INTERNATIONAL MARKETING AND MANAGEMENT RESEARCH
SERIES EDITOR: ANSHU SAXENA ARORA

palgrave pivot

Sustainable Innovation

Trends in Marketing and Management

Edited by
Anshu Saxena Arora · Sabine Bacouel-Jentjens
Mohamad Sepehri · Amit Arora

UNIVERSITY OF THE DISTRICT OF COLUMBIA
SCHOOL OF BUSINESS AND PUBLIC ADMINISTRATION

palgrave macmillan

International Marketing and Management Research

Series Editor
Anshu Saxena Arora
School of Business and Public Administration
University of the District of Columbia
Washington, DC, USA

International Marketing and Management: Perspectives from the Global Logistics & International Business Education and Research Center provides a forum for academics and professionals to share the latest developments and advances in knowledge and practice of global business and international management. It aims to foster the exchange of ideas on a range of important international subjects and to provide stimulus for research and the further development of international perspectives. The international perspective is further enhanced by the geographical spread of the contributors.

More information about this series at
http://www.palgrave.com/gp/series/14845

Anshu Saxena Arora
Sabine Bacouel-Jentjens
Mohamad Sepehri • Amit Arora
Editors

Sustainable Innovation

Trends in Marketing and Management

palgrave
macmillan

Editors
Anshu Saxena Arora
School of Business and Public Administration
University of the District of Columbia
Washington, DC, USA

Mohamad Sepehri
School of Business and Public Administration
University of the District of Columbia
Washington, DC, USA

Sabine Bacouel-Jentjens
ISC Paris Business School
Paris, France

Amit Arora
School of Business and Public Administration
University of the District of Columbia
Washington, DC, USA

International Marketing and Management Research
ISBN 978-3-030-30420-1 ISBN 978-3-030-30421-8 (eBook)
https://doi.org/10.1007/978-3-030-30421-8

This Palgrave Pivot imprint is published by the registered company Springer Nature Switzerland AG.
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Foreword

Sustainable Innovation: Trends in Marketing and Management is the sixth issue in the Palgrave Macmillan series, International Marketing and Management Research. Ten pieces, carefully selected and crafted, constitute this sixth volume. As in previous issues, this volume continues on the trajectory to deepen new facets of research in international business behavior, policies and processes, offering fresh perspectives and new frames of analysis bearing on innovation capabilities. New exploratory ground is broken in this volume, part of a series directed by Anshu Saxena Arora, confirming that international business in its various expressions is an evolving and dynamic field, responsive to the dual forces of innovation and digital transformation combining to challenge extant models.

This volume therefore addresses the next generation of international business issues rooted in innovatory techniques and the associated digital transformation impacting all business functions across all national markets, with a sharpened emphasis on offline and online digital domains, among others. The Parsons New School in New York and also schools like the Savannah College of Art and Design (SCAD) recognize that design-led firms assess the innovatory process to be organically tied to what is design thinking. Similarly, Adobe in its best practices and *Design Thinking: A Manual for Innovation* considers disruptive innovation a key to best industry practices, often yielding greater global market shares for companies which nourish creativity through design innovatory thinking. PWC notes in its 2017 Innovation Benchmark Report based on a global study of over 1200 companies in forty-four countries that industry disruption

through sustainable innovation is increasingly the norm, not an anomaly and that no company can afford to ignore this imperative.

This sixth volume ranges, in its topical and exploratory essays, from a new look at global value chains to redefine the nature of global trade flows to the use of social media in understanding both customer value creation and enhanced organizational performance, to the psychology of online marketing, to the centrality of cultural consumption in trade, this volume offers multiple lenses, rooted both in conceptual treatments and in case studies. The transformational processes considered here, particularly of consumer industries—a special focus in this volume—are propelled by major demographic, cultural, demographic, regulatory and technology trends which underpin the various contributions.

The tsunami of big data which has been unleashed on all business sectors has challenged both managers and researchers, as this volume demonstrates in its applications and research foci. The various contributions embedded in this sixth volume plumb the potential and the challenges that maturing sustainable innovative information technologies present to international business disciplines. It also opens up new vistas on the question of the integration of digital capabilities such as social, mobile, analytics and cloud in the process of transforming how business address consumer behavior, needs and trends; more generally, how businesses work and address the resulting opportunities and risks.

No business process, individual firm or industry sector will be spared by the combination of technological innovation and digitalization. Noteworthy is that none of the prophecies seeking to explain how this transformational process will occur or the likelihood of its successful outcome have been validated. There are few if any research works underlining the considerable challenges that firms encounter in making optimal use of data. Nor is the nascent and fast-growing field of data science(s) capable of forecasting how firms and industries will react. Deep learning, as is implied in this volume, challenges operational concepts and, in this sense, this sixth volume is an appreciable contribution in shedding light on the complex phenomena of building innovation capabilities for business performance.

Perhaps the great lesson to be derived from the contributors is that innovation and digital transformation are not fundamentally about technology but about strategy. Benn Konsynski, Distinguished University Professor of Information Systems & Operations Management at Emory

University's Goizuetta Business School, noted that organizations should begin by rethinking business and commerce and then work their way backward. This volume is a step in that direction.

John R. McIntyre is Professor of Management in the Scheller College of Business at the Georgia Institute of Technology, Atlanta, GA, USA. He is the founder of the Georgia Tech Center for International Business Education and Research, a national center of excellence, now entering its 24th year of operations and dedicated to promoting research, education and outreach in the cognate field of international business. In 2017, he was made honorary professor at the ICN Graduate School of Business, University of Lorraine, Nancy-Metz, France.

Georgia Institute of Technology
Atlanta, GA, USA

Contents

1 **Quasi-Passive Lower and Upper Extremity Robotic Exoskeleton for Strengthening Human Locomotion** 1
Aryaman Arora and John R. McIntyre

2 **Ideate-Generate: Design Thinking and User Experience (UX) for Sustainable Impact on Global Product Development of Wearable Technologies in the Healthcare Industry** 15
Alexandra Washington, Samira Soumahoro, and Anshu Saxena Arora

3 **Seeing Is Believing: The Disruptive Effect of Sustainable and Functional Product Design in Electric Bikes for Emerging Economies** 25
Delonte D. Bright, Edna Laetitia Aude Diouf Ogandaga, and Anshu Saxena Arora

4 **Do Greener Products Earn More Green? Examining Biomimicry along with Incremental and Radical Sustainable Product Innovations for UX Designs** 33
Snehapriya Bharatha, Elizabeth Jensolowsky, Michael Teiman, Anshu Saxena Arora, and Jennifer Edmonds

5 Buyer-Supplier Relationships: Role of Collaboration, Sustainability, and Technology 47
Loucace Dorcas Ampe-N'DA, Barbara Ann Payne, Robert Iyeli Spake, Shavon Sharpe, and Amit Arora

6 The Road to Sustainable Transportation in Supply Chains: A Stage-Level Approach 59
Meena Hotak, Evelin Turcios, Divina Grace Dayrit, and Amit Arora

7 Coaching, Agility and Sustainable Leadership 71
Christophe Bacouël

8 Innovation in Employee Selection: Tracing the Use of Hugo Münsterberg's Test for Motormen 81
Nicole Cannonier

9 Family Business Sustainability: The Intergenerational Transfer of Social Capital and Network Contacts 101
Fabian Bernhard, Miriam Hiepler, and François-Xavier Engel

10 Sustainable Well-Being at Work: A French-Swedish Comparison 133
Anne-Sophie Bacouel and Thomas Vergnol

Index 149

Editors

Amit Arora is Associate Professor of Supply Chain Management (SCM) in the School of Business and Public Administration at the University of the District of Columbia (UDC). Prior to joining UDC, he was Associate Professor and Co-Director of Nicholas Giuffre Center for SCM at Bloomsburg University. Previously, he was Assistant Professor and Director of Global Logistics & International Business Center at Savannah State University. Amit holds a PhD from Georgia Southern xena University. He got his SCOR (Supply Chain Operations Reference) certification from the Supply Chain Council in 2013. He is the special issue editor for the *International Journal of Emerging Markets* for "Value Chain Innovations in Digital, Social Media, and Mobile Commerce". He has ten years of experience in the auto industry in India with Hyundai and Honda.

Sabine Bacouel-Jentjens is Professor of Management at the ISC Paris Business School in France. She is the head of the school's management department and directs the "International Business Management"—Master Program. Furthermore, she is the head of the school's Assessment of Learning Committee. Sabine's international exposure is supported by many teaching missions at business schools in Europe, the USA and China. In addition to research and teaching, she has more than a decade of practical experience in the financial services sector, working in both specialist and management positions for the Dresdner Bank and later Allianz Group in Germany.

Anshu Saxena Arora PhD, PMP, is Associate Professor of Marketing in the School of Business and Public Administration at the University of the District of Columbia, Washington, DC, USA. Previously, she worked as Associate Professor of Marketing at the Jay S. Sidhu School of Business and Leadership, Wilkes University, Wilkes-Barre, PA. Before joining Wilkes University, she was Associate Professor of Marketing and Chairperson of Department of Business (Management, Marketing and Supporting Areas) in the College of Business Administration, Savannah State University, Savannah, GA, USA. She is a Certified Project Management Professional (PMP) from Project Management Institute (PMI), USA, and holds a Foundation Certificate in IT Service Management from Information Systems Examination Board (ISEB), UK. Arora has been a visiting professor at ISC Paris Business School in France, University of California, Davis, and Thunderbird School of Global Management at Arizona State University. She has more than a decade of industrial and academic experience. She has worked in companies like Hyundai Motors India Limited, Lufthansa German Airlines, and Siemens India. In July 2019, Arora received the prestigious National Science Foundation (NSF) grant for establishing the Logistics & International Trade (LIT) Analytics Center of Excellence and developing STEM-Business focused LIT concentration program at the University of the District of Columbia. She is the senior editor of marketing for the *International Journal of Emerging Markets (IJoEM)*. She is the special issue editor for two 2020 *IJoEM* special issues on "Global value chains, international trade, and markets: The role of emerging economies" and "Value chain innovations in digital, social media, and mobile (DSMM) commerce." She is the series editor for *International Marketing and Management Research* published by Palgrave Macmillan Publications, UK, and she has written six volumes of a recent book titled *Sustainable Innovation: Trends in Marketing and Management* to be published in November 2019. She has written more than 40 research papers in national and international journals of repute, and has presented about 50 papers in national and international conferences. Her research interests and expertise include digital/DSMM marketing, marketing analytics, social media strategy mix and social media measurement, stereotypical advertising polysemy, consumer behavior, ambient advertising, innovative experiential learning models in marketing and logistics/supply chain management, relational supply chain strategy relationships, and project management.

Mohamad Sepehri is Dean of the School of Business and Public Administration at the University of the District of Columbia (UDC). Prior to joining UDC in 2015, Sepehri was Associate Dean & Director of the Graduate Business Programs and Coordinator of the Adult/Accelerated Degree Program at the Davis College of Business in Jacksonville University. Dean Sepehri holds a triple-major PhD in Management, Higher Education Administration, and Strategic International & Political Economy from Indiana University, Bloomington. Sepehri has over 35 years of experience in strategic planning and global competitive market analysis. He is a consultant and research analyst to business corporations and a number of city, county, and state governments.

Associate and Copy Editors

Julius Ndumbe Anyu is Tenured Full Professor of Public Policy at the SBPA at the University of the District of Columbia, Washington, DC, and holds a PhD in Political Science from Howard University. Anyu previously served as associate professor, assistant professor, and lecturer at the University of the District of Columbia and Howard University from 1999 to 2012. Anyu has authored several scholarly peer reviewed articles and newspaper articles. His published books include *Case Studies of Conflict in Africa* (2013), *The Foreign Corrupt Practices Act: A Catalyst for Global Corruption Reform* (2007) and *Democracy, Diamond and Oil: Politics in today's Africa* (2006). Anyu serves as assistant editor at the *International Journal of Organizational Innovation*. From 2000 to 2013, he served as assistant editor at the *Mediterranean Quarterly*. Under his editorial leadership, the journal published articles from a stellar list of contributors including former President Jimmy Carter and former UN Secretary General Boutros Boutros-Ghali, and a long list of academics, foreign ministers, prime ministers, and prominent diplomats.

University of the District of Columbia, Washington, DC, USA

Sergey Ivanov is Professor of Management at the School of Business and Public Administration, University of the District of Columbia, Washington, DC, USA. His professional practice and scholarly interests are in the field of scientific organizational research in government, multinationals and military organizations. He holds a PhD from The George Washington University's School of Business, working under the leadership of Elliott Jaques on dynamic theories in organizational science. Ivanov has taught management and organizational courses at the University of the District of

Columbia, as well as The George Washington University, for over a decade, and provided consultancy services to a wide variety of organizations, including the US Department of Defense, Fortune 1000 corporations, and others clients. More information about Sergey Ivanov is available at www.SergeyIvanov.org, where he freely answers questions and shares ideas.

University of the District of Columbia, Washington, DC, USA

Jun Wu is Assistant Professor of Management at Georgia Gwinnett College. She got her doctoral degree from Old Dominion University and her research interests include governance environments, economic transition, business strategy, foreign investment, cross-cultural management and more. Her research appeared in journals such as *Journal of International Management*, *Management International Review*, *International Business Review*, *Journal of Accounting and Public Policy* and others, and her commentaries have appeared in *The Financial Times*, *Hong Kong Economic Journal* and others.

Georgia Gwinnett College, Georgia, USA

Editorial Assistant

Loucace Dorcas Ampe-N'DA is pursuing her MBA at the School of Business and Public Administration, University of the District of Columbia, Washington, DC, USA. She holds a Bachelor of Business Administration (BBA) degree in Management with a specialization in Management Information Systems from the University of the District of Columbia, Washington, DC, USA.

Editorial Review Board

Contributors

Loucace Dorcas Ampe-N'DA is pursuing an MBA at the School of Business and Public Administration, University of the District of Columbia, Washington, DC, USA. She holds a bachelor's degree in Management Information Systems from the University of the District of Columbia, Washington, DC, USA.

Amit Arora is Associate Professor of Supply Chain Management at the School of Business and Public Administration in the University of the District of Columbia, Washington, DC, USA.

Aryaman Arora is a high school senior student at the School Without Walls in Washington, DC. He is enrolled in college courses in Computer Science at The George Washington University and Georgetown University.

Anne-Sophie Bacouel graduated in International Business Administration from WHU Otto Beisheim School of Management in Germany (B.A.) and is a student in the CEMS Master's in International Management at Rotterdam School of Management and Vienna University of Economics and Business.

Christophe Bacouël holds an MBA from Kellogg School of Management Evanston and a master's degree in Coaching and Personal Development from the University of Paris II Panthéon-Assas. He has extensive experience in investment banking and learning and development in Europe and more recently as an executive coach. He is working for Insights in France.

Fabian Bernhard is Associate Professor of Management and a member of the Family Business Center at EDHEC Business School in Paris, Lille, Nice, and London. His research interests are emotional dynamics in family businesses, the preparation of next generational leaders and the psychological attachment to the family business.

Snehapriya Bharatha works as a business analyst at Deloitte LLP, Mechanicsburg, PA. She graduated with a master's in Business Administration from Wilkes University, Wilkes-Barre, PA.

Delonte D. Bright is an MBA student in the School of Business and Public Administration at the University of the District of Columbia, Washington, DC, USA.

Nicole Cannonier is Assistant Professor of Management at the College of Business Administration at Savannah State University, USA.

Divina Grace Dayrit graduated with a BBA in Management from the University of the District of Columbia, Washington, DC, USA.

Jennifer Edmonds is the dean of the School of Business and Digital Media at Georgian Court University, New Jersey, USA.

François-Xavier Engel holds a master's degree in Business Management from the EDHEC Business School in France. He works as an M&A analyst at Lincoln International in Paris.

Miriam Hiepler is a research fellow at the chair for Entrepreneurship and Family Business at the University of Siegen. Her research interests focus on business succession processes, social capital and network structures of family businesses.

Meena Hotak graduated with a BBA in Management from the University of the District of Columbia, Washington, DC, USA.

Elizabeth Jensolowsky graduated with a BBA in Marketing from Wilkes University, Wilkes-Barre, USA.

John R. McIntyre is Professor of Management in the Scheller College of Business at the Georgia Institute of Technology, Atlanta, GA, USA.

Edna Laetitia Aude Diouf Ogandaga is an MBA student in the School of Business and Public Administration at the University of the District of Columbia, Washington, DC, USA.

Barbara Ann Payne is pursuing an MPA at the School of Business and Public Administration, University of the District of Columbia, Washington, DC, USA. She holds a BBA degree in Management from the University of the District of Columbia, Washington, DC, USA.

Samira Soumahoro is an MBA student in the School of Business and Public Administration at the University of the District of Columbia, Washington, DC, USA.

Anshu Saxena Arora is Associate Professor of Marketing at the School of Business and Public Administration in the University of the District of Columbia, Washington, DC, USA.

Shavon Sharpe is a Bachelor of Business Administration (BBA) in Management degree student at the School of Business and Public Administration, University of the District of Columbia, Washington, DC, USA.

Robert Iyeli Spake is a BBA student in the School of Business and Public Administration at the University of the District of Columbia, Washington, DC, USA.

Michael Teiman graduated with an MBA degree from Wilkes University, Wilkes-Barre, USA.

Evelin Turcios is a BBA student in the School of Business and Public Administration at the University of the District of Columbia, Washington, DC, USA.

Thomas Vergnol holds a master's degree in International Business and Management from the ISC Paris Business School, France. He recently joined Nova Consulting.

Alexandra Washington is an MBA student in the School of Business and Public Administration at the University of the District of Columbia, Washington, DC, USA.

List of Figures

Fig. 1.1 Hip joint module—constant force mechanism (adapted from Yu et al., 2012) 9
Fig. 1.2 Knee and ankle joint as conceptualized 10
Fig. 4.1 Velcro consists of two pieces of fabric tape that attach on opposing sides by connecting small nylon loops with a fabric bedding 40
Fig. 4.2 Different versions of iPhone that show the various shapes and sizes it occurred in 41
Fig. 4.3 The exterior of the H_2ERO PACK is going to look like a backpack 42
Fig. 4.4 The sock-shaped filter inside the canteen 43
Fig. 6.1 Stage-level approach (Golicic et al., 2010) to implement sustainable transportation 63
Fig. 7.1 Leadership as a function of a coaching and agile organization 77
Fig. 8.1 New motorman hires, Dallas Consolidated Electric Street Railway 90
Fig. 8.2 Retention rates among motormen, Dallas Consolidated Electric Street Railway 93
Fig. 9.1 Mutual role adjustment between predecessor and next-generation family member(s) (Source: Adapted from Handler [1994]) 104
Fig. 9.2 Social capital transfer and buildup during the business succession process as described by the study participants 120
Fig. 10.1 Culture map of Sweden and France 136

List of Tables

Table 1.1	Overview of existing lower extremity robotic exoskeletons	4
Table 1.2	Overview of existing upper extremity robotic exoskeletons	6
Table 8.1	Codes used in Hugo Münsterberg's test for the selection of motormen	90
Table 9.1	Profile of interviewees and their family business	110
Table 10.1	Details of respondents	140

CHAPTER 1

Quasi-Passive Lower and Upper Extremity Robotic Exoskeleton for Strengthening Human Locomotion

Aryaman Arora and John R. McIntyre

Abstract Most of the robotic exoskeletons available today are either lower extremity or upper extremity devices targeting individual orthotic (elbow, knee, and ankle) joints. However, there are a few which target both lower and upper extremities. This chapter aims to propose a design for a wearable quasi-passive lower and upper extremity robotic exoskeleton (QLUE-REX) system, targeting disabled users and aged seniors. This exoskeleton system aims to improve mobility, assist walking, improve and enhance muscle strength, and help people with leg/arm disabilities. QLUE-REX combines elbow, knee, and ankle joints with options to synchronize individual joints' movements to achieve the following: (1) assist in lifting loads of 30–40 kilograms, (2) assist in walking, (3) easy and flexible to wear without any

A. Arora (✉)
School Without Walls, Washington, DC, USA

J. R. McIntyre
Georgia Institute of Technology, Atlanta, GA, USA
e-mail: john.mcintyre@scheller.gatech.edu

A. Saxena Arora et al. (eds.), *Sustainable Innovation*,
International Marketing and Management Research,
https://doi.org/10.1007/978-3-030-30421-8_1

discomfort, and (4) be able to learn and adapt along with storing time-stamped sensor data on its exoskeleton storage media for predicting/correcting users' movements and share data with health professionals. The research's main objective is to conceptualize a design for QLUE-REX system. QLUE-REX will be a feasible modular-type wearable system that incorporates orthotic elbow, knee, and ankle joints effectively in either synchronous or asynchronous modes depending on the users' needs. It will utilize human-walking analysis, data sensing and estimation technology, and measurement of the electromyography signals of user's muscles, exploiting biomechanical principles of human-machine interface.

Keywords Quasi-passive lower and upper extremity robotic exoskeleton (QLUE-REX) system • Mobility dysfunction • Biomechanics • Robotics • Actuators • Exoskeleton operating system

Introduction

Traumatic brain and spinal cord injuries along with strokes are major causes of disabilities in the industrialized world (Almekkawy et al., 2019; Hesse et al., 2003; Rupal et al., 2017). Approximately, 10% of the non-institutionalized adult population in the most industrialized world nations report that they have at least some difficulty walking or use a mobility aid (Iezzoni, 2003; Zaroug et al., 2019), and 39.0 million people over the age of 18 in the United States alone (16.2% of the adult population) report an ambulatory disability with 32.3 million reporting difficulty walking (Taylor, 2018).

Mobility dysfunction is highly correlated to falls with serious implications (Almekkawy et al., 2019; Arnold & Faulkner, 2002; Bacsu et al., 2012; Stokes & Lindsay, 1996). Falls result in identifiable leg weakness and have a threefold increase among persons with impaired gait or balance (Bacsu et al., 2012; Leveille et al. 2002; Zaroug et al., 2019). Additionally, the developed world has begun facing the growing issue of aging. As birth rates decline, the working population diminishes as well. Combined with rising life expectancies, the senior population in these nations is also increasing. Successfully addressing mobility dysfunction in disabled and seniors has the capacity for significant savings in overall healthcare spending (Almekkawy et al., 2019; Hesse et al., 2003; Molteni et al., 2018).

Such a solution exists in exoskeletons. In simple words, a robotic exoskeleton is a machine that fits around a human and aids with move-

ment, load carrying, virtual reality, and so on. Most of these systems cover the lower body—hence the name "exoskeleton", meaning "outer skeleton" (Lewis & Ferris, 2011; Zaroug et al., 2019). There are many benefits to using exoskeletons. They can help the elderly and disabled walk with greater ease. They can be used in construction to carry building materials. In the military, they give greater mobility and can provide information about the wearer's health in case of an emergency (Chu, Kazerooni, & Zoss, 2005). This solves several health-related problems and can be a useful aid in many fields where workers are overworked and need bodily help. Exoskeletons can help disabled and seniors to join today's workforce. Indeed, this process has already started in Japan with Cyberdyne, a Japanese company, leading the way and introducing lower-body exoskeletons into the industry (https://www.cyberdyne.jp/english/). In other developed nations, however, namely, in North America and Western Europe, exoskeletons have remained a niche in the medical industry. This chapter outlines the design recommendations for a quasi-passive lower and upper extremity robotic exoskeleton (QLUE-REX) system, which intends to provide physical support and gather muscle data to improve mobility dysfunction and strengthen human locomotion.

Existing Solutions

This section provides an overview of existing lower and upper extremity exoskeletons and compares existing designs and design issues, technical functionality, and clinical applicability leading to both commercial and technical comparisons of existing devices, highlighting their respective strengths and weaknesses. Since many of the existing exoskeletons are lower-body systems, we present a comparison table for lower extremity exoskeletons first (see Table 1.1). Further, Table 1.2 presents a comparison of existing upper extremity exoskeletons.

QLUE-REX System: Need and Conceptualization

Keeping in view the gaps in existing solutions (Tables 1.1 and 1.2) and limited commercial availability of full-body exoskeletons, we offer design recommendations for a modular, flexible, and wearable quasi-passive lower and upper extremity robotic exoskeleton (QLUE-REX) system targeting disabled users, aged seniors, and regular users aiming to lift heavy loads for business applications. The broader impact of the idea and commercial potential stems from the lack of such a product for the healthy and working

Table 1.1 Overview of existing lower extremity robotic exoskeletons

Product name	*Description*	*Advantages*	*Disadvantages*	*References*
Atlante (Medical—Paraplegics)	Self-contained autonomous device, dynamic balancing control, designed by Wander Craft Ltd.	No use of crutches, 3-hour battery life, joystick, actuation by electric motors	Cost: 33,000 USD	Rupal et al. (2017) www.wandercraft.eu (accessed on May 15, 2019)
Rex	A heavy structure with self-balancing system; non-invasive brain interface for data acquisition from the brain—Artificial Intelligence (AI) embedded	No need of support, uses joystick, AI capabilities, actuation by electric motors	Heavy; cost: 150,000 USD	Kilicarslan et al. (2013) https://exoskeletonreport.com/product/rex/ (accessed on May 15, 2019)
Indego	Comes in two variants: Indego personal, and Indego therapy	Lightweight system, easy, comfortable, actuation by DC brushless motors	Lower battery life of 1 hour as compared to others; cost: 140,000 USD	http://indego.com/indego/en/home (accessed on May 15, 2019)
Ekso	It weighs less than 100 kg and can fit any height from 5 ft. 2 in to 6 ft. 4 in	Used mostly in hospitals with hydraulic actuators	Cost: 100,000 USD	https://eksobionics.com/ (accessed on May 15, 2019)
ReWalk	2-hour battery life, crutches needed, actuated by DC motors, speeds up to 2.2 km/h	Not as expensive as others; cost: 70,000 USD	Crutches needed; control through wrist-pad controller	https://rewalk.com/ (accessed on May 15, 2019)
Raytheon XOS 2	Military 2nd gen suit; Defense Advanced Research Projects Agency (DARPA) funded; 17:1 weight ratio	Full-body suit; increases strength considerably	Military only	Brown (2012)
Human Universal Load Carrier	Military use; licensed to Lockheed; up to 90 kg weight	Longer battery life than others; fast speed with loads	Military only	Lockheed Martin (2015)

HAL (Cyberdyne)	Uses signals from the brain to sync with wearer's steps; multi-purpose	Uses brain signals, better stability, safety certified	Heavy battery	Cyberdyne (2015)
Honda Walk Assist w/Body Support	Supports bodyweight by helping legs; based on Advanced Step in Innovative MObility (ASIMO) technology	Reduced fatigue over long periods of time	Prototype phase	Honda (2009)
MIT Media Lab	Quasi-passive system—extends leg motion instead of directly carrying load	Quieter than normal	Large, bulky, heavy battery	Dollar and Herr (2008)
European Space Agency (ESA)	Tele-manipulation system controls robotic explorers from faraway distances	Very lightweight; innovative application	Doesn't help the wearer—only for telepresence	European Space Agency (2014)
BLEEX (University of California, Berkeley)	Early model of a load-carrying exoskeleton; hydraulic; can carry up to 36 kg	Pioneer of current technologies	Outdated	Chu et al. (2005), Zoss et al. (2005)

Table 1.2 Overview of existing upper extremity robotic exoskeletons

Product name	*Description*	*Advantages*	*Disadvantages*	*References*
ARMin III	Arm therapy exoskeleton with an ergonomic shoulder actuation	ARMin III robot provides *vertical* translation movement of the humerus head (HH), with a simple mechanical structure; currently tested on chronic stroke subjects	Optimized for clinical use only	Nef, Guidali, and Riener (2009)
Pneu-WREX	A pneumatic robot based on the Wilmington Robotic Exoskeleton (WREX), a passive, mobile arm support developed for children with arm weakness caused by a debilitative condition	Pneu-WREX uses pneumatic actuators, non-linear force control, and passive counter-balancing to allow application of a wide range of forces during naturalistic upper extremity movements	Device is limited since it can apply only a fixed pattern of assistive forces to the arm	Sanchez et al. (2005) for WREX; Silveira et al. (2018)
EXO-UL7	Upper arm exoskeleton device for stroke rehabilitation	Comfortable	Expensive	Shen et al. (2018)
CAREX	A cable-driven exoskeleton robot (CAREX) based on three lightweight cuffs	5 degrees of freedom (DOF) upper limb exoskeleton	Small stiffness, low precision, and weak bearing capacity	Li et al. (2019)
EXO-UL8	12 DOF (6 active) reconfigurable hand exoskeleton for rehabilitation that will be installed on the existing upper limb exoskeleton	Maximized mechanism isotropy and device functionality	No weakness found; it is multi-fingered, multi-DOF, physically reconfigurable, and designed to attach to a full-arm exoskeleton	Ferguson, Dimapasoc, Shen, and Rosen (2018)

Manus (MIT)	Rehabilitative system for stroke patients	Not harmful, comfortable	Needs improvement (best amongst the existing solutions)	Krebs et al. (2004); Hogan et al. (1998); Singh et al. (2018)
Cozens Arm Robot	Barely an exoskeleton—just a servo motor to apply torque to the elbow	Actually rehabilitative	Obsolete	Cozens (1999); Singh et al. (2018)
MIME	For stroke patients; as effective as a therapist	Significantly heals—at least as good as hands-on therapy	Obsolete	Singh et al. (2018); Lum et al. (2005)
ARM–Guide	Diagnostic tool for strokes and brain injuries; also therapeutic	Very rehabilitative	Old	Reinkensmeyer et al. (2000); Singh et al. (2018)

population of the world. Outside of Japan (where Cyberdyne is currently profitable in the exoskeleton industry), the potential applications of exoskeletons to construction, packaging, and logistical supply lines for militaries are unexploited. The aging population, too, could be part of the workforce for a longer time—giving a boost to the world economy. QLUE-REX will use an adjustable framework to make sure that users can wear it comfortably. It should be able to intuitively predict the movements of the wearer and move accordingly to maximize efficiency, and adapt based on data received through its sensors.

The ultimate goal is to reduce metabolic energy expenditure when carrying heavy objects (weighing 30–40 kilograms) and reduce fatigue over long periods of time—all while providing at least an eight-hour battery life and maximum degrees of freedom movements for upper and lower limbs. Some of the benefits of using QLUE-REX are:

1. QLUE-REX uses orthotic joints which combine torsion spring with clutches for lower extremity structure under microprocessor control and externally positioned actuators to be placed on elbow joint of arm-control module of upper extremity exoskeleton structure.
2. QLUE-REX requires no customization and can be easily fitted to legs and arms with one training session.
3. QLUE-REX adapts to user's walking speed and step length; helps in augmenting leg strength while walking, climbing/descending stairs, up and down motion, and carrying heavy loads on straight or inclined surfaces.
4. Finally, QLUE-REX, being a flexible and adjustable system, reduces effort needed to walk and use arms effectively for carrying weights and stores sensors' data on its exoskeleton storage media and allows uploading data to health professionals.

QLUE-REX Design Recommendations

We focus on the lower extremity exoskeleton first, which consists of four modules.

1. Central torso module—this module should be connected to the lower components of the exoskeleton and holds the exoskeleton by connecting the user's upper body (wearable hyper carbon shapewear with shouwlder strap) with the hip module to provide stability to the overall exoskeleton.

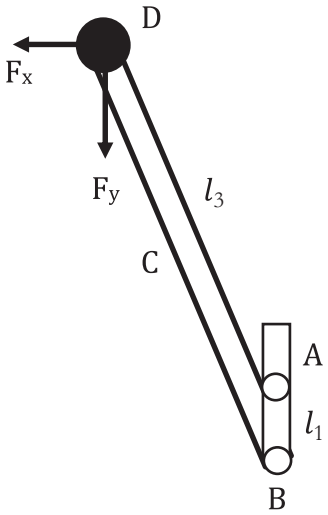

Fig. 1.1 Hip joint module—constant force mechanism (adapted from Yu et al., 2012)

2. Hip joint module—this module bears the total weight of the upper extremity exoskeleton system by a constant force as calculated by Yu et al. (2012) (see Fig. 1.1).

Using the equations used for Fig. 1.1 (adapted from Yu et al., 2012), we get the following:

$$x = (l_2 + l_3)\sin\theta, y = l_1 - (l_2 + l_3)\cos\ \theta$$

A linear spring is connected between A and C, and its length is expressed as:

$$r^2 = l_1^2 + l_2^2 - 2l_1 l_2 \cos\ \theta$$

If we assume that the external force exerted on to the spring mechanism is from the loaded weight on the backpack and there is no ducking motion while the wearer operates this system, the F_x = 0, F_y = constant exerted force for each axis is considered as:

$$F_{eff} = -k_2(r - r_0) + \frac{l_2 + l_3}{l_1 l_2} r F_y$$

Therefore, the equilibrium position of the spring mechanism while loading the weight is calculated as:

$$r = \frac{k_s r_0}{k_s - \left(\frac{l_2 + l_3}{l_1 l_2}\right) F_y}; \left(k_s \neq \frac{l_2 + l_3}{l_1 l_2} F_y\right)$$

3. Knee joint module—this is actuated by the knee joint motor.
4. Ankle joint module—this is a flexible silicone structure with a carbon base, which has an ankle actuator. Figure 1.2 shows a combination of both knee and ankle joint modules.

For the upper-body portion of the exoskeleton, the following module is recommended:

Arm and elbow support module—this module is supported by two actuators as conceptualized by van Ninhuijs et al. (2013). Incorporating all the elements of upper and lower extremities, the QLUE-REX full-body exoskeleton system is recommended to use five or more sensors that will allow precise measurement of joint angles, force-generating element positions, torque, tilt angles, temperature, and voltage. These sensors will be used to control QLUE-REX's mechanical state in response to the user's selected gait and will collect data and adapt the state accordingly.

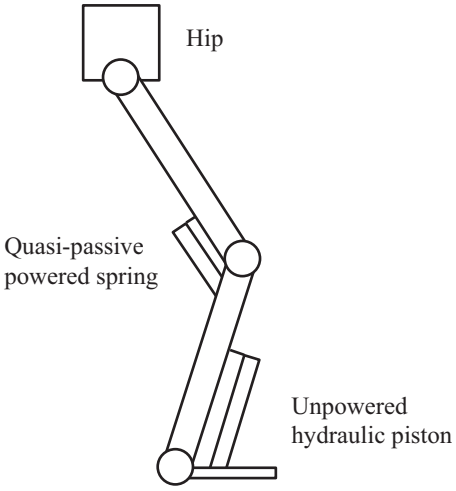

Fig. 1.2 Knee and ankle joint as conceptualized

Conclusion

In this chapter, we propose design recommendations for upper and lower limb exoskeletons that should be multi-degrees of freedom (DOF), physically reconfigurable, and designed to easily attach to a full-arm/full-leg exoskeleton. Rehabilitative interventions yield results when researchers integrate and provide design recommendations for both top-down and bottom-up exoskeletons supported by robotic systems for task-oriented motor training (Morone et al., 2017). Just like human-computer or human-robot interactions, overground exoskeletons need patient's engagement at all times since a patient controls these wearable devices and is responsible for maintaining balance and navigating in different terrains/surfaces. Advanced robotic technologies help patients in a big way by allowing therapists and medical providers to activate neural networks otherwise lost, take full advantage of functionality, and expedite recovery (Krucoff, 2016). In conclusion, we can say that exoskeletons are critical for humans with disabilities and can be used as a neural interface for rehabilitation. Patient-robot interaction (as a subset of human-robot interaction [HRI], including socio-cultural, psychological and behavioral relationships of motion, fine motion assistance, emotion, attachment with the robot or exoskeleton, motivation of using the device, meaning of the task, feedback from the exoskeleton, and so on) is extremely important for exoskeleton use in disabilities and rehabilitation.

