Chapter 20
Conclusion and a Way Forward for Managing Complex Tasks

Hassan Qudrat-Ullah

Abstract This is the final chapter of our book, where we have given you a way forward and a future with hope. We urge you to embrace systems thinking to tackle the complex issues of our turbulent times. Together, with a systems thinking-based mindset, we can make this world a better place. Systems thinking is not only a tool but also a way of life. It can help you see the connections, patterns, and dynamics that shape our reality. It can also help you create positive change and innovation in your personal and professional life. We hope that this book has inspired you to become a systems thinker and a systems leader. We hope that you will join us in this journey of learning and discovery, and share your insights and experiences with others. We hope that you will use systems thinking to create a sustainable future for yourself and humanity.

Keywords Systems thinking approach · Bounded rationality · Time constraints · Feedback · Complex tasks · Practical insights · Causal models · Decision-aiding solutions · Theoretical perspectives · Climate change · Healthcare · Education · Digital technologies

20.1 Introduction-Finally!

We have explained the challenges and limitations that human decision makers face in complex tasks, such as bounded rationality, escalation of commitment, time constraints, uncertainty, and biases. We have argued that the systems thinking approach can help us overcome or mitigate these challenges and limitations by expanding our perspective, considering multiple viewpoints, testing our assumptions, learning from feedback, and designing effective solutions. We have demonstrated how we can use causal models to represent the structure and dynamics of complex tasks, and how we can use them to build and test the effectiveness of decision-aiding solutions. We have also presented practical insights that can help us

H. Qudrat-Ullah (✉)
School of Administrative Studies, York University, Toronto, ON M9V 3K7, Canada
e-mail: hassanq@yorku.ca

H. Qudrat-Ullah (ed.), *Managing Complex Tasks with Systems Thinking*, Understanding Complex Systems, https://doi.org/10.1007/978-3-031-40635-5_20

make better decisions while dealing with complex tasks. These insights are derived from the analysis and simulation of the causal models and the decision-aiding solutions. We have provided various examples of theoretical perspectives and innovative causal-loop-modeling-based applications in different domains, such as climate change, healthcare, education, digital technologies, agriculture, and sustainability. We hope that this book has inspired you to apply a systems thinking approach to your complex tasks and to become a better decision-maker and performer.

We have reached the end of this journey, where we have explored systems thinking and its applications in various domains such as education, technology, agriculture, sustainability, and healthcare. We have shared some theoretical and methodological advancements in systems thinking and system dynamics, such as integrating behavioral economics, value networks, and systems engineering. We have shown how these advancements can help us deal with the complexity and uncertainty of real-world problems and systems. We have also presented some examples of how systems thinking can help us tackle some of the most urgent and complex challenges in these domains, such as improving student learning experience and outcomes, fostering problem-solving skills and creativity, exploring gender inequality and solutions for women in science, bridging the digital gap and addressing the IT professional shortage, solving social dilemmas in water management and biosecurity, exploring the systemic causes and effects of land inequality and plastic recycling, assessing the impact of ESG spending on public perception of the oil sands, and improving healthcare policy decisions and outcomes for HIV/AIDS prevention and treatment, N95 mask supply chain, and endangered species conservation. We have demonstrated how to use causal loop modeling and system dynamics simulation to understand and improve the dynamics and feedback of these systems, and how to simulate and compare different scenarios and policies for enhancing system performance. We have also offered some insights and tools for applying systems thinking to our problems and contexts, and for becoming systems thinkers and leaders. We have proposed some principles and practices for developing systems thinking mindset and skillset. We hope that this book has motivated you to use systems thinking to address your challenges and to make a positive difference in the world.

20.2 A Way Forward

As we have seen in this book, systems thinking is a powerful and practical approach to improving human decision making and performance in complex tasks. However, systems thinking is not a one-time or one-size-fits-all solution. It is a continuous and adaptive process that requires constant learning and improvement. Therefore, we encourage the readers to apply the systems thinking approach to their problems and contexts and to seek feedback and learn from their experiences. We also encourage the readers to explore more resources and opportunities for learning and applying systems thinking, such as books, journals, courses, workshops, conferences, communities, and networks. We hope that the readers will continue their journey of systems

thinking and become systems thinkers and leaders who can contribute to a better world.

20.3 Future Research Directions

Besides proving innovative solutions and practical insights for the decision makers of various domains including education, digital technology, agriculture, sustainability in consumption and supply of products and services, and healthcare, here we present some promising research avenues for our researchers across the globe. We will organize these research opportunities thematic-wise.

