interactivity for tourists.

The Schengen Agreement. Schengen, implemented in 1995, was a European treaty that provided for the removal of border controls between participating countries. It eased the crossing of borders for Europeans and visitors to Europe as internal border controls were abolished and a common visa policy implemented.

Social media. The first social network, Six Degrees, was launched in 1997, and this service let users create profiles and list friends. The gaming site "Frienster came along in 2002 and advanced the interaction between users allowing them to share texts and photos. Facebook was introduced in 2004, and YouTube began in 2005, just to mention a few of the most influential social media. The importance of social media in connection with holidaymaking is very significant in the sense that the authority over destination images shifts from the tourist industry to the tourists. Increasingly, the tourist industry utilizes social media as a marketing and communication channel.

Blogging. Blogs are web-based discussion or informational sites first introduced in 1997. The blogs used to be "owned" by a writer who wrote about a topic in the form of a chronological diary. In 1999, the technology developed so that those who followed the blog could upload comments, and pictures and videos could also be added. Blogging became popular among travelers, who could find inspiration for special-interest tourism. The tourism enterprises, destinations, and events adopted blogging as an integrated part of marketing and communication. Blogging contributed to the undermining of "authoritative" tourism information.

Viagra. Viagra is a standard treatment for erectile dysfunction, and it has a significant recreational use because it is believed that the drug increases libido and improves sexual performance. The sale and use of Viagra is found to be associated with certain spa and health tourism destinations as well as destinations and night-life resorts known for more extensive prostitution.

Common currency and monetary union. The Euro came into existence in January 1999, and the Europeans shifted to the currency in 2002. The ideas of a monetary union range back to the 1920s, as a measure to facilitate international trade. For tourists in Europe, the monetary union has been of considerable practical importance and led to a higher price transparency.

Augmented reality. The idea of augmented reality comes from cinema technology, but it was not released until 1999. An augmented reality system generates a merged view for the user that is the combination of the real scene viewed by the user and a virtual computer-generated scene that augments the picture with additional information and supports the interpretation or entertainment. Devices for augmented reality are smart phones or glasses with a camera mounted in the corner. Augmented reality was instantly seen as a device of importance for tourism sightseeing and for interpretation in museums and at events.

GPS. The Global Positioning System was developed in 1973 to overcome the limitations of previous navigation systems. Public use of GPS started in 2000. GPS helps travelers find their way, and the use of paper maps has decreased. A GPS can be customized to accommodate for traveler's personal preferences. Adventure seekers use GPS for gaming and communication, and the tourist industry and destinations data mine the logs for value information about travel behavior.

Genetically modified golf turf. The first genetically modified plant was produced in 1982, and in 2003, the herbicide producer Monsanto applied for permission to market the modified bent grass turf for golf courses. The new grass would allow golf courses to use herbicides, also produced by Monsanto, to fight weeds, and eventually to ensure the uniformity, quality, aesthetics, and playability of golf course turf. Environmental and biosafety issues put market introduction on halt.

Micro blogging. Micro blogging services such as Twitter let the subscribers post very short personal messages online and

broadcast them to a group of other subscribers who have chosen to be "followers." Twitter launched its service in 2006. Tweeting has also become a way for enterprises and destinations to announce updated offers, events, etc.

Body scanning. The x-ray was invented by Röntgen in 1885, and medical radiography emerged early in the 19th century. Scanning technologies developed into digital formats in the 1970s. In 2007, technology was introduced for full-body scanning as a device for security controls in airports, at events etc., thus replacing metal detectors. Scanning technology has further potentials in terms of gaming, shopping, fitness etc., yet to be developed.

Artificial weather. The Chinese hosts of the 2008 Olympic Games had prepared for rain at the opening ceremony, not with umbrellas, but with a technique to force rain clouds to give off their moisture in another area. The best possible experience for the visitors and sports people and an optimal image for the millions of TV viewers were essential for the Chinese hosts. The scientific foundations for change of weather conditions were established in the 1940s, as part of military developments, and it was used later to ensure rain for crops in dry areas.