References

Almekkawy, M., Chen, J., Ellis, M., Haemmerich, D., Holmes, D., Linte, C., … Zderic, V. (2019). Therapeutic systems and technologies: State-of-the-art, applications, opportunities and challenges. *IEEE Reviews in Biomedical Engineering*.

Arnold, C. M., & Faulkner, R. A. (2002). The history of falls and the association of the timed up and go test to falls and near-falls in older adults with hip osteoarthritis. *Journal of the American Geriatrics Society, 50*, 671–678.

Bacsu, J. R., Jeffery, B., Johnson, S., Martz, D., Novik, N., & Abonyi, S. (2012). Healthy aging in place: Supporting rural seniors' health needs. *Online Journal of Rural Nursing and Health Care, 12*(2), 77–87.

Brown, M. (2012). *xOS 2 Exoskeleton* [PDF document]. Retrieved May 15, 2019, from http://www.ele.uri.edu/Courses/bme281/F12/TimothyB_2.pdf

Chu, A., Kazerooni, H., & Zoss, A. (2005). On the biomimetic design of the Berkeley lower extremity exoskeleton (BLEEX). Proceedings of *Robotics and*

Automation, ICRA 2005, Proceedings of the 2005 IEEE International Conference on Intelligent Robots and Systems (pp. 4345–4352). https://doi.org/10.1109/ROBOT.2005.1570789

Cozen, J. A. (1999). Robotic assistance of an active upper limb exercise in neurologically impaired patients. *IEEE Transactions on Rehabilitation Engineering, 7*(2), 254–256.

Cyberdyne. (2015). *What's HAL®?* Retrieved May 15, 2019, from http://www.cyberdyne.jp/english/products/HAL/index.html

Dollar, A. M., & Herr, H. (2008). Design of a quasi-passive knee exoskeleton to assist running. Proceedings from *Intelligent Robots and Systems, 2008. IROS 2008. IEEE/RSJ International Conference on* (pp. 747–754). Nice, France: IEEE/RSJ. https://doi.org/10.1109/IROS.2008.4651202

European Space Agency. (2014). *The ESA Exoskeleton*. Retrieved May 15, 2019, from http://www.esa.int/Our_Activities/Space_Engineering_Technology/Automation_and_Robotics/The_ESA_Exoskeleton

Ferguson, P. W., Dimapasoc, B., Shen, Y., & Rosen, J. (2018, October). Design of a hand exoskeleton for use with upper limb exoskeletons. In *International symposium on wearable robotics* (pp. 276–280). Cham: Springer.

Hesse, S., Schmidt, H., Werner, C., & Bardeleben, A. (2003). Upper and lower extremity robotic devices for rehabilitation and for studying motor control. *Current Opinion in Neurology, 16*(6), 705–710.

Hogan, N., Aisen, M. L., & Volpe, B. T. (1998). Robot-aided neurorehabilitation. *Rehabilitation Engineering, IEEE Transactions on, 6*(1), 75–87. https://doi.org/10.1109/86.662623

Honda. (2009). *Honda – Walk Assist*. Retrieved May 15, 2019, from http://corporate.honda.com/innovation/walk-assist/

Iezzoni, L. I. (2003). *When walking fails*. Berkeley, CA: University of California Press.

Kilicarslan, A., Prasad, S., Grossman, R. G., & Contreras-Vidal, J. L. (2013, July). High accuracy decoding of user intentions using EEG to control a lower-body exoskeleton. In *2013 35th annual international conference of the IEEE Engineering in Medicine and Biology Society (EMBC)* (pp. 5606–5609). IEEE.

Krebs, H., Ferraro, M., Buerger, S. P., Newberry, M. J., Makiyami, A., Sandmann, M., … Hogan, N. (2004). Rehabilitation robotics: Pilot trial of a spatial extension for MIT-Manus. *Journal of NeuroEngineering and Rehabilitation, 1*(5). http://dx.doi.org/10.1186%2F1743-0003-1-5

Krucoff, M. O., Rahimpour, S., Slutzky, M. W., Edgerton, V. R., & Turner, D. A. (2016). Enhancing nervous system recovery through neurobiologics, neural interface training, and neurorehabilitation. *Frontiers in Neuroscience, 10*, 584.

Leveille, S. G., Bean, J., Bandeen-Roche, K., Jones, R., Hochberg, M., & Guralnik, J. M. (2002). Musculoskeletal pain and risk for falls in older disabled women living in the community. *Journal of the American Geriatrics Society, 50*(4), 671–678.

Lewis, C. L., & Ferris, D. P. (2011). Invariant hip moment patterns when walking with a robotic hip exoskeleton. *Journal of Biomechanics, 44*(5), 789–793.

Li, G., Fang, Q., Xu, T., Zhao, J., Cai, H., & Zhu, Y. (2019). Inverse kinematic analysis and trajectory planning of a modular upper limb rehabilitation exoskeleton. *Technology and Health Care*, (Preprint), 1–10.

Lockheed Martin. (2015). *HULC*. Retrieved May 15, 2019, from http://www.lockheedmartin.com/us/products/exoskeleton/hulc.html

Lum, P. S., Burgar, C. G., Van der Loos, M., Shor, P., Majmundar, M., & Yap, R. (2005). The MIME robotic system for upper-limb neuro-rehabilitation: Results from a clinical trial in subacute stroke. In *Proceedings from ICCOR 9th International Conference on Rehabilitation Robotics, 2005* (pp. 511–514). Chicago, IL: IEEE. https://doi.org/10.1109/ICORR.2005.1501153

Morone, G., Paolucci, S., Cherubini, A., De Angelis, D., Venturiero, V., Coiro, P., & Iosa, M. (2017). Robot-assisted gait training for stroke patients: Current state of the art and perspectives of robotics. *Neuropsychiatric Disease and Treatment, 13*, 1303.

Nef, T., Guidali, M., & Riener, R. (2009). ARMin III–arm therapy exoskeleton with an ergonomic shoulder actuation. *Applied Bionics and Biomechanics, 6*(2), 127–142.

van Ninhuijs, B., van der Heide, L. A., Jansen, J. W., Gysen, B. L. J., van der Pijl, D. J., & Lomonova, E. A. (2013). Overview of actuated arm support systems and their applications. *Actuators, 2*(4), 86–110. https://doi.org/10.3390/act2040086

Reinkensmeyer, D. J., Kahn, L. E., Averbuch, M., McKenna-Cole, A., Schmit, B. D., & Rymer, W. Z. (2000). Understanding and treating arm movement impairment after chronic brain injury: Progress with the ARM guide. *Journal of Rehabilitation Research and Development, 37*(6), 653–662. Retrieved May 15, 2019, from http://www.rehab.research.va.gov/jour/00/37/6/pdf/reinkensmeyer.pdf

Rupal, B. S., Rafique, S., Singla, A., Singla, E., Isaksson, M., & Virk, G. S. (2017). Lower-limb exoskeletons: Research trends and regulatory guidelines in medical and non-medical applications. *International Journal of Advanced Robotic Systems, 14*(6). http://dx.doi.org/10.1729881417743554

Sanchez, R. J., Wolbrecht, E., Smith, R., Liu, J., Rao, S., Cramer, S., … & Reinkensmeyer, D. J. (2005, June). A pneumatic robot for re-training arm movement after stroke: Rationale and mechanical design. In *9th International Conference on Rehabilitation Robotics, 2005.* ICORR 2005 (pp. 500–504). IEEE.

Shen, Y., Ma, J., Dobkin, B., & Rosen, J. (2018, July). Asymmetric dual arm approach for post stroke recovery of motor functions utilizing the EXO-UL8 exoskeleton system: A pilot study. In *2018 40th annual international conference of the IEEE Engineering in Medicine and Biology Society (EMBC)* (pp. 1701–1707). IEEE.

Silveira, A. T., Souza, M. A. D., Fernandes, B. L., & Nohama, P. (2018). From the past to the future of therapeutic orthoses for upper limbs rehabilitation. *Research on Biomedical Engineering, 34*(4), 368–380.

Singh, H., Unger, J., Zariffa, J., Pakosh, M., Jaglal, S., Craven, B. C., & Musselman, K. E. (2018). Robot-assisted upper extremity rehabilitation for cervical spinal cord injuries: A systematic scoping review. *Disability and Rehabilitation: Assistive Technology, 13*(7), 704–715.

Stokes, J., & Lindsay, J. (1996). Major causes of death and hospitalization in Canadian seniors. *Chronic Disease in Canada, 17*, 63–73.

Taylor, D. M. (2018). Americans with disabilities: 2014. *Household Economic Studies*. Retrieved July 28, 2019, from https://www.census.gov/content/dam/Census/library/publications/2018/demo/p70-152.pdf

Yu, S. N., Lee, H. D., Lee, S. H., Kim, W. S., Han, J. S., & Han, C. S. (2012). Design of an under-actuated exoskeleton system for walking assist while load carrying. *Advanced Robotics, 26*(5–6), 561–580.

Zoss, A., Kazerooni, H., & Chu, A. (2005). On the mechanical design of the Berkeley Lower Extremity Exoskeleton (BLEEX). In *Proceedings from Intelligent Robots and Systems, 2005. (IROS 2005). 2005 IEEE/RSJ International Conference on* (pp. 3465–3472). Edmonton, AB: IEEE. https://doi.org/10.1109/IROS.2005.1545453

Zaroug, A., Proud, J. K., Lai, D. T., Mudie, K., Billing, D., & Begg, R. (2019). Overview of Computational Intelligence (CI) techniques for powered exoskeletons. In *Computational intelligence in sensor networks* (pp. 353–383). Berlin, Heidelberg: Springer.

CHAPTER 2

Ideate-Generate: Design Thinking and User Experience (UX) for Sustainable Impact on Global Product Development of Wearable Technologies in the Healthcare Industry

Alexandra Washington, Samira Soumahoro, and Anshu Saxena Arora

Abstract Recently user experience (UX) has become a critical component of product innovation. Research and development teams often use this data to help determine a product's potential prior to going to market. As companies are increasingly becoming global, products and services must be developed to meet the needs of global users. Understanding how the country of origin impacts a specific user's experience and their desires is important to new product development. This chapter examines how user experience impacts the development of new innovations globally. Additionally, we examine and address the following research questions.

A. Washington (✉) • S. Soumahoro • A. Saxena Arora
School of Business and Public Administration,
University of the District of Columbia, Washington, DC, USA
e-mail: alexandra.washington@udc.edu; samira.soumahoro@udc.edu;
anshu.arora@udc.edu

A. Saxena Arora et al. (eds.), *Sustainable Innovation*,
International Marketing and Management Research,
https://doi.org/10.1007/978-3-030-30421-8_2

- How do companies ideate and generate design thinking through UX for new product development worldwide?
- How does the UX data collected from user feedback of users around the world encourage ideas for new product development?
- How can companies redesign and redevelop products to meet new user needs, or generate raw ideas for designing new products designed based on UX?

Our research focuses on innovation ideas based on UX in the wearable technologies industry, more specifically those used in and created for the healthcare industry globally.

Keywords Ideate • Generate • User experience • Raw idea • Design thinking • Innovation • User needs • World economies

Introduction

According to the United States Census Bureau, the US population is significantly older than it was 16 years ago (Newcomb & Iriondo, 2017). This ever-growing population of aged Americans has led to ongoing changes in the healthcare industry with wearable technologies becoming more and more popular. Wearable technologies are categorized as "wearable computers that can be integrated into a person's clothing or personal accessories [and] is capable of storing and processing data, and enabling real-time data to be exchanged between a network and the device" (Nasir & Yurder, 2015). Primarily used to track and collect health and fitness data, wearable technologies offer promising benefits in the management of chronic diseases (Goncu-Berk & Topcuoglu, 2017).

Rheumatoid arthritis (RA) is a chronic inflammation disorder affecting many joints, especially those in the hands, feet, and knees; it affects people around the world every day, limiting mobility and causing bone erosion and joint deformity. A 2010 study found that more than 17.6 million people worldwide suffer from RA (Rheumatoid Arthritis, 2019). In recent years innovations in wearable technologies for the treatment of patients suffering from RA has grown but understanding why people accept or reject these technologies based on their user experience (UX) is imperative to understanding their sustainability in the marketplace. This chapter examines new wearable technologies in the healthcare industry treatment,

from around the world, and how patient attitudes toward the innovation impact product development. Additionally, we examine how companies are using design thinking methodology for new product development, and how they redesign, redevelop, or create new products to meet new user needs.

Ideation, User Experience, and Design Thinking

Design thinking is a framework used in the innovation processes that prioritizes the users' desires, needs, and challenges (Eines & Vatne, 2018). Design thinking is also described as a procedure of making and testing creative thoughts to improve an item or take care of existing issues. It alludes to the subjective, tactical, and actual forms by which designers create design ideas giving individuals a conventional structure for product development, appropriate for any industry. Within the design thinking, process is ideation. Frequently the most interesting phase the goal of ideation is to generate a number of ideas that are then pared down to the best, most practical, and innovative ones (Dam & Siang, 2018).

In ideation-generation, design masterminds initiate thoughts—as inquiries and solutions—through inventive and inquisitive exercises; for example, they may use worse possible scenarios to spark ideas. User experience (UX) plan is the way toward producing items that give important and significant experiences to clients. This includes the structure of the whole procedure of getting and incorporating the newly conceived item (Kremer, Schlimm, & Lindemann, 2017). In developed and emerging economies, customer experience combines parts of promotion, advertising and distinctive designing, ease of use, and capacity of a product. This process is used globally to make innovations more successful.

Design Thinking and Product Innovation in Healthcare

With a movement away from traditional treatments in hospitals, continuous innovation is necessary to impact the ever-changing needs of both patients and practitioners (Eines & Vatne, 2018). Researchers with the US Department of Health and Human Services, on behalf of the Center for Disease Control, found that design thinking is being used across a variety of healthcare settings and conditions (Altman, Huang, & Breland, 2018). They described design thinking in the healthcare industry as "'action-oriented rapid prototyping' of solutions … an iterative process, with

innovation emerging only after cycling through several rounds of ideation, prototyping, and testing, which distinguishes it from the traditional linear and often top down approach to health invention design" (Altman et al., 2018).

According to Adi Gaskell, a contributor for Forbes.com, "in a world where a day scarcely goes by where a new innovation isn't announced," it's no wonder innovations in healthcare are on the rise (Gaskell, 2016). In healthcare, innovation is essential to ongoing quality development. In 2015 at the Children's Hospital of Philadelphia (CHOP), based in Philadelphia, PA, the establishment of a new Office of Entrepreneurship & Innovation was created with a goal of providing centralized support for both existing and future innovations (Gaskell, 2016). Central to the CHOP success is the sense of fulfillment felt by hospital staff, knowing they have in some way contributed to a medical breakthrough that will impact children worldwide. One crucial component of CHOP's success is their access to external resources, often limited even for smaller firms in developed economies, but completely out of reach for developers in emerging economies. In Ghana, for example, having access to financial resources enhances relationships between product innovativeness and new product performance (Story, 2015). After completing a study of 108 senior executives in China, researchers (Kotabe, Jiang, & Murray, 2017) found that "as latecomers to enter into the global industry, innovation is a costly and highly risky investment for firms in emerging markets. With intense competition coupled with a lack of experience and governmental support, these firms rarely see success" (Kotabe et al., 2017).

Wearable Electronics and User Experience (UX) in Healthcare

Since the creation of the first wearable electronic device, a computer, created by mathematics professor Edward Throp in the 1960s, wearable technologies have not only achieved mainstream popularity, they have become the "world's best-selling consumer electronic product after smartphones." The healthcare industry has seen some of the most rapid growth with innovations in wearable technologies. Gadgets like the Fitbit have made tracking health information commonplace. The prevailing thought of a wearable gadget is a wellness tracker or some other keen electronic device that can be used on the body. In any case, there is a broad scope of these gadgets, including implantable gadgets and the principal FDA-endorsed pill that

can track whether or not a patient is taking their medication as instructed. Abilify is an antipsychotic used to treat schizophrenia and bipolar issues. The Abilify MyCite is a part of the medications' new ingestible sensor installed in a pill that sends responses to a wearable patch that transmits data to a mobile application (Walsh, 2017). The FDA approved the pill in November 2017. It speaks to a distinct potential advantage in the treatment of psychological well-being issues and different illnesses where prescription adherence has been a worry.

User experience, UX, has been extremely important in the development of these new wearable technologies. Therapy gloves, or smart technology gloves, have been used for many years by healthcare professionals in rehabilitation for stroke patients, but in 2017, Gozde Goncu-Berk and Nese Topcuoglu released a study on their smart glove developed explicitly for persons suffering from rheumatoid arthritis. Their prototype was designed to seek solutions to the following three problems: (1) pain control through compression and electrical stimulation, (2) treatment of joint deformities, and (3) wearability (Goncu-Berk & Topcuoglu, 2017). They found that users were at first reluctant to use the glove because "they fail to meet the norms of social interaction" but saw it as a viable alternative to medications (Goncu-Berk & Topcuoglu, 2017). Yang Qiu and colleagues studied FunKnee, a novel sensor-equipped knee support paired with mobile device-supported games, designed explicitly for Total Knee Replacement (TKR) rehabilitation (Qiu et al., 2017). The FunKnee uses human-centered design theory to develop the games that go along with the rehabilitation therapy. Unlike Goncourt-Berk who collected data from patients, Qiu and his team surveyed practicing physiotherapists who all agreed that FunKnee would be "clinically useful to them in terms of increasing care continuity, exercise compliance and overall effectiveness" (Qiu et al., 2017). In cardiology, there are wearable gadgets that can give data on heart cadence and the patient's welfare, and other critical patient data points like blood pressure rates, breathing disorders, and blood sugar levels. These gadgets convey excellent measures of information and specialists' trust that the data can begin finding their way into electronic well-being accounts, like Apple's Health app. In any case, these gadgets are still in their introductory phase; however, they may not be FDA approved yet, and this is because there is some inquiry regarding the reproducibility of the measures from these gadgets.

Within the healthcare industry, the majority of innovations are born out of an opportunity to create value through further investment (Kornish

& Ulrich 2014). With both innovations aimed at treating rheumatoid arthritis, the therapy gloves and the FunKnee, there was an apparent and existing need to improve at-home treatment. Using feedback, or UX from previous innovations in the treatment of this chronic disease, both innovations were created. In the study on design thinking in healthcare by Altman, Huang, and Breland:

> *Within a sample experimental crossover design, a design thinking based graphical information display to improve nurses ability to detect changes in patient physiological states in an intensive care unit (ICU) was compared with a conventional display in commercial, electronic ICU charting system. The design thinking intervention resulted in improved detection of changes in patient states and greater ease of use, usefulness, satisfaction, and support of understanding.* (Altman et al., 2018)

As in the case of Goncu-Berk and Topcuoglu, there was a recognized need from nurses for improved services to patients in the ICU. They found that most design thinking interventions and/or innovations had positive effects. While there is little data to explicitly state, support, or explain why an innovation was necessary based in UX prior to implementation, all studies reviewed in this research showed positive UX results when going through the implementation or testing phases of a new innovation. The Altman study cited small sample sizes and/or pilot studies and criteria used to access the quality of an innovation based on traditional research approaches as "problematic," because it posed challenges to evaluating the effectiveness of the design thinking approach (Altman et al., 2018).

We wish to examine the research questions: how does UX data collected from user feedback of users around the world encourage ideas for new product development; and how can companies redesign and redevelop product to meet new user needs, or generate raw ideas for designing new products designed based on user experience? While all the research supports the development of new innovations based on UX, it primarily focused on success in the marketplace or potential improvements to the prototype being discussed, rather than continued development of new innovations. Additionally, research on UX, as it relates specifically to different markets, is also limited. Both the FunKnee and therapy gloves were developed in emerging markets but neither discussed the specific impact of their market on the development of their innovation. For both innovational studies, UX was focused on the hesitation or disinterest of potential users due to the public perception of the product and having to literally wear it. Neither

study identified any specific cultural or economic disadvantages during the development or testing stages. Only in the research on Ghana and design thinking, economic resources were cited as a potential hindrance to design thinking. Knowing that the potential limitation in innovation is a lack of resources from firms, we propose the following:

Proposition 1
Design thinking methodologies will lead to new product innovations in healthcare and wearable technology innovations.

Proposition 2
The positive effect of UX in the design of a new innovative product will be strengthened as product innovation capability increases.

New Innovation Concept

Looking more specifically at the treatment of rheumatoid arthritis (RA), we would propose a brace similar to the therapy gloves that has similar functionality that could be used or worn on other areas, like the knee, or the back. There are examples of textile-based splint ideas for designing smart gloves for RA patients used in chronic pain management (Goncu-Berk & Topcuoglu, 2017). For example, Totes-Isotoner Corporation, Cincinnati, Ohio, the United States, is the market-leading provider of branded accessory products including umbrellas, rainwear, gloves, sandals, and slippers in the United States and Europe (https://www.totes.com/). Their glove is composed of nylon and elastane fiber blend, which is known to significantly improve hand-grip strength (Nasir, Troynikov, & Massy-Westropp, 2014). Similarly, the FUTURO (from the Kendall Company, Massachusetts, the United States) glove is composed of a blend of wool and elastane fibers. Kendall International, Inc., manufactures, markets, and distributes disposable medical supplies and devices. Their FUTURO™ Energizing Support Glove provides comfort by surrounding the wrist with 360 degrees of support and the stretchy glove offers mild compression, all while providing great range of motion (https://www.futuro-usa.com/3M/en_US/futuro-us/products/~/FUTURO-Compression-Glove/?N=4318+3294508210+3294529207&rt=rud).

Knowing that persons suffering from RA have problems with pain, swelling, joint deformities, feelings of skin tightness, and weakness on many joints beyond the typically hand and finger joints, our brace could be fitted to wrap around any major joint on the body, including the back

and hip. They would be custom-created to match the size of a potential patient and made of polyester sweat-absorbing fabric and fitted much like compression stockings. They would have the ability to lace or strap on (not slide on like most over-the-counter braces, which can be extremely difficult for RA patients to put on) for comfortable wear during the day or night. Battery operated, the brace would be programmed with the ability to detect swelling automatically offering compression on a timed schedule with technology similar to that found in deep vein thrombosis compression machines found in hospitals. It would also offer both heat therapy by selecting the option via remote control and cooling benefits when hooked up to standard ice therapy machines. The objective would be to offer a brace similar to ones already developed for patients with RA to be worn at any time, to provide comfort, and to ease the many symptoms of the disease. For future research, we propose that the smart brace can be enhanced with electronic features like reminding, warning, or encouraging patients for continuous use of the product (Goncu-Berk & Topcuoglu, 2017).

Conclusion and Future Research

Design thinking has impacted the healthcare industry in a number of ways over the last decade, especially in the development of wearable technologies. While many innovations, like the pace maker, have existed for years, new breakthroughs are occurring around the world every day. It is important to begin gathering more data as the future of design thinking innovations is being used across a variety of settings, within healthcare and other industries alike, but there is inconsistent methodology and significant limitations to the available research that limits our ability to draw solid conclusions about the true impact of this new approach to developing innovations. Further research on the impact and acceptance of new innovations must be done for emerging economies to clearly identify the reception of new innovations by users worldwide. Much of the research on design thinking in healthcare has also been limited to the development, or redevelopment, of products used by patients and practitioners, with little research done on how services are rendered. For example, in the research by Altman, while the initial feedback was well received, the design thinking innovation did not cut down on workload, which could discount the positive perception of these innovations. Overall, design thinking innovations that are developed using UX result in innovations that garner great successes worldwide. Further research into their specific impact in emerging economies will help explain how developers, no matter where they are, can create products that can be used globally.

References

Altman, M., Huang, T. T., & Breland, J. Y. (2018). Peer reviewed: Design thinking in health care. *Preventing Chronic Disease, 15*, 1–13.

Dam, R., and Siang, T. (2018). Stage 3 in the design thinking process: Ideate. Retrieved May 15, 2019, from https://www.interaction-design.org/literature/article/stage-3-in-the-design-thinking-process-ideate

Eines, T. F., & Vatne, S. (2018). Nurses and nurse assistants' experiences with using a design thinking approach to innovation in a nursing home. *Journal of Nursing Management, 26*(4), 425–431.

Gaskell, A. (2016, November 17). Building A Culture Of Innovation In Healthcare. Retrieved from https://www.forbes.com/sites/adigaskell/2016/11/08/building-aculture-of-innovation-in-healthcare/#6fb717a944a7

Goncu-Berk, G., & Topcuoglu, N. (2017). A healthcare wearable for chronic pain management. Design of a smart glove for rheumatoid arthritis. *The Design Journal, 20*(sup1), S1978–S1988.

Kornish, L. J., & Ulrich, K. T. (2014). The importance of the raw idea in innovation: Testing the sow's ear hypothesis. *Journal of Marketing Research, 51*(1), 14–26.

Kotabe, M., Jiang, C. X., & Murray, J. Y. (2017). Examining the complementary effect of political networking capability with absorptive capacity on the innovative performance of emerging-market firms. *Journal of Management, 43*(4), 1131–1156.

Kremer, S., Schlimm, A., & Lindemann, U. (2017, July). The ExodUX framework: Supporting comprehensive user experience design. In 2017 Portland International Conference on Management of Engineering and Technology (PICMET) (pp. 1–10). IEEE.

Nasir, S., & Yurder, Y. (2015). Consumers' and physicians' perceptions of high tech wearable health products. *Procedia-Social and Behavioral Sciences, 195*, 1261–1267.

Nasir, S. H., Troynikov, O., & Massy-Westropp, N. (2014). Therapy gloves for patients with rheumatoid arthritis: A review. *Therapeutic Advances in Musculoskeletal Disease, 6*(6), 226–237.

Newcomb, A., & Irondo, J. (2017, June 22). The Nation's Older Population Is Still Growing, Census Bureau Reports. Retrieved from https://www.census.gov/newsroom/press-releases/2017/cb17-100.html

Qiu, Y., Li, K. M., Neoh, E. C., Zhang, H., Khaw, X. Y., Fan, X., & Miao, C. (2017, April). Fun-knee: A novel smart knee sleeve for Total-Knee-Replacement rehabilitation with gamification. In IEEE 5th international conference on Serious Games and Applications for Health (SeGAH). IEEE (pp. 1–8).

Rheumatoid Arthritis. (2019). About arthritis and RA. Retrieved May 15, 2019, from https://globalranetwork.org/project/disease-info/

Story, V. M., Boso, N., & Cadogan, J. W. (2015). The form of relationship between firm-level product innovativeness and new product performance in developed and emerging markets. *Journal of Product Innovation Management, 32*(1), 45–64.

Walsh, S. (2017). Press announcements – FDA approves pill with sensor that digitally tracks if patients have ingested their medication. Retrieved May 15, 2019, from https://www.fda.gov/newsevents/newsroom/pressannouncements/ucm584933.htm

CHAPTER 3

Seeing Is Believing: The Disruptive Effect of Sustainable and Functional Product Design in Electric Bikes for Emerging Economies

Delonte D. Bright, Edna Laetitia Aude Diouf Ogandaga, and Anshu Saxena Arora

Abstract The bicycle industry has improved over the years. Manufacturers have created different types of new bikes such as the Juliet bike for women and the Revive E-bike. Sustainability and convenience are key in a world where innovations benefit not only consumers, but also the economy and the world. Product design is the detailed specification of a manufactured item's parts and how the item will perform its intended functionality in an efficient, safe, and reliable manner. E-bikes by design can become a sus-

D. D. Bright (✉) • Edna Laetitia Aude Diouf Ogandaga • A. Saxena Arora
School of Business and Public Administration,
University of the District of Columbia, Washington, DC, USA
e-mail: delonte.bright@udc.edu; ednalaetitiaauda.dio@udc.edu;
anshu.arora@udc.edu

A. Saxena Arora et al. (eds.), *Sustainable Innovation*,
International Marketing and Management Research,
https://doi.org/10.1007/978-3-030-30421-8_3

tainable solution for consumers in an emerging economy that has low monetary wealth. This research addresses the following questions.

- How important is a product's design to a product's value and lifespan?
- How does implementing innovations in E-bikes affect emerging economies?

The research provides managerial implications based on consumer habits and attitudes toward new products, such as E-bikes, in developing economies.

Keywords Product design • Functionality • Electric bikes • Sustainable transportation • Emerging economies

Introduction and Review

This chapter seeks to discover the evolutionary pathways of the electric bikes industry in the business ecosystem framework. It focuses on the role of the government for promotional and restrictive policies in the development of the E-bike industry and business players in the industry ecosystem of the E-bike industry (Ruan, Hang, & Wang, 2014; Sowrov & Alam, 2019). This research specifically discusses the evolution of E-bike in the emerging economies and highlights the strategies used to develop E-bike in the business ecosystem (Hsu et al., 2013).

New product design refers to new concept development in developing new products. It involves engineers, who use tools of modern product development practice to meet the customer demands, and requires the use methods, which involve the best technologies for quality products (Ljungberg, 2007; Schöggl, Baumgartner, & Hofer, 2017).

Sustainable product design is the process of selecting materials and creating design for sustainable products. It utilizes methods and models to obtain products that have low environmental impact (Otto & Wood, 2003). The bicycle industry has changed over the years, and components such as brakes, pedals, cranks, and hubs have been redesigned using innovation process. Our research discusses international standards developed, and what they mean for the industry structure. This research also emphasizes on international standards for the industry and how they affect the

level of innovation in the industry (Galvin & Morkel, 2001; Sowrov & Alam, 2019).

This research contributes to emerging and bottom-of-pyramid (BoP) economies by providing innovative models of success in the electric bikes industry for businesses globally. To this end, this chapter addresses three research questions that deserve further attention to fill the gap in the extant literature.

1. How important is a product's design to a product's value and lifespan?
2. How do innovative new products in the E-bike industry affect a developing community and economy?
3. What are the benefits of E-bikes over other non-sustainable alternatives?

Innovative new products in the E-bike industry will strengthen the economy by allowing consumers to save money on a sustainable form of transportation and use money on other needs. Many countries have high gas prices resulting in high amounts of money spent on transportation. The main benefit of E-bikes is the smaller impact on the environment along with much less strain on finances. Electric bikes can now allow for the user to power and use their phones in association with the E-bikes to work as a GPS for the bike. This allows greater and more efficient transportation while on bike (Sowrov & Alam, 2019).

In today's society, new innovations are constantly being created with the hope of overall success. Disruptive innovation is and still remains a growing trend in today's economy. These disruptive innovations have the ability to have a major impact on the economy. Changes to product design and business models lower costs and improve value for money, which in turn unlocks mass-market segments of consumers with limited throwaway income (Tai & Veraart, 2019). A first-time customer with minimal knowledge and expectations on the product or service makes it possible to test or improve a disruptive innovation quickly and in a more cost-effective way than in developing markets (Sowrov & Alam, 2019; Tai & Veraart, 2019). E-bike is an example of disruptive innovation globally.

Sustainable product design is defined as the ability to make a sustainable product and meet the current needs of the consumer without jeopardizing future generations (Younesi & Roghanian, 2015). In today's world, sustainable product design is receiving a lot of attention. About 50% of consumers have concerns about the environment, and companies are paying attention

by adding environmental requirements into the early stages of product design (Younesi & Roghanian, 2015). As a result, companies will have a greater life span by paying attention to the quality of their products and their consumers' needs (Younesi & Roghanian, 2015). The 3-D product design scale uses aesthetics, functionality, and symbolism when designing a product (Homburg et al., 2015). Product design is an important factor in promoting your product to your customer. Using data from recent studies, design thinking researchers were able to study these three dimensions of aesthetics, functionality, and symbolism and how they positively impact purchase intention, word of mouth, and willingness to pay (Homburg et al., 2015).

Gestalt theory suggests how people perceive objects and postulates that the whole is more than the sum of its parts. People perceive the entirety of an object (the "gestalt") rather than analyzing its separate parts (Homburg et al., 2015). For example, when a disruptive innovation arises on the market, the entirety of the product and its overall benefits to the consumer typically receive more focus than its individual parts. Similarly, the entirety of a brand's product portfolio may possess a different reputation than that of one particular product. As a result, a consumer may have a poor experience with a particular product, but still prefers the product's overall brand (assuming they have a good experience with other brand's products). Finally, in regard to product design, each stage consists of a set of activities undertaken by people from different functional areas (Tai & Veraart, 2019). However, the design of the finished product in its entirety is what makes an impression among the industry and its consumers. Therefore, we have the following propositions:

Proposition 1
Sustainable and functional product design will have a disruptive effect in the electric bikes industry in the emerging economies.

Proposition 2
E-bikes by design in a developing economy will create sustainability for consumers that have low monetary wealth, while lowering the deleterious impact on the plan climate.

In the following sections, we examine the E-bike industry in detail. We further focus on at least two innovations in the industry discussed.

Thereafter, we introduce our design innovation for emerging economies. The study concludes with discussions and implications for design contributions of innovative models in the E-bike industry across emerging economies.

Industry Analysis

The numbers of electric bikes have increased over the years, in Europe, America, and especially in China. In Germany 11% of all bicycles sold are electric bikes. Based on German naturalistic cycling study, we measured and compared the speed of three bicycle types: conventional bicycles, pedelecs, S-pedelecs under naturalistic conditions. Annual electric bike sales in China have grown from 40,000 in 1998 to 10 million in 2005. It has been a quick transition from human-powered bicycles, buses, and gasoline-powered scooters to an all-electric vehicle technology system. Below, we present case studies highlighting innovations in the bike industry.

Case Example 1: Clipless Pedals

Clipless pedals are an innovation that was created to allow the cyclist to bike more efficiently without the burden of the straps. "They used the same principles as used in ski boot bindings, allowing the rider to easily clip in and out of the pedal (particularly beneficial if you "touch down" compared to toe straps which would invariably keep you attached to your bike)". In addition to the practical safety benefits, clipless pedals increased pedaling efficiency by allowing cyclists to utilize a full circular pedal stroke (Bridgewood, 2015). The ability to clip in and out of the pedals of the bike makes things such as triathlons easier because you can save time getting on and off your bike. Clipless pedals are also considered safer than the traditional strap bike pedals. The biggest proponent of clipless pedals was Bernard Hinault, who won the Tour De France using clipless pedals; after his infamous win everyone else in the field also started to use clipless pedals.

Case Example 2: Electronic Gears

It is said that once someone uses electronic gears they will not want to switch back to manual. Both manufacturers Shimano and Campagnolo started experimenting with electronic gears in the mid-2000s. Shimano released their first generation Di2 electronic gears in 2009, and Campagnolo

released its first electronic group set in 2011. Both sets have revolutionized the biking industry. For the average cyclist, the task of switching gears while biking and knowing when to do so can be a pain but that is no longer a problem with automatic gears, making it the automatic car of the biking industry.

Our Product Innovation Idea

Our product innovation idea is inspired from Bough Bikes Company (http://boughbikes.com/). They are made with hardwoods, such as ash and walnuts, which are sustainable products. This wooden bike was created by Jan Gunneweg and Piet Brandjes, who started to make and sell wooden bikes through their company Bough Bikes. They are very popular at Amsterdam's Schiphol Airport Business Park and at Dutch companies like Novotel and Rabobank. The bikes are used by their employees and their guests. This bike is environmentally friendly because wood requires less energy to process. *Cycling Weekly* has published the top ten bike industry innovations (Bridgewood, 2015).

Our idea is the solar powered electric bike, which has a wooden frame. Jack Butler built himself a custom mid-drive electric bicycle based on a Surly Troll bicycle (https://surlybikes.com/bikes/troll) with a pull behind suspension Aevon STD100 trailer for holding his gear and solar panels, a self-sustained vehicle powered by the sun. A solar powered electric bicycle has an advantage because of its lower energy demands. A custom mid-drive electric bicycle is based on a Surly Troll bicycle with a pull behind suspension for holding his gear and solar panels.