20.3.1 Theoretical and Methodological Advancements

If you are inspired by the four unique contributions to this theme, you will find many exciting research questions to explore, such as:

If you are interested in reliability assurance of subsea oil and gas production systems (Chap. 2), you will find many exciting research questions to explore in this topic, such as: how to apply the systems engineering approach to other types of offshore oil and gas production systems, such as floating production storage and offloading (FPSO) units, or deepwater production systems, how to extend the systems engineering approach to cover the entire life cycle of offshore oil and gas production systems, from design to decommissioning, and how to incorporate sustainability and environmental aspects, how to integrate the systems engineering approach with other disciplines, such as human factors engineering, safety engineering, or asset management, to optimize the performance and reliability of offshore oil and gas production systems, how to use advanced technologies, such as digital twins, artificial intelligence, or machine learning, to enhance the reliability analysis, testing, and risk management of offshore oil and gas production systems, and how to evaluate the impact of climate change and extreme weather events on the reliability of offshore oil and gas production systems, and how to adapt the systems engineering approach accordingly.

If you are curious about scientific vocations and the PM-SD methodology, you will find many fascinating research questions to explore in Chap. 3, such as: how to adapt and apply PM-SD to other domains and contexts, such as education, health, or environment, and how to compare and contrast its effectiveness and impact across different settings, how to improve and refine the PM-SD methodology, such as by incorporating more advanced tools and techniques for system dynamics modeling and simulation, participatory data collection and analysis, or stakeholder engagement and facilitation, how to explore and understand the underlying mechanisms and factors that influence the development of scientific vocations among children and adolescents, such as motivation, interest, self-efficacy, or social support, how to design

and implement more comprehensive and sustainable interventions for promoting science vocations, such as by integrating PM-SD with other approaches, such as inquiry-based learning, science communication, or mentoring, and how to foster more collaboration and communication among researchers, practitioners, policymakers, and educators in the field of science vocations, and how to create a common language and framework for this interdisciplinary field.

This chapter (i.e., Chap. 4) opens new avenues for research and practice in the field of behavioral economics and system dynamics. Future work in this field could explore how to design and conduct behavioral experiments to inform system dynamics models, how to incorporate more behavioral concepts and theories into system dynamics, how to use more advanced tools and methods for representing and analyzing time, how to apply this approach to more complex and diverse domains and contexts, and how to foster more collaboration and communication between behavioral economists and system dynamicist.

Finally, Chap. 5 of this theme suggests future research directions to improve and expand this interdisciplinary field and to foster more collaboration and communication between value network analysts and causal loop diagrammers. Some interesting research questions are: how to extend and refine the methodology to incorporate other types of systems thinking tools and methods, such as stock and flow diagrams, system archetypes, or system dynamics simulations, how to apply the methodology to different domains and contexts, such as public policy, social innovation, or environmental sustainability, and how to evaluate its impact and effectiveness, how to develop and use more advanced techniques and software for analyzing value networks and causal loop diagrams, such as network analysis, machine learning, or artificial intelligence, and how to foster more collaboration and communication between value network analysts and causal loop diagrammed, and how to create a common language and framework for this interdisciplinary field.

20.3.2 Learning Analytics and Interactive Multimedia with Systems Thinking

Do you want to learn from the three innovative and exceptional contributions to this theme? If so, you will find many fascinating and doable research questions to explore in this theme, such as:

If you are curious about the topics of learning analytics and interactive multimedia experience, you will find many interesting questions to explore in Chap. 6, such as: how can you use causal loop modeling to identify the key feedback loops that link the learning process with the user experience in different domains and contexts of learning? How can you improve and refine the causal loop modeling approach by incorporating more variables and indicators, validating the model with empirical data, or using system dynamics simulation to test different scenarios and interventions? How can you investigate and understand the key mechanisms and factors that

influence the user experience and learning outcomes in multimedia projects, such as motivation, interest, emotion, cognition, or metacognition? How can you design and implement more effective and innovative multimedia projects that enhance the user experience and learning outcomes, such as by using adaptive learning, gamification, storytelling, or social interaction? How can you foster more collaboration and communication among researchers, practitioners, designers, and educators in the field of learning analytics and interactive multimedia experience, and how can you create a common language and framework for this interdisciplinary field?

If you are curious about the topics of system dynamics and education, you will find many interesting questions to explore in Chap. 7, such as: How can you use system dynamics to foster problem-solving skills and creativity in primary-school students in different domains and contexts of learning, such as STEM, social studies, or arts? How can you improve and refine the system dynamics approach by using more advanced tools and techniques for system dynamics modeling and simulation, collaborative teaching strategies, or assessment methods? How can you investigate and understand the key mechanisms and factors that influence the development of problem-solving skills and creativity among primary-school students, such as motivation, interest, emotion, cognition, or metacognition? How can you design and implement more effective and innovative interventions that foster problem-solving skills and creativity among primary-school students, such as by using gamification, storytelling, or project-based learning? How can you foster more collaboration and communication among researchers, practitioners, teachers, and students in the field of system dynamics and education, and how can you create a common language and framework for this interdisciplinary field?