Avatar. The avatar—a word from Hinduism for a god descending onto earth—became popular in the film and gaming universe, which bloomed in the 1990s. However, online services soon discovered that personalized helpers could improve customer services on the Internet. With Artificial Intelligence, the embodied agents were capable of giving answers to simple questions that customers asked. In 2012, avatars were detached from the immediate computer environment, and full-body sized avatars were introduced in airports to help travelers find their way. The avatars represent new and economically efficient customer services and lead to competitive advantages through labor savings.

Discussion

The previous section has been a "tour de force" of innovations that have transformed tourism. Each of the innovations was only described with a brief overview of the history and implications. In this section, I will discuss some of the findings that have emerged from compiling the list in order to state the impacts for the tourism industry and to pinpoint the implications for innovation research in tourism.

On a very general level, the list of 100 innovations clearly demonstrates how immensely dependent tourism development is on innovations that take place in science and technology. Imperative developments of the steam engine, electricity, the combustion engine, the jet engine, microwave, etc. transform into benefits for tourism. However, biological and chemical research also influences the development of tourism, which can, for example, be seen in the cases of drugs. New materials, for example, in textiles, plastic, and synthetic fibers, have led to functional equipment and gadgets. Military- and space-related research and investment has affected tourism, for example, in the case of outdoor equipment, the WWW, and GPS.

The list also includes a range of organizational and institutional innovations, many of which have not had a primary goal of affecting tourism. This is the case in major changes in the EU transnational cooperation, the liberalization of, for example, the provision of infrastructure, and principles of consumer protection. Accordingly, the innovative modernization of governance affects tourism directly and indirectly.

What are the more specific impacts of the innovations on tourism? Table 1 suggests a very rough categorization of tourism impacts. When looking at the list vertically, it is clear to see that the most frequently occurring effects concern the social and physical efficacy for the tourists, as seen in column 2. Eighty of the 100 innovations help tourists to produce recreational benefits and pleasures for themselves. Improved infrastructures, for example, make it easier and more comfortable to reach destinations. New materials used for sports equipment improve the performance of the core tourism activity. Air conditioning and solar cells make it possible to increase comfort and enhance the possibility to utilize holidays more efficiently on preferred activities. Accordingly, innovations have implied that being a tourist and enjoying a holiday is much easier since the innovations have removed barriers, pains, struggles, anxieties, and inconveniences.

In 59 of 100 cases, the innovations had an impact on the operations, productivity, and use of resources in the tourism enterprises. Recent changes in information and communication technology (ICT) have benefited tourists, but they have also changed the communication of the enterprises with customers as well as staff. The institutional innovations such as discount coupons, air traffic associations, airline deregulation, credit cards, etc. were crucial in terms of acquiring not only more business but also businesses operating more profitably.

Half of the 100 innovations changed the properties and increased the variety of products and services as they are experienced by the tourists. The development in materials that are included in sports and outdoor equipment promoted advances in the experience, as did the range of developments in ICT. In earlier days, institutional innovations such as museums and national parks ignited a reason to go.

Increased mobility is the effect of 45 of the shown innovations. Clearly, infrastructure has contributed to higher speed and farther travel distances, but innovations such as the GPS, barcodes, online maps, etc. also added to the picture. The caravan is a good example of a device that motivated mobility, and changed luggage formats and technologies contributed to mobility as well.

Thirty-three of 100 innovations contributed to the opening and forming of new tourist destinations. That is the case for groundbreaking means of transportation and infrastructures such as the railway, automobile, ocean liner, highway,

and canal building. The development of equipment that is easier to carry and has protective properties was of importance for the developing category of outdoor and wilderness tourism, and many categories of innovation made it possible to travel under more extreme climate conditions. With deregulation, the competitiveness of destinations shifted, and new hot spots emerged.

When it comes to institutional changes, the table shows 32 indications, including paradigmatic political changes, such as deregulation, labor regulations, and transnational cooperation. Furthermore, major health- and safety-related actions had implications for tourism. The critical innovations include the regulation of air traffic, collaboration in ticketing and money transfers, and not least, the WWW and subsequent innovations.