Our bicycle will provide the consumer with an array of motivational tools such as a hydration system, heart rate monitor, pedal sensor, and camera with GPS activation. The hydration system offers a cooling mist for relief on hot days, while the heart rate monitor will track the consumer's target heart rate and calories burned during their ride, ensuring the rider maintains their target heart rate and experiences a full fat-burning workout. The pedal sensor will provide an accurate speed-reading and ensure the consumer is pedaling correctly. Finally, the camera can be used for safety features; for instance, if the cyclist were to be injured during a ride, the camera (with its GPS activation) will signal their exact coordinates. It can also be used to record the consumer's ride.

The primary materials used to construct our bike are IsoTruss (http://www.isotruss.com/) and Aramid (http://www.aramid.com/). IsoTruss is

12 times stronger than steel, but 1/12th the weight. The material is commonly used as an alternative to traditional wood, steel, aluminum, and composite structures. IsoTruss can be built in a variety of different shapes and sizes, making it a great addition to our eco-friendly bike. Meanwhile, Aramid is a synthetic material that is five times stronger than steel. This material is placed below the outer shell of the bike; in case of a collision, Aramid will slide slightly across the inner core, absorbing the shock.

Our future aspirations are to create an innovative product that allows bicyclists to stay safe and more comfortable while riding. Additionally, the bike is equipped with solar panels and made of sustainable materials. Our bike-enabled system will allow cyclists to view or track their statistics safely without distractions or pausing their ride. Lastly, our bikes will provide another engaging alternative to gym memberships.

Conclusion

This chapter contributes to emerging economies by providing innovative models of success in the electric bikes industry for businesses. It addresses problems that deserve further attention to fill the gap in the extant literature. It discusses the important elements of product design to a product's value and lifespan and examines how innovative new products in the E-bike industry affect developing communities and economies. We brought forth an E-bike innovation and its benefits over other non-sustainable alternatives. Innovative new products in the E-bike industry will strengthen the economy by allowing consumers to save money on a sustainable form of transportation and use money on other needs.

References

Bridgewood, O. (2015). The top 10 road bike innovations. *Cycling Weekly*, August 14. Retrieved May 15, 2019, from www.cyclingweekly.com/news/product-news/the-top-10-road-bike-innovations-176384

Galvin, P., & Morkel, A. (2001). The effect of product modularity on industry structure: The case of the world bicycle industry. *Industry and Innovation, 8*(1), 31.

Homburg, C., Schwemmle, M., & Kuehnl, C. (2015). New product design: Concept, measurement, and consequences. *Journal of Marketing, 79*(3), 41–56.

Hsu, C. C., Choon Tan, K., Hanim Mohamad Zailani, S., & Jayaraman, V. (2013). Supply chain drivers that foster the development of green initiatives in an

emerging economy. *International Journal of Operations & Production Management, 33*(6), 656–688.

Ljungberg, L. Y. (2007). Materials selection and design for development of sustainable products. *Materials & Design, 28*(2), 466–479.

Otto, K. N., & Wood, K. L. (2003). *Techniques in reverse engineering and new product development product design*. Beijing, China: Tsinghua University Press.

Ruan, Y., Hang, C. C., & Wang, Y. M. (2014). Government's role in disruptive innovation and industry emergence: The case of the electric bike in China. *Technovation, 34*(12), 785–796.

Schöggl, J. P., Baumgartner, R. J., & Hofer, D. (2017). Improving sustainability performance in early phases of product design: A checklist for sustainable product development tested in the automotive industry. *Journal of Cleaner Production, 140*, 1602–1617.

Sowrov, K., & Alam, R. (2019). Designing a smart bicycle helmet for reducing emergency response time after accident. *Innovations*, March 2.

Tai, S. Y. T. T., & Veraart, F. (2019). Making the bicycle Dutch: The development of the bicycle industry in the Netherlands, 1860–1940. In *Invisible bicycle* (pp. 126–155). Leiden: Brill.

Younesi, M., & Roghanian, E. (2015). A framework for sustainable product design: A hybrid fuzzy approach based on quality function deployment for environment. *Journal of Cleaner Production, 108*, 385–394.

CHAPTER 4

Do Greener Products Earn More Green? Examining Biomimicry along with Incremental and Radical Sustainable Product Innovations for UX Designs

Snehapriya Bharatha, Elizabeth Jensolowsky, Michael Teiman, Anshu Saxena Arora, and Jennifer Edmonds

Abstract Companies strive on product designs. Household sector innovators modify and innovate consumer products as small projects. Innovators use gestalt theory and look at the idea as a whole rather than in parts. These ideas are developed based on the three-dimensional strategy: aesthetics, functionality and symbolism. These design dimensions together show positive influences on a customer's willingness to pay and generate a positive effect on purchase intentions. There is a

S. Bharatha (✉)
Deloitte LLP, Mechanicsburg, PA, USA
e-mail: snehapriya.bharatha@wilkes.edu

E. Jensolowsky • M. Teiman
Wilkes University, Wilkes-Barre, PA, USA
e-mail: michael.teiman@wilkes.edu

A. Saxena Arora et al. (eds.), *Sustainable Innovation*,
International Marketing and Management Research,
https://doi.org/10.1007/978-3-030-30421-8_4

strong predictive link between raw idea and consumers' purchase intentions. Therefore, experts consider consumer panel evaluations. In recent years, making product design ideas environmentally friendly has become popular. Biomimicry is a new concept which encourages designers and product managers to innovate with product designs through emulation of biological forms, processes, patterns and systems. Biomimicry-driven projects produce double intellectual property with double energy savings for one-sixth the resources. The betterment of a product would be done with the help of user experience and design. These design ideas can include radical or incremental innovations. This chapter addresses the following questions:

- What role does biomimicry play in incremental and radical innovations?
- Explain how the new innovative product ideas follow three dimensionality: aesthetics, functionality and symbolism?
- How important is user experience (UX) design in biomimicry-based product innovations?

With respect to the above questions, we discuss three case studies in the consumer goods industry that incorporate biomimicry, user-oriented design and three-dimensional product design strategy of aesthetics, functionality and symbolism. We further suggest an innovative product idea incorporating elements of biomimicry, UX design and sustainable product design. The research provides implications for researchers and managers in developing environmentally sustainable innovations which are user-friendly by understanding new product design and biomimicry.

Keywords New product design • Three-dimensional product design strategy • Biomimicry • Purchase intentions • Consumer goods • Radical and incremental

A. Saxena Arora
School of Business and Public Administration,
University of the District of Columbia, Washington, DC, USA
e-mail: anshu.arora@udc.edu

J. Edmonds
Georgian Court University, Lakewood, NJ, USA
e-mail: jedmonds@georgian.edu

Introduction and Review

Companies strive on competition and new product designs to improve customer retention and company's performance. In order to create a new product design, designers and innovators should consider the three-dimensional product design strategy. These design dimensions include aesthetics, functionality and symbolism. "Aesthetics" refers to the appearance and beauty of a product. Functionality discusses about the usefulness and the product's ability to fulfil its purpose. Symbolism is used to present and communicate the product to the consumers (Chen, 2019; Homburg, Schwemmle, & Kuehnl, 2015; Osorio et al., 2019). Symbolism is necessary because aesthetics and functionality alone cannot capture the whole product design. When the new product design focus on the three-dimensional product design strategy, they are more likely to fulfil consumer needs through user experience and user-oriented design.

User-oriented design is developing and manufacturing a product or service based on the need of the consumer. For the product to be considered "user-oriented", the supplier must have a deep understanding of the customer. In addition, the consumer must have a desire to use or interact with that good. Moreover, the user should also benefit from this product. Just like anything, in order for the product/service to be successful, it is important that it gains support and recognition from the consumer/target market. Chen (2019), Osorio et al. (2019) and Veryzer and de Mozota (2005) conducted research on how user-oriented design was incorporated within new product development. They looked into how user-oriented design enhanced new product development and idea generation by producing superior product solutions, while facilitating product appropriateness. Their research also created a foundation to continue to understand new measurements for enhancing new product like, like user-oriented design. They explain how user-oriented design improves new product development. User-oriented design is very closely related to radical and incremental innovation.

Incremental and radical innovations are both different and unique in product innovativeness landscape (Arora & Arora, 2017). For example, Chinese automakers like Geely Automobile Holdings Ltd. and FAW Group Corp. are experimenting to manufacture "mild hybrid cars" over the next two years that are gasoline-powered cars coupled with 48-volt battery technology for providing additional energy to power steering and other high-energy devices (Ramsey, 2016). This may be regarded as an

example of "incremental technology" change since mild hybrid vehicles use smaller batteries and an electric motor to boost fuel economy without increasing the price of vehicle as much as an electric car or currently available hybrid vehicle. In contrast, an example of radical/disruptive technological innovation is the first launch of gasoline-electric hybrid vehicle or fully electric car. Radical technology changes "will initially under-perform established technologies in a mainstream market and will have features that only a fringe market segment will value, but because of increasing demand for these new features, a disruptive technology redefines the performance trajectories" (Slocum & Rubin, 2008, p. 19). Other examples of "radical technology" shifts are typewriters: manual to electric, to dedicated word processors, to personal computers; or imaging technologies: daguerreotype to tintype, to wet plate photography, to dry plate, to roll film, to electronic imaging, to digital electronic imaging (Slocum & Rubin, 2008).

Arora and Arora (2017) provided examples of incremental and radical innovations. In incremental innovation category, the Jasper Morrison Brunch set (kettle, coffee maker and toaster) by the German premium home appliance manufacturer Rowenta (https://jaspermorrison.com/projects/electrical/rowenta) uses high-design inviting curves and subtle gestures where surface and structure merge as the basis of communication. On the contrary, in the radical innovation category, Toshiba's automatic rice cooker launched in 1955 and continuing at present (https://www.toshiba-lifestyle.co.jp/living/tourist/en/special/index_j.htm) was one of the first home electronic products to bring a recognizably simple, low-design Japanese style to the rice cooker category mainly inspired in design by Western products.

Kornish and Ulrich (2014) discussed the importance of perception surrounding a raw idea in relation to the success of the final product. The study discovered that online consumer panels are more reliable than the ratings of so-called experts when it comes to identifying a "good idea". More so, samples of consumer opinions as small as 20 proved to be a reliable source of accuracy. There is also a stronger link between a raw idea and consumer purchase intent than there is between purchase intent and market outcome. Gestalt theory deals with viewing at objects rather than some of its parts which includes user experience ad user-oriented design, material of the product, design, idea and many more. Examples of new product designs that involved raw idea of incremental/radical changes with the help of gestalt theory for customer satisfaction are touch screen

mobile phones. Majority of today's generation uses Apple and Android phones. With the help of user experience and recommendations, incremental changes are being made to this technology to better the product. When these touch screen smartphones were launched for the first time, they were radical innovations. Another consumer good related to user-oriented design are fitness trackers. Fitness trackers, like the Apple watch, can now fit around consumers' wrists and can upload data that will instantly upload to their phone. In addition to telling the time, the watch can serve multiple purposes based on consumers' demands. These products were radical innovations when created for the first time; however, the sustainability of these products increased over the years due to incremental innovations.

In this research, we examined biomimicry along with incremental and radical innovations. Biomimicry is the process of producing a product that mimics that of nature's biological processes (Sharma & Sarkar, 2019). It is an important tool behind environmental sustainability across industries. Increasing consumer fads as well as strict environmental regulations force companies to look at their products in a new light. Kennedy and Marting (2016) explore a case study that "suggests biomimicry may be a highly promising approach for driving innovation, and particularly environmentally sustainable innovation". They also found that biomimicry can increase competition, customer relations and business value. This chapter is the *first* to focus on biomimicry, new product design and sustainability in the context of the consumer goods industry. Our research questions are:

1. What role does biomimicry play in incremental and radical innovations?
2. Explain how the new innovative product ideas follow three dimensionality: aesthetics, functionality and symbolism?
3. How important is user experience (UX) design in biomimicry-based product innovations?

This chapter is organized into four sections. First, in this section, we provide descriptions of new product design; three-dimensional product design strategy of aesthetics, functionality and symbolism; and sustainability in the context of gestalt theory. Second, we incorporate the idea of user-oriented design and further discuss about radical and incremental innovation ideas. Third, we focus on sustainable product design through case studies in the consumer goods industry through the lenses of

biomimicry and understanding consumers' purchase decisions and willingness to pay for sustainable innovative products. Next, we develop a new product idea incorporating elements of biomimicry and sustainable product design. Finally, we present theoretical and managerial implications for researchers and product managers in developing environmentally sustainable innovations by understanding new product design and biomimicry.

Three Dimensionality

In the twenty-first century, robotic products are designed to assist and entertain people at home, institutions and workplace. An extensive research was conducted in the US and abroad by building real homes that facilitate the needs of elders, children and cognitively and physically impaired residents. It was found that people tend to collect and use products that are functionally, aesthetically and symbolically fit with their home environment.

An example of product dimensionality (aesthetics, functionality and symbolism) can be found through studies comparing Roomba versus Flair. Research has shown that the robotic Roomba vacuum cleaner had a substantial and lasting impact on people rather than the non-robotic Hoover's Flair. Roomba, the autonomous, semi-intelligent vacuum, resulted in lower stress levels at home. Although Flair and Roomba had similar functionality, Flair did not have the similar long-lasting effects. Roomba has been found to be very user-friendly; in one family, a 13-year-old child was able to "take over" the responsibility of cleaning her own room (Forlizzi, 2007). Roomba with its new and convenient cleaning method enabled individuals of age 90 to clean more frequently (Forlizzi, 2007). The three dimensionality in the product design plays a major role in improving the user experience. There were many positive and negative aesthetic comments made about Roomba. The most common disliked aesthetic feel was the "clackety-clack" noise the Roomba made as it was working. The functionality of Roomba was praised for its accessibility, autonomy, ease of use and suctioning power, whereas Flair's functionality was praised for its lightweight form and flexible head. It was, however, criticized for its inability to stand up and its poor suctioning power. Families receiving the Flair vacuum made a symbolic association that it was designed for "older people", "people who do not clean" and "people who do not make a lot of dirt". Both Roomba and Flair were accepted for their functionality of cleaning (Forlizzi, 2007).

Biomimicry and User Experience

User experience (UX) or user centred design (UCD) is creating and manufacturing a product or service based on the consumer's needs. Without understanding the customer's demands, you cannot consider your product to be UX centred. Biomimicry is designing and manufacturing a product based on biological existence. In this chapter, we are exploring the combination of both UX design and biomimicry. More specifically, how important UX design is in biomimicry-based products. Arosha Gamage and Richard Hyde designed a framework that enhances ecological sustainability by increasing the applicability of biomimicry theory into architectural practice (Gamage & Hyde, 2012).

Many biomimicry designs can seem beneficial in theory, but if it is not what the market demands, then the production is worthless. We can use biomimicry directly and indirectly. Direct biomimicry is taking the same idea to human production, whereas indirect biomimicry uses only some assets of the bio product. An example of UX biomimicry would be a newly designed shoe, which replicates the structure of a bird's skull (https://www.dezeen.com/2012/07/17/biomimicry-shoe-by-marieka-ratsma-and-kostika-spaho/). The heel of a women's shoe on silhouettes has to absorb a huge amount of pressure and weight. Without strong support, the heel can buckle, therefore causing the shoe to collapse. However, using the same structure as a bird's skull, the heel has stronger support than the traditional structure. This design is also UX as the shoe will remain light as well as strong. Women like their shoes to be light, so the features comply with that demand. In addition, the design is efficient, as well as light and strong.

Biomimicry was first defined in 1997 by Benyus (1997). The core concept of biomimicry is that nature has already developed processes to solve design issues that innovators work to overcome. The concept of cradle-to-cradle focuses on creating products that, after their primary use is over, become resources for other products. Research behind the application of both biomimicry and cradle-to-cradle in the design process is scarce. Ecodesign is an overarching term for adding environmental sustainability to product design. The term has been used for over 30 years and much research has been conducted into the application of ecodesign in product development. For the purpose of the study, it is a baseline for concepts such as biomimicry and cradle-to-cradle design. Velcro is a common household name but not many realize it was an original idea based off of biomimicry. Georges de Mestral was a Swiss engineer who went for a walk

Fig. 4.1 Velcro consists of two pieces of fabric tape that attach on opposing sides by connecting small nylon loops with a fabric bedding

through the woods in 1941 and discovered burrs hanging from his pants. It took eight years of research and development before Mestral patented his product and named it after the words "velours", which means "loop" in French, and "crochet" (Suddath, 2010). The first Velcro design was composed of cotton but soon the material was replaced with nylon, which proves to be more durable. Figure 4.1 shows the hook-and-loop fastener consisting of two fabric strips, one with a base tape and one with loops that attach together (Suddath, 2010). In 1958, when the Velcro company was founded, it was advertised as "the zipperless zipper".

Incremental and Radical Innovation

A series of unique ideas and structural arrangements are necessary for radical innovation (Ettlie, Bridges, & O'Keefe, 1984; Koberg, Detienne & Heppard, 2003). Most innovations are built on an already existing one that requires modifications to existing aesthetics, symbolism and functionality of the product. In some cases, the inventions are entirely changed.

iPhones are the talk of the town now. They were first introduced to the world in 2007 as radical or disruptive innovation. Since then, it has been the only phone with a different software, IOS. Once the iPhones craze increased, an incremental change has been made every year to the phone. It not only differed in size, shape and overall appearance, it also differed in its picture quality (refer to Fig. 4.2). When iPhone 5 was introduced, the first finger screening password was introduced and now the iPhone X has

Fig. 4.2 Different versions of iPhone that show the various shapes and sizes it occurred in

a face recognition software. iPhones are an example of both incremental and radical innovation. As the software is a radical change, the appearance is an incremental change.

Velcro is used across industries. It has made incremental change to existing products. In the 1960s, NASA Apollo astronauts used Velcro to hold equipment in place while in space. Hospitals used Velcro on equipment as well as the gowns given to patients. Velcro can be found on airplane flotation devices as well as automobiles underneath floor mats. It is also very prominent in the athletic world. Puma was the first company to design a shoe that replaced shoelaces with Velcro. Now Velcro is a staple on children's shoes and across industries.

An example of an incremental biomimicry design would be how the nose of bullet trains has evolved. To increase speed, having the frontend of a train to be more streamline increases the efficiency of trains. By using biomimicry, designers have made an incremental change to the shape of trains by implementing the design of a kingfisher's beak. In the past, flat noses have slowed trains down, as well as made them more susceptible to accidents. Now, trains are faster, therefore more efficient, in addition to being safer for customers.

H_2ERO PACK: Innovation Idea

From our households to our water bottles, water filtration systems can be found nearly everywhere you go. Even though there are many water filtration systems on the market, there is a still a dirty water epidemic. Millions of people go without clean drinking water every day. According to UNICEF, "dirty water and poor sanitation kills over 5000 children every

day". This number is increased in the event of natural disasters such as the recent devastation in Puerto Rico, where over 55% of people did not have access to clean water after Hurricane Maria. Our product innovation idea, the H_2ERO PACK, seeks to eradicate this number.

The H_2ERO PACK, manufactured from sustainable materials, is a backpack that acts as both a filtration system and a travelling storage container for water during times of natural disasters. It is durable, affordable and keeps the filtered water cold by using insulated material. The H_2ERO PACK will hold approximately two gallons of water. The exterior of the bag (refer to Fig. 4.3) will be constructed from 900D Polyester and PCV-free and toxic-free recycled materials made from rPET (recycled polyethylene terephthalate) water bottles. Beeswax will be added on the exterior of the backpack to make it water resistant. The interior of the bag will be constructed from 900D Polyester and PVC-free and toxic-free recycled materials made from rPET water bottles. We will also add cellulose insulation to the interior of the backpack to ensure consistent temperature. Mainly made from recycled newspaper, cellulose is arguably the granddaddy of green insulation. With an *R*-value similar to fiberglass (near 3.5 per inch), cellulose—either blown or sprayed—features the same benefits as fiberglass without the cons such as formaldehyde and potentially harmful fire retardants. It also provides tougher resistance against air leaks and is one of the less expensive green insulation options on the market.

Fig. 4.3 The exterior of the H_2ERO PACK is going to look like a backpack

The inside of the bag will consist of Triton Copolyester because it is lightweight, is stain resistant, is low-cost and offers temperature control. The filtration system will be composed of a soy-based material. The WSU (Washington State University) and Chinese team developed a new kind of air filtering material that uses natural, purified soy protein and bacterial cellulose, an organic compound produced by bacteria. Soy contains 18 types of amino groups. Each of the chemical groups has the potential to capture passing pollution at the molecular level. The researchers used an acrylic acid treatment to disentangle the very rigid soy protein, so that the chemical groups can be more exposed to the pollutants (Souzandeh, Johnson, Wang, Bhamidipaty, & Zhong, 2016). The filter will be shaped as a sock for easy usage (refer to Fig. 4.4).

Our research involved three dimensionality, user design, biomimicry and incremental versus radical design. The H_2ERO PACK, modelled after hiking backpacks and water bladders, is aesthetically pleasing. It offers functionality and symbolizes health and well-being during times of disaster. It is very easy to use and is based upon user design. The reusable sock can simply be cleaned of debris and replaced for future use. Biomimicry played a key role in the development of the product. Beeswax, cellulose and soy are natural products produced by nature and can be used to solve everyday design implications. The H_2ERO PACK will be an incremental change on the market. As mentioned before, there are many water filtration systems available. However, the H_2ERO PACK will differentiate itself because it will be the most sustainable item at the lowest price, with a focus on disaster relief.

Fig. 4.4 The sock-shaped filter inside the canteen

Discussions and Conclusions

The concepts we covered in our research were three-dimensional strategy: aesthetics, functionality and symbolism; raw idea; biomimicry; radical or incremental innovations; user experience; and gestalt theory. The three dimensions consist of three factors (aesthetics, functionality and symbolism) which are equally important. Biomimicry is the design of a product based on existing biological organisms. As discussed, biomimicry can be the imitation of forms, processes, patterns or systems. Biomimicry is more present than ever now and plays an important part in incremental and radical innovations. Radical innovation is the creation of a new product that doesn't already exist. Alternatively, incremental innovation is changing a product that is already in the market. Both radical and incremental designs can be biomimicry innovated. User experience is the creation/production of a service or product based on the demand of the consumer. In order to satisfy consumer needs, marketers need a deep understanding of the demand. Finally, the gestalt theory views the product as a whole, rather than the individual parts.

In conclusion, greener products do earn more green. Companies strive on product designs and a three-dimensional strategy: aesthetics, functionality and symbolism. These design dimensions together show positive influences on a customer's willingness to pay and generate a positive effect on purchase intentions. There is a strong predictive link between raw idea and consumers' purchase intentions. Therefore, consumer panel evaluations are a better way to determine "good ideas" rather than ratings by experts. Biomimicry-driven projects produce double intellectual property with double energy savings for one-sixth the resources. Environmentally friendly design ideas are a continuing popular demand among consumers and they are here to stay.

References

Arora, A. S., & Arora, A. (2017). WYSIWYG – Seeing is believing: Consumer responses to levels of design newness, product innovativeness, and the role of country-of-origin. *Journal of International Consumer Marketing, 29*(3), 135–161.

Benyus, J. M. (1997). *Biomimicry: Innovation inspired by nature*. HarperCollins.

Chen, S. (2019). Design thinking approaches. In *The design imperative* (pp. 111–121). Cham: Palgrave Macmillan.

Ettlie, J. E., Bridges, W. P., & O'Keefe, R. D. (1984). Organization strategy and structural differences for radical versus incremental innovation. *Management Science, 30*(6), 682–695.

Forlizzi, J. (2007). How robotic products become social products: An ethnographic study of cleaning in the home. In *Proceedings of the ACM/IEEE international conference on Human-robot interaction* (pp. 129–136). New York: ACM.

Gamage, A., & Hyde, R. (2012). A model based on Biomimicry to enhance ecologically sustainable design. *Architectural Science Review, 55*(3), 224–235.

Homburg, C., Schwemmle, M., & Kuehnl, C. (2015). New product design: Concept, measurement, and consequences. *Journal of Marketing, 79*(3), 41–56.

Kennedy, E. B., & Marting, T. A. (2016). Biomimicry: Streamlining the front end of innovation for environmentally sustainable products: Biomimicry can be a powerful design tool to support sustainability-driven product development in the front end of innovation. *Research-Technology Management, 59*(4), 40–48.

Koberg, C. S., Detienne, D. R., & Heppard, K. A. (2003). An empirical test of environmental, organizational, and process factors affecting incremental and radical innovation. *The Journal of High Technology Management Research, 14*(1), 21–45.

Kornish, L. J., & Ulrich, K. T. (2014). The importance of the raw idea in innovation: Testing the sow's ear hypothesis. *Journal of Marketing Research, 51*(1), 14–26.

Osorio, F., Dupont, L., Camargo, M., Palominos, P., Peña, J. I., & Alfaro, M. (2019). Design and management of innovation laboratories: Toward a performance assessment tool. *Creativity and Innovation Management, 28*(1), 82–100.

Ramsey, M. (2016). Baidu to test drive autonomous cars in the US. *WSJ Online Article*.

Sharma, S., & Sarkar, P. (2019). Biomimicry: Exploring research, challenges, gaps, and tools. In *Research into design for a connected world* (pp. 87–97). Singapore: Springer.

Slocum, A., & Rubin, E. (2008). Understanding Radical Technology Innovation and its Application to CO_2 Capture R&D: Interim Report, Volume One—Literature Review.

Souzandeh, H., Johnson, K. S., Wang, Y., Bhamidipaty, K., & Zhong, W. H. (2016). Soy-protein-based nanofabrics for highly efficient and multifunctional air filtration. *ACS applied materials & interfaces, 8*(31), 20023–20031.

Suddath, C. (2010). A brief history of: Velcro. *Time Magazine*.

Veryzer, R., & de Mozota, B. B. (2005). The impact of user-oriented design on new product development: An examination of fundamental relationships. *The Journal of Product Innovation Management, 22, 128–143.*

CHAPTER 5

Buyer-Supplier Relationships: Role of Collaboration, Sustainability, and Technology

Loucace Dorcas Ampe-N'DA, Barbara Ann Payne, Robert Iyeli Spake, Shavon Sharpe, and Amit Arora

Abstract The relationship between buyers and suppliers is crucial for any organization that is willing to be flexible and adapts to these changing times. Flexibility becomes hard to attain if the buyer-supplier relationships (BSR) are restricted; on the other hand, it is risky to adopt a laissez-faire mentality because of opportunism. The purpose of this chapter is to yield a framework for understanding the evolution of buyer-supplier relationships in supply chain management. The methodology is based on researching case examples with agreements and collaborative processes, trust, and information sharing. The goal is to contrast the past and the present changes in the buyer-supplier relationships for several companies and then determine the benefits or drawbacks of those relationships. The questions

L. D. Ampe-N'DA (✉) • B. A. Payne • R. I. Spake • S. Sharpe • A. Arora
School of Business and Public Administration,
University of the District of Columbia, Washington, DC, USA
e-mail: loucace.ampe@udc.edu; barbara.payne@udc.edu; robert.spake@udc.edu; shavon.sharpe@udc.edu; amit.arora@udc.edu

A. Saxena Arora et al. (eds.), *Sustainable Innovation*,
International Marketing and Management Research,
https://doi.org/10.1007/978-3-030-30421-8_5

that will be addressed in this chapter are as follows: What are the positive and negative aspects of the collaborative process of buyer-supplier relationships? How do the triple P's (people, planet, profit) factor into these relationships? How sustainability affects the buyer-supplier relationship over the years? How information technology helps increase transparency and trust in buyer-supplier relationships?

Keywords Evolution • Buyer-supplier relationship (BSR) • Flexibility • Adaptation • Laissez-faire • Opportunism • Collaborative processes • Transparency • Trust • Information technology • Information sharing • Sustainability

Introduction

Over the years, a broader strategic approach in supply chain management has been adopted due to globalization. More organizations are moving away from individualism toward networking and exchange. The buyer-supplier chain involves the upstream and downstream flow of products, services, finances, and information from the supplier to the buyer whereby a collaborative relationship is now the key element for many successful companies today. Based on the annual reports of any organization, one can see how engaged they are in enhancing buyer-supplier relationships (BSR). Ulaga and Eggert (2006) found that supplier support services and personal interactions between buyers and suppliers are core differentiators in key supplier relationships, and Storey, Emberson, and Reade (2005) underline that collaborative relationships require constant nurturing.

This research focuses on the continuous development of the BSR concept and its scope over time and factors both negative and positive impact of BSR. Companies that have expanded their supply chain globally have to adjust to the way communication is executed according to foreign customs in order to create a positive and qualitative relationship. The relationship aspect of the buyer-supplier has been covered in many past studies; therefore, the importance of relationships is the foundation of any competitive organization for long-term sustainability. This chapter aims to answer a series of questions through literature review and case study examples such as Walmart and Procter & Gamble, and concludes that from the evolution process, buyer-supplier relationships have increased and evolved. The following questions will be addressed:

- What are the positive and negative aspects of the collaborative process of buyer-supplier relationships?
- How do the triple P's (people, planet, profit) of sustainability factor into these relationships?
- How information technology helps increase transparency and trust in buyer-supplier relationships?

Literature Review

Many past studies have researched various aspects of buyer-supplier relationships, focusing on the levels of collaboration, communication, social responsibility, and the use of technology. However, limitations from contradictory results are suggested within this research because only certain aspects of BSR are investigated. For example, in communication, Kurnia and Wahjudono (2015) suggest that an ongoing strategic relationship should be the norm. Communication, sustainability, and technology affecting all forms of BSR should be studied. This chapter examines multiple researchers and proposes that additional investigation be conducted to understand the evolution of the buyer-supplier relationships better.

The issue of managing buyer-supplier relationships has attracted a growing body of academic research in recent decades (Terpend, Tyler, Krause, & Handfield, 2008). This chapter sheds light on obstacles and opportunities regarding the effectiveness of Dutch construction firms in managing buyer-supplier relationships and their level of maturity. Based on portfolio optimization, it is noticed that buyer-supplier do not fully use external resources through buyer-supplier cooperation, which impedes trust and performance. Multiple aspects were used in this chapter to determine effectiveness such as the quality of suppliers, portfolios, process integration, and performance evolution. Improvement such as a product-oriented model by Kraljic (1983) and relationship-oriented model by Krapfel has to be used, given the fact that many companies have to reduce the size of their supplier base to become more competitive and flexible and to reduce costs and risks. It is argued that the lack of ongoing relationships is the main reason for the construction industry's failure to increase efficiency and innovation. The above implies that Dutch construction companies lack the knowledge and competencies of a sustainable base for buyer-supplier relationships when buying goods and services (Bemelmans et al., 2018).

Li and Shen (2016) have examined different types of manufacturers such as not-for-profit and for-profit to study their sustainable design operations. A non-profit manufacturer aims to maximize the demand quantity and a for-profit manufacturer targets maximizing profits. These two objectives are considered under a decentralized and a centralized setting. The author states that the purpose of sustainable design is to reduce the negative impacts either on people or on the planet while keeping the objectives, as stated above, in mind. This can all take place by incorporating health and safety attributes for people, and environmental characteristics for planet into products (Isaksson, Gravari, & Johnson, 2015)

Additionally, the author developed an analytical model that examines the sustainability of design operations of a supply chain for manufacturers and retailers. The sustainable design focuses on satisfying customers' needs under the three P's of sustainability: people, profit, and the planet. Also, the author states that it is possible to achieve an excellent sustainable design attaining profit or no profit for all in the supply chain.

Quais Ifrah (2016) states that every organization wants to thrive in a win-win situation. Parts of an organization work together to achieve the best outcome. The author included that the supply chain management is the brainwave of an organization's network, linked upstream and downstream processes and activities, creating products and services which are delivered to the customer. A fluid system is essential to building a good relationship between buyer and supplier. The author further states that the lead time can be a competitive advantage among buyers and suppliers which affects performance. Companies face the challenge to respond to varied customers' requirements and demand uncertainties. Lead times typically include two components: order lead time and information lead time. Suppliers and buyers should have mutual understanding and make a contingency plan in case the lead times are uncertain. Transportation delay is another problem in lead time because of long distance. Distribution network should be designed in such a way in order to optimize the transportation requirements and lead times. Enterprise resource planning (ERP) systems may be implemented to strengthen the management information systems in supply chains in order to reduce lead times by providing real-time data.

Seuring and Muller (2008) believe that the academic and corporate interest in sustainable supply chain management has risen considerably in recent years. They offer a review on sustainable supply chain management by examining 191 articles published from 1994 to 2007. Based upon their historical review, they provide a conceptual framework to summarize the

research in this field. The authors conclude with two distinct strategies: (1) supplier management for risks and performance, (2) supply chain management for sustainable products. Both authors believe that the practitioners in companies and academics might find the review useful, as it outlines significant lines of research in the field. They discuss specific features of sustainable supply chains as well as limitations of existing research.

Patterson, Grimm, and Corsi (2004) state that since the implementation of technology in supply chains in the 1990s, system errors have gone down by 99%. Companies that use manufacturing execution systems (MES) were able to have better relationships with their customers because they can keep track of real-time operations and gained the capability to make alterations and react to last-minute customer changes and requests. Furthermore, installing enterprise resource planning (ERP) systems allows all departments to be on the same page.

Daniel Jimenez-Jimenez (2018) discusses how informational technology (IT) has radically and/or incrementally improved relationships and trust downstream and upstream of the supply chain. The author was able to discuss these findings by conducting surveys with 200 different companies. The author states that for companies to be able to stay up to date with changing technology, they need to seek out external influences so that they can maximize production, synergy, and the ability to collaborate with external entities to their operation.

Case Studies

Based on our literature review we identified several case studies of organizations that attempt to answer our research questions.

Amazon is engaged in a relationship with buyers and suppliers, and they are supported in controlling the supply chain by creating a love-hate relationship, whereas customers are now co-dependent on Amazon. Amazon provides a service worldwide called Amazon Web Services (AWS). In our research, we found that the AWS is a subsidiary of Amazon.com that provides on-demand cloud computing platforms to individuals, companies, and government officials, on paid subscriptions. According to a report by Hern (2017), the AWS division has reached a global high since 2016: 23 million items ordered from Amazon's sellers, and cyber deals were up 40% compared to a year earlier. Moreover, 43% of Amazon's share of total US online sales is based on research by Slice Intelligence, and 64 million customers signed up for the video streaming service called

Prime. Amazon's founder, Jeff Bezos, was ranked fifth in the league of the world's wealthiest people. Last, 1.3 million is the estimated number of servers that comprise AWS, the enormously profitable cloud computing arm. We can conclude that Amazon's AWS is big and customers are becoming dependent on these services, making it impossible for buyers-suppliers to live without them.

China's online retailer **JD.COM** uses blockchain, Internet of Things (IoT), warehouse managing systems, and other industry standard components to decrease human errors and liability. An article in SCMR claims that JD.COM operates the most extensive retail supply chain in China, setting the standard for online shopping through its commitment to quality, authenticity, and unrivaled nationwide fulfillment network. Also, the company is committed to sourcing only quality, authentic goods from around the world for its more than 236 million customers. JD.COM operates a system that has a nationwide logistics network and also deploys drone services for delivery (SCMR, 2017). In 2009, JD.COM Inc. generated less than $0.5 billion of sales. However, in the 12 months ending September 2015, the company generated over $25 billion in revenue (MLJ, 2015). The article also mentions about implementation of JD's customer value proposition captured in its company logo, which contains four characters: more, fast, good, and save.