If you are curious about the topics of systems thinking and gender equality in science, you will find many interesting questions to explore in Chap. 8, such as: How can you use systems thinking to address the issue of gender inequality in other domains and contexts of science, such as industry, government, or civil society, and how can you measure and compare the feedback loops and structural factors across different settings? How can you improve and refine systems thinking to address the issue of gender inequality in science, by using more variables and indicators, validating the model with empirical data, or using system dynamics simulation to test different scenarios and interventions? How can you investigate and understand the key mechanisms and factors that influence the development and persistence of gender inequality in science, such as social norms, stereotypes, biases, or power relations? How can you design and implement more effective and innovative strategies and solutions that promote gender equality and equal opportunity in science, by using participatory methods, empowerment approaches, or policy changes? How can you foster more collaboration and communication among researchers, practitioners, policymakers, and educators in the field of gender equality and science, and how can you create a common language and framework for this interdisciplinary field?

20.3.3 Bridging the Digital Gap with Systems Thinking

If you are inspired by the two state-of-the-art applications of systems thinking applications available in this theme, you will find many promising research questions to explore, such as:

If you are curious about the topics of system thinking and AI technology for addressing the digital gap, you will find many interesting questions to explore in Chap. 9, such as: How can you use system thinking and AI technology to address the digital gap in different domains and contexts, such as health, education, or governance? How can you improve and refine system thinking and AI technology to address the digital gap, by using more data sources and indicators, validating the models with empirical evidence, or using human-in-the-loop approaches? How can you investigate and understand the key mechanisms and factors that influence the digital gap, such as social norms, digital skills, infrastructure, or policies? How can you design and implement effective and innovative solutions that use system thinking and AI technology to address the digital gap, such as by using gamification, crowdsourcing, or blockchain? How can you foster collaboration and communication among researchers, practitioners, policymakers, and users in this field, and create a common language and framework for this interdisciplinary field?

Based on your interest in the research presented in Chap. 10, future research directions could explore how to develop and assess systems thinking competencies and skills among different stakeholders, such as leaders, managers, employees, students, and citizens in the IT field. Systems thinking can enhance critical thinking, creativity, collaboration, and communication skills, which are essential for the digital economy. Additionally, future research could examine how to overcome the barriers and risks of adopting emerging digital technologies, such as talent shortages, implementation costs, and security threats.

20.3.4 Addressing Agricultural Issues with Systems Thinking

If the three inspiring contributions to this theme entice you enough to further exploration of the topic then here are several future research opportunities for you:

Future research directions could explore how IoT and System Dynamics can be integrated with other technologies and methods to enhance water management in different contexts and scales (please see Chap. 11). For example, how can IoT and System Dynamics be combined with blockchain, cloud computing, artificial intelligence, or geographic information systems to improve data security, storage, analysis, or visualization? How can IoT and System Dynamics be used with participatory approaches, stakeholder engagement, or social learning to foster collaboration and trust among water users and managers? How can IoT and System Dynamics be adapted to different water systems, such as urban water supply, irrigation, wastewater

treatment, or groundwater management? Future research could also address the challenges and risks of implementing IoT and System Dynamics for water management, such as technical issues, ethical concerns, legal frameworks, or social impacts.

If Chap. 12 inspires you for future research, you could explore how systems thinking and cooperation can be applied to different aspects and dimensions of land inequality, such as land ownership, land use, land governance, land rights, and land value. Systems thinking can help understand the root causes and consequences of land inequality, as well as the feedback loops and interdependencies among various actors and factors involved. Cooperation can help create more inclusive and participatory processes and mechanisms for addressing land inequality, such as multi-stakeholder dialogues, collective action, social movements, and policy advocacy. Future research could also examine how systems thinking and cooperation can be influenced by or influence other global challenges and trends, such as climate change, food security, migration, urbanization, and digitalization. Systems thinking and cooperation can help identify synergies and trade-offs among these challenges and trends, and foster more holistic and integrated solutions.