There are 30 innovations that reformed the way to process information within and across institutional boundaries, and most of these are of fairly recent date. Loyalty programs established new types of business collaboration and consumer relations. Global networks were created within the banking, telecommunication, and travel services. The WWW continues to bind tourists and tourism enterprises together in still more advanced structures that change benefits for the tourist and shift competitiveness, control, and dominance among providers.

If we look at Table 1 horizontally, the extent of the innovations can be witnessed. The most revolutionary innovations, here innovations with 6 or 7 marks, are the railway, the automobile, the passenger aircraft, the WWW, and social media. The ocean liner, sleeping car, minibus, barcodes, computer tablet, airline deregulation, mobile phone, and common currency also appear as important innovations for tourism, as they transcend 5 domains of changes. It is hardly surprising that these innovations account for such significant effects, with deep implications for tourists as well as for tourism enterprises and destinations.

The texts about the single innovations suggest an array of subsequent impacts during a lengthy period of development and implementation. For example, RFID was first used to localize objects, and later adapted for staff management and allocation. More recent developments allowed customers to follow objects of interest, for example their own luggage, or friends could locate each other in outdoor games and exercises. Subsequent use is connected to data mining and business intelligence. Other innovations have also enhanced their implications over time, such as guidebook systems like Lonely Planet and Michelin, and computer reservation systems.

New services and experiences are continuously occurring on the market. For example, an activity that was once an adventure for experts in one decade—with its restricted technological properties—became a mainstream tourism pleasure the next decade because of a reduction in risk factors and the facilities becoming more accessible through other innovations; mountain climbing comes to mind. Likewise, the previously pricey services, such as spa treatments, now occur as part of new business concepts where a reengineering of the original ideas create both higher accessibility and new services, including self-service.

Conclusions and Limitations

Traveling affects the body and mind on many different levels, and traveling can be stressful for the body as well raising cognitive and social challenges. This overview shows that over time, and thanks to the innovations, tasks have been eased, and control and predictability over the situation has increased. Fascinatingly, the tourist industry is greatly assisted by science and technology and by conceptual innovations and governmental modernization, which affect consumer behavior as well as the competitive environments. In this perspective, the significant growth in economic and social importance of tourism is not only the merit of tourism actors themselves.

What are the potential implications of this approach for the study of tourism history? What does it add to other scholars' significant work, for example Towner (1988, 1995), Walton's (2009), Löfgren (1999) and Featherstone, Thrift, and Urry (2005)? First and foremost, this study demonstrates that much innovative power in tourism does not originate from tourism itself; it is the effect of something that happens elsewhere. It is important to say that tourism is not merely to blame for this. Tourism is strongly interrelated with other economic and social fields. Blameworthiness is only appropriate if tourism industries and their organization assert themselves to be omnipotent in the field of innovation. They are, as demonstrated here with 100 examples, not innovation pioneers and loners, and they will hardly become so in the future.

The study raises many supplementary questions and it calls for further research. Essential topics concern the density of innovations over time, and the speed with which innovations disseminate into tourism. The first innovation identified in this study was from 1414 and the last from 2012, a span of 600 years. Perhaps not surprisingly, the density of innovation has increased from 1850 and onwards, an effect of the rapid industrialization in the second half of the 19th century. The 20th century also represents a period of strong innovative activity with significant implications for tourism. However, the cases show that there is often a considerable time lag before discoveries are brought into tourism. For example, the principle of gliding was known for a long time, but new materials combined with the original knowledge catapulted leisure-related use. Some of the party drugs consist of substances known for decades, but clubbing in connection with mass tourism facilitated the use of it. Other innovations were very rapidly transformed into touristic use. Thomas Cook was an astonishingly fast mover when it comes to the utilization of the rail infrastructure for leisure travel. Some of the ICT innovations, such as mobile telephones and the WWW, came swiftly into use. Camera technologies also gained immediate popularity after their introduction. In terms of sports equipment and facilities, a speedy implementation has been supported by competitions and the recognition as official sports disciplines.