Walmart's competitive purpose is to deliver the best quality of products and services at the lowest price for customers. Walmart executed its "Everyday Low Prices" (EDLP) program in the 1970s and 1980s to guarantee a wide range of quality products and services at a moderate price compared to other retailers. Walmart's supply chain consists of three segments: procurement and distribution, logistics, and inventory management. To adhere to EDLP policy, Walmart decided to abandon their logistics intermediaries and integrate vertically. This resulted in tightening the internal relationships of Walmart and increased transparency by having warehousing, freight, distribution center, and some suppliers (livestock farmers, meat packaging, boxing manufactures, and so forth) under one umbrella.

Nguyen (2017) analyzes features that helped create Walmart's successful integrated supply chain that contributes to its dominant position in the retail market, and identifies issues existing in Wal mart's supply chain. He discusses critical findings which indicated that it was necessary to build the Triple-A supply chain for not only Wal mart but also firms in the twenty-first century. Triple-A is a system that organizations use as a resource to move products or services from supplier to buyer.

Positive and Negative Aspects of the Collaboration in Buyer-Supplier Relationships

Collaboration is a critical element of success for any company that has a goal to grow and develop in the long term (Ramanathan & Gunasekaran, 2014). The world is becoming highly globalized and, as a result, companies are provided with the ability to shorten lead times and product lifecycle, ensure that all the processes and information flows go faster while the costs associated with production decreases (Cruz, 2013). All this can be achieved through the effective supplier partnering that also allows maintaining a competitive advantage. For example, Walmart is a leading retailer that provides its consumers with the most attractive prices in the market. This is possible for Walmart because it partners with more than 3000 diverse suppliers and continues to increase their number (Plambeck, Lee, & Yatsko, 2012). However, there are some adverse outcomes in partnering with a large number of suppliers which include the inability to easily segment the supply base, and increased complexity of supplier performance measurements.

There are also some risks and trust issues associated with buyer-supplier relationships. For example, when it comes to trust issues, it is possible that when a company works with a particular supplier over a long time, they develop a trust relationship (Gullett et al., 2009). This may lead to negative consequences because the supplier can become too familiar and friendly, and essential checks and balances may be overlooked and attention to details ignored. As a result of a high level of trust between companies, a buyer company can face a risk of underperformance due to its supplier. This may result in the company not being able to meet the needs and expectations of customers and a decrease in the level of their loyalty. In the long term, this can lead to a failure of the business. For example, Procter & Gamble has been grappling with the underperformance of its stock over the past decade and is currently not far from losing its leading position on the global market. In an attempt to improve the situation, Procter & Gamble decided to re-work its supply chain to lower cost and to establish new relationships with new suppliers.

Role of Triple P's (People, Planet, and Profit) in Buyer-Supplier Relationships

Fish (2015) explains the three pillars of sustainability including people, planet, and profit, and how millennials expect businesses to be socially responsible in a sustainable manner. The author discusses how social sustainability considers the motivation, skills, and loyalty of employees and

supply chain partners. The proposed Amazon headquarters in Virginia, USA, will bring a new School of Computing, and an institute focused on digital innovation at George Mason University hosting about 1000 students every year. Amazon will hire 100,000 new full-time employees in the next 18 months while enhancing their internal employees to 280,000 people, which projects a 56% surge compared to the end of 2016 (Vincent, 2018).

Additionally, the author explains the concept of environmental sustainability and how it pertains to the impact of products and how it affects the environment, predominantly global warming and pollution. One company that significantly stood out is Walmart. The author explained how Walmart's "supplier sustainability assessment" reviews its suppliers' information on energy and climate which relates to energy costs, greenhouse gas emissions, as well as material efficiency which pertains to waste and quality. Also, natural resources such as raw material sourcing and people and community relate to responsible, ethical production.

To meet this demand, there must be room for inimitability such as the integration of new product development with sustainable supply chain management. The author states that without economic sustainability businesses will cease to exist. As this information is applied to everyday task, it will assist with the growth of a successful new product within a supply chain and some of the tools and techniques that are available to management to help in decision-making.

According to Kumar and Rahman (2015), the sustainability of an entire supply chain is the final product that affects the performance of each partner in the chain management. The authors also concluded that BSR plays a vital role in improving the sustainability of the supply chain.

A study by Harvard University (Nidumolu, Prahalad, & Rangaswami, 2009) finds the growing need for integrating sustainability in supply chain management. If incorporated strategically, sustainability in supply chain can contribute to profitability and create value and speed. Many companies are limited to implementing sustainability practices within their organization and are unable to extend these practices to their suppliers and customers. These challenges reduce the ability to progress and benchmark the tools that are available to develop and implement a sustainable plan. One requirement of a successful sustainable supply chain is collaboration which may not be hard to implement. Collaboration may be achieved by sharing information with other partner companies.

Role of Information Technology to Help Increase Transparency and Trust in Buyer-Supplier Relationships

In 1911, Frederick Taylor wrote *The Principles of Scientific Management*. Taylor is said to be the grandfather of supply chain management because the systemizing operations and logistics were created to help transport good and services across vast distances effectively.

In the 1940s before World War II scientific management was first tested on organizing and supplying the US military in the Pacific and the Atlantic fronts. This was the first time massive logistics was being used, much paperwork got lost, and supplies got lost and delayed in their transfers.

A couple of decades before the great wars, ideas evolved for creating the forklift to simplify warehouse work to logistics to help the war efforts. Mechanization started to take effect and managers started to get used to orchestrating massive operations. Moreover, they started to trust the systems in order to obtain accurate information on logistics. As the 1950s moved on, mechanization started to be adopted by several companies. Since transportation is a critical part when it comes to the push (procurement, manufacturing, and replenishing cycle) and pull (customer orders cycle) of a supply chain, containers started to be standardized with a width of 8 ft. so that they could fit cargo trucks, freight ships, and railways.

During the 1960s–1970s computers came into the scene. Managers started to slowly shift the record keeping from manual to computerized data collection because computer logistics was able to gain recognition. Even though training and machinery was an expensive investment, logistics helped many companies improve their bottom line. Modern-day corporations/systems have IT working effectively; now they are adding blockchain and the Internet of Things (IoT) to better the relationships/efficiency in a corporation or between systems. Now that most companies have a sound logistics system in place we currently are working on sustainability and revisiting relationships on the supply chain due to the extra time that has been allocated by the use of information technology (Muellur, 2018).

Implications and Conclusion

This research examined past literature on the evolution of buyer-supplier relationships, its implications on knowledge, trust, sustainability, and information sharing, and how it impacts innovation. This study further

adds to this growing stream of research. Twenty years ago, the competition was company versus company; now it is supply chain versus supply chain. The research goes on to show that managers should know that their competitive advantage is in their supply chain. Maximizing efficiency in this area will create a strong relationship between buyers and suppliers and streamline the supply chain due to higher transparency. It is even expected that 85% of customer interactions will be managed without a human by 2020 (Gartner, 2011). Therefore, the study is extremely relevant both from academic and from managerial perspectives.

No single approach to relationship management is inherently superior. However, companies that are rigid and have poor adaptability will not survive the new sustainable, economic, and profitable supply chain race. It can be argued that buyer-supplier relationships play an essential role in facilitating knowledge and financial transfer. For the growth of an innovative business model or technology, valued-based relationships through strategic alliance should be established. Companies need to develop a full understanding of the past, present, and future need of their buyers and suppliers and fulfill them in a socially, environmentally, economically responsible way. Strong relationships are equivalent to a robust supply chain.

References

Bemelmans, J., Voordijk, H., Vos, B., & Buter, J. (1996–2018). Assessing buyer-supplier relationship management: Multiple case-study in the Dutch construction industry. *American Society of Civil Engineering*. Retrieved from https://ascelibrary.org/doi/pdf/10.1061/%28ASCE%29CO.1943-7862.0000418

Cruz, J. M. (2013). Modeling the relationship of globalized supply chains and corporate social responsibility. *Journal of Cleaner Production, 56*, 73–85.

Fish, L. A. (2015). How sustainable is your new product development process? Hint: Supply chain plays a role. *Supply Chain Management Review, 19*(6), 26–33. Retrieved from https://search-proquest-com.proxydc.wrlc.org/docview/1732800926?accountid=28903

Gartner. (2011). Gartner customer 360 summit. Retrieved August 12, 2017, from https://www.gartner.com/imagesrv/summits/docs/na/customer-360/C360_2011_brochure_FINAL.pdf

Gartner. (2020). Building more profitable customer relationships. Retrieved from https://www.gartner.com/imagesrv/summits/docs/na/customer-360/C360_2011_brochure_FINAL.pdf

Gullett, J., Do, L., Canuto-Carranco, M., Brister, M., Turner, S., & Caldwell, C. (2009). The buyer–supplier relationship: An integrative model of ethics and trust. *Journal of Business Ethics, 90*(3), 329–341.

Hern, A. (2017). Amazon web services: The secret to the online retailer's future success. *Journal from the Guardian*. Retrieved from www.guardian.com

Ifrah, Q. (2016). The role of effective buyer supplier relationship on supply chain performance. Medium. Retrieved from https://medium.com/supply-chain-hubspot/the-role-of-effective-buyer-supplier-relationship-on-supply-chain-performance-9adb16a8d6ba

Isaksson, R. B., Gravari, R., & Johnson, M. (2015). The Crippled bottom line – Measuring and managing sustainability. *International Journal of Productivity and Performance Management, 64*(3), 334–355. http://dx.doi.org.proxydc.wrlc.org/10.1108/IJPPM-09-2014-0139

Jimenez-Jimenez, D., Martínez-Costa, M., & Sanchez, R. C. (2018). The mediating role of supply chain collaboration on the relationship between information technology and innovation. *Journal of Knowledge Management*. https://doi.org/10.1108/JKM-01-2018-0019

Kumar, D., & Rahman, Z. (2015). Sustainability adoption through buyer supplier relationship across supply chain: A literature review and conceptual framework. Retrieved from www.researchgate.net/publications/28005669

Kraljic, P. (1983). Purchasing must become supply management. *Harvard Business Review, 61*(5), 109–117.

Kurnia, H. W., & Wahjudono, D. B. K. (2015). Buyer-supplier relationship analysis (a case study of C.V. CS). *Journal of Management Research of Macrothink Institute, 7*(4). http://dx.doi.org/10.5296/jmr.v7i4.7980

Li, Q., & Shen, B. (2016). Sustainable design operations in the supply chain: Nonprofit manufacturer vs. for-profit manufacturer. *Sustainability, 8*(7), 639. doi:http://dx.doi.org/10.3390/su8070639

MLJ. (2015). JD.com: Building a Chinese. Retrieved from www.rctom.hbs.org

Muellur, C. (2018). IOTA: Supply chain as a use case – Chris Mueller (aka IOTA SUPPORTER) – Medium. [online] Medium. Retrieved December 3, 2018, from https://medium.com/@iotasuppoter/iota-supply-chain-as-a-use-case-a2e5ac212e3f

Nidumolu, R., Prahalad, C. K., & Rangaswami, M. R. (2009). Why sustainability is now the key driver of innovation. *Harvard Business Review, 87*(9), 56–64.

Nguyen, T. T. H. (2017). Wal-Mart's successfully integrated supply chain and the necessity of establishing the Triple – A supply chain in the 21st century. Retrieved from http://cejsh.icm.edu.pl/cejsh/element/bwmeta1.element.cejsh-545ac8ef-f3fe-4d25-9947-7f1371f9f394

Patterson, K. A., Grimm, C. M., & Corsi, T. M. (2004). Diffusion of supply chain technologies. *Transportation Journal*, 5–23. Retrieved from Shibboleth Authentication Request, wwwjstor-org.proxydc.wrlc.org/stable/20713571?seq=1#metadata_info_tab_contents

Plambeck, E., Lee, H. L., & Yatsko, P. (2012). Improving environmental performance in your Chinese supply chain. *MIT Sloan Management Review, 53*(2), 43.

Ramanathan, U., & Gunasekaran, A. (2014). Supply chain collaboration: Impact of success in long-term partnerships. *International Journal of Production Economics, 147*, 252–259.

SCMR. (2017). *Supply Chain Management Review*. APICS and JD.com Expand Strategic Relationship. Retrieved from www.scmr.com

Seuring, S., & Muller, M. (2008). Sustainable supply chain management. *Journal of Cleaner Production, 16*. Retrieved from www.sciencedirect.com

Storey, J., Emberson, C., & Reade, D. (2005). The barriers to customer responsive supply chain management. *International Journal of Operations & Production Management, 25*(3), 242–260.

Terpend, R., Tyler, B. B., Krause, D. R., & Handfield, R. B. (2008). Buyer–supplier relationships: Derived value over two decades. *Journal of Supply Chain Management, 44*(2), 28–55.

Ulaga, W., & Eggert, A. (2006). Value-based differentiation in business relationships: Gaining and sustaining key supplier status. *Journal of Marketing, 70*(1), 119–136.

Vincent, B. (2018). With Amazon coming, Virginia schools look to boost computer education. *NBC News*. Retrieved from https://www.nbcnews.com/tech/tech-news/amazon-coming-virginia-schools-look-boost-computer-education-n94245

CHAPTER 6

The Road to Sustainable Transportation in Supply Chains: A Stage-Level Approach

Meena Hotak, Evelin Turcios, Divina Grace Dayrit, and Amit Arora

Abstract One of the prevailing concerns in the study of supply chains is the effect of the aggregate amount of greenhouse gas (GHG) emissions caused by transporting goods. The mode of transportation used, whether by air, road, sea or rail, creates harmful impacts in the environment, society and economy. Sustainable transportation aims to reduce these effects and, at the same time, provide efficiency on fuel use. This chapter delves into a literature review of scholarly articles to determine how companies can achieve and maintain transportation sustainability in the supply chain. This study addresses the following questions:

M. Hotak (✉) • D. G. Dayrit
University of the District of Columbia, Washington, DC, USA
e-mail: meena.hotak@udc.edu; divinagrace.dayrit@udc.edu

E. Turcios • A. Arora
School of Business and Public Administration,
University of the District of Columbia, Washington, DC, USA
e-mail: evelin.turcios2@udc.edu; amit.arora@udc.edu

A. Saxena Arora et al. (eds.), *Sustainable Innovation*,
International Marketing and Management Research,
https://doi.org/10.1007/978-3-030-30421-8_6

- Which mode of transportation has the least harmful effects on the environment, society and economy and is the most efficient in terms of fuel use?
- How can a stage-level approach aid in the process of implementing a sustainable transportation in the supply chain?
- What policies should a company implement to promote sustainable transportation internally and throughout its supply chain network?

Keywords Sustainable transportation • Supply chain • Freight rail • Intermodal • Stage-level approach • GHG emissions • Environment • Economy • Society

Introduction

Among the many concerns that have encouraged companies to pursue sustainability in supply chains, the amount of greenhouse gas (GHG) emissions accumulated over the years due to transportation is a huge driving factor. Since the rise of online shopping, road and air freight has inflicted high pressure on the transportation industry and its stakeholders. A high demand of getting products from point A to point B, as quickly as possible, has caused an extensive amount of activity in the freight transportation sector. Because of this, stakeholders are always vigilant regarding every single move that companies make, while companies pursuing sustainability are staying cognizant of their efforts and are thinking of ways to minimize GHG emissions.

Recently the Environmental Protection Agency (EPA) released a report about the trends of GHG emissions. Among the sectors included in the report, transportation is the largest offender of air pollution, which accounts for approximately 1854 teragrams (Tg) (1 Tg = 1 million metric tons) or 28.5% of the total carbon dioxide (CO_2) emissions for 2016. This percentage is then broken down by the GHG emission of each vehicle type: cars, light trucks and motorcycles (61%), trucks (23.3%), aircraft (2.2%) and freight railroads (2%) (EPA, 2018).

To minimize transportation pollution, the Association of American Railroads (AAR) stated that, on average, railroads are four times more fuel efficient than trucks. If only 10% of the aggregate merchandise that were moved by trucks were transported by rail, 1.5 billion gallons of fuel will be saved in a year. Railroad transportation will also minimize highway congestion, road wear and tear, and the stress to build expensive new highways (AAR, 2018).

Similarly, Masoud and Mason (2017) dispute the importance of having multiple modes of transportation in the supply chain. Based on the literature review, the authors found that intermodal transportation or the use of standardized containers that can be transferred to multiple modes of transportation may have a positive effect on integrated cost and contributes towards a sustainable supply chain.

Litman and Burwell (2006) shed light on the goal of sustainable transportation which is "to ensure that the environment, social and economic consideration are factored into the decision affecting transportation activity" (Litman & Burwell, 2006, p. 333). In fact, on their research, they address the negative effects of freight transportation on the economy, society and the environment. Among these are air and water pollution, traffic congestion and human health. Without considering the triple bottom line, companies are missing out on the true essence of sustainability.

These methods do not come as straightforward. They may bring challenges for managers, especially if the company is new to the idea of promoting sustainability. Golicic, Boerstler and Ellram (2010) suggest a stage-level approach of reducing carbon footprint in the supply chain. At the foundational level, a company sets up measurable goals and objectives and determines which suppliers or carriers is it compatible to work with. Level 2 involves educating employees on sustainability and reinforcing a company culture that places environmental awareness on one of its top priorities. Lastly, at level 3, a company takes significant actions that focus on reducing emissions supply chain wide and leveraging technology to increase efficiency.

Due to these claims, this chapter argues that to achieve and maintain sustainable transportation in the supply chain, companies must strategize from the ground up, not only to ensure a smooth and effective implementation, but also to make sure that it does not skip any of the three pillars of sustainability: environment, economy, society.

Literature Review

Transportation should be one of the priorities in the sustainability goals of a company. Almost every business has a product that needs to be transported from suppliers to the ultimate customers. If everyone in the company, including stakeholders, is involved in the process of using a more sustainable option, it would create a greater impact on decreasing the negative effects of freight transportation.

According to a study conducted in the National Institute for Transport and Logistics (NITL) by Evangelista, Sweeney, Ferruzzi and Carrasco (2012), the global economic crisis and the desire for a sustainable growth are increasing. The healthier usage of natural resources and sustainable transportation increases the possibility to develop a greener economy. The core idea of this is to find out a better way of implementation for companies, especially third-party logistics (3PLs), to minimize the negative environmental impacts caused by its transportation activities (Evangelista et al., 2012).

As a solution to the growing impact of freight transportation, AAR (2018) suggests the use of railroads. There are a variety of ways that railroad transportation use reduces fuel consumption and GHG emissions: acquiring new rail engines, increasing freight content, developing state-of-the-art computer systems, training, reducing idling and creating new technologies (AAR, 2018). There has been 104% improvement since 1980 and a 21% gain since 2000 in fuel efficiency which was achieved because of the technology embedded on rail transportation such as low-torque bearings, aerodynamic drag-reducing devices, green locomotives and advanced defect detectors. As of 2017, a ton of cargo can travel up to 479 miles using only a gallon of fuel (AAR, 2018).

A study by Ubeda, Arcelus and Faulin (2011) proposes changes in the logistics systems that would help reduce the negative impact in the environment. Some of the changes are improving delivery and route schedules, reducing the number of trips and developing an environmentally friendly method to solve routing problems. If companies apply at least one of these principles into their daily decision-making process, it would create a big difference on how transportation impacts the environment. For example, reducing the number of trips would help reduce the emissions caused by trucks. The less trucks on the road, the less harm it would cause to the environment. One company that applies this is Walmart. They have put sustainability in transportation as part of their decision-making process. Their goal is to deliver more while driving fewer miles. They partner with different vendors to make this possible (Ubeda et al., 2011).

Litman and Burwell (2006) add other suggestions to decrease transportation footprint on the supply chain. For instance, to decrease air pollution, companies should consider using alternative fuels that would be less harmful to the environment such as natural gas, biofuel and other non-fossil energy sources. When coming up with solutions, managers or those involved in the decision process should make sure that those solutions do not affect other environmental concerns. For instance, to help with

transportation sustainability, having electric trucks on the road would be more sustainable. However, in reality this would create other issues, such as radiation risks, thermal pollution and terrorist threats. For this reason, many should be involved in the planning and decision-making of sustainable transportation. Solutions should be made that would impact all the concerns of sustainability while also making sure that those solutions do not create other problems (Litman & Burwell, 2006).

Golicic et al. (2010) studied a sample of 44 companies pursuing sustainable transportation and examined the methods that they applied to attain their goal. A total of 11 transportation practices were being implemented by these companies, which were further summarized into three stages: establishing a foundation, changing company practices and impacting the supply chain (Golicic et al., 2010).

Figure 6.1 adapted from Golicic et al. (2010) illustrates the stages of reducing the supply chain carbon footprint which is composed of establishing a foundation, changing internal company practices and impacting supply chain practices. In Fig. 6.1, level 1 deals with establishing a foundation which incorporates goals for limiting transportation and logistics impact, measuring that impact using appropriate metrics/tools and

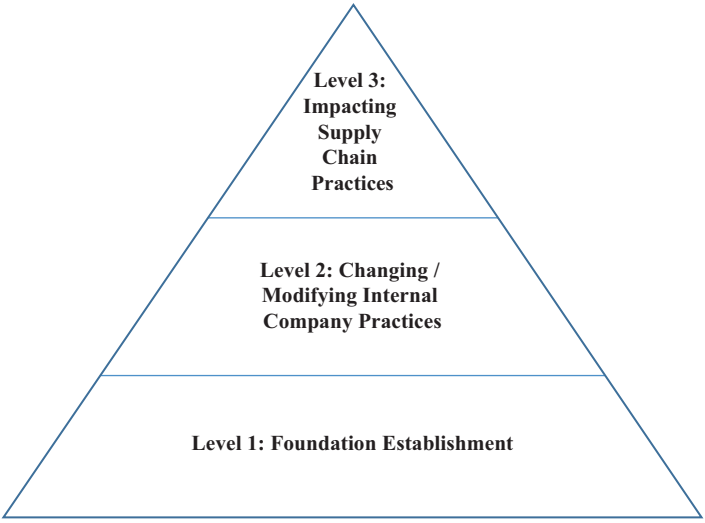

Fig. 6.1 Stage-level approach (Golicic et al., 2010) to implement sustainable transportation

building sustainable partnerships with other organizations pursuing sustainable practices. Level 2 focuses on managing ways to reduce environmental impacts and creating awareness within organizations through employees' training programs in sustainability and environment. Level 3 deals with high-level supply chain sustainability impact by impacting transportation, logistics and supply chains within organizations by decreasing fuel use, using environmentally friendly modes, reducing shipment volume, reducing/optimizing inventory levels and technology adoption for improving efficiency and effectiveness.

At the foundational level, top management sets up measurable goals and objectives, performs a cost-benefit analysis and determines which partners are they compatible to work with. By having measurable goals and objectives, the company will be able to monitor and translate their progress into dollars, as well as compare it with the industry's average performance. When choosing partners, it is important that their goals are in parallel with the company (Golicic et al., 2010).

Secondary level suggests that company practices be aligned with its goals on sustainable transportation. Starting with its own fleet of vehicles, the company must assess if these contribute to a sustainable transportation or not. Creating training programs that educate employees to go green is also a great way to steer the company toward its mission. Transportation allowances may encourage them to commute rather than drive to work. Lastly, the use of videoconferencing, instead of traveling for a meeting, saves the company on transportation costs and instills in employees an understanding of the harmful effects of air transportation (Golicic et al., 2010).

Once the company has gained strong support from top management and employees, it is then ready to proceed to level 3. This would include taking significant actions in the supply chain by aggressively decreasing fuel use, switching loads to more sustainable modes, investing on technology that reduces GHG emissions, increasing shipment efficiency and reducing shipment volume and lead times (Golicic et al., 2010).

Research Methodology: Case Studies

L'Oreal

L'Oreal is one of the companies that is making moves toward sustainable transportation in the supply chain. In 2017, freight trucks remain to be the largest contributor of environmental footprint for L'Oreal with an

estimate of 60%, followed by 37% in air cargo. Due to this, the company has committed to decrease its supply chain transportation emissions by 60% through 2020 and 25% by 2030. Currently with about 70,000 products worldwide, the company faces an enormous challenge to pursue its sustainable transportation efforts in the coming years (Cosgrove, 2018). How can L'Oreal achieve its goal?

The company plans to follow best practices for a greener transportation which includes reducing reliance on air freight and adopting an intermodal transportation by leveraging rail and sea freight and converting alternative vehicles for city deliveries. L'Oreal also adjusted its supply chain transportation strategies by shifting as much volume as possible from air freight to a more sustainable mode of transportation. It has also reduced cost and doubled down on efficiency and execution (Cosgrove, 2018).

However, L'Oreal failed to earn the organization's support before engaging in aggressive actions to reduce its carbon footprint. The company's supply chain standards and prospective director, François-Régis Le Tourneau, explained that the most important element in making the upgrades to alternative fuels is internal buy-in (Cosgrove, 2018). From here, we can see that the company fell short on levels 1 and 2 of the stage-level framework. Without the needed support from top management and employees, as well as a lack of understanding and learning not only within the company but also throughout its supply chain network, L'Oreal will have difficulties in sustaining its goal to reduce emissions from its supply chain transportation.

Ryder System, Inc.

Ryder System, Inc. (Ryder), on the other hand, has been successful in achieving and maintaining a sustainable transportation in its supply chain. Ryder is a third-party logistics (3PLs) company dedicated to support businesses in achieving a greener supply chain through advanced vehicle technology solutions and alternative sources: electric power, natural gas and hydro-powered vehicles. Ryder's sustainable line of transportation services was made possible due to a strategic partnership with electric vehicle manufacturers such as Chanje, creating the first ever nationwide leasing and rental fleet of electric vehicles. This partnership exists to provide modern transportation solutions, at the same time minimizing fuel costs, exhaust and noise pollution by shifting last mile delivery to electric means (Business Wire, 2018).

Ryder's goal is to create a broad range of zero-emission light, medium and heavy duty commercial vehicles for rent, lease and sale. Their goal became clear and uncontested because of the training programs created for its employees highlighting the value of zero-emission vehicles. Every year, Ryder's management travels across ten cities in the US and Canada to educate their employees about the importance of their innovation practices and the reason for investing on such. Because of these and of many other efforts, Ryder was recently awarded the 2018 Green Fleet Award for driving new technologies for environmental sustainability (Business Wire, 2018).

Apart from monitoring its own carbon footprint, Ryder also looks after the impacts that it has made on its clients. Willow Run Foods, a small egg delivery company and one of Ryder's long-term clients, has been saving $100,000 and reducing 50 tons of carbon footprint every year by leasing 15 compressed natural gas vehicles from Ryder (Ryder, 2015). By using our stage-level approach framework, we can see that Ryder has made their goal possible because of a strong foundational and internal understanding (levels 1 and 2) to support its mission of reducing its supply chain carbon footprint (level 3).

Subaru

Third-party logistics are not the only business models that should help in decreasing the negative environmental effects. Other companies such as auto manufacturers should also decrease the activities that impact the environment negatively. For instance, Subaru which has an automotive assembly plant in Lafayette, Indiana, threw all of its waste to zero-landfill (zero-landfill means the reuse or recycling of 98% of all potential waste). Subaru took the initiatives to go zero-landfill in 2004 by using Kaizen—continuous improvement philosophy. The company is celebrating another milestone of achieving zero-landfill and for being a leader in green manufacturing through its sustainable automotive assembly plant (Markham, 2015).

For all business operating companies, waste means money but a stage-level approach of reducing waste will maximize or positively affect the bottom line gradually. As an example, when Subaru estimated that the zero-landfill program would cost $7.5 million in a year, the company also received $11.5 million of financial benefits, making it a win-win situation (Markham, 2015).

Subaru is not satisfied to keep only its own operations lean, clean and green. It also has a leading role in teaching other business companies such as Whole Foods and Raytheon with no cost on how to go zero-landfill. Subaru is not only a developing auto assembly plant inside, it is a responsible company on the outside too. It is the only US company to be designated a Backyard Wildlife Habitat by the National Wildlife Federation, because its facility is a sanctuary for wildlife including deer, bald eagles, coyotes and many more (Markham, 2015). Indeed, Subaru went above and beyond in their actions toward sustainability, impacting the triple bottom line: environment, economy and society.

Managerial Implications

Although many studies were found for supply chain sustainability, only a few of them focus primarily on transportation. Most of the articles fail to cover the three pillars: environment, economy and society, which are important to achieve sustainability in its full potential. This chapter aims to fill these gaps to help business owners, operations and supply chain managers in finding ways to achieve and maintain a sustainable transportation in the supply chain.

- Business owners must plan which mode best suits their needs and at the same time contributes to their commitment to sustainability. Freight rail has the least harmful effects on the environment, society and economy (AAR, 2018). Intermodal transportation is also an environmentally friendly and cost-effective way of moving products to consumers (Masoud & Mason, 2017).
- A stage-level approach will help a company in the process of establishing its goals toward sustainability. By doing this, managers will ensure a smooth and effective implementation and they will be able to cover the three pillars of sustainability: environment, society, economy (Golicic et al., 2010).
- Supply chain managers must work with sustainable-oriented suppliers and prioritize their engagement. By establishing a culture of shared understanding with employees and partnering with suppliers that have similar practices when it comes to sustainability, the impact would be enormous (Golicic et al., 2010).

Conclusion and Future Study

Transportation drives development. It links people, connects local communities to the world, builds markets and facilitates trade. In turn, sustainable transportation can drive sustainable development. Therefore, deciding which mode of transportation to use and what policies to implement are crucial in achieving a company's goal on sustainability.

In our research, we have found out that freight rail (AAR, 2018) and an intermodal transportation (Masoud & Mason, 2017) are not only fuel efficient, they are also cost-effective and minimize traffic congestion.

In addition, we have also learned that a stage-level approach would help a company accomplish its sustainable transportation goals in a more effective manner (Golicic et al., 2010). By establishing a foundation, changing internal company practices and impacting supply chain practices, managers will be able to figure out what mode of transportation best suits their needs, which suppliers or carriers they should work with and how to keep track of their performance to ensure successful and continuous improvement.

Although we have found few companies who have reached their goal on sustainable transportation based on a stage-level approach, our research relies heavily on evidence-based observation. It is still necessary to conduct a quantitative or an in-depth study to further support the usefulness and accuracy of the model.

References

A.A.R. (2018, June). Freight railroads help reduce greenhouse gas emissions. Retrieved from https://www.aar.org/data/freight-railroads-help-reduce-greenhouse-gas-emissions/

Business Wire. (2018, October 18). Ryder receives 2018 green fleet award for driving new technologies for environmental sustainability. Retrieved from https://www.businesswire.com/news/home/20181018005936/en/

Cosgrove, E. (2018, October 4). Want a more sustainable supply chain? L'Oreal says avoid air freight. Supply Chain Drive. Retrieved from https://www.supplychaindive.com/news/Why-L-Oreal-avoids-air-freight-emissions/538652/

Evangelista, P., Sweeney, E., Ferruzzi, G., & Carrasco J.C. (2012). Green supply chains initiatives in transport and logistics service industry: An exploratory case study analysis. *National Institute for Transport and Logistics.* Retrieved from https://arrow.dit.ie/cgi/viewcontent.cgi?article=1064&context=nitlcon

Golicic, S., Boerstler, C., & Ellram, L. (2010). Greening transportation in the supply chain. *MIT Sloan Review*. Retrieved from https://sloanreview.mit.edu/article/greening-transportation-in-the-supply-chain/

Litman, T., & Burwell, D. (2006). Issues in sustainable transportation. *International Journal of Global Environmental Issues, 6*, 331–347. https://doi.org/10.1504/IJGENVI.2006.010889

Markham, D. (2015). Subaru celebrates 10 years of zero landfill manufacturing. Retrieved from https://www.treehugger.com/corporate-responsibility/subaru-celebrates-10-years-zero-landfill-manufacturing.html

Masoud S., & Mason, S. (2017). Assessing the cost impact of multiple transportation modes to enhance sustainability in an integrated, two-stage, automotive supply chain. *Informatics*. Retrieved from https://www.mdpi.com/2227-9709/4/4/34

Ryder. (2015). Willow run foods and Ryder: Case study. Pdf. Retrieved from https://ryder.com/-/media/ryder/ryder-global/…/case-study_willow-run-foods.pdf

U.S. E.P.A. (2018, April 12). Chapter 2: Trends in greenhouse gas emissions. Retrieved from https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2016

Ubeda, S., Arcelus, F., & Faulin, J. (2011). Green logistics at Eroski: A case study. *International Journal of Production Economics, 131*, 44–51. https://doi.org/10.1016/j.ijpe.2010.04.041

CHAPTER 7

Coaching, Agility and Sustainable Leadership

Christophe Bacouël

Abstract Today, executives are struggling with how to lead best in a volatility-uncertainty-complexity-ambiguity (VUCA) world. This calls for leadership agility and agile organizations, implicating change. Studies found that a key force leading to meaningful change is leadership sustainability. The purpose of this chapter was to examine the relevance of coaching to the advancement of leadership in changing working environments. Coaching has become popular in the context of leadership development and change in complex environments. Despite its widespread use, little evidence describes the necessity and impact of coaching. Furthermore, the emergence of agile organizations might call for novel leadership styles. This chapter proposes an emerging model of sustainable leadership as a function of coaching and the agile organization.

Keywords Coaching • Sustainable leadership • Agility

C. Bacouël (✉)
Insights Learning & Development France, Paris, France

A. Saxena Arora et al. (eds.), *Sustainable Innovation*,
International Marketing and Management Research,
https://doi.org/10.1007/978-3-030-30421-8_7

Introduction

Coaching is a fast-growing global industry as evidenced by a considerable increase in coaches, professional coaching organizations and coaching-related research (Dunlop, 2017). While there is evidence about the positive impact of coaching on coachees and their organizations, less attention has been paid to the interaction of the individual (coachee), the organizational context and the coach (Turner & Hawkins, 2016). For instance, Stober and Grant (2006) call for more research on the impact of coaching at both individual and organizational levels.

While the coaching of leaders, the so-called executive coaching, focused in the mid-twentieth century primarily on 'remediation for derailing executives' (Carey, Philippon, & Cummings, 2011, p. 52), it then moved toward an executive development purpose helping leaders to develop competencies that enhance their capacity to understand and distinguish their own feelings, manage their own behavior and manage relationships (Carey et al., 2011).

Today, executives are struggling with how best to lead in a volatility-uncertainty-complexity-ambiguity (VUCA) world (Horney, Pasmore, & O'Shea, 2010). This calls for leadership agility and agile organizations. Agility provides actionable strategic guidance. Agile organizations have established a shared vision and purpose such that collaborators feel personally and emotionally engaged in their work, behave entrepreneurially and actively participate in refining the strategic direction of the organization (McKinsey & Company, 2017).

The focus of the research presented here is on sustainability leaders who can be described as individuals who are compelled to make a difference by deepening the awareness of themselves in relation to the world around them (Visser & Courtice, 2011). By elaborating on the impact of leadership coaching in agile working environments an emerging model of sustainable leadership will be proposed.

The Particularities of Executive Coaching

The coaching of employees in leadership positions is a highly individualized form of leadership development and focuses on developing the coachees' full potential by coaching them 'to think and act beyond existing limits and paradigms' (Bawany, 2018, p. 54).

The topics of accompaniment of the leader are numerous. Leaders have to identify their strengths and areas of development; examine their behavior impact on others; and reflect on their values, goals and effectiveness. This leads to continuous renewal and evolvement of their self (Bawany, 2018).

Mintzberg (2013) claims that leadership is a vocation. This call to engage, to help and to guide others finds its source in childhood, in the schoolyard or the playground. From childhood on, one's personal experiences lead one to wake up to one's preferences, joys, deficits and fears. According to psychotherapist Alice Miller (1997), the leader and the coach have a point in common in that they are generally *hurt children*. Both experienced an early lack in the relationship with others and acquired a unique way of being by developing social and interpersonal skills to fill this lack. Therefore, the leader and the coach have a specific ability that intuitively calls them to help people bring out the best of themselves. However, someone's shortcomings surface and claim their due often in the second half of life (Halbout, 2013). Thus, an early lack that has allowed the leader to develop behavior to succeed at the beginning of his/her career can later become an obstacle in their leadership exercise at the highest function. When accepting the hypothesis of the leader being a hurt child then healing should come through personal work on one's self. This is where the coach's and the leader's path cross.

Coaching Toward Working on One's Own Self

One development theme of the leader with his coach is his vision of the world. However, the perception of the leader is subjective as the reality is filtered by his senses, his beliefs, his culture. Therefore, the leader, accompanied by the coach, must become aware of the prejudices and injuries accumulated during his life as those influence and limit his perceptions. Jung (2001, p. 111) states that 'we cannot live the afternoon of life according to the program of life's morning, for what was great in the morning will be little at evening and what in the morning was true, at evening will have become a lie'. In the exercise of power, the leader can be assisted to learn to know himself better, to avoid projecting his legitimate fears, to gain confidence and to develop his awareness of being and to act. It allows him to tame his shadow and open up to the world. In the process of individuation, the leader gradually opens to consciously integrate, through successive stages, the contents of his unconscious.

The coaching allows the leader to take better care of himself and the people in his charge by developing his sensitivity, transcending his fears and better serving his collaborators. If the leader does not work on himself (beliefs and representations) with a coach, there is a risk of transferring his projections on others (members of his team, his peers and his hierarchy) with possible detrimental effects.

Evaluating and Interpreting Reality to Transform Situations

Korzybski's (1933) map–territory relation ('The map is not the territory'—page 58) describes the relationship between an object and its representation and concludes that people tend to confuse models of reality with reality itself. Watzlawick (1980) has defined two levels of realities: the territory is the first-order reality and the map the second-order reality representing the simplification, the interpretation or the work of the cartographer. To understand one's self, the leader needs to be understood by some other. To be understood by some other, he needs to understand this other (Watzlawick, 1980). When analyzing situations, the coach always starts from the leader's reality which is second-order. Thus, coaching helps the leader to perceive his reality differently. Reframing can change the perception of the subjective reality of a situation and consequently change its meaning. This will allow the leader to develop new options for change (Watzlawick, 1980).

The Quality of Being and Exemplarity of the Leader

The development of being is at the heart of coaching and giving meaning to action is necessary to find the reason for being. Thus, for the leader, Being precedes Doing which itself precedes Achieving. The order of things is essential. Effective leadership of others requires the leader to have good personal insights such as an awareness of one's own personal thoughts, feelings and behavior (Gill, 2002). Coaching has been shown to increase such insights (Grant, 2007). The leader is expected to display a number of principles and qualities, ethical and behavioral, which he may wish to discuss with his coach: how to be credible, courageous, responsible, effective, authentic, honest, exemplary, and so on.

Placing the Benevolent Intention Before Action

Intention is also at the heart of coaching. The meetings between the coach and the leader are animated by a benevolent intention. Therefore, *benevolent coaching* is a combination of 'accompaniment, guidance, and committed support and availability' (Loignon & Boudreault-Fournier, 2012, p. 1194) arising out of a flexible approach and an in-depth understanding of the leader's conditions and social context. This allows the leader to exchange safely, recharge and accumulate energy. The benevolent intention of the coach is at the heart of the emotions of the leader, and helps to raise his level of consciousness, developing the self-esteem and esteem of others, which in turn engenders a benevolent intention of the leader himself.

Creating and Anchoring the Vision

Developing a vision and embodying values are also at the heart of coaching. The creation of a vision can be facilitated by freeing his creative ability. To support the process of creating the vision, the coach trains the leader to work in awareness and, thus, to develop his confidence in order to formulate and anchor an inspiring vision.

Coaching Aiming at Developing the Leader's Intuition

For Bergson (1999), intuition can give access to the absolute as opposed to the rational or scientific intelligence whose vocation is to think matter. Intuition is the only way to truly know the mind. Coaching will help the leader develop his intuition and become aware of his limiting thoughts. He will increase his faculty of observation, distinguish more nuances and collect more information, enriching his subconscious and his intuition.

Principles of the Agile Organization

Since the late 1990s, the framework of agility has changed the way operations run. Originated in software development, agility came up with a set of values and practices based on lean thinking. While lean focused on eliminating waste, providing value to customers and individuals taking ownership over how they work, agility added the aspects of team-based structure and iterative delivery (Breyter & Narayanan, 2017). Agility is the ability of

an organization to quickly develop and implement flexible and dynamic skills. It relies on four basic principles:

Priority to people and interactions means promoting dialogue, creativity and time savings instead of focusing on processes and tools. By giving decision power to those (individuals and teams) who perform the actual work, market- or customer-related issues can be met fast (Breyter & Narayanan, 2017).

Priority to customer needs and features focuses on outcome (instead of output) management. Self-guided teams embedded in a learning culture are able to recognize and react to a fast-changing environment and innovate to serve new customer demands (Gothelf & Seiden, 2017).

Priority to collaboration with clients leads to the delivery of an operational product of good quality because it is often tested and responds to the real needs of customers as regularly submitted to their opinion.

Priority to adaptability and changes over following plans by the adoption of an iterative and incremental cycle allows the team to adapt to the context and changes during a project (Breyter & Narayanan, 2017).

Agility enables continuous improvement and superior financial indicators. Agile companies are worth more than their reference industry group. They have higher earnings per share, with higher net margins. Return on assets is higher and revenue growth is higher than comparable businesses (Holbeche, 2018).

An Emerging Model of Leadership, Coaching and Agile Organization

Agility makes innovation the business of all employees. Trusting the intelligence of employees who know best what to do is an essential quality of the leader. Agility promotes great freedom of action for employees and managerial innovation redistributes power and leadership in the organization. The agile organization is instrumental in providing a framework for leaders to develop and exercise more humanistic leadership (see Fig. 7.1).

Executive coaching and the agile organization help make leadership more humanistic and effective. The development of coaching in organizations allows leaders to be able to exert more influence and to spread more quickly a leadership culture that will itself be strengthened within the framework created by the agile principles that promote the implementation of innovation and change. The topics of coaching are adapted to the reality of the accompanied leader.

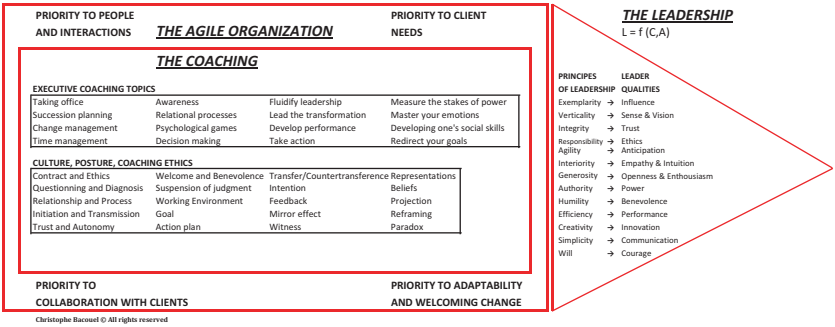

Fig. 7.1 Leadership as a function of a coaching and agile organization

The model above uses examples of leadership coaching topics, coaching methods, leadership principles (or values) and leader qualities (or skills) as they can be defined by an organization, for example. Here, leadership (L) is a function (f) of executive coaching (C) and agile organization (A): L = f (C, A).

The *leadership principles* are based on the values of the organization and guide the intention and the behavior of the leader to exercise effective leadership for the employees and the organization. The *leader qualities* derive from the leadership principles and correspond to the skills expected of the leader in his/her action to achieve objectives and exercise responsibilities. As an illustration, the principle of 'exemplarity' of the leader allows him/her to exert an 'influence' on his/her organization and the external environment; the principle of 'verticality' allows him/her to be a bearer of 'sense' and to define a mobilizing 'vision' for the organization; or the principle of 'integrity' allows to generate 'trust' of his/her interlocutors and to grant this 'trust' to stakeholders.

The model is flexible and adaptable to each organization in form and content. It is an example based on the culture, values and skills of an organization and its leaders. It allows the leader to define his leadership principles (values and culture) and the expected leader qualities (skills). The establishment of an agile organization and/or a coaching program of its leaders will facilitate leadership sustainability through the achievement of the objectives of the various stakeholders.

Conclusion

The aspiration of leaders toward a humanistic and efficient leadership is important. Sustainable leaders adopt new ways of seeing, thinking and interacting that result in innovative, sustainable solutions (Visser & Courtice, 2011). Coaching and agility in organizations can help the leader achieve this aspiration. The principles of agility in the organization provide a framework for prioritizing flexibility and human interaction to foster dialogue, creativity, speed in decision-making and experimentation, while removing unnecessary processes. The essential goals of agility are to focus on transparency and innovation to redistribute leadership, power, trust and autonomy to managers and employees in the organization so that the leader can focus on his/her core mission of deploying effective leadership to his peers, employees and shareholders.

The coaching will help the leader to know himself better, to adapt his behavior to others, to communicate in a conscious way, to develop a method of analysis of systems and organizations, to develop a culture of good acting and performance. This requires the leader to:

- Act well for himself because the act of presence to oneself is a prerequisite for any presence to another
- Develop a clear intention of immaterial performance within a framework of inspiring values because immateriality is the source of material performance
- Develop a vision and values that make sense
- Cultivate enthusiasm, harmony and cohesion within teams
- Listen to his employees to help them progress and develop their autonomy (Getz, 2011)

References

Bawany, S. (2018) Coaching of NextGen Leaders. Leadership Excellence, 4, 54–57. Retrieved from: https://www.hr.com/en/magazines/leadership_excellence_essentials/april_2018_leadership/coaching-of-nextgenleaders_jfi7jv1q.html

Bergson, H. (1999). *The creative mind: An introduction to Metaphysics.* Indianapolis: Hackett Publishing Company.

Breyter, M., & Narayanan, D. Z. (2017, October–December). Lean Enterprise: Using agile and lean practices to transform organizations. *Workforce Solutions Review*, 9–16.

Carey, W., Philippon, D. J., & Cummings, G. G. (2011). Coaching models for leadership development: An integrative review. *Journal of Leadership Studies, 5*(1), 51–69.

Dunlop, C. W. (2017). The success and failures of the coaching industry. Forbes Coaches Council. Retrieved September 15, 2018, from https://www.forbes.com/sites/forbescoachescouncil/2017/10/05/the-success-and-failure-of-the-coaching-industry/#9c95d076765f

Getz, I. (2011). Leader of the free culture leadership. *Excellence Essentials, 28*(28), 5–5.

Gill, R. (2002). Change management – Or change leadership? *Journal of Change Management, 3*(4), 307–318.

Gothelf, J., & Seiden, J. (2017). *Sense and respond: How successful organizations listen to customers and create new products*. Boston, MA: Harvard Business Review Press.

Grant, A. M. (2007). Enhancing coaching skills and emotional intelligence through training. *Industrial & Commercial Training, 39*(5), 257–266.

Halbout, R.-M. (2013). Coacher, ça s'apprend? In F. Bournois & T. Chavel (Eds.), *Le livre d'or du coaching*. Paris: Eyrolles.

Holbeche, L. (2018). *The Agile Organization: How to build an engaged, innovative and resilient business*. London: Kogan Page.

Horney, N., Pasmore, B., & O'Shea, T. (2010). Leadership agility: A business imperative for a VUCA world. *People & Strategy, 33*(4), 32–38.

Jung, C. G. (2001). *Modern man in search of a soul*. London; New York: Routledge.

Korzybski, A. (1933). *Science and sanity. An introduction to non-Aristotelian systems and general semantics*. Lakeville: The International Non-Aristotelian Library Pub. Co.

Loignon, C., & Boudreault-Fournier, A. (2012). From paternalism to benevolent coaching. *Canadian Family Physician, 58*(11), 1194–1195.

McKinsey & Company. (2017). How to create an agile organization. Survey. Retrieved September 15, 2018, from https://www.mckinsey.com/business-functions/organization/our-insights/how-to-create-an-agile-organization

Miller, A. (1997). *The drama of the gifted child*. New York: Basic Books.

Mintzberg, H. (2013). *Simply managing: What managers do – And can do better*. San Francisco: Berrett-Koehler Publishers.

Stober, D. R., & Grant, A. M. (2006). *Evidence based coaching handbook*. Hoboken, NJ: John Wiley & Sons, Inc.

Turner, E., & Hawkins, P. (2016). Multi-stakeholder contracting in executive/business coaching: An analysis of practice and recommendations for gaining maximum value. *International Journal of Evidence Based Coaching and Mentoring, 14*(2), 48–65.

Visser, W., & Courtice, P. (2011). Sustainability leadership: Linking theory and practice. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1947221

Watzlawick, P. (1980). *The invented reality: How do we know what we believe we know?* New York: W. W. Norton & Company.

CHAPTER 8

Innovation in Employee Selection: Tracing the Use of Hugo Münsterberg's Test for Motormen

Nicole Cannonier

Abstract Hugo Münsterberg pioneered innovative employee assessment techniques to improve safety in the electric railway industry. His experiments with motormen or trolley operators in the United States shed light on employee testing relating to workplace safety and employee well-being. This chapter charts the development of Hugo Münsterberg's selection test for motormen within the United States. It traces the test's life-cycle from its beginning at Boston Elevated Railway Company to its use at Dallas Consolidated Electric Street Railway and Milwaukee Electric Railway and Light Company. This chapter draws on archival correspondence, conference proceedings, published articles, and texts to map the course of Hugo Münsterberg's test for motormen. The conclusion reached in this chapter is that Münsterberg's test, although enlightening in its design and purpose, was too much in its infancy to draw definite conclusions

N. Cannonier (✉)
College of Business Administration, Savannah State University, Savannah, GA, USA
e-mail: cannoniern@savannahstate.edu

A. Saxena Arora et al. (eds.), *Sustainable Innovation*, International Marketing and Management Research,
https://doi.org/10.1007/978-3-030-30421-8_8

about its efficacy. Field trials at Dallas Consolidated Electric Street Railway and Milwaukee Electric Railway and Light Company show his test successfully eliminated accident-prone motormen during the employee selection process in some instances. His railway simulation method also influenced the designs adopted by other test developers who advanced occupational testing in the electric railway beyond Hugo Münsterberg's death in 1916.

Keywords Selection test for motormen • Innovation • Psychological testing • Hugo Münsterberg • Design thinking • Railway safety

Introduction

Businesses view innovation as a necessary driver of profit, market share, and sustainability. To evolve, companies must innovate to align themselves with the needs of their stakeholders (Wong, Tjosvold, & Liu, 2009). Companies are both proactive and reactive in their innovations. In the latter, companies may innovate due to losses associated with core business practices, products, materials, and services (Ettlie & Reza, 1992). Work dangers, resulting in injury, fatality, downtime, and equipment damage or loss all hurt bottom line financial performance. Innovative practices such as Total Quality Management (TQM) and Business Process Reengineering (BPR) provide a means to isolate safety factors that impede work efficiency and increase costs. Further, design thinking allows companies to align their efficiency and cost-reduction goals with those of employee and public safety. Design thinking is 'a disciple that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity' (Brown, 2008, p. 86). Hugo Münsterberg designed a train simulation exercise to assess the fitness of motormen (also referred to as trolleymen and trolley operators) and facilitate employee selection decisions.

The railway industry in the early 1900s was especially unsafe for motormen and their passengers. Railroad records often point to poorly built railcars and the underutilization of traffic signals as the cause of many injuries, collisions, and derailments (Aldrich, 1997). Hugo Münsterberg, however, focused on the operator of the trolley as a source of accidents. His working hypothesis was that hiring operators who were less prone to accidents would reduce crashes and derailments. Münsterberg's contribution to work process efficiency, occupational safety, and employee well-being

was the creation of an experimental design to test and differentiate individuals based on their ability to operate a trolley safely.

The Safety Institute of America in 1915 awarded the Boston Elevated Railway Company the Brady Medal for safety among electric railway carriers in the United States. It was the first award of this medal. It celebrated the achievements of the American electric railway company that did the most during that year to ensure the health and safety of its workers and the public (Boston Elevated Railway Company, 1914). At the time of the award, the company had achieved a remarkable zero fatalities and 952 injuries from train accidents (Boston Elevated Railway Company, 1914). The carrier had aggressively pursued accident prevention through mechanical and human safeguards with much success. It is with the latter that this study is concerned. Operators of these large, fast-moving, potentially dangerous machines were a focal component of safe train operation and warranted investigation. Boston Elevated Railway Company invited Hugo Münsterberg, then head of the psychology department at Harvard University, to develop a psychological test to aid in this matter. Münsterberg proposed to answer this question: Can a psychological test identify a safe train operator who could anticipate danger, resist distraction, keep attention constant, and make quick actions to avoid or mitigate the effects of an accident (Münsterberg, 1913)? The test and its results helped win Boston Elevated Railway Company the Brady Medal.

In 1911, Hugo Münsterberg published *Psychologie und Wirtschaftsleben* (Psychology and Economic Life). The true impact of this text was felt when it appeared in English in 1913 under the title *Psychology and Industrial Efficiency*. In it he detailed his pioneering work to improve the safety of streetcar motormen at Boston Elevated Railway Company and demonstrated the economic value of using such tests to reduce accidents. This publication provided initial guidance for evaluating motormen, also referred to as motormen and trainmen, in the United States. It was the first of its kind to discuss in any detail a way to assess the mental fitness of motormen. Münsterberg believed psychological assessments could reveal characteristics of a job candidate that would make him more likely act in an unsafe manner. This chapter traces the development and application of this test from its conception at Boston Elevated Railway Company to attempts to replicate it at Dallas Consolidated Electric Street Railway and Milwaukee Electric Railway and Light Company. The findings call the test's efficacy into question. Its contribution to establishing early parameters for constructing psychological tests for motormen, however, is well established (e.g. Arnold,

1966; Burnham, 2009; Hale, 1980; Viteles, 1932; Weiss and Lauer, 1930). Unfortunately, Münsterberg's untimely death in 1916 made further refinement of the test impossible.

Safety Legislation Takes on the Unsafe Rails

At the time of Münsterberg's publication on motormen, the public had just begun to consider traffic safety a social concern (Weiss & Lauer, 1930, p. 11). Only 12 years prior had Congress passed the Accident Report Act that made companies report train accidents that caused injury or loss of $150 or more (Aldrich, 2006). Publication of these statistics brought considerable attention to rising deaths and injuries on the rails. The coverage by periodicals reporting on these tragedies was more pervasive than it had been in the 1800s. It tended to vilify rail carriers, referring to them as murderers, slaughterers, and butchers (Aldrich, 2006). In many instances, periodicals cast the blame for these accidents on railway managers and owners (Aldrich, 2006). The campaign for further railway legislation was hard fought and the effects not immediately discernible. A yielding regulatory system and insufficient oversight still allowed violators sufficient latitude and incentive for evasion (Somers & Somers, 1953).

The campaign for greater safety legislation gained momentum in the early 1900s with the passage of several new laws. In March of 1907, trainmen could no longer work more than 16 hours per day, where previously they worked upward of 20 hours (Aldrich, 2006). In 1908, mounting union pressure helped eliminate the fellow servant rule (Aldrich, 2006). Since its inception in 1842, the doctrine made it easy for railway owners to deny liability in accident suits. Employees who were injured because of a fellow worker's negligence were not compensated for their injuries by the employer (Brown et al., 2002). In addition, courts denied liability in those cases where employers could show their workers accepted the risk or were themselves somewhat culpable (Fishback & Kantor, 2000, pp. 2–6). Without protection from the fellow servant rule, accidents cost companies more. In the same year, an employee compensation law was approved by Congress. It later spawned an outpouring of state-governed compensation laws that extended coverage to non-federal employees (Lubove, 1967). By 1910, the second Accident Report Act passed into law. It required carriers to report their injuries and fatalities to the Interstate Commerce Commission (ICC), not just train accidents (Aldrich, 2006). It gave further reach to the ICC, allowing federal investigation of train accidents (Aldrich, 2006).

Casualties on the Railway

Hugo Münsterberg had the first occasion to use his selection test in 1911 during the early beginnings of the US safety movement.[1] By then, the upswing in economic activity had brought a considerable increase in accident rates despite mechanical enhancements to trains. Fatality rates among train workers 'jumped one-third, from 0.67 in 1897 to as high as 0.92 per million manhours in 1907' (Aldrich, 2006, p. 182). In the latter year, 7.98 per 1000 trainmen lost their lives in an accident (Aldrich, 2006). Deaths and injuries associated with streetcar accidents were fewer but still devastating. From 1910 to 1912, there were 5664 deaths from streetcars compared to the 23,782 from the railroad (United States Department of Labour, 1915). Although the job of a motorman bore a high degree of risk, 'the tradition was strong that you [the employee] "just naturally" paid a price in blood and suffering for any kind of job that was worth doing, whether it was building a bridge, making steel, running a railroad, or punching out buttons for the garment trade' (Roche, 1951, p. 15).

There were several train accidents involving railway employees that may have suggested motormen were the cause. Safety engineers advised that with all possible allowances made for faulty machinery, unsafe worker practices accounted for the majority of accident cases (Williams, 1919). In 1902, to recoup lost time, the Stockton Flyer sped along the tracks before colliding with the rear end of the Owl. The Owl remained stationary on the track because of mechanical trouble, and a relay message to the Stockton Flyer did not transmit. The crash killed 27 (Mollenkopf, 1982). In 1906, the Washington DC Terra Cotta train wreck injured 50 and claimed 53 lives because due caution was not taken in managing rail traffic on a foggy night (The Evening World, 1906). In very similar circumstances, the Quebec and Boston Air Line Express collided in one of the worst wrecks on record in New Hampshire's history; 25 died in the crash (Cannon Reporter, 1907).

[1] Somers & Somers (1953) identified two dates. First is the National Safety Council, which credits the beginning of the 'modern' safety movement to the formation of the First Cooperative Safety Congress in 1912. Second is two events occurring in 1907: the appointment of the first professional to a safety committee at the Association of Iron and Steel Electrical Engineers and the holding of a safety exhibit at the American Museum of Natural History in New York City, which eventually grew into the American Museum of Safety.

The Economics Behind Railway Accidents

Accidents cost organizations relatively little in terms of injury compensation. Surveys taken in the early twentieth century showed that just half the families who lost a member in a fatal accident received compensation valued at one year's earnings; many families received far less (Fishback & Kantor, 2000, pp. 37–38). From 1908 to 1910 the average employee payout for a railroad accident was $70 for a temporary disability, $1296 for a permanent partial disability, and $1157 for a death (Aldrich, 2006, p. 191). These payouts may have done little to comfort or offer security to victims and their families. They did, however, erode the profits of rail carriers. As an example, the Philadelphia Rapid Transit Company for eight years ending in 1910 paid 6.08 percent of its gross earnings in accident claims (Wilcox, 1921, p. 270). Yet the costs associated with damaged railcars and railway lines may have been the true impetus for seeking safety improvements. Electric streetcars cost carriers several thousand dollars. In 1906, a 44-seat streetcar cost a Buffalo electric railway company $7000 (Dickson, 1915). Railway companies were interested in pursuing new practices that could control accident-related costs by improving motorman safety. Hugo Münsterberg had one of the first opportunities to conduct an investigation of this kind at Boston Elevated Railway Company.

Hugo Münsterberg: The Applied Psychologist

Hugo Münsterberg was born on June 01, 1863, in the city of Danzig, Germany (Münsterberg, 1922). He was one of four boys born to Mortiz and Ann Münsterberg (Münsterberg, 1922). Münsterberg earned an M.D. degree in 1887 from the University of Heidelberg and a Ph.D. in experimental psychology from the University of Freiburg in 1885 (Benjamin, 2000). He began as an unsalaried lecturer at the University of Freiburg after graduation and was promoted shortly thereafter to a rank equivalent to associate professor in the United States (Benjamin, 2000). Münsterberg's success in running his own laboratory in Germany prompted Professor William James of Harvard University to invite him to head its psychology laboratory (Münsterberg, 1922). His accomplishments at Harvard soon earned him the highest salary ever paid at the university (Arnold, 1966).

Münsterberg developed an interest in the study of human behavior at work. W.H. Arnold referred to him as the only eminent scientist of his time willing to risk his reputation on the 'grim and often unglamorous business of industrial management' (Arnold, 1966, p. 20). His approach demonstrated the value of applying experimental principles to industrial problems. They served, firstly, to find men who were mentally fit to perform a particular job; secondly, to determine the psychological conditions that support optimum performance; and, lastly, to influence the mind of the worker to produce consistently good performance (Viteles, 1932, p. 42). In this manner, Münsterberg pioneered the field of industrial psychology (Arnold, 1966). His 'prodigious prestige' made him well known within the business community, and many companies sought after him to assist with their employee selection processes (Arnold, 1966).

Development of a Motorman Selection Test at Boston Elevated Railway Company

Boston Elevated Railway Company was the first carrier to express an interest in having Hugo Münsterberg assist with its motorman selection procedure. The company had long been a pioneer in railway safety (Slocombe & Bingham, 1927), but like other railway carriers, it had experienced several expensive accidents involving motormen. On March 01, 1912, the American Association for Labour Legislation (AALL) brought psychologists and representatives of street railway companies together to discuss motorman accidents.[2] Mr. Martin J. Insull of the Louisville Northern Railway and Lighting Company in Albany, Indiana, brought the issue before the AALL. Insull had himself endeavored to find a valid method to aid employee selection (Blake, 1922). He had a particular interest in what he termed the 'man failure' of electric motormen (Blake, 1922). It is in this capacity that Insull introduced the matter to Hugo Münsterberg. He hoped that Münsterberg and other like-minded individuals could be brought together by AALL to address accident rates among electric railway operators.[2]

[2] Correspondence from the Secretary of the American Association for Labor Legislation (AALL) to Hugo Münsterberg dated February 10, 1912, inviting him to a meeting concerning the use of psychological tests with motormen. Retrieved from the Kheel Center for Labor Management Documentation and Archives, AALL collection, #5001mf, reel7.

Several possible causes of these accidents were discussed at the meeting. Fatigue, performance, and accident time of day were all deemed important factors, but the participants gave greater weight to understanding the mental constitution of motormen (Münsterberg, 1913, pp. 63–64). Of the psychologists present, Münsterberg gained access to an operating railway carrier to test the suitability of trainmen. He felt the gravity of the problem warranted laboratory investigation although this problem was new for experimental psychologists.[3] Only two years prior had something of this kind been attempted by Münsterberg's student, Charles Sherwood Ricker, with chauffeurs (Blatter, 2015).

Differences could be discerned between motormen who experienced few accidents and those who were prone to them. Carriers claimed that some of their motormen experienced few accidents because they were adept at anticipating danger (Münsterberg, 1913, p. 64). Those who were less skillful experienced an inordinate number of mishaps on the railway. Münsterberg investigated this assertion using the Boston Elevated Railway Company's experienced and less experienced motormen. This allowed him to determine whether 'the mental makeup of the man predisposed him to cause or to prevent accidents' (Münsterberg, 1912, p. 2). The time taken to react to a perceived danger could determine the fate of those involved. He observed, however, no characteristic differences in reaction time for motormen with few and frequent accidents (Münsterberg, 1913, p. 65). Men retained by the carrier had quick reaction times; those with slow times were terminated (Münsterberg, 1912, p. 13). As the investigation revealed, even the best motormen at Boston Elevated Railway Company did not have extremely rapid reaction times (Münsterberg, 1912, pp. 3–4). Given this finding, reaction time was treated as a non-factor in determining accident proclivity (Münsterberg, 1912, pp. 3–4). Other criteria were considered and dismissed as necessary. A factor such as sharpness in vision was foremost in detecting obstacles, signal lights, pedestrians, and animals along the roadway, but it too was evaluated during the hiring process and not considered in Münsterberg's study (Münsterberg, 1913, p. 65). He, therefore, excluded reaction time and vision strength from his analysis of motormen (Münsterberg, 1913, p. 65).

[3] Report by Hugo Münsterberg to the American Association for Labor Legislation (AALL) describing his work with motormen at Boston Elevated Railway Company dated May 25, 1912. Retrieved from the Kheel Center for Labor Management Documentation and Archives, AALL collection, #5001mf, reel7.

Münsterberg's Selection Test for Motormen

Münsterberg believed mental processes, which he related to attention, affected an operator's ability to sense and react to potential dangers on the roadway. Therefore, he constructed a device through which he could measure attention. He created an artificial likeness of the motorman's streetcar and work environment within his laboratory. Streetcars were passenger trains operating on rails in the center of a street. They operated by electric overhead wires (Propp, n.d.). A conductor worked at the rear of the car, while the motorman sat at the front, controlled the entrance and exit doors, and operated the streetcar (Bregger, 2008, p. 16). From his seat, the motorman's duty was to collect and deliver passengers to their destination without incident. Instead of creating a replica of the train on the street railway, Münsterberg wished to create test conditions that would 'awaken in the man the same subjective feeling which he has in doing his work' (Münsterberg, 1912, p. 4).

After several failed attempts using complicated instruments, Münsterberg settled on using a simple test. It involved a small moving conveyor belt that drew obstacles into a subject's view through a glass window in a black wooden box (Münsterberg, 1912). Obstacles appeared on cards displayed through the window of the box. Figure 8.1 presents a model of what this apparatus may have resembled (Viteles, 1932, p. 290). The test subject assumed the role of the trainman operating his streetcar. His ability to identify objects that presented a serious threat to the streetcar determines the score on the test.

There were 12 cards used in the device, each card representing a street. The cards were nine and a half by twenty-six and a half inches and divided into twenty-six equal squares (Münsterberg, 1913, p. 69). In the center of the card appeared a double-lined column that symbolized a railway line. It divided the 26 squares equally on either side of the central column. Within this column were letters of the alphabet, one stacked above the other, from A to Z. Each square represented a point along the streetcar's path where potential danger could be placed. The test subject was to discern whether those objects presented a clear and present danger to the train and its occupants. The objects represented pedestrians, horses, and automobiles. These were coded with the numbers one, two, and three in the colors red and black and placed on the cards (Münsterberg, 1912, p. 4). Table 8.1 further describes this coding. The dangerous cards were those with red numbers. Subjects had to discriminate between red numbers to

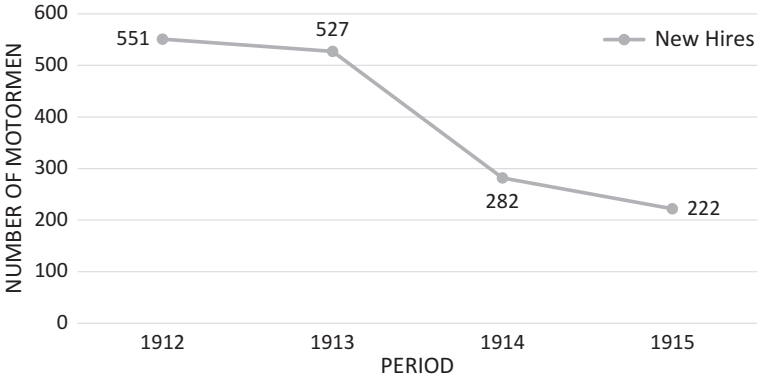

Fig. 8.1 New motorman hires, Dallas Consolidated Electric Street Railway

Table 8.1 Codes used in Hugo Münsterberg's test for the selection of motormen

Digit color	*Threat severity*	*Number*	*Object*	*Speed of movement*
Black	Non-threating: Object runs parallel to train, does not approach it	**1**	Pedestrian	Moving the distance of 1 step from one square to another
Red	Threatening: Object moves from either side of the train toward train tracks	**2**	Horse	Moving the distance of 2 steps and is twice the speed of the pedestrian
		3	Automobile	Moving the distance of 3 squares and is thrice the speed of the pedestrian

estimate the speed of the object and assess its risk to the train by its placement within one of those 26 squares. Münsterberg explained the dangers subjects perceived during the test.

A red digit 3 which is four steps from the track is to be disregarded, because it would not reach the track. A red digit 3 which is only one or two steps from the track is also to be disregarded, because it would pass beyond the track, if it took three steps. But a red 3 which is three units from the track, a red 2 which is two units from the track, and a red 1 which is one unit from the track would land on the track itself, and the aim is quickly to find these points (Münsterberg, 1912, p. 6). The test performance of

subjects established criteria for differentiating motormen based on attention level. Münsterberg examined the scores of well-trained motormen and those who were newer to the service. These scores established the parameters for acceptable and unacceptable performance. Candidates who made more than 20 mistakes were to be excluded outright for subpar performance. If the candidate made fewer than 20 mistakes, a formula was to be applied. It required multiplying the number of omissions by ten and adding to that product the number of seconds taken to complete the test. The results were as follows: Scores 'above 350 were considered very good … From 350–450 may be counted as fair, 450 to 550 as mediocre, and over 550 as very poor', with allowances made for older motormen (Münsterberg, 1912, p. 15, 1913, pp. 79).

Boston Elevated Railway Company adopted the motorman selection test as part of its aggressive campaign to address its safety issues. The test provided data that could be used in accident prevention (Boston Elevated Railway Company, 1914). Like other railway companies in the United States, existing methods of education, persuasion, and selection were no longer helping the company meet its safety goals (Burnham, 2009, p. 70). In 1914, when the Boston Elevated Railway Company won the Brady Medal, it had done so in part for the mental test developed by Hugo Münsterberg. Along with the test, the company assigned more inspectors to supervise motormen, conducted a 'safety-first' campaign with school children, instituted safety committees, and developed personnel policies regarding intoxication (Boston Elevated Railway Company, 1914). For the year ending June 30, 1914, the company had reduced its turnover of 'blue-uniformed men' from 2380 to 1166 or a remarkable 50.5 percent compared to the year ending March 31, 1912. This increased retention resulted in 52 percent fewer employees needing to be hired during the same period. In addition, the number of accidents declined despite an increase in trips and train passengers. There were 25.3 percent fewer accidents in July 1914 compared to July of the preceding year (Boston Elevated Railway Company, 1914).

The test developed at Boston Elevated Railway Company was one of the first to set psychological parameters for evaluating employees in the United States. Münsterberg was adamant, however, that his test was in its infancy. It required several attempts at replicating the study to further refine the test (Münsterberg, 1912, p. 15). When Münsterberg published his book *Psychology and Industrial Efficiency*, many learned for the first time of its existence (Burnham, 2009). It piqued the interest of

psychologists and businesspeople alike (Hale, 1980). There is no record to suggest Münsterberg continued to pursue selection tests with motormen after his stint at Boston Elevated Railway Company. His untimely passing in December of 1916 while delivering a lecture at Radcliffe College prevented his further engagement with motorman research (Associated Press, 1916). But there were some who attempted to make use of his motorman test.

Test Replication at Dallas Consolidated Electric Street Railway Company

Safety-first initiatives took root amongst many of the street railway companies across the United States in the early 1900s. Accident avoidance soon became a principal concern of these railway carriers (Burnham, 2009). In May of 1916, *The Electric Railway Journal* published several conference papers on streetcar motormen.[4] It is here that Mr. Gerhardt, superintendent of transportation at the Dallas Consolidated Electric Street Railway, reported his results using Hugo Münsterberg's selection test.

Among all the railway companies, traditional methods of selection were declining in their efficacy. At Dallas Consolidated Electric Street Railway, its existing methods removed 80 percent of its applicant pool from further consideration. Candidates were no longer considered if physically disabled, repulsive in appearance, dirty in dress, overweight, too young or too old, too short or too tall, or showing signs of disease or excessive tobacco and alcohol use (Gerhardt, 1916). The remaining 20 percent underwent psychological tests; these encompassed attention, observation, and judgment. To decipher among the remaining candidates, scientific principles were becoming essential in most accident reduction initiatives (Burnham, 2009).