Why do some innovations affect tourism rapidly and substantially, while others stagger for a long time before they are exploited in a tourism context? These are complex questions

that cannot be answered properly without careful empirical investigation of each single innovation. However, are there theoretical explanations to when and how innovations are permitted to transform tourism? A further inquiry into literature on innovation diffusion may open some new and interesting interpretative contours. A possible way to proceed is to adapt and develop theories and concepts of boundary spanning, commonly used to address (inter)organizational communication flows, knowledge transfer and innovation patterns (Ancona and Caldwell 1992; Marrone 2010; Tushman 1977), and also to some extent used in the research on industry clustering (Vixted 2009).

When it comes to innovations that transformed tourism, a principal question is what categories of boundaries exist between the innovating and supplying industries on the one side and the tourism industry on the other hand. Technology formats are suggested by the literature as a key boundary. Technological compatibility, for example, across geographical borders, may enhance the dissemination of innovations. The knowledge base, including the scientific traditions, can also constitute boundaries, and the permeability can be determined by the rigidity versus the openness of disciplines. The boundary-spanning literature also places a great importance on the organizational boundaries, including corporative and governmental structures and legal systems.

A second issue in the boundary-spanning literature is to define the critical enablers and the gatekeepers: organizations, bodies, and even individuals who control the flow over the boundaries, and with the interest in either facilitating or hampering the process of innovation disseminations. Some actors may have an interest in delaying the dissemination, for example military frontrunners where civil use can weaken the military position. Other gatekeepers have an interest in more rapid dissemination, but perhaps restricted in some respects for example in terms of corporative alliances or for the purpose of national protectiveness. Enabler and gatekeeper roles and relationships can be further analyzed in order to understand the mechanism of innovation diffusion.

A third issue is the existence and functioning of boundary-spanning arenas. These are the areas of exchange of ideas, places where the processes of information filtering and the coordinating takes place. The arenas are locations, events, and fields where actors from different economic and geographical spheres come together. The world exhibitions have been mentioned as essential for the transformation of tourism, and they are examples of boundary-spanning arenas. In this context, it is also essential to comprehend the continuous modernization and the roles of national and international authorities, associations, and NGOs as arena creators.

The boundaries between tourism research and other disciplines are also challenged. Innovation studies require historical, economic, political, sociological, technical, and other categories of expertise in interdisciplinary setups (Liburd 2012), and if research is to contribute to the development of tourism, untraditional alliances are certainly needed. Knowledge flows are highly unpredictable, and there are no comfort zones for tourism researchers.

Conclusively, boundary-spanning innovation may be a fruitful approach to further studies of transformations in tourism, yet to be initiated and exploited.

It is often claimed that tourism should enhance its innovativeness, as this is believed to increase economy growth, productivity, and employment. Policy makers often find it indispensable—for the benefit of tourism innovation—to expose the sector to an open information flow and to stimulate internal knowledge creation (Shaw and Williams 2009; Hjalager 2012). However, this study demonstrates that it is just as essential to simultaneously target supplying sectors and to amplify the absorptive capacity of the tourism sector (Cohen and Levinthal 1990). Hence, future research about how innovation transformed tourism can be of importance in how international, national, and local governments choose to compose their tourism policies.

This inevitably raises the question about where to look for the next generation of innovations in tourism. Taking advantage of this study, researchers and policy makers may want to pay closer attention to core fields of advancement in science and technology. The message is not to look for an answer to the question exclusively in tourism research but also and in combination with for example life sciences, which embraces the knowledge of how to affect human physical performance, mental moods, and social benefits. Or get into the depth with the progress in ecosystems research, thus to start an alley of reinterpretation of the spatial and climatic environments of the tourism experience. When national and transnational governments launch ambitious research programs in for example smart building technology, sophisticated materials, healthy ageing, modernized educational systems, environmental technology, or advanced information technology, it is potentially of crucial importance for tourism. Although it may be difficult to prophesy to any level of accurateness, there is hardly a single field of science and technology that does not contain some foundations for the future of tourism.

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