Gerhardt described what many rail carriers were struggling with at the time—'the elimination of the unfit applicant before he is placed on the car as a trainman' (Gerhardt, 1916, p. 943). Of the three tests used at Dallas Consolidated Electric Street Railway, only two were Münsterberg's. The first test administered to a candidate was an attention test. Although it carried the same name as the test used at Boston Elevated Railway Company, this attention test evaluated the ability to receive and follow instructions. The second test was an observation test. This was Münsterberg's psycho-

[4] Southwestern Electrical and Gas Association conference in Galveston, Texas, held May 17–20, 1916.

logical test developed at Boston Elevated Railway Company. With few adaptations, the test remained mostly unchanged. Gerhardt's test used four numbers instead of three; the fourth number represented a fire apparatus or jitney. It made use of color-coded squares in red and green to express the urgency of the danger. Münsterberg's original test used white squares and red and black digits to communicate the same. The third test administered to the candidates was a judgment test. It was another of Münsterberg's tests that he created for selecting sea captains; it too was adapted by Dallas Consolidated Electric Street Railway for use with its motormen (Gerhardt, 1916). This test measured a candidate's ability to react appropriately when presented with complicated situations.

The Dallas Consolidated Electric Street Railway achieved dramatic results with these tests. Figures 8.1 and 8.2, respectively, show substantial declines in the number of new hires and improved retention rates across the period 1912 to 1916. This by Gerhardt's (1916) estimate may have saved the company anywhere from $25 to $75 per operator in hiring and training costs. With these tests, the railway company selected candidates who were more likely to be successful in the motorman position. Consequently, fewer motormen vacated their positions or had to be terminated. As fewer vacancies needed to be filled, resources that were once dedicated to employee selection and training could be directed elsewhere.

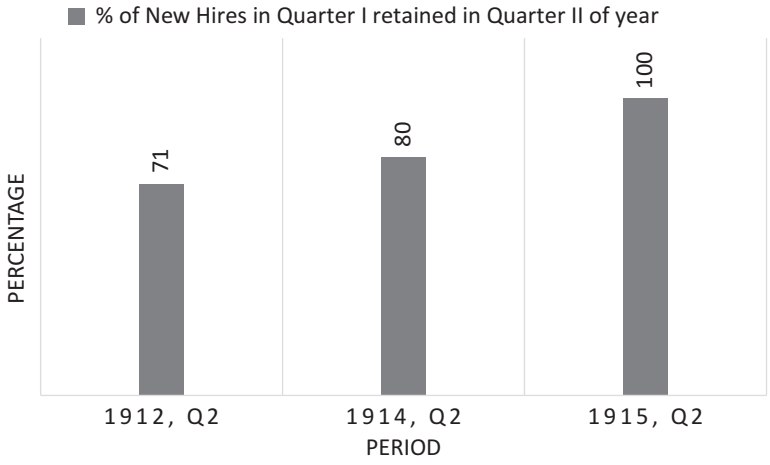

Fig. 8.2 Retention rates among motormen, Dallas Consolidated Electric Street Railway

Test Replication at Milwaukee Electric Railway and Light Company

Shortly after Münsterberg's research was published, attempts were under way at Milwaukee Electric Railway and Light Company to replicate the test with its motormen. The company was seeking to reduce its volume of accidents involving its motormen with this new test. What is known of its testing results was shared by Morris Viteles, then professor of psychology at the University of Pennsylvania (Sheehy et al., 1997). He had in 1920 developed his own series of tests at the company for the same purpose (Viteles, 1925, 1932). Viteles was never privy to the results involving Münsterberg's test. Therefore, he had no firsthand knowledge of its success or failure. What Viteles (1925, 1932) conveys, however, suggests Münsterberg's test was not well received at the Milwaukee Electric Railway and Light Company. He explains that 'the sentiment among the officers of the company was decidedly against further experimental work with this test' (Viteles, 1925, p. 173).

Viteles found Münsterberg's test inadequate for selecting safe motormen (Viteles, 1925). This he reasoned was a sound basis for not starting his research where Münsterberg left off. That his test resembled Münsterberg's acknowledges that he viewed the test as not altogether misguided. This similarity, however, Viteles insists, was fortuitous (Viteles, 1925). The principal challenge to Münsterberg's approach was that he focused too narrowly on the abilities needed to operate a train safely. In addition to maintaining constant attention, Viteles assessed the muscular response to rapidly changing stimuli (Viteles, 1932). This, he believed, was necessary for any test professing to make a valid differentiation between individuals based on proneness to accidents (Viteles, 1925). More specifically, his test addressed vision efficiency, reaction time, auditory response, and distraction (Schmidt, 1937).

Conclusion

In March of 1912, an informal gathering of parties interested in reducing accidents involving motormen met in Boston.[5] It was there that a suggestion by the American Association for Labour Legislation to try a few

[5] Correspondence from the Secretary of the American Association for Labor Legislation to Hugo Münsterberg dated February 22, 1912, providing particulars (time and possible

psychological tests on motormen led Hugo Münsterberg to develop the earliest scientific test for motorman selection in the United States (Viteles, 1932, p. 288). The innovative test design gave candidates a real sense that they were operating a streetcar while making decisions that might influence its safe passage. Münsterberg considered the problem of accident-prone motormen to be one of attention; the problem involved the inability to regulate one's attention, resist distraction, and foresee possible dangers (Münsterberg, 1913).

In 1913 when Münsterberg published his findings on motormen there was an urgent need to curtail trolley accidents on the electric street railways. It was estimated that no more than 25 to 33 percent of accidents could be averted using safety devices or mechanical safeguards alone (Williams, 1919). Making inroads toward solving the problem meant improving the quality of individuals selected to be motormen. The poor decisions of some motormen had cost street railway companies as much as 13 percent of their gross income and 50,000 per year in indemnity cases (Münsterberg, 1913, pp. 63–64). Burnham (2009) suggested that prior to Münsterberg, managers had attempted to find a solution to this problem. They implicitly tried to isolate those human factors that might classify a person as accident-prone. They did so, however, without the guidance of scientific principles that Münsterberg utilized in his test. Scientific management was gaining ground at this time. It offered a new way to examine the practical problems of work and causes of accidents. To Münsterberg's disappointment, Frederick Taylor's scientific management ignored the psychological considerations inherent in the 'labor problem' (Hale, 1980, p. 150). It was these considerations that concerned Münsterberg most. He dedicated the latter part of his career to bridging the divide between laboratory research and real-world application (Benjamin, 2000).

Münsterberg's selection test for motormen provided preliminary guidelines for reducing accidents. The perception that psychological tests could assist with workplace problems was becoming more favorable. Business owners and psychologists took great interest in the test and what it could potentially do to reduce street railway accidents. Walter Dill Scott (1913) applauded Münsterberg for devising simple tests to solve economic problems. His motorman test eliminated the need to evaluate candidates in the

attendees) of a two-day meeting concerning the use of psychological tests with motormen. Retrieved from the Kheel Center for Labor Management Documentation and Archives, AALL collection, #5001mf, reel7.

field. Candidates needed to put themselves in the frame of mind used to operate the trolley while in the simulation exercise. This test design meant candidates could be assessed in less time and still undergo a valid test of attention. These advantages were appealing to railway owners as they economized on selection costs.

Münsterberg's work at the Boston Elevated Railway Company was part of a larger safety campaign under way at the company. The test provided data relevant to accident prevention on their street railways and, among other efforts, helped secure the company the Brady Medal for safety improvements in 1915. Münsterberg (1913) concluded that 'an experimental investigation of this kind which demands from each individual hardly 10 minutes would be sufficient to exclude perhaps one-fourth of those who are nowadays accepted into the service as motormen' (p. 81). It is unclear, however, whether the company continued to use this test as part of its selection process for motormen.

This chapter's investigation of Münsterberg's test for motormen revealed that there was limited application of the test in the United States. Since its development at Boston Elevated Railway Company, it was used at two railway carriers.[6] The test performed well in isolating accident-prone motormen in one case but not the other. Results achieved at Dallas Consolidated Electric Street Railway were the most promising. In discussing his use of the test, the superintendent of transportation at the company acknowledged, 'It is gratifying to state that the tests so made bear out the theory to a remarkable degree' (Gerhardt, 1916, p. 945). The company reduced the number of new motorman hires by 60 percent between 1912 and 1915 and increased the average length of service for its motormen by 77 percent between November 1911 and April 1916 (Gerhardt, 1916). The validity of these results have been challenged, however. As noted by Viteles (1932), Gerhardt did not refer to the number of men tested at his company within any period, nor did he define the standard criteria used for selection. Goldman (1918) claimed that the test indirectly assessed intelligence and that it was intelligence that led a candidate to operate a train safely. That Gerhardt (1916) used two additional tests to assess the worth of a candidate supports Viteles' assertion that Münsterberg had too narrowly

[6] A review of published material on the topic revealed only the carriers discussed in this chapter within the United States. Viteles (1932) in his chapter on tests in the transportation industry mentioned another study claiming negative results done outside the United States by J. Fontègne. This study was not considered here.

defined the criteria for eliminating accident-prone candidates during the selection process. This discrepancy may account for the unfavorable results gained at Milwaukee Electric Railway and Light Company. The detailed findings involving the test were never published, but the carrier expressed its dissatisfaction with the test when it sought to develop new tests for the same purpose.

Hugo Münsterberg created a test aimed at reducing accidents among railway carriers. Its purpose was to provide these companies with a tool that could identify persons likely to cause accidents. It was a simple psychological test, but it was the first attempt to understand the mental process leading to sound decision-making among train operators. It provided a model that could be replicated or adapted for use in the workplace. Economic and social pressure to curtail railway accidents created a tremendous need for such a test. Many psychologists were still focused on developing and refining their theories and were reluctant to use their knowledge in the workplace (Goldman, 1918). Münsterberg was less cautious, however. He felt experiments concerning workplace problems were essential to theoretical advancements in applied psychology. His test to determine individual differences among motormen has been noted as one of the most important advancements toward the practical use of psychology (Goldman, 1918). The test received limited application after its conception, and Münsterberg's hypotheses were not always supported. Nevertheless, this chapter shows that the test itself may have done more to create a bridge between the laboratory and workplace than it did to reduce accidents involving motormen. Perhaps, this was the greatest achievement of all—advancing the adoption of psychological tests in the workplace.

References

Aldrich, M. (1997). *Safety first: Technology, labor and business in the building of work safety, 187–1939*. Baltimore, MA: Johns Hopkins University Press.

Aldrich, M. (2006). *Death rode the rails: American railroad accidents and safety 1828–1965*. Baltimore, MD: Johns Hopkins University Press.

Arnold, W. J. (1966). Measuring minds for the job. *Business Week*, January 29, pp. 2, 20–21.

Associated Press. (1916). German educator succumbs while conducting class at Radcliff. *The Cornell Daily Sun*, December 18, p. 10.

Benjamin, L. T., Jr. (2000), Hugo Münsterberg: Portrait of an applied psychologist, in Kimble, G. & Wertheimer, M. (Eds.), *Portraits of pioneers in psychology*, American Psychological Association, Washington, DC, Vol. 4, pp 113-130.

Blake, H. W. (Ed.). (1922). New methods in the selection of employees. *Electric Railway Journal, 60*(18), 696–732.

Blatter, J. (2015). Screening the psychological laboratory: Hugo Münsterberg, psychotechnics, and the cinema, 1892–1916. *Science in Context, 28*(01), 53–76.

Boston Elevated Railway Company. (1914). *Safety on the Boston elevated railway. Data presented to the American museum of safety in competition for the Anthony N. Brady memorial gold medal*. Boston, MA: Boston Elevated Railway Company.

Bregger, D. D. (2008). *Images of America: Buffalo's historic streetcars and buses*. Charleston, SC: Arcadia Publishing.

Brown, T. (2008, June). Design thinking. *Harvard Business Review*.

Brown, T., Huebner, T. S., Brown, R. B., Thompson, R. A., Vile, J, R., & Pierce, C. A. (2002). *A history of the Tennessee Supreme Court*. Knoxville, TN: University of Tennessee Press.

Ettlie, J. E., & Reza, E. M. (1992). Organizational integration and process innovation. *Academy of Management Journal, 35*(4), 795–827.

Burnham, J. C. (2009). *Accident prone: A history of technology, psychology, and misfits of the machine age*. Chicago, IL: University of Chicago Press.

Cannon Reporter. (1907). Twenty-five dead! Two score injured! In the worst wreck New Hampshire ever knew Quebec Express meets freight head-on. Retrieved January 15, 2015, from http://www.rootsweb.ancestry.com/~nhchs/Reporter/20Sep1907.html

Wilcox, D. F. (1921). *Analysis of the electric railway problem*. New York, NY: Afferton Press.

Dickson, E. J. (1915). Buffalo's railway facilities. *Electric Railway Journal, 45*(3), 135–136.

Fishback, P. V., & Kantor, S. E. (2000). *A prelude to the welfare state: The origins of workers' compensation*. Chicago, IL: University of Chicago Press.

Gerhardt, P. W. (1916). Scientific selection of employees. *Electric Railway Journal, 47*(21), 943–945.

Goldman, H. (1918). The applied psychology of Hugo Munsterberg. *Journal of Applied Psychology, 2*(2), 116–129.

Hale, M., & Jr. (1980). *Human science and social order: Hugo Münsterberg and the origins of applied psychology*. Philadelphia, PA: Temple University Press.

Lubove, R. (1967). Workmen's compensation and the prerogatives of voluntarism. *Labour History, 8*(3), 254–279.

Mollenkopf, J. (1982). The Byron rail disaster. *California History Magazine*, Vol. LXI, 292–301.

Münsterberg, H. (1912). *Untitled document. Microfilm*. Boston, MA: American Association for Labour Legislation.

Münsterberg, H. (1913). *Psychology and industrial efficiency*. Boston, MA: Houghton Mifflin.
Münsterberg, M. (1922). *Hugo Münsterberg: His life and work*. New York, NY: D. Appleton and Company.
Propp, G. (n.d.). Trolley types of Boston. Retrieved September 20, 2015, from http://www.bostonstreetcars.com/
Roche, J. M. (1951). *Safety and the foreman*. Chicago, IL: National Foremen's Institute.
Schmidt, E. P. (1937). *Industrial relations in Urban transportation*. Minneapolis, MN: University of Minnesota Press.
Scott, W. D. (1913). Review of the book *Psychology and Industrial Efficiency*, by H. Münsterberg. *Psychological Bulletin, 10*(7), 282–283.
Sheehy, N., Chapman, A. J., & Conroy, W. A. (Eds.). (1997). *Biographical dictionary of psychology*. New York, NY: Routledge Taylor & Francis Group.
Slocombe, C. S., & Bingham, W. V. D. (1927). Men who have accidents: Individual differences among motormen and bus operators. *Personnel Journal, 6*(1), 251–257.
Somers, H. M., & Somers, A. R. (1953). Industrial safety and health in the United States. *Industrial and Labour Relations Review, 6*(4), 475–496.
The Evening World. (1906). 53 Dead in train horror and 50 others injured; Five men under arrest. Retrieved January 15, 2015, from http://chroniclingamerica.loc.gov/lccn/sn83030193/1906-12-31/ed-1/seq-1/#words=Terra+Cofta+wreck+WRECK
United States Department of Labour. (1915). *Industrial Accident Statistics*. Bulletin No. 157. Washington, DC: Government Printing Office.
Viteles, M. S. (1925). Research in the selection of motormen: Part II. Methods devised for the Milwaukee Electric Railway and Light Company. *Journal of Personnel Research (Pre-1986), 4*(4), 173–199.
Viteles, M. S. (1932). *Industrial psychology*. New York, NY: W. W. Norton & Co.
Weiss, A. P., & Lauer, A. R. (1930). *Psychological principles in automotive driving*. Columbus, OH: Ohio State University.
Williams, S. J. (1919). Safety as the employment executive should see it. In *Industrial Management: The Engineering Magazine* (Vol. 57, pp. 501–503).
Wong, A., Tjosvold, D., & Liu, C. (2009). Innovation by teams in Shanghai, China: Cooperative goals for group confidence and persistence. *British Journal of Management, 20*(2), 238–251.

CHAPTER 9

Family Business Sustainability: The Intergenerational Transfer of Social Capital and Network Contacts

Fabian Bernhard, Miriam Hiepler, and François-Xavier Engel

Abstract This chapter explores how social capital influences the sustainability of family businesses over generations. In a volatility-uncertainty-complexity-ambiguity (VUCA) world, relationships and networks become more and more important. Although social capital is accumulated over time and not easily transmitted, its transfer to the next generation must be a top priority in every family business. A qualitative method of data

F. Bernhard (✉)
EDHEC Business School, Paris, France
e-mail: Fabian.Bernhard@edhec.edu

M. Hiepler
University of Siegen, Siegen, Germany
e-mail: Miriam.Hiepler@uni-siegen.de

F.-X. Engel
Lincoln International, Paris, France
e-mail: Francois-Xavier.Engel@edhec.edu

A. Saxena Arora et al. (eds.), *Sustainable Innovation*, International Marketing and Management Research,
https://doi.org/10.1007/978-3-030-30421-8_9

analysis was used to better understand the process and the mechanisms through which social capital and the firm's relationships are transferred in intra-family succession.

Keywords Social capital • Sustainable family business • Succession • Next generation

Introduction

Family-owned businesses (FOBs) are the most frequently encountered business models in the world accounting for nearly 70% of the global GDP (Osunde, 2017). In Europe, 14 million FOBs provide over 60 million jobs. In many countries, they account for 55% to 90% of all companies (KPMG Enterprises, 2015). Given these significant figures, the importance of FOBs in European economies is preeminent.

With Europe's aging population, more and more FOB leaders will retire in the coming years, making succession a relevant topic. In France, for instance, 20% of SMEs managers are 60 years old or older whereas they were only 13% in 2000 (Nougein & Vaspart, 2017). As a result, many FOBs will change hands in the next ten years. Because of the sustainable orientation of FOBs, the strong desire to preserve the family character of the business, to keep the control over the company within the family and to respect the legacy of previous generations, most of the incumbents intend to transmit the family business to younger members of the owning family (Deloitte, 2016).

A well-known challenge, however, is that only few FOBs succeed in their succession over time and ensure sustainable competent family leadership across generations (Le Breton-Miller, Miller, & Steier, 2004). Succession of ownership and management to the next generation is therefore one of the main concerns that FOBs face (Handler, 1992). It is a greater concern for FOBs than for nonfamily companies because the process includes more emotional elements, a higher potential for intergenerational conflicts and a smaller pool of talent on which to bet (Le Breton-Miller et al., 2004).

Although most of the family business leaders rank succession as one of the most important subjects on their minds, over 40% of them admit that they have not sufficiently prepared their succession during the past decade (Bhalla & Kachaner, 2015). However, poorly planned successions may

have severe consequences for the business. It has been observed that recurring causes of business failure come from "business incompetence" because of a lack of knowledge and preparation (Chirico & Laurier, 2008). Mazzola et al. (2008) and Sharma (2004) state that the successor must have developed some fundamental characteristics when he or she takes over the company, among which business and industry knowledge is often tacit (Cabrera-Suárez, De Saa-Perez, & Garcia-Almeida, 2001; Steier, 2001). The successor must also have developed several abilities, like decision-making and interpersonal skills (Chrisman et al., 1998). Equally important are not only the legitimacy and the acquired credibility from both family and nonfamily stakeholders (Barach et al., 1988; Steier, 2001) but also the networks and social capital (Steier, 2001).

Although family business succession across generations has been discussed in the literature for a long time (Sharma, 2004), little attention has been devoted to the transfer of social capital and networks across generations (e.g. De Freyman et al., 2006; Steier, 2001). Yet, many strategic advantages lie in the social capital and relationships that the firm has nourished and is able to keep over time (Steier, 2001). In the current new economy, much of the value resides indeed in business networks (Steier, 2001). Social capital is an asset which is not easily transferred, and Malinen (2001) highlights that the transfer of the tacit knowledge and networks of contacts is a central concern of incumbents. Consequently, the purpose of the present chapter is to answer to this need and to offer insights about the way social capital and networks outside of the firm can be transferred across generations.

Theoretical Background

We define a family-owned business (FOB) as "a business governed and/or managed with the intention to shape and pursue the vision of the business held by a dominant coalition controlled by members of the same family or a small number of families in a manner that is potentially sustainable across generations of the family or families" (Chua et al., 1999). Every transition process usually includes changes on the management level and changes on the ownership level (KPMG Enterprises, 2017). Our analysis focuses only on the change on the management level. The person transmitting the leadership at the top management position is called the incumbent whereas the member of the next generation onto whom leadership is being transferred is called the successor. We refer to successors who are family

members (by blood or by law). While in nonfamily businesses the management is separated from the leader's private life, in FOBs the systems of family and business overlap, and thus create unique challenges. In addition to the leadership, the successor must juggle his or her own goals with the values and objectives of the owning-family's aspirations (Bernhard, 2018; Bhalla & Kachaner, 2015).

Succession Process

It is important to understand succession in FOBs as a process rather than an isolated event (Handler, 1990), which needs to be planned long in advance (Lansberg, 1988; Sharma et al., 2001; Ward, 1987). Succession is indeed a complex process with four distinct phases (initiation, integration, joint reign and withdrawal) (Cadieux, 2007) during which the incumbent has to plan both equity transfer and the transfer of less tangible considerations like power, knowledge, skills, legitimacy and credibility to the successor (Le Breton-Miller et al., 2004; Mazzola et al., 2008). It is noteworthy to mention that the succession process is based on a mutual understanding between the incumbent intending to transmit leadership of the FOB and the (or more) successor(s) intending to take over (Cabrera-Suárez et al., 2001; Bernhard et al., 2017; De Freyman & Richomme-Huet, 2010). During this process, Handler (1994) outlines that the roles of the incumbent and successor evolve and adjust over time (see Fig. 9.1). The incumbent evolves indeed from the role of monarch over delegator to consultant whereas the successor evolves from helper over manager to leader.

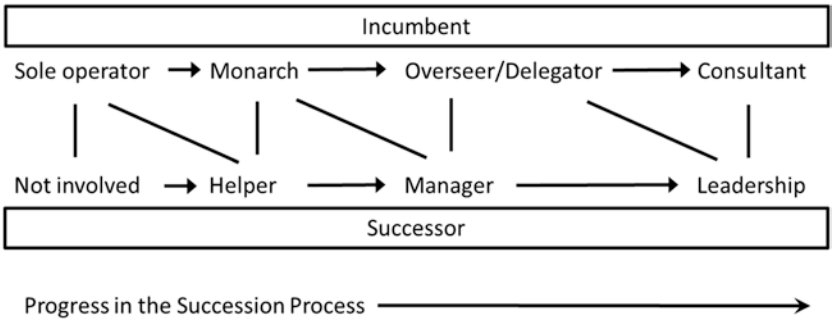

Fig. 9.1 Mutual role adjustment between predecessor and next-generation family member(s) (Source: Adapted from Handler [1994])

As emphasized by Handler (1994), the last two stages of this role transition are the most critical to effective successions. It is during these pivotal phases that a good preparation of the next generation becomes most apparent (Tatoglu, Kule, & Glaister, 2008).

An early start in the preparation of the successor to run the business is key (Bhalla & Kachaner, 2015; Nougein & Vaspart, 2017). On top of that, an early preparation enables the owning-family to protect themselves from unexpected incident hazards like illness or death of involved actors (De Massis et al., 2008). Lastly, it is important to ensure that potential successors have an early exposure to the business. Indeed, the sooner the successor gains experience with the business, the better the incumbent can help him or her to get familiarized with essential business elements and assist in a progressive transfer of tacit knowledge (Bhalla & Kachaner, 2015; Cabrera-Suárez et al., 2001; Goldberg, 1996; De Massis et al., 2008). An early exposure will indeed enable the successor to build relationships with key suppliers, lenders and customers; to build his/her credibility within the company and to understand the culture and insights of the family business (De Massis et al., 2008). Therefore, as suggested by Goldberg (1996), successors with extensive prior experiences within the FOBs tend to be more successful than late entrants.

Knowledge Transfer

Knowledge is a key strategic resource of FOBs. Some authors even quote it as the most valuable asset that a firm possesses (Chirico & Laurier, 2008). The effective transmission of this knowledge to the successor is therefore an important aspect in sustainable FOBs' succession (Cabrera-Suárez et al., 2001). Knowledge, which acts as an "enabler of longevity" (Chirico & Laurier, 2008), can be quickly defined as know-what, know-how, know-why and know-who (Malecki, 1997). Nevertheless, it is essential to differentiate between *pure knowledge*, that is, the theoretical principles acquired through education and academic courses, and *skills* (or tacit knowledge), which is the ability to carry out an activity by using and leveraging the accumulated pure knowledge (Chirico & Laurier, 2008). The former can be transmitted quite easily using text books, manuals and so on. The transmission of the latter to the successor is a greater challenge for FOBs because it is not tangible and highly personal, and it often needs to be experienced and practiced over time through training, face-to-face interactions, participation in activities and so on (Chirico & Laurier, 2008).

Although the pure knowledge acquired outside of the company is important, it is the sharing of inside knowledge which will ensure the next generation to understand the ins and outs of the business. Therefore, the large amount of firm-related tacit knowledge that the incumbent has accumulated over time (Lee et al., 2003) is a source of competitive advantage for the family business and the successor's ability to acquire the incumbent's key skills and network of contacts is one of the main challenges in the preparation of the next generation to take over the company to ensure its continuity and its competitive edge (Cabrera-Suárez et al., 2001). Malinen (2001) finds that the transmission of their tacit knowledge and networks of contacts to the successor was one of the main incumbent's concerns.

Social Capital Transfer

The literature emphasizes the importance of developing the successor's relationships with key stakeholders, essentially with the incumbent (Cabrera-Suárez et al., 2001; Goldberg, 1996; Venter et al., 2005) but also with other family members, employees of the company (Bernhard & O'Driscoll, 2011; Sieger et al., 2011) as well as key customers and suppliers. The accumulation of an FOB's social capital, also known as "relational wealth" (Steier, 2001), can become a valuable resource if managed properly (Adler & Kwon, 2002; Baron & Markman, 2000; Steier, 2001).

Social capital is defined as "the resources individuals obtain from knowing others, being part of a social network with them, or merely from being known to them and having a good reputation" (Baron & Markman, 2000). In a nutshell, social capital "involves the relationships between individuals and organizations that facilitate action and create value" (Adler & Kwon, 2002; Hitt & Ireland, 2002).

Adler & Kwon (2002) differentiate between two kinds of social capital, i.e. bridging and bonding. Bridging focuses on external relations, which are outside of the company, whereas bonding focuses on internal ties within the organization. Our analysis will concentrate on the bridging of social capital, that is, the creation and maintenance of external relationships of the family business. A specifically interesting aspect is the question of how these relationships can be transferred during an intra-family succession process.

Many authors acknowledge that social capital is an asset, which is accumulated over years and which cannot be easily transmitted (Adler & Kwon, 2002; Steier, 2001). Nevertheless, nowadays, much of the firm value does

not lie in physical capital but rather in intangible capital such as business networks (Steier, 2001). Indeed, abundant social capital is likely to lead to a better access to information, better cooperation, trust from others and easier access to economic resources such as loans, protected markets or investment tips (Baron & Markman, 2000; Nahapiet and Ghoshal, 1998; Steier, 2001). In their study, Adler & Kwon (2002) also point out that social capital strengthens supplier relations, regional production networks and interfirm learning. Social capital can thus offer many benefits for the FOB.

As every FOB is immersed in a specific social context, the involved actors are embedded in several preexisting relationships (Steier, 2001) and the ability to handle them is a top priority for the sustainability of the family business. Nevertheless, it is important to keep in mind that networks are not one-sided and that without reciprocity, the relationships will depreciate over time (Adler & Kwon, 2002). Although social capital is an intangible asset, the literature argues that it can be transmitted to the next generation. As every company is embedded in a social context, the incumbent is included in a vast network of preexisting relationships that the company has built over years (Steier, 2001). One of the main goals of the successor is to understand these various networks and become a full player within this social context.

Steier (2001) identifies four situations differing in the transfer of social capital to the successor: (1) sudden succession, (2) rushed succession, (3) natural immersion and (4) planned succession. Sudden successions often appear because of unforeseeable events such as the death of the incumbent (De Massis et al., 2008), whereas rushed succession happens when circumstances force both the incumbent and the successor to make rapid decisions about the future of the FOB, such as the serious illness of the incumbent (Steier, 2001). Natural immersion is a smoother way to transmit the FOB's social capital. In fact, the successor has time to gradually discover the network structure and relationships with key suppliers, key contacts and others. In this situation, the successor gradually starts expanding roles across functions over time, doing the incumbent's job, and he or she is gradually being transferred the decision-making power. In a planned succession, the incumbent recognizes the importance of the social capital for the FOB and makes a long-term effort to transmit the asset to the successor (Steier, 2001). Steier (2001) argues that the incumbent should first include the successor within his or her social capital, and then later let him or her make their own decision about the relationship they want to keep and/or develop.

Given the importance of social capital in family businesses (Adler & Kwon, 2002; Steier, 2001) and the relatively little attention given to the subject in the literature (Sharma, 2004), we focus on the transfer of social capital and social networks outside the firm to understand the processes through which FOB's relationships and networks are transmitted.

Empirical Study

Using an exploratory qualitative approach (Eisenhardt, 1989; Yin, 2014), the interviewees in the study were all members of the next generation, to whom the family business was transmitted by the previous generation. Every interviewee experienced a smooth gradual succession or natural immersion in the sense of Steier (2001). Most of the successors entered the business after studying and getting an experience outside of the company. Their initial motivations were quite different, but they started by acquiring a low-level or medium-level management position, and they gradually reached the upper echelons, getting more and more responsibilities to run the business. All of the interviewees have worked closely with the incumbent, who was in charge of the transfer of management across generations.

The interviews were held in French or German and then translated into English. The work of translation has been meticulously realized in order to avoid bias in the interpretations of the specificity of the language and context. At the beginning of each interview, general questions were asked about the business, the history of the family business, the shareholders and the processes through which the participants were transferred the family business. Then the interviewees were specifically asked questions about the FOB's various social networks and key relationships and the way by which these relational assets had been transferred to them.

The participants were identified through personal contacts. Four family businesses participated. During the initial contact, they were briefly explained the concept and the goal of the study. All but one agreed to schedule a slot for an interview. The one who did not accept reported a lack of time because the succession had just taken place. All the FOBs interviewed were operating in the food industry. The participants wished to remain unnamed, that's why they are anonymized and displayed by their participant index number (P_#).

FOB 1 produces Alsatian wine and markets it all over the world. The FOB was founded in 1865. Participant 1 (P_1) belongs to the fifth generation of the family business which he took over in 1999 from his father.

The company has changed a lot during the last 153 years. The incumbent reported that each generation is different and has played a part in the building of the family business.

FOB 2 is a Germany-based producer of food packaging founded in 1928. Participant 2 (P_2) represents the fourth generation of the family business and she took over the company in 2018, after joining it in 2009. Her father retired in 2009 and he hired an external CEO, because his daughter was not ready to handle a CEO position yet. During these last years, the contract of the external CEO was coming to an end, and it was decided that Participant 2 will take over.

FOB 3, founded in 1938, is an Alsace-based company producing Sauerkraut. Participant 3 (P_3) represents the fourth generation of the family business. Today the capital is equally divided between the four shareholders: the Participant 3, the participant's father, the participant's godfather and his cousin. Since the previous year, they operate under the "Pact Dutreil," which is a French legal plan to ease the patrimonial transmission, given that each of them engages to work in the company for the following six years. Today, the company is consequently run by these four shareholders, so the transmission is still in progress. In 2023, the family business is likely to be run by Participant 3 and his cousin.

FOB 4 is Alsace-based and specialized in the coffee roasting since 1926. Today, all the shareholders are within the family. Participant 4 (P_4) belongs to the third generation of the family business. His father was appointed Managing Director in 1977 and President in 1987. The participant entered the family business in 2003, after a career in the purchasing department of various companies, and he took the FOB's presidency in 2009, when his father retired. Participant 4 works with his sister, who is in charge of all the legal aspects regarding the family business (Table 9.1).

The transcribed interviews were coded, following an open-coding methodology (Strauss & Corbin, 1990). Key concepts were identified by making cross-transcript comparisons and organizing the data into distinct categories. Main focus was to identify the different steps through which the social capital was transferred to the next generation. The coding analysis was led by the interview protocol, which in a systematic way asked the participants about their own experience of succession, and especially the way they had received social capital. Similarities and differences of each process were compared, and the results were organized into broader and concrete categories. Existing concepts were used to offer a framework, explaining the whole process of transfer of external social capital across generations in family businesses.

Table 9.1 Profile of interviewees and their family business

	Company								
	Creation	*Industry*	*Entry*	*Taking over*	*Generation*	*Gender*	*Role*	*Age*	*Duration*
Participant 1	1865	Wine	1986	1999	5th	M	CEO	52	65 min
Participant 2	1928	Food packaging	2009	2018	4th	F	CEO	c.35	33 min
Participant 3	1938	Sauerkraut	2015	OP[a]	4th	M	Co-CEO	24	54 min
Participant 4	1926	Coffee	2003	2009	3th	M	CEO	40	59 min

[a]On progress

Research Findings

The findings section illustrates the importance of social capital within family businesses and identifies the key stakeholders engaged. Furthermore, the various steps through which social capital is transferred across generations, from the incumbent's introduction of the successor to the effective management of social capital, are highlighted.

The Importance of Relationships in FOBs

Overall, the participants of the study emphasized the importance of social capital to their family business, and each participant highlighted the significance of relationships in their day-to-day activities.

P_1: "Relationships are key in the business."

Social networks have consequently a high value in the eyes of the interviewed people because they bring a lot of benefits to the business. Social networks are relevant to get information, to get some help or advice in specific situations, to get new thoughts and new perspective on the business, and they are a way to expand the owned business.

P_4: "Beyond the quality of their products, it is the information we get through this network which matters."

When the participants were asked about the various social networks in which the family business was inserted, various important key networks were named. The given answers to social networks could be classified in the following groups: (1) customers and suppliers, (2) other entrepreneurs/family businesses, (3) family members, (4) employees and (5) others. All interviewees named the customers and suppliers. The participants emphasized the need to maintain good relationships with them.

Most of the interviewees stated other entrepreneurs/family businesses as key relationships. Interestingly, they are said to be also important in their day-to-day activities. For example, they can give a hand in specific situations, and they bring new ideas for business, a fresh look on how to do things, or new ideas on how the company should be run.

P_1: "For example, last month I needed an additional tractor and one other wine-grower lent me one." … "My father and I went to Australia in 1996 [to meet some wine-grower]. […] It was really interesting to observe another know-how."

They are an important source of information, which is why other entrepreneurs within the same industry are highly appreciated. Not rarely they share business intelligence, best practices, crucial information on the market, the economic context, materials, to each other.

P_4: "There are the networks with other entrepreneurs in order to exchange the best practices, the strength of each, information on suppliers, on machines."

In this vein, social capital is a way to bring a benchmark to the family business. As they have often built personal relationships beyond doing business together, a high level of trust is built between each other over the years. As a result, they offer benchmarking with trust to the family business.

P_4: "Benchmark, and benchmark with trust. The information coming from them are better."

Most of the interviewees stated to take part in various business organizations such as federations. These organizations enable them to meet new people, to pool and gather information about the market.

P_3: "It is essential to keep in touch with them [other entrepreneurs] in order to get some insights on the market, on the production, on the difficulties they encountered. For instance, it enables us to get information about the promotion which will be implemented."

Surprisingly, only few of the interviewees named the family as a key stakeholder. The ones who named it, however, highlighted the importance to have good relationships with those family members who are active in the family business. In some cases, some major decisions are taken in line with the family.

P_3: "Secondly, there are the internal relations between my father, my godfather, my cousin and me. It is essential to exchange, to share and to speak about what we are doing. If one calls a customer, it is important to tell the others what was said, what information we got and so on."

The employees were also named as a key stakeholder (Bernhard & O'Driscoll, 2011; Sieger et al., 2011). The importance of employees was emphasized because in numerous cases they are really attached to the family business, and the business owners often know them very well. It was important to know what the employees wanted and how to deal with them.

Finally, banks, lawyers and accounting companies were named by a few of them. It can be observed from the comments that they are more than "paid" relationships. The family business acts only as a customer and they were not regarded as being part of a social network per se. Nevertheless, these trustful relationships could also be important for getting information and support.

> *P_1: "I was introduced to the chartered accountant by my father. […] Once I took over the family business, we maintained a very good relationship together. I think he is the person who helped me the most. […] There was a time when he was nearly a co-manager because he had such an eye on the business that he could have replaced me for one month if needed (he laughs). I managed to entrust to him my worries, my conflicts with others. We had a mutual assistance."*

Transfer of Social Capital Across Generations in FOBs

From the insights gained from the interviews, four main stages were identified in the process of transfer of social capital across generations: (1) the *presentation* phase, (2) the *observation* phase, (3) the *integration* phase and (4) the *management* phase. In the following we will provide a more detailed overview of the identified phases.

Phase 1: Presentation of the successor During this phase, the role of the incumbent is to introduce and familiarize the successor with the firm's social capital. In every transmission of social capital, the first step is the successor's introduction to the FOB's stakeholders. The presentation phase marks the first time the successor is included within the firm's social capital, in which resides a vast network of preexisting relationships. In each of our cases, the presentation of the successor to key relationships took place before the actual taking over. It is an occasion for the family's stakeholders to put a face to a name of the successor, that is, to meet the one who they will deal with, and to note that the future of the family is insured because a successor was found. From the successor's perspective, it is a good way to meet and understand the different FOB's stakeholders and

social networks. Most of these presentations took place gradually over time. One interviewee noticed that these presentations started at a very young age, before he even entered the family business and chose his way.

P_1: "Since I was a teenager, my father presented me to the customers, to the suppliers, to various stakeholders as the successor of the business."

According to him, it enables the incumbent to give another dimension to the family business because it is a good signal that its tradition and heritage will be perpetuated over years.

P_1: "[This way of doing] brings some histories and anecdotes, that the customers love. If there is a successor, they see that there is a continuity in the family business."

Nevertheless, in most cases the successor's introduction took place once the successor actively entered the family business. In fact, the gradual succession, which was experienced by the participants, enabled the successor to be introduced step by step to the main stakeholders as the next incumbent. The way the successor was presented varies from one case to another, or from one relationship to another within the same family business. Firstly, as the successor has worked closely with the incumbent in the transition, he followed him in the meetings or in the business lunches, where he was introduced to stakeholders as the next successor. Whenever the incumbent was meeting someone for any reason, he joined him. The underlying idea was to make the successor known.

P_2: "We did a lot of company visits, customer visits. We had meetings with them, we had a lunch with them or whatever. Then there were trade shows. When customers were coming, I was introduced to them by the external CEO as the next business-manager."

In addition to accompanying the incumbent in various physical meetings with FOB's stakeholders, the successor was given the stakeholder's contact details by the incumbent. Then, it was up to him to give them a call and to introduce himself as the FOB's next leader.

P_2: "We did a list with all the contacts we have and then we decided what contact will be met personally."

P_3: "My father gave me the contact details and I gradually started calling the different stakeholders. For example, I called the different central buying services […] in order to introduce myself as the successor."

Nevertheless, at this stage, the successor has often no business role, except introducing himself or herself and explaining his or her aspirations, background, competencies and experiences. In fact, real sales work was needed because the successor had to prove to the stakeholders that he or she was committed to take over the business.

P_3: "The first year, I was just there physically to introduce myself, to talk about my academic studies and why I was there."

Interestingly, some interviewees mentioned that they met some of their customers through a company visit. In fact, they were in charge of presenting the facilities, the plant and the company as a whole to the customers. It was a good way to talk with them, to answer their questions and to show them that they will be good business owners, who know what they are talking about.

P_1: "At the beginning, I was entrusted with the task of making the group visits of the wine cellar. When you manage to explain to a group of 30, 40 or 100 persons your job, to keep people interested and to answer people's questions, you realize that you are in the right place because you manage to transmit them a message. You are aware of that, because they order some bottles and they buy your wine."

Phase 2: Observation In the second phase, which can partly overlap with the first one, the successor was introduced to the stakeholders. Now the goal is to observe how the incumbent handles these preexisting relationships and how the successor is evolving in this vast network of preexisting relationships.

P_3: "I observed him and learnt."

The successor still has no active role to play except to observe and learn. By observing, he or she learns how to lead a business talk or a negotiation, for instance, to know the stakeholders, and how to speak to them. Thus, the second stage can be considered as a phase of information collection.

P_3: "I also accompanied my father to the physical meetings, like the annual one with Auchan. […] I started knowing our customers. I was not leading the interview. I was observing how my father was handling the meeting, what he was saying, how he was presenting the evolution of the business and so on."

In this phase, the incumbent has an important role to play. Concurrently with taking the successor to the meetings, he or she has to teach how to handle relationships. The incumbent must transmit the necessary knowledge, which was acquired over time and which the successor will need in the future.

As the successor gets embedded in an environment of preexisting relationships, he or she has indeed not all the information about the customers and their history with the family business. Even if he or she starts knowing the stakeholders, the incumbent has to provide relevant information about them and has to contextualize the relationships and express his or her own thoughts and feelings about them. For example, the incumbent and the successor can take time aside once a week to discuss about the various relationships and social networks of the company.

P_2: "We got used to meeting once a week to talk about business stuff and also about people. We were going through the list of contacts and he told me whatever he knows about the contacts we were dealing with. He explained to me every specific situation encountered with the contact and the history of the relationships."

As a result, a transfer of knowledge takes place from the incumbent to the successor in this phase. The incumbent has accumulated knowledge on the stakeholders over time, and an important part is to transmit this knowledge to the next generation. The successor must learn the specificities of each stakeholder.

P_2: "We have one customer who is a huge soccer fan and who is supporting Borussia Dortmund. The external CEO told me that every time the soccer team was losing that I should not call him for a couple of days because he must be in a bad mood. But if they win, you can call him because he is in a good mood."

Phase 3: Integration Before the integration phase, the successor has accumulated information about stakeholders and starts integrating that now. At this stage, the successor starts knowing the stakeholders because of having met them, observed them, exchanged words with them and

gathered some information on them. Slowly the successor starts establishing business relationships with them. As he or she has entered the business quite long before, he or she had time to learn the product and the specificities of the family business, so that he or she starts developing self-confidence.

In phase 3, the incumbent ideally starts letting go and giving the successor more and more responsibilities. Now it is time for the successor to directly deal with the FOB's relationships. The successor starts being in touch with the stakeholders, talking to them in the name of the company and as the next business owner. In a way, the successor becomes the representative of the family business.

> *P_3: "The second year, I also accompanied my father [to an annual meeting with a big customer], but this time it was my turn to lead the meeting […] I was in charge of making conversation, exhibiting and explaining the figures, exposing our forthcoming projects."*

During the integration phase, it becomes essential that the incumbent gives more and more responsibilities to the successor. Ideally, the responsibility of handling the relationships is gradually transferred. The successor starts calling the stakeholders, solving disagreements or problems, managing any business-related issue. After embedding the successor in the social networks of the family business, the necessity starts to build own relationships in addition to these preexisting ones. For example, as illustrated by one study participant, he or she goes to various events organized by federations in order to meet people. Some interviewees even noticed that during the integration phase, the incumbent urged the stakeholders to directly deal with the successor.

> *P_4: "Often, my father was pretending not to be there, so that people deal directly with me. He told the switchboard to pass the call onto me. And I was in charge of answering the customers."*

Nevertheless, in the integration phase, the successor is not left alone. The incumbent is still there if needed. He or she gives advice and can accompany the successor in the decision-making process. Sometimes, the successor faces difficulties with a stakeholder's query or does not have all the abilities to handle the matter yet. Consequently, it is important that the incumbent remains available, to help the successor.

P_3: "My father was there to help me if need be."

It is important to note that even if the incumbent helps backstage, the successor is in charge of keeping in touch with the stakeholders. The incumbent should play only the role of a consultant.

P_4: "But it was my task to tell the customer the decisions and to present it. This way of transmitting enables me to learn a lot."

In the integration phase, however, the successor also starts taking on some initiatives. Fulfilling the responsibilities, starting to take decisions, and having his or her own experience with the relationships, these are the first steps of the successor as the next manager of the company.

In the integration phase, it may be difficult for the successor to handle relationships because of intimidation, and the fear of making mistakes. Indeed, the successor is dealing with relationships which existed long before and which are essential to the company. In such cases it is the role of the incumbent to reassure the successor.

P_3: "What was difficult was the first time I had them on the phone, notably with the big customers, because I knew that I had in front of me, a company who accounts for 10/15% of our sales. So, I wonder what I am going to say to them and I was hoping not to tell them stupid things."

That said, in most of the FOBs interviewed, the successor had no major problem in handling the relationships. As the transmission was gradual, natural and extended over time, the successor had time to know the stakeholders, to have a good command of the FOB's functioning, to be self-confident in their product and to have a perspective on the business. Thus, they were well integrated into the firm's social capital.

Interestingly, all interviewees highlighted the advantage of being a family business at this stage. In fact, they were welcomed with kindness, because the stakeholders loved the idea that a successor was found within the company. It is indeed important for them because the arrival of a successor is the warranty that there is a future in the family business and that their relationships will be perpetuated in the coming years.

P_3: "They take it very positively [the successor's arrival] because they liked the fact that a family member took over the business. It is important for them because they know that the relations won't end with the retirement of my father

or godfather. They see that there is a future in the company and the relationship will carry on."

P_4: "The customers were very kind. If they have a good relationship with the business, they like the fact that there is a new generation taking over the business. In every family business, it is the dream of the boss that there is a successor within the family."

Phase 4: Management In the management phase, the transfer of social capital from the incumbent to the successor is completed. After gradual inclusion into the vast networks of preexisting relationships by the incumbent, the successor is now completely embedded in the firm's social capital and managing alone the company relationships in the new role as the manager of the family business.

P_3: "Today, the transfer has been done so I am in charge of the relation with Pomona. I am their representative."

P_4: "The transfer was very natural, people got used to dealing with me."

The next step is to analyze and to decode these relationships. In fact, the successor has to define the benefits brought by each relationship and choose the ones to continue, the ones to break up and the ones to create.

P_1: "I started analyzing which relationships were good for the future of the company and which were bad. […]. I classified these relationships. I looked for a way to rationalize these relationships."

After decoding the networks in which the family business is included, one of the main tasks of a study participant was to ensure the continuity and increase of the relevant relationships, which could bring a lot of benefit to the family business and were essential to the success of the family business.

P_3: "The goal is to reinforce our link with them and to keep in touch."

P_2: "I tried to keep them as close as possible."

Once the incumbent is in charge of managing external social capital, the successor must reassess the firm's external social capital to cut some relationships, which might be helpful in appearance but are poisonous in reality.

P_1: "Nevertheless, when I observed how they were working in the organization [wine-making syndicate, gathering all the wine producer of the area], I gave them an ultimatum: either the situation changed, or I left. And I left the syndicate! I didn't need them. They didn't bring me anything, except nuisances."

The role of the successor is also to bring a new wind into the business; he or she brings freshness and innovation. The successor can also expand the operations of the family business by breaking into new markets for instance. For doing so, he or she has to create new relationships, new networks and, consequently, enlarge the firm's social capital.

P_1: "I started founding a network of importers abroad."

At this stage, we only described the different milestones of the successor to become gradually immersed into the FOB's social capital. From the analysis of the interviews, we determined, however, three elements that the successor must build over time to pass from one step to another: trust with the incumbent, credibility and trusting relationships with preexisting relationships. All of them are illustrated in Fig. 9.2 and then discussed in more detail in the following section.

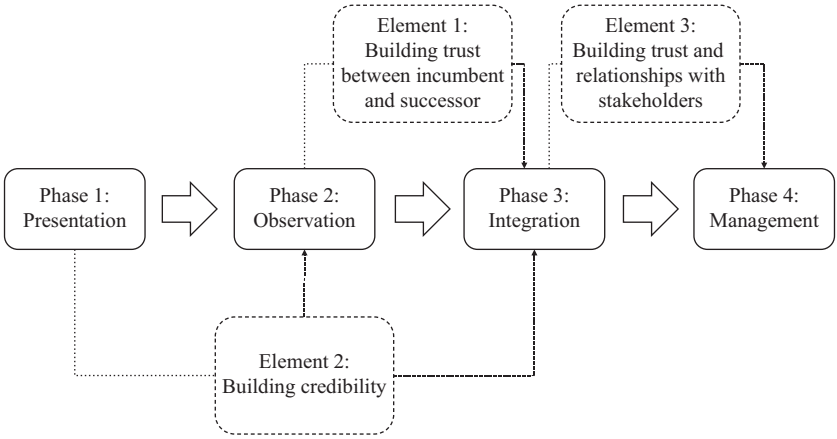

Fig. 9.2 Social capital transfer and buildup during the business succession process as described by the study participants

Element 1: Building Trust Between the Incumbent and the Successor

During the interviews, the importance of building a good trusting relationship between the incumbent and the successor was mentioned several times. This is a necessary condition for the success of the overall transmission process. If the incumbent does not have trust in the successor, he or she will not let go and will not delegate responsibilities, so that the successor will not gain the necessary independence and experience. Indeed, the incumbent must be convinced that the successor has all the abilities required to handle the business and manage the FOB's social capital.

As all the interviewed successors experienced a gradual succession, they had time to understand the culture of the FOB, as well as the particularities of the business, to meet the employees and stakeholders and to get familiar with the processes (Bernhard, 2011). Every interviewee acknowledged the importance of the time dimension in the transition process over years.

> *P_2: "I had worked in the company for ten years, so I knew pretty much what was going on, I know the products and I know the processes."*

Thus, the successors reckoned that they had proven themselves over years and that they had shown to the incumbent that they were trustworthy. This trust on the successor reassured the incumbent on the heir's potential to handle the business and eased the successive delegation of increasing responsibilities. It was pointed out by study participants that trust is not self-evident but was earned step by step.

> *P_1: "During these 11 years of transmission, I had the chance that my father delegated me a lot of responsibilities. I took over the family business quickly. He trusted me quickly."*

> *P_4: "My father had gradually delegated many functions to me. The process was very fluid and natural."*

Some of them highlighted, however, that the incumbent must be willing and committed to transmit his or her company to the next generation. When one participant was asked about the conclusions he would draw about his experience of transmission, he emphasized the harmony between him and his father. He compared his successful experience to the failure of an acquaintance whose father had never let go.

P_4: "I know a company, in which the father had never managed to let go. The son contented himself from doing lower-end operational task with no view. [In the end] the son left the company, although [initially] they had decided to work together and to transmit gradually the company."

Notwithstanding the ability of the incumbent to let go, it was also stated that it is important that the incumbent remains present and plays the role of adviser if needed, offering long-term experience and expertise.

P_2: "I had the chance to have a father who stepped back and on whom I could count if needed."

In all observed cases, the successor had worked closely with the incumbent during the transition period. Thus, a positive working relationship was gradually built between them, so that the transmission of knowledge and social capital was gradual and smooth. They learnt to work together over time. Unlike nonfamily businesses, where the changes at the management level may allow no or very short transition periods, the succession phase can be quite long in FOBs, so that a lot of information can gradually be transferred. This situation gives opportunities to both the successor and the incumbent to exchange, to discuss, to debate and to share knowledge throughout the years. Then, the successors could observe in detail how business was handled. The interviewed successors noticed that the incumbent included them quickly in the decision process.

P_3: "We take all major decisions together […] we share all information."

P_2: "We had a really close collaboration. Our offices were next to each other for a couple of years, and most of business decisions, which were made, were discussed between us."

Element 2: Building Credibility

When the successor starts to develop business relationships with the FOB's stakeholders, having the trust of the incumbent and bearing the family's name is not enough. In addition to develop his or her credibility toward the incumbent, the successor must indeed appear credible in the eyes of other company stakeholders. The successor needs to prove that he or she is a valid and trustworthy person, who has all the abilities required to run the business, ensuring that their collaboration will thrive in the future.

When the interviewees were asked about the way they developed their credibility and legitimacy, the following elements were emphasized: (1) formal education, (2) experiences outside of the family business, (3) knowledge from inside and (4) company visits.

Some of the participants emphasized the importance of having an education in line with the role of the business owner. Formal education (1) is indeed a good indicator that the successor has the background required to run the business. It may be viewed as a sign of competence.

P_1: "I was legitimated because of my studies [oenology studies]. I had indeed a good command of how wine is made so I was looking credible to them."

All participants highlighted the benefits of having got professional experience outside of the family business (2). It provides the successor with a broader perspective on managerial issues and helps in the development of adapting to other business situations. As they went out of their comfort zone, they learnt how to react to people in specific situations. They also developed their personality in another environment, which sometimes could be hostile.

Getting outside experiences helps a lot when it comes to building legitimacy. It gives the successor the credibility and respect when joining the family business, because it shows that the successor is competent, has reached some achievement and has proven worth somewhere else.

P_4: "I have also gained credibility because of my experience. I am often saying that I won my spurs elsewhere. That is totally true."

The participants acknowledged that they built their credibility toward key stakeholders through their excellent understanding of the family business and the products they deliver (knowledge [3]). The fact that the transition process lasted several years and that they held various positions within the family business enabled them to spend time to get familiar with the company and the processes. Thus, they gained their legitimacy by showing to the stakeholders that they know what they are talking about.

P_2: "I had worked in the company for ten years, so I knew pretty much what was going on, I know the products and I know the processes."

Some participants acknowledged that they gained their credibility in the eyes of key stakeholders, and customers notably, through the visits of their company (4). In fact, in both cases, the incumbent let the successor explain the business and the different processes of fabrication. This was a good way to show the customers the successor's credibility by demonstrating his or her ability to talk about the business, the industry, the products.

> *P_4: "So, when they come to visit us, I was in charge of making the visit with all the customers. It was a good way to meet them, to test my capability of talking of the business. […] My father welcomed them in the morning, […] Then I discussed with them and I showed them around the factory. I talked with them and I answered their questions."*

Element 3: Building Trusting Relationships with Key Stakeholders

Every successor acknowledged their embedding in a vast network of preexisting relationships that they needed to handle.

> *P_1: "We don't start from a blank page."*
>
> *P_2: "When you take over, you are playing in a preexisting environment."*
>
> *P_3: "Most of our customers were there before I took over, so I needed to integrate them later."*

It is important to keep in mind that some relationships are not just simple connections. There is a band of deep trust because both sides know they can count on each other. For instance, if one of them needs information, the other will share it with sincerity.

> *P_2: "Our collaboration is indeed built on the reliability and the trust they have on us built on the history of quality of our products and our reactivity if needed."*
>
> *P_4: "There are thousands of suppliers of green coffee in the world, but we worked only with 6 or 7 of them since 20 or 30 years. They give the right information and if we have a problem, they fix it."*

Once the successors have taken over, it is now their role to ensure that these trusting relationships remain sustainable. When one participant was asked about the way he developed and perpetuated the trustful relationships across generations, he highlighted that the sustainability lies in the mutual

loyalty. There is a myriad of other relationships to build, but he emphasized the importance to favor the most reliable ones:

P_4: "We are loyal to our suppliers. We have only added two suppliers in the last 20 years because the previous ones went bankrupt. These people recognize our fidelity."

Being family-owned proves to be an advantage, because stakeholders have trust not only in the incumbent, but also in the entire family running the business. In our cases, the successors bear the incumbents' name, so there's a continuity in the family business. In fact, a part of the transfer of social capital across generation relies on the family's reputation.

P_4: "I was impressed by […] the trust they have in my father and in the name of my family."

Nevertheless, interviewees emphasized that it is important that the successor does not take the relationships for granted. The successor must make every effort to preserve the good relationship over time.

P_3: "It is important to not take them for granted, but to carry on building the links with them, by knowing their needs, calling them, knowing the business figures."

It is key to regularly call them or pay them a visit to ask for news and give some information about the business situation.

P_3: "We try to have them [big customers] on the phone twice or three times a year. We are also trying to see them whenever it is possible."

A central aspect to the interviewees is to make key stakeholders feel that they are of important value to the FOB, that they are granted a special status and that their opinion counts.

Frequent contact can also be directly business-related. It is indeed also important to call them whenever there is a business problem.

P_3: "We got a problem with Auchan because together with my father we noticed that the figures had dropped. So, we took our phone and called them to enquire, we asked them questions and so on. This enabled us […] to show our customers that we are taking care of our relationships and that they are of high value in our eyes."

In addition to maintaining strong links with key stakeholders, the interviewees also emphasized the importance of building and growing their own history with the various stakeholders:

P_1: "On the contrary, I maintained some relations because we got to know each other, or I appreciated their intervention and their way of doing things."

P_1: "I was introduced to the chartered accountant by my father. […] I managed to entrust to him my worries, my conflicts with others. We had a mutual assistance."

Similarly, a few interviewees highlighted that they had built strong ties with their suppliers because they had an internship there during their university studies. As the successors had worked in the company for some months, they built trusting relationships with the business owner, the members of the next generation and the employees (Bernhard, 2011).

P_4: "I met our suppliers through my internships. I spent time with them. I developed strong relationships with them. They trusted me, they gave me access to all information I needed. I got to know their margin."

P_3: "I have also made a 3-month internship at Joker, which is one of our suppliers, who makes packaging in plastics. I have worked with the salesmen, so I went with them and met their big customers."

The importance of building trusting relationships and strong links with key stakeholders was stressed because this ensured a smooth resolution whenever a problem arose.

P_3: "If one day, there is a problem with our products and in parallel, we don't have a regular relationship with them, they would change their supplier and we will be out of the process. On the contrary, maintaining a sustainable relationship with them over time enables us to reinforce our link. In case of a problem, it would be easier to sweeten the pill, because they know and trust us."

Discussion

In this study we addressed the question of how external social capital is transferred to the next generation in FOBs. Our goal was to better understand the mechanisms and the evolving role of both the incumbent and the successor in the succession process. A series of interviews led to the emergence of a theoretical framework (Fig. 9.2), illustrating the dynamics

and mechanisms of the transfer of social capital within FOBs via a four-step process. This process is in line with the framework illustrated by Handler (1994) on the succession process as a whole. In addition to the four-stage life cycle, a mutual role adjustment between the incumbent and the successor was observed. The incumbent's gradual withdrawal is accompanied by the gradual taking on of power by the successor. Indeed, one of the interviewees compared this transfer process with a pair of scissors. As included in the concept of "natural immersion" (Steier, 2001), the successor usually enters the family business by getting into a lower- or medium-level management position and gradually reaches the top echelons after getting the approval by the incumbent.

The study offers meaningful conceptual and empirical evidence about how external social capital is transferred to the next generation in family businesses, by clarifying the different steps of the transmission process. The study also offers support to the concept of "natural immersion" built by Steier (2001), according to which the successor gradually assimilates the nuances of network structure and relationships.

Nevertheless, we found that some preconditions are essential to ensure a smooth process. A good relationship between the incumbent and the successor is essential (Cabrera-Suárez et al., 2001, Goldberg, 1996, Venter et al., 2005) to ensure a successful transfer of social capital across generations. The incumbent must be willing and devoted to share the information on the firm's social networks with the successor, that's why a trustful relationship between them must be fortified over time (Element 1) (De Massis et al., 2008). Our study also suggests that successors need to prove to the incumbent that they are valid and trustworthy, and that they have all the required abilities to run the business (Element 2). To reach this goal, our study reveals that successors can leverage the skills they acquired through education (Barbera et al., 2015; Dyer, 1986) or job experiences outside of the FOB (Tatoglu et al., 2008; Venter et al., 2005). Successors can also attain legitimacy by the quality of their performed work. Moreover, the study suggests another way for successors to build credibility, namely, through demonstrating superior knowledge and a good command of the family business they had acquired. It is important to keep in mind that the credibility of the successor is instrumental in enabling a successful integration of the successor within the social capital of the FOB (Barach et al., 1988; Venter et al., 2005). Lastly, successors have to build their own "history" with the stakeholders. They must move beyond the status of being "the son/daughter of" to being "the father/mother of." Consequently, they must build trustful relationships with stakeholders over time (Element 3). Another interesting finding is

that being a family business helps a great deal in the transmission process because the stakeholders regularly regard it as a positive sign when a successor is found within the family. Notably, the family reputation is another part of the transfer of social capital across generations, which, however, happens automatically.

For business owners and their families directly concerned with the topic of succession, this chapter emphasizes the importance of social capital within FOBs and provides frameworks explaining the requirements and major steps by which key relationships can be transferred. Malinen (2001) shows that one of the main concerns of incumbents is how to transfer their tacit knowledge and networks of contacts to the successor. From this perspective, our study can offer some answers to such concern.

Limitations and Future Research

Although relevant outcomes were observed in the case studies, the findings are of only limited generalizability because of the small size of our sample. Second, in addition to translation bias, a bias from the sample may arise, because of our choice of successors willing to share their views and experiences with us. Notwithstanding these limitations on successors' feedback, our goal was not to test any theory or hypothesis, but to understand the wider process through which social capital is transferred from one generation to the next.

Another limitation of the study is that our emergent framework (see Fig. 9.2) was not tested or backed by a sufficient sample of interviewees but evolved from a combination of analyzed narratives and existing findings from the family business. A second round of interviews, ideally with a representative sample of successors, would be useful to test the emerging processes. Such a sample would ideally consist of successful, but also of failing successions.

In our study, we based our analysis on the experiences of the participant and viewed it from the successor's perspective. Future research may also study the phenomenon of transfer of social capital from the incumbent's perspective.

Furthermore, our study can give only a glimpse on the social skills that the successor needs to develop over time. In fact, talking about external social capital implies managing and creating links with human beings. Consequently, social skills must be built to efficiently handle these relationships. Reflecting on these social skills is difficult for the interviewed

successors, and more objective data from outsiders would be necessary. Lastly, in our study, we mainly focused our analysis on the transfer of external social capital. Further research on the topic of the transmission of internal social capital is needed to better understand how the transfer of relationships with the employees or the family takes place (Bernhard, 2011).

Conclusion

Succession is one of the prevalent topics in the family business literature (Sharma, 2004) and the role of the incumbent is to ensure the survival of the firm by preparing the next generation to take over an FOB. The transfer of social capital, in which resides key resources, is one of the major aspects of this preparation. Relational assets play a critical role in a family firm's survival and success (Steier, 2001). In fact, FOBs are embedded in a specific social context, composed of various relationships and networks with external stakeholders. When the successor enters the family business, he or she is immersed in a vast network of preexisting relationships (Steier, 2001). The role of the incumbent is to bring the successor into these networks of external relationships and accompany him or her over time. The capacity of the successor to handle, maintain and nourish these networks and external relationships is a key determinant for a successful succession and the sustainability of the family firm (De Massis et al., 2008; Steier, 2001). In our study, we identified four stages through which the incumbent gradually transmits the firm's external social capital to the successor: presentation, observation, integration and management. Based on our case data, we also found key elements that a successor needs to develop during the process to ensure a smooth transfer of social capital: the trust with the incumbent, credibility as well as trusting relationships with the stakeholders. The presented research enables the reader to get a better understanding of the process through which social capital is transferred from one generation to the next.

References

Adler, P., & Kwon, S. (2002). Social capital: Prospects for a new concept. *The Academy of Management Review, 27*(1), 17–40.

Barach, J. A., Gantisky, J., Carson, J. A., & Doochin, B. A. (1988). Entry of the next generation: Strategic challenge for family business. *Journal of Small Business Management, 26*(2), 49–57.

Barbera, F., Bernhard, F., Nacht, J., & McCann, G. (2015). The relevance of a whole-person learning approach to family business education: Concepts, evidence, and implications. *Academy of Management Learning & Education, 14*(3), 322–346.

Baron, R. A., & Markman, G. D. (2000). Beyond social capital: How social skills can enhance entrepreneurs' success. *The Academy of Management Executive, 14*(1), 106–116.

Bernhard, F. (2011). *Psychological ownership in family businesses: Three essays on antecedents and consequences*. Lohmar, Germany: Eul Verlag.

Bernhard, F. (2018). *Holding on to family values or adapting to a changing world – The case of Barilla global business value innovations* (pp. 117–127). Springer.

Bernhard, F., & O'Driscoll, M. P. (2011). Psychological ownership in small family-owned businesses: Leadership style and nonfamily-employees' work attitudes and behaviors. *Group & Organization Management, 36*(3), 345–384.

Bernhard, F., Pundt, A., & Martins, E. (2017). The role of leadership and related mediators in the development of psychological ownership in organizations. In C. Olckers, L. van Zyl, & L. van der Vaart (Eds.), *Theoretical orientations and practical applications of psychological ownership* (pp. 181–202). Springer.

Bhalla, V., & Kachaner, N. (2015). *Succeeding with succession planning in family businesses*. The Boston Consulting Group.

Cabrera-Suárez, K., De Saa-Perez, P., & Garcia-Almeida, D. (2001). The succession process from a resource-and knowledge-based view of the family firm. *Family Business Review, 14*(1), 37–46.

Cadieux, L. (2007). Succession in small and medium-sized family businesses: Toward a typology of predecessor roles during and after instatement of the successor. *Family Business Review, 10*, 95–109.

Chirico, F., & Laurier, W. (2008). The creation, sharing and transfer of knowledge in family business. *Journal of Small Business and Entrepreneurship, 21*(4), 413–433.

Chrisman, J. J., Chua, J. H., & Sharma, P. (1998). Important attributes of successors in family business: An exploratory study. *Family Business Review, 11*(1), 19–34.

Chua, J. H., Chrisman, J. J., & Sharma, P. (1999). Defining the family business by behavior. *Entrepreneurship Theory and Practice, 23*(4), 19–39.

Deloitte. (2016). *Next-generation family businesses: Evolution, keeping family value alive*.

De Freyman, J., & Richomme-Huet, K. (2010). Entreprises familiales et phénomène successoral. Pour une approche intégrée des modes de transmission. *Revue française de gestion, 200*, 161–179.

De Freyman, J., Richomme-Huet, K., Paturel, R., & Toulon, I. (2006). Condition model for transferring social capital in family business succession. *Proceedings of the International Research Entrepreneurship Exchange*.

De Massis, A., Chua, J. H., & Chrisman, J. J. (2008). Factors preventing intra-family succession. *Family Business Review, 21*(2), 183–199.

Dyer, W. G., Jr. (1986). *Cultural change in family firms: Anticipating and managing business and family transitions.* San Francisco: Jossey-Bass.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review, 14*, 532–550.

Goldberg, S. D. (1996). Effective successors in family-owned business. *Family Business Review, 9*(2), 185–197.

KPMG Enterprises. (2015). *European family business trends – Modern times?*

KPMG Entreprises. (2017). *Baromètre des entreprises familiales européennes* (6th ed.).

Handler, W. C. (1990). Succession in family firms: A mutual role adjustment between entrepreneur and next-generation family members. *Entrepreneurship Theory and Practice, 15*(1), 37–51.

Handler, W. C. (1992). The succession experience of the next generation. *Family Business Review, 5*(3), 283–307.

Handler, W. C. (1994). Succession in family business. *Family Business Review, 7*(2), 133–157.

Hitt, M. A., & Ireland, R. (2002). The essence of strategic leadership: Managing human and social capital. *Journal of Leadership & Organizational Studies, 9*(1), 3–14.

Lansberg, I. (1988). The succession conspiracy. *Family Business Review, 1*(2), 119–143.

Le Breton-Miller, I., Miller, D., & Steier, L. P. (2004). *Toward an integrative model of effective FOBs succession. Entrepreneurship Theory and Practice, 28*(4), 305–328.

Lee, D. S., Lim, G. H., & Lim, W. S. (2003). Family business succession: Appropriation risk and choice of successor. *Academy of Management Review, 28*(4), 657–666.

Malecki, E. (1997). *Technology and economic development: The dynamics of local, regional, and national competitiveness.* Amsterdam: Addison-Wesley.

Malinen, P. (2001). Like father like son? Small family business succession problems in Finland. *Enterprise and Innovation Management Studies, 2*(3), 195–204.

Mazzola, P., Marchisio, G., & Astrachan, J. (2008). Strategic planning in family business: A powerful developmental tool for the next generation. *Family Business Review, 21*(3), 239–258.

Morris, M. H., Williams, R. O., Allen, J. A., & Avila, R. A. (1997). Correlates of success in family business transitions. *Journal of Business Venturing, 12*(5), 385–401.

Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital and the organizational advantage. *Academy of Management Review, 23*, 242–266.

Nougein, C., & Vaspart, M. (2017). *Rapport d'information fait au nom de la délégation aux entreprises relatif aux moyens de favoriser la transmission d'entreprise au bénéfice de l'emploi dans les territoires.* Sénat français, session ordinaire de 2016/2017.

Osunde, C. (2017). Family businesses and its impact on the economy. *Journal of Business & Financial Affairs, 6*(1), 1–3.

PwC. (2017). *Croissance, innovation, transmission, quels enjeux pour les entreprises familiales?*

Sharma, P. (2004). An overview of the field of family business studies: Current status and directions for the future. *Family Business Review, 17*(1), 1–36.

Sharma, P., Chrisman, J. J., Pablo, A. L., & Chua, J. H. (2001). Determinants of initial satisfaction with the succession process in family firms: A conceptual model. *Entrepreneurship Theory and Practice, 25*(3), 17–35.

Sieger, P., Bernhard, F., & Frey, U. (2011). Affective commitment and job satisfaction among non-family employees: Investigating the roles of justice perceptions and psychological ownership. *Journal of Family Business Strategy, 2*(2), 78–89.

Steier, L. (2001). Next-generation entrepreneurs and succession: An exploratory study of modes and means of managing social capital. *Family Business Review, 14*(3), 259–276.

Strauss, A. L., & Corbin, J. M. (1990). *Basics of qualitative research: Grounded theory procedures and techniques.* Newbury Park, CA: Sage Publications.

Tatoglu, E., Kule, V., & Glaister, K. (2008). Succession planning in family-owned businesses. *International Small Business Journal, 26*(2), 155–180.

Venter, E., Bochoff, C., & Maas, G. (2005). The influence of successor-related factors on the succession process in small and medium-sized family businesses. *Family Business Review, 18*(4), 283–303.

Ward, J. L. (1987). *Keeping the family business healthy: How to plan for continuing growth, profitability, and family leadership.* San Francisco: Jossey-Bass.

Yin, R. K. (2014). *Case study research design and methods* (5th ed.). Thousand Oaks, CA: Sage.

CHAPTER 10

Sustainable Well-Being at Work: A French-Swedish Comparison

Anne-Sophie Bacouel and Thomas Vergnol

Abstract Recent studies have promoted a "sustainable well-being–productivity synergy." Despite a plethora of literature on the beneficial effects of sustainable well-being at work, a look across the borders shows that the concept of well-being at work is not equally spread. Although worldwide studies have reported differences in well-being amongst nations, only few studies have so far tried to explain these differences from a cultural perspective. This chapter examines the perception of French and Swedish employees on their well-being at work. Within the framework of Hofstede's culture map we analyze cross-cultural differences to obtain a refinement of broadly communicated surveys on well-being in different parts of the world. The results of our qualitative study show that Swedes tend to per-

A.-S. Bacouel (✉)
Rotterdam School of Management, Rotterdam, The Netherlands
e-mail: anne-sophie.bacouel@whu.edu

T. Vergnol
ISC Paris Business School, Paris, France
e-mail: thomas.vergnol@iscparis.com

A. Saxena Arora et al. (eds.), *Sustainable Innovation*,
International Marketing and Management Research,
https://doi.org/10.1007/978-3-030-30421-8_10

ceive higher levels of well-being than the French due to opposite scores on the cultural dimensions of power distance, uncertainty avoidance and masculinity.

Keywords Sustainable well-being at work • France • Sweden • Hofstede • Culture map

Introduction

Well-being at work is often associated with Scandinavian countries. Many studies have shown that Sweden is one of the countries where people are happiest at work: on a scale of 1 to 10, well-being in Sweden scores an average of 7.5 with 31% of the Swedes rating their well-being as high (between 8 and 10) (Bernelas, 2013). On the contrary, France is one of the countries that ranks on top for consumption of antidepressants and work-related psychosocial problems such as musculoskeletal disorders (MSDs) and burnout. Although worldwide studies have reported differences in well-being amongst nations (e.g. Shinwell & Shamir, 2018), only few studies have so far tried to explain these differences from a cultural perspective (e.g. Basabe et al., 2002; Duguleana, 2014). Based on Hofstede's (1991) culture map the objective of this study is to analyze how national cultural settings impact the well-being of people at work. Why are employees in some countries happier than in other countries? Are there different degrees of sustainability well-being–productivity synergy? We try to answer these questions by focusing on two culturally opposing countries: France and Sweden.

Well-Being at Work

Subjective well-being refers to "how and why people experience their lives in positive ways, including both cognitive judgments and affective reactions" (Diener 1984, p. 542). Subjective well-being alludes to a broad assessment of one's state of life in general and of various important life domains such as physical health, relationships, work, financial situation (Netemeyer et al., 2018).

The notion of workplace well-being emerged in the second half of the twentieth century as researchers focused on the development of new organizational models that could reconcile business performance with the professional well-being of individuals (e.g. Cooper and Marshall, 1978;

Danna and Griffin, 1999; Walia & Nishta, 2018). Studies have shown that improved well-being impacts not only the employees but also the way they perform their work, which ultimately has an impact on the company's bottom line (O.C. Tanner Institute, 2016). Employees with poor well-being are found to be less creative, tend to make inferior quality decisions and are more absent from work. In this way they consistently reduce the overall contribution of the organization (Price & Hooijberg, 1992). However, employees with high levels of psychological well-being relate more positively to others, are keener toward change, learn better and are able to effectively solve problems (Cartwright & Cooper, 2008). Moreover, employees are more engaged in work when they feel that their leader cares about them.

In this context, Peiró and colleagues (2014, p. 11) introduced the concept of sustainable well-being–productivity synergy "as the long-term promotion, and maintenance of the synergy of happy workers who display high levels of job performance, making organizations more competitive." They view sustainability as the "continuing symbiosis between well-being and performance at work, and as a connection between the two that is mutually reinforcing, contributing to a spiral of well-being and good economic performance" (p. 11). The researchers identify four types in the interaction between well-being and performance at work: (1) unhappy and unproductive workers, (2) happy and unproductive workers, (3) unhappy and productive workers and (4) happy and productive workers. The latter type corresponds to the concept of sustainable well-being–productivity synergy (Peiró et al., 2014).

Even though the understanding of well-being at work can vary, social relations, the content of work, the work environment, development and professional fulfillment, work-life balance can be seen as defining key elements of the notion. While the level of well-being at work is difficult to measure and therefore to compare, it is clear that it tends to differ greatly depending on the political, economic, societal and social situation of a given country.

The Cultural Field and Its Influence on Well-Being

Sweden and France are quite different in terms of their history and cultural values. The Hofstede (1991) grid of multicultural analysis puts the Swedish and the French cultures on opposite ends. We can assume that these countries' perceptions of well-being and how they discuss and respond to it will vary according to their cultural dimensions (see Fig. 10.1).

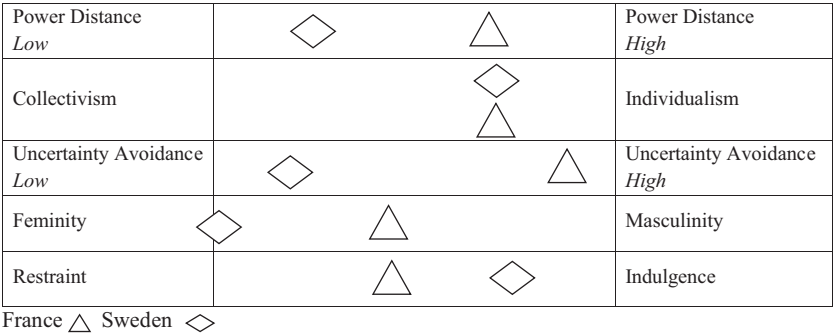

Fig. 10.1 Culture map of Sweden and France

Power distance refers to the extent to which national cultures expect and accept that power is distributed unequally in society (Hofstede, 2001). In high-power-distance countries subordinates and authorities are separated by an important distance, expressed by respect and formal deference for higher-status people (Basabe et al., 2002). For high-power-distance cultures typical strong social differences are supposed to cause high stress and negative emotional situations which are associated with unpleasantness of emotional experience (i.e. lower well-being) (Arrindell et al., 1997). According to the Hofstede dimensions, France belongs to high-power-distance cultures while Sweden scores relatively low in power distance.

The *individualism-collectivism* dimension addresses *the degree of interdependence a society maintains among its members.* In individualistic societies people look after themselves and their direct family only, while in collectivist societies people belong to "in-groups" that take care of them in exchange for loyalty (Hofstede, 1991). Individualistic cultures promote introspection and focus attention on inner experience while collectivist cultures emphasize relatedness (Basabe et al., 2002). However, the impact of this dimension on well-being remains inconclusive so far. Some research suggests that individualistic cultures afford the freedom to pursue individual goals and feel satisfaction, creating situations which elicit positive emotions. In contrast, feelings of social support and associated well-being might be greater in collectivist societies (Basabe et al., 2002; Diener et al., 1995). Sweden and France can be equally seen as individualistic countries.

Uncertainty avoidance refers to the extent to which people feel threatened by ambiguous situations and *have created beliefs and institutions that try to avoid these* (Hofstede, 1991). High uncertainty avoidance nations such as France are emotional and security-seeking while Sweden belongs to low uncertainty avoidance cultures which feel more relaxed and accept more risks. Previous studies confirm that uncertainty avoidance is related to high anxiety and to lower well-being or unpleasantness of emotional experience (Arrindell et al., 1997; Hofstede, 1991).

The *masculinity* dimension refers to the extent to which cultures are driven by competition, achievement and success while femininity favors quality of life and caring for others. Masculine cultures emphasize stereotypical gender roles, and the dominant values are success, assertiveness and money, while feminine cultures, such as Sweden, disregard gender role differences and competition and value cooperation and concern for the weak (Hofstede, 1991). France scores medium with regard to the masculinity-femininity dimension, but clearly higher than Sweden. One important potential consequence of feminine values is the perceived obligation to provide emotional support. Social support can therefore be assumed to be higher in feminine cultures and provides the individual with a strong network in times of distress. Former studies have shown that feminine cultures exhibit higher pleasantness of emotional experience (i.e. higher subjective well-being) (Arrindell et al., 1997).

Hofstede et al.' (2010) dimension of *indulgence* refers to the extent to which people try to control their desires and impulses. Indulgent cultures, such as Sweden, possess a positive attitude and have a tendency toward optimism. Moreover, leisure time is highly appreciated, and people act as they please. France scores somewhat in the middle between indulgent and restraint cultures. However, paired with high uncertainty avoidance, the French are assumed to be less relaxed and to enjoy life less often.

The Context of Well-Being in France and Sweden

According to health and environmental statistics by the OECD (2017a, 2017b), both France and Sweden should be countries with a high level of well-being as they both enjoy a high life expectancy, a low obesity rate for the French and highly appreciated water and air quality for the Swedes. However, on a scale from 1 to 10 the French grade their workplace well-being at only 6.4 with only 10% grading it as very high (between 8 and 10), while the Swedes place it at 7.5 and 31% grade it as very high

(Bernelas, 2013). Moreover, 8% of the French population work more than 50 hours per week (OECD, 2017a), unemployment rate was nearly 9% in January 2019, and France is one of the OECD countries where the fear of losing one's job is the highest. In contrast, only 1% of Swedes work more than 50 hours a week (OECD, 2017b), and unemployment rate was 6% in January 2019. With regard to work-life balance, being a woman in France has no or very little effect on the probability of obtaining more flexible hours (Bustreel et al., 2012). On the other hand, Sweden stands out with its parental leave statistics: in 2016, there was a high frequency of interruptions and reductions in the activity of mothers of children under the age of eight (75% and 45%, respectively) (Govillot, 2013). Similarly, Sweden tops the Global Gender Gap Report ranking of the countries where gender equality is most respected with a fourth place, while France only ranks at place 17 (World Economic Forum, 2016).

It is also interesting to note that when the French are asked to define what they associate with well-being at work, the reconciliation of private and professional life comes second, just after the nature of the work (ANACT, 2017). When it comes to collective stakeholder commitment, the circumstances in France and Sweden differ as well. Trade unions, the State and companies are all stakeholders in the area of workplace well-being. Trade unions play an important role in both countries; however, the unionization rate was at a staggering 7.9% in France in 2015, while it was at 66% in Sweden, one of the highest rates in Europe (OECD, 2018a).

The French State tries to ensure the well-being of its population through various agencies such as the Labor Inspectorate, the National Agency for Food Safety, Environment and Labor, the Orientation Council on Working Conditions, the Occupational Health Plans and the National Agency for the Improvement of Working Conditions, following a top-down approach in line with French high power distance. However, the Swedish State follows a bottom-up approach by putting great importance on education, with three government offices (Ministry for Education, Ministry for Higher Education and Research and Ministry for Upper Secondary School and Adult Education and Training) dedicated to it. The French State relies mostly on prevention through the publication of studies and prevention campaigns (Ministère Français, 2017). Various studies have been sponsored in recent years, such as the Stiglitz Commission (Stiglitz et al., 2009) and other studies (Lachmann et al., 2010), in order to create new indicators of well-being and investigate psychological health at the workplace.

Companies play an important role when considering workplace well-being. Again, the situation in Sweden is better than the one in France: 64% of French employees rate the social climate in their company as good and only 7% rate it is as very good while 83% of Swedish employees consider the social climate in their company to be good and 30% consider it very good (Bernelas, 2013). Swedish employees are more satisfied than the French with regard to their tasks, their working environment, the material conditions of their company, their workload, their remuneration and their development possibilities (Bernelas, 2013).

Another factor influencing workplace well-being is the style of leadership. The French leadership style can be described as "top-down," authoritative and autocratic, which does not necessarily inspire employees (Pelletier, 2011). This type of leadership might cause bad reactions from employees, as shown in the case of France Telecom, where 35 employees committed suicide within two years (2008–2009) due to work pressure (Johannes & Hambursin, 2012). In contrast, Swedes bank on a decentralized, democratic, inclusive and consensual leadership style that underlines collective decision-making.

Methodology

An inductive, interpretative research approach was chosen to compare diverse perceptions of well-being in the two national settings. Data collection was based on episodic interviewing, a particular narrative interview technique to gain access and develop understanding of the interviewees' experiences through descriptions of particular episodes (Flick, 2000). While an interview guide was used, other issues brought up by the interviewees were discussed. Consequently, the interview guide evolved throughout the interview process. Such an approach is not appropriate for generalizing findings (Eisenhardt, 1989); however, this limitation is not in conflict with our research interest of exploring how well-being at work varies across cultural settings.

The interviews were conducted face to face or over the phone, lasted between 30 and 60 minutes, and were recorded and transcribed. The interviewees were selected according to the following criteria: how they fit into the global population of both countries (nationality, gender, profession) and the added value they could bring to solving the issue touched on in this chapter. A total of seven participants (four Swedes and three French) were interviewed as given in Table 10.1.

Table 10.1 Details of respondents

Respondent	*Occupation*	*Nationality*	*Workplace*	*Intercultural experience*
Freja	Logistics Manager	Swedish	Swedish company in Sweden	Working experience in France in a French company
Lena	Head of Logistics Department	Swedish	Scandinavian company in Sweden	
Greta	Student	Swedish	Swedish University	Studies at a French business school in France
Björn	Product and Logistics Director	Swedish	French company in France	Work experience in France, Sweden, Italy
Erwan	Commercial Director	French	Swedish company in France	Works for a Swedish company in France
Thomas	Key Account Manager	French	French company in France	Worked for a Swedish company in France
Sophie	Occupational Health Nurse	French	French company in France	

The analysis of the interviews involved three steps: (1) Identification of relevant episodes in the interview files (word documents). (2) Thematic selection of episodes for examining on which particular features of well-being the episode focused. (3) Discussing these issues within the research team to achieve a common understanding about the impact of the two cultural settings on described issues of well-being.

Results and Discussion

Although our sample of interviewees is rather small, their narratives seem to confirm the suggestions presented earlier on how cultural dimensions impact the well-being of a society.

Swedish Cultural Features Favor the Perception of Well-Being at Work

The narratives about well-being in Sweden basically refer to features of power distance, uncertainty avoidance and the masculinity dimension. Sweden scores low in *power distance* which significantly impacts the leader-subordinate relationship. A leader is perceived more as a coach and less as a superior rendering social distance smaller.

In Sweden, people are encouraged to talk directly with other departments, it is less compartmentalized. Thus, managers are present only to coach, supervise and give direction—they delegate a lot and trust. (Björn)

We consider [in this company] that it is important to be a leader before becoming a manager. Through training, we offer the learning of tools and methodologies. The personality of the leader must be in line with that of the members of the group, the role of the leader is then to create an atmosphere conducive to work, in which each employee can fully flourish. (Lena)

This mode of more participative leadership encourages the leader to take risks and initiatives:

Managers have more confidence, employees become more imaginative, are not afraid to make decisions or give their opinion and are therefore no longer afraid to make mistakes. This also has an impact on their well-being at work, which is significant. (Erwan)

In the same vein, the Swedish leader also promotes transparency and information sharing:

You have to be transparent to create a climate of trust. I do a five to ten minutes meeting every morning with my team, everyone expresses what he thinks, what he did the day before and what he will do today. (Björn)

Ensuring well-being of employees at work even becomes a mission for Swedish leaders when companies introduce an individualized monitoring within the company:

We have an annual interview with our manager on our level of general well-being and work. It is a very good thing. (Freja)

It was suggested that societies with low *uncertainty avoidance*, such as Sweden, are more relaxed and open to risks. In Sweden, employees are invited to share their mistakes so that the community can benefit and avoid these mistakes. The interviewees are well aware that admitting mistakes is not necessarily easy for the concerned individual but serves a common goal.

When we slide on a plate of ice, we get up and we look if someone saw us, for fear of ridicule. On the contrary, it should be assumed and indicated to others that there is a danger there. (Lena)

We must analyze them [the mistakes] and find a solution so that this does not happen again. Any negative experience can become—after analysis—a positive surplus value. If this is the case, then it is the continuous improvement. (Erwan)

Sweden, scoring high on *femininity*, disregards gender roles and focuses more on cooperation than on competition.

We have a loss of creativity among women when female managers are not sufficiently represented. (Lena)

Favoring gender equality improves the reconciliation between private and professional life:

The state encourages us to take parental leave, so they are taken to a same extent by the fathers and by the mothers. This reduces discrimination in hiring as both parents are likely to go on leave for a child, around 28–30 years of age. (Freja)

As Swedes have a low-power-distance culture, there is less need for them to focus on relationship with their superiors, for instance, in working long extra hours.

Swedes focus more on their tasks, respect meeting schedules and are therefore more productive. It also allows them to free up time, to finish work earlier and thus to be more serene at night to enjoy their family. Employees who leave late at night are seen as poorly organized people in their work. (Greta).

France's Cultural Features Point to Less Well-Being at Work

The narratives about well-being in France do equally refer to features of power distance, uncertainty avoidance and the masculinity dimension, however, with different focus.

France scores high in *power distance* creating a strong hierarchical distance between leaders and subordinates which is learned early through socialization.

In France you have to go between two leaders to talk to another team, it's very hierarchical […]. And also they have great respect of hierarchies from primary school. (Björn)

Many managers think that if they hold the information then they hold the power. But this is not the case. It is the information-sharing that succeeds and makes people successful. You have to share. (Erwan)

However, employees, in particular those who are not on top of the hierarchy, wish leaders to be more participative, transparent and open to dialogue:

> *Communication allows to open the dialogue, to be able to work as a team but also, for the employees, to trust them and their leaders. This allows you to say things—good or bad—without the employee feeling fault. (Sophie)*

But implementation of a participative leadership style which is not in line with France's deeply ingrained high-power-distance culture is not always easy:

> *It worked very well, it is necessary that the managers accept it and begin to discover it. With 70% of my dealers it went very well, with 30% however, it was more difficult. (Erwan)*

It was suggested that cultures with high *uncertainty avoidance* are afraid of risks and mistakes and try to avoid these, resulting in feelings of anxiety and lower well-being. The interviewees reported that making mistakes is France was seen very negatively and consequently punished.

> *In France, we tend to punish and criticize when we make mistakes. (Erwan)*

> *I find that the French are afraid to make decisions and give their opinion, they are afraid of being fired and making mistakes—but when we are afraid, we are not productive. (Björn)*

Although France scores medium on the *masculinity-femininity* score, its culture shows less feminine features than its Swedish counterpart by encouraging competition from a young age.

> *In the French system, the goal is to be the best individually. (Björn)*

> *When I was in Paris—during group work—the students did not respect the schedules, or they arrived ten minutes late, this is very badly seen in Sweden, even at school. (Greta)*

However, French employees wish their workplaces to be more relaxed and require more responsibility and action from employers:

Well-being at work depends on the atmosphere of the company, the impulse given by the entrepreneur and the team spirit and belonging to a group. […] Companies should develop friendly spaces, relaxation and sports. This would unite the teams while building a climate of trust. Moreover, limiting excessive working hours and time in transportation by offering, for example, free time and/or the opportunity to work from home could be a solution to reduce stress at work. (Thomas)

Happy Swedes and the Unhappy French: A Refinement of the Picture

The interviews above confirmed the results of extant surveys on well-being at work. Swedes generally report a higher perception of well-being at work than French do. By using Hofstede's (1991) culture map from a well-being perspective, we were able to refine the relationship between cultural setting and perceived well-being.

Our results suggest that Swedes report higher well-being due to low power distance which favors more open and supportive leader-subordinate relationships. Scoring low on uncertainty avoidance, Swedes favor learning from mistakes instead of punishing them, therefore eliminating the anxiety to commit errors. Lastly, being a feminine culture, Sweden encourages gender equality allowing all genders to have more work-life balance.

In the case of France, our results suggest that high power distance and strong uncertainty avoidance create a context of more anxiety where employees fear punishment when committing errors and where transparency is withheld to preserve extant power patterns. Scoring medium on the masculinity-femininity dimension, France's gender equality efforts do not necessarily translate into better work-life balance. The French generally work long hours in a competition coined context.

On the basis of the narrative data presented here, it is not possible to make clear statements about the sustainable well-being–productivity synergy. One of the Swedish interviewees clearly linked well-being to productivity by stating: *when we are afraid, we are not productive*. However, the OECD (2018b) ranks France 10th and Sweden 12th in its ranking of the most productive OECD countries, with productivity being measured as GDP per hour worked. Thus, the French are slightly more productive than the Swedes. On the other hand, the narratives of this study show a higher well-being in Sweden compared to France. Therefore, further studies are needed to find out which type of well-being–productivity relationship prevails in the

countries studied. At first glance, high well-being at work in Sweden seems to lead to relatively high productivity, whereas in France high productivity is achieved despite very low well-being at work.

Our study only relies on few interviews and results therefore cannot be generalized. However, they show tendencies which are worth being researched further. Stemming from what has been discussed above, future research on well-being at work should not neglect the impact of country culture. A refinement of perceptions of well-being in a country is important when companies (but also employees) transcend borders. Employees might want measures to improve their well-being (as witnessed for the French case) but measures that work in one country might fail in another due to deeply ingrained cultural features.

Conclusion

Despite a plethora of international literature on the beneficial effects of sustainable well-being at work, this study shows that perception of well-being at work varies across cultural settings and that specific cultural features favor or impede the building of well-being. By comparing cross-borders, we tried to get a more sophisticated understanding of culture-specific differences with regard to well-being at work and measures to foster this. We were able to show that even though a society might wish more well-being, the measures successfully taken in one society might not work in the demanding society due to deeply ingrained cultural features.

References

ANACT. (2017). *Agence nationale pour l'amélioration des conditions de travail.* Retrieved from https://www.anact.fr/

Arrindell, W. A., Hatzichristou, C., Wensink, J., Rosenberg, E., van Twillert, B., Stedema, J., & Meijer, D. (1997). Dimensions of national culture as predictors of cross-national differences in subjective well-being. *Personality and Individual Differences, 23*, 37–53.

Basabe, N., Paez, D., Valencia, J., Gonzalez, J. L., Rimea, B., & Diener, E. (2002). Cultural dimensions, socioeconomic development, climate, and emotional hedonic level. *Cognition and Emotion, 16*(1), 103–125.

Bernelas, L. (2013). *Etudes Internationales – Un regard croisé France/Suede du bien etre au travail des salariés.* Retrieved from http://labrh.opinion-way.com/labrh/etudes-internationales-un-regard-croise-francesuede-du-bien-etre-au-travail-des-salaries.html

Bustreel, A., Cornuau, F., & Pernod-Lemattre, M. (2012). Concilier vie familiale et vie professionnelle en France: les disparités d'horaires de travail. *Relations industrielles, 67*(4), 681–702.

Cartwright, S., & Cooper, C. L. (Eds.). (2008). *Oxford handbook on organisational well-being*. Oxford: Oxford University Press.

Cooper, C. L., & Marshall, J. (1978). *Understanding executive stress*. London: Macmillan.

Danna, K., & Griffin, R. W. (1999). Health and well-being in the workplace: A review and synthesis of the literature. *Journal of Management, 25*(3), 357–384.

Diener, E. (1984). Subjective well-being. *Psychological Bulletin, 95*(3), 542–575.

Diener, E., Diener, M., & Diener, C. (1995). Factors predicting the subjective well-being of nations. *Journal of Personality and Social Psychology, 69*, 851–864.

Duguleana, L. (2014). National cultural dimensions and well-being in some countries of the world, in 2013. *Cross-Cultural Management Journal, XVI, 2*(6), 305–314.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review, 14*(4), 532–550.

Flick, U. (2000). *Episodic interviewing*. In M. W. Bauer & G. D. Gaskell (Eds.), *Qualitative researching with text, image and sound* (pp. 75–92). London: Sage.

Govillot, S. (2013). *Après une naissance, un homme sur neuf réduit ou cesse temporairement son activité contre une femme sur deux*. Insee première, 1454. Retrieved from https://www.insee.fr/fr/statistiques/1281361

Hofstede, G. (1991). *Cultures and organizations. Software of the mind*. London: McGraw Hill.

Hofstede, G. (2001). *Culture's consequences: Comparing values, behaviors, institutions, and organizations across nations*. Thousand Oaks, CA: Sage Publications.

Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). *Cultures and organizations. Software of the mind*. London: McGraw Hill.

Johannes, K., & Hambursin, C. (2012). Conflit social et suicides chez France Télécom. *Recherches en communication, 37*, 193–207.

Lachmann, H., Larose, C., & Penicaud, M. (2010). *Bien-être et efficacité au travail – 10 propositions pour améliorer la santé psychologique au travail*. Retrieved from http://www.dgdr.cnrs.fr/drh/protect-soc/documents/fiches_rps/rapport_lachmann.pdf

Ministère Français. (2017). *L'Etat garant de la protection de la santé et de la sécurité au travail*. Récupéré sur Politiques publiques. Retrieved from http://www.vie-publique.fr/politiques-publiques/regulation-relations-travail/sante-securite-travail/

Netemeyer, R. G., Warmath, D., Fernandes, D., & Lynch, J. G., Jr. (2018). How am i doing? Perceived financial well-being, its potential antecedents, and its relation to overall well-being. *Journal of Consumer Research, 45*(1), 68–89.

O.C. Tanner Institute. (2016). *The impact of excellent employee well-being*. O.C. Tanner.

OECD. (2017a). How's life in France? Retrieved from https://www.oecd.org/statistics/Better-Life-Initiative-country-note-France.pdf

OECD. (2017b). How's life in Sweden? Retrieved from https://www.oecd.org/statistics/Better-Life-Initiative-country-note-Sweden.pdf

OECD. (2018a). Trade Unions: Trade union density, *OECD Employment and Labour Market Statistics* (database). Retrieved from https://doi.org/10.1787/data-00371-en

OECD. (2018b). *OECD compendium of productivity indicators 2018*. Paris: OECD Publishing. Retrieved from https://read.oecd-ilibrary.org/economics/international-productivity-gaps_5b43c728-en#page8

Peiró, J., Ayala, Y., Tordera, N., Lorente, L., & Rodríguez, I. (2014). Sustainable well-being at work: A review and reformulation. *Papeles del Psicólogo, 35*(1), 5–14.

Pelletier, B. (2011). *Les difficultés pour développer le leadership en France*. Gestion des risques interculturels: Entreprises & Management interculturel. Retrieved from http://gestion-des-risques-interculturels.com/risques/les-difficultespour-developper-le-leadership-en-france/

Price, R. H., & Hooijberg, R. (1992). Organizational exit pressures and role stress: Impact on mental health. *Journal of Organizational Behavior, 13*(7), 641–651.

Shinwell, M., & Shamir, E. (2018). Measuring the impact of businesses on people's well-being and sustainability: Taking stock of existing frameworks and initiatives. *OECD Statistics Working Papers*, No. 2018/08. Paris: OECD Publishing. https://doi.org/10.1787/51837366-en

Stiglitz, J. E., Sen, A., & Fitoussi, J. P. (2009). Report by the commission on the measurement of economic performance and social progress. Retrieved from https://ec.europa.eu/eurostat/documents/118025/118123/Fitoussi+Commission+report

Walia, K., & Nishtha. (2018). The relationship between employee wellbeing and spirituality at workplace. *IUP Journal of Organizational Behavior, 17*(3), 28–44.

World Economic Forum. (2016). Global gender gap index 2016. Retrieved from http://www3.weforum.org/docs/GGGR16/WEF_Global_Gender_Gap_Report_2016.pdf

Index[1]

A
Accessories
  automatic gears, 30
  camera with GPS activation, 30
  clipless pedals, 29
  electric gears, 29–30
  first generation Di2, 29
  heart rate monitor, 30
  hydration ystem, 30
  naturalistic conditions, 29
  naturalistic cycling study, 29
  pedal sensor, 30
  pedelecs, 29
  S-pedelecs, 29
Action-oriented rapid prototyping
  experimental crossover design, 20
  iterative process, 17
Adaptation, 56, 63
Aesthetics, 35, 37, 38, 40, 44
Agile organization (A), 72, 76–77
Agility, 72–78
Amazon, 51, 52, 54

B
Biological processes, 37
Biomimicry, 35–44
Blockchain, 52, 55
Bough Bikes Company, 30
Buyer-supplier relationships (BSR), 48–56

C
Children's Hospital of Philadelphia (CHOP), 18
Collaborative processes, 49
Communication, 48, 49
Consumer, 35–39, 44
  demands, 37, 39, 44

[1] Note: Page numbers followed by 'n' refer to notes.

A. Saxena Arora et al. (eds.), *Sustainable Innovation*,
International Marketing and Management Research,
https://doi.org/10.1007/978-3-030-30421-8

Cradle-to-cradle, 39
Cross-cultural
  cultural perspective, 134
  France, 134–139, 142–144
  happy Swedes, 144–145
  political, 135
  Scandinavian, 134
  social, 135–137
  societal, 135
  Sweden, 134–140, 144, 145
  unhappy French, 144–145
Culture
  collective stakeholder commitment, 138
  collectivist, 136
  cross-cultural, 135–137, 140–142, 145
  femininity, 137, 143
  Hofstede, 135–137
  Hofstede's culture map, 134, 144
  individualism-collectivism, 136
  introspection, 136
  loyalty, 136
  masculinity, 140, 143
  power distance, 136, 142, 144
  relatedness, 136
  security-seeking, 137
  uncertainty avoidance, 137, 140, 142
Customer, 35–37, 39, 41, 44

D
Data sensing, 8
Deleterious impact, 28
Design, 35–44
Design thinking, 16–22
  innovations, 22
Disability, 2, 11
Disruptive innovation, 27, 28
Dominant coalition, 103

E
Ecodesign, 39
Electric railway industry, 83, 86, 94
Electronic bikes
  business ecosystem framework, 26
  E-bikes, 28
  solar panels, 30, 31
  solar powered electric bike, 30
Enterprise resource planning (ERP), 50, 51
Environment, 54, 61, 62, 64, 66, 67
Environmental, 37
Evolution, 48, 49, 55
Executive coaching (C), 76–77
Exoskeletons, 2–11
  robotic, 2–11
Experimental psychologists, 88

F
Family businesses
  employees, 106, 111
  family members, 111
  relational assets, 108, 129
  trusting relationships, 120, 124–126
Fellow servant rule
  faulty machinery, 85
  fellow worker's negligence, 84
  Interstate Commerce Commission (ICC), 84
  mechanical enhancements, 85
Flexibility, 49
Functionality, 35, 37, 38, 40, 43, 44
  three-dimensional functionality, 35, 44

G
Gender equality, 138, 142, 144
  masculinity-femininity dimension, 137, 144
Gestalt theory, 36, 37, 44

H
Health and safety, 50
Healthcare, 2
Healthcare industry, 16–22
Health disorders
  antipsychotic, 19
  bipolar, 19
  compression stockings, 22
  deep vein thrombosis, 22
  joint deformities, 19
  pace maker, 22
  rehabilitation, 19
  schizophrenia, 19
  social interaction, 19
H_2ERO PACK, 41–43
Humanistic leadership
  authentic, 74
  cohesion, 78
  courageous, 74
  credible, 74
  effective, 74
  effective leadership, 74, 77, 78
  ethical, 74
  exemplary, 74
  harmony, 78
  honest, 74
  intuition, 75
  leadership principles, 77
  prerequisite, 78
  rational, 75
  responsible, 74
  scientific intelligence, 75
  verticality, 77
Human-robot interaction
  patient-robot interaction, 11
Human walk analysis
  ambulatory disability, 2
  mobility, 2

I
Information technology, 49, 55
  information sharing, 55
Innovation, 49, 54, 55, 66
  design thinking, 82
  incremental, 35–37, 44
  mental processes, 89, 97
  radical, 35–37, 40–41, 44
  selection test for motormen, 89–92, 95
  test's efficacy, 83
International standards, 26
Internet of Things (IoT), 52
iPhone, 40, 41

K
Knowledge transfer
  inside knowledge, 106
  natural immersion, 107, 108, 127
  pure knowledge, 105, 106
  tacit knowledge, 103, 105, 106, 128

L
Leadership (L)
  agile organization (A), 72, 76, 77
  executive coaching (C), 76, 77
  function (F), 77
  L = F (C, A), 77
Leadership styles
  autocratic, 139
  bottom-up approach, 138

Leadership styles (*cont.*)
consensual, 139
decentralised, 139
democratic, 139
hierarchical, 142
inclusive, 139
information sharing, 141
participative leadership style, 141
top down approach, 138
Logistics, 52, 55, 62–64

M
Manufacturers, 50, 52, 65, 66
Manufacturing, 35, 39
Medical industry, 3
health professionals, 8
Module
ankle joint, 10
arm and elbow support, 10
central torso, 8
hip joint, 9
knee joint, 10
Motormen\trolley operators, 82–97
Münsterberg, Hugo, 82–97

O
Orthotic joints
ankle, 10
elbow, 8
knee, 10

P
Performance
Business Process Reengineering (BPR), 82
designer's sensibility, 82
financial performance, 82
Total Quality Management (TQM), 82
work efficiency, 82
Product design
aesthetics, 28
functionality, 28
gestalt theory, 28
product portfolio, 28
symbolism, 28
3D product, 28
Product innovation, 17–18, 21
design masterminds, 17
Psychological testing, 83, 87n2, 92, 95, 95n5, 97
Psychologie Und Wirtschaftsleben, 83
Psychology and Industrial Efficiency, 83, 91
Purchase intention
monetary wealth, 28
willingness to pay, 28
word of mouth (WoM), 28

Q
Quasi-passive lower and upper extremity robotic exoskeleton system (QLUE-REX), 2–11

R
Railway safety
Accident Report Act, 84
collisions, 82
derailments, 82
Safety Institute of America, 83
safety legislation, 89–92
Raw idea, 36, 44
Rheumatoid arthritis (RA), 16, 19–22
Robotic products, 38
Roomba, 38

S
Sensors, 8, 10
Social capital transfer
information, 107, 111, 127

intangible capital, 107
natural immersion, 107, 108, 127
physical capital, 107
planned succession, 102, 107
rushed succession, 107
social networks, 106, 108, 111, 113, 114, 116, 117, 127
sudden succession, 107
Supply chain management
retailers, 50
risks, 51
supplier, 51, 68
transparency, 56
Sustainability, 37, 39
environmental, 37, 39
Sustainability–3 Ps
people, 49, 50, 53–54
planet, 49, 50, 53–54
profit, 49, 50, 53–54
Sustainable family business
family-owned businesses (FOBs), 102–129
intra-family succession, 106
network, 103–129
next generation, 102, 103, 105–109, 116, 121, 126, 127, 129
relationship, 103–129
social capital, 102–129
succession, 102–129
Sustainable leadership
adapt, 76, 78
agile organizations, 72, 76–77
agile principles, 76
agility, 72–78
autonomy, 78
coaching, 72–78
dialogue, 76, 78
dynamic skills, 76
entrepreneurial, 72
executive coaching, 72, 76, 77
freedom, 76
lean thinking, 75
outcome, 76, 78
quality, 74, 76, 77
remediation, 72
transparency, 78
trust, 77, 78
Sustainable leadership orientation
credibility, 103–105, 120, 122–124, 127, 129
delegator, 104
helper, 104
knowledge, 102–129
leader, 104, 114
legitimacy, 103, 104, 123, 127
manager, 102, 104, 118, 119
monarch, 104
skills, 103–106, 127, 128
successor, 102–129
Sustainable materials
aramid, 30, 31
isotruss, 30, 31
Sustainable product design, 37, 38
environmental requirements, 28
lifespan, 27
sustainable transportation, 27
Sustainable well-being at work
musculoskeletal disorders (MSDs), 134
productivity synergy, 135, 144
psychological health, 138
psychosocial well-being, 134
synergy, 134, 135, 144
transcend borders, 145
Symbolism, 35, 37, 38, 40, 44

T

Technology, 35–37

U
User centered design (UCD), 39
User experience (Ux), 35–44
  generate, 16–22
  ideate, 16–22
  raw idea, 20
  user needs, 17, 20
User-oriented design, 35–37
  user design, 43

V
Velcro, 39–41
Volatility-uncertainty-complexity-ambiguity (VUCA), 72

W
Walmart, 48, 52–54
Wearable electronics
  compression, 19
  electrical stimulation, 19
  ingestible sensor, 19
  smart glove, 19
  therapy gloves, 20
  wearable gadgets, 18, 19
  wearable technologies, 16–22
Wearable system, 3
World economies
  China, 18
  emerging economies, 18
  Ghana, 18