Are you curious to learn more about this topic after reading Chap. 13? Then this chapter will guide you through several exciting directions for future research, such as how system thinking and cooperation mechanisms can be tailored to different types and levels of biosecurity adherence, such as individual, organizational, or national. System thinking can help understand the factors and motivations that influence people's decisions to cooperate or not in biosafety procedures, as well as the outcomes and impacts of those decisions. Cooperation mechanisms can help design and implement interventions that encourage and support people's compliance with biosafety standards, such as incentives, sanctions, feedback, or recognition. Future research could also examine how system thinking and cooperation mechanisms can be integrated with other approaches and tools to enhance biosecurity adherence, such as risk assessment, scenario planning, simulation modeling, or stakeholder analysis. System thinking and cooperation mechanisms can help develop and evaluate strategies that improve biosecurity performance and reduce biological hazards in various contexts.

20.3.5 Sustainability Science and Systems Thinking

Are you inspired by the two innovative and outstanding contributions to this theme? If so, you will discover many intriguing and practical research questions to pursue in this theme, such as:

Are you eager to learn more about how systems thinking and a System Dynamics model can help you improve plastic recycling and sustainability in Bangladesh? Then Chap. 14 will spark your interest with several fascinating research questions to explore in this theme, such as: How can systems thinking and a System Dynamics model help you understand the current state and challenges of plastic recycling in

Bangladesh, such as the sources, flows, and destinations of plastic waste, the environmental and social impacts of plastic pollution, and the barriers and opportunities for plastic recovery and valorization? How can systems thinking and a System Dynamics model help you suggest efficient techniques for collecting, sorting, and valuing recyclables, such as the use of incentives, communication, education, or technology to increase the participation and awareness of different stakeholders, such as consumers, collectors, recyclers, or policymakers? How can systems thinking and a System Dynamics model help you transform plastic waste into valuable resources and achieve sustainable development goals, such as the use of reverse and circular economy principles to reduce plastic consumption, increase plastic reuse and recycling, and create new markets and jobs for recycled plastic products?

Are you interested in learning more about how system dynamics and ESG spending can help you improve public perception of the Canadian Oil Sands? Then Chap. 15 will offer you several intriguing research questions to explore in this theme, such as: How can system dynamics and ESG spending help you analyze the effects of reinvesting profits from Oil Sands into environmental, social, and governance (ESG) initiatives on various stakeholders, such as First Nations, environmentalists, investors, and the general public? How can system dynamics and ESG spending help you improve the environmental, social, and economic impacts of oil production, such as reducing greenhouse gas emissions, enhancing stakeholder cooperation, and creating new markets and jobs for sustainable oil products? How can system dynamics and ESG spending help you achieve net-zero emissions by 2050, such as using carbon capture, utilization, and storage (CCUS) technology, adopting circular economy principles, and supporting clean energy transition?

20.3.6 Dealing with the Complexity of Healthcare Systems

Do you want to learn how systems thinking can help us address some of the most pressing and complex challenges in healthcare? If you are intrigued by such research questions, then the four unique empirical studies based on systems thinking approaches will engage you with several fascinating research questions, such as:

Are you passionate about learning how to use systems thinking to solve the toughest healthcare problems? Then Chap. 16 will help you explore the following research questions, among others: How can causal loop modeling help you understand and improve the dynamics and feedback loops of healthcare systems, such as the causes and consequences of medical errors, patient safety, and quality of care? How can systems thinking help you see the big picture and the details of healthcare problems, and how to address them holistically and systemically, such as the interactions and interdependencies among health policies, health services, health outcomes, and health determinants? How can systems thinking help you enhance your skills and knowledge in healthcare management, and become a systems thinker and a healthcare leader, such as the competencies and capacities needed to apply

systems thinking tools and methods, communicate systems insights, and facilitate systems change?

If you are interested in learning how to use systems thinking to solve the toughest healthcare problems, then Chap. 17 will immerse you in amazing stories of systems thinking in action for healthcare and will inspire you to explore various research questions, such as: How can a system dynamics simulation-learning environment, SIADH-ILE, help you understand and improve HIV/AIDS management in Canada, using a combined approach for HIV/AIDS prevention and treatment? How can SIADH-ILE enhance your decision-making skills and help you fight against HIV/AIDS, using data from action experiments, a questionnaire, and qualitative feedback from the participants? How can SIADH-ILE help you develop and evaluate strategies that improve biosecurity performance and reduce biological hazards in various contexts?

If you are interested in learning how to protect endangered species from extinction, then this chapter (i.e., Chap. 18) will offer you several exciting directions for future research. You will discover how systems thinking can help you understand and improve the dynamics of conservation efforts for endangered animals, such as: How can a system dynamics model help you compare the outcomes and impacts of different conservation strategies, by simulating the scenarios of conservation and no conservation for these species? How can systems thinking help you take a systemic and holistic approach to conservation, by considering the interrelationships and feedback loops among the various factors that affect the survival and well-being of these species, such as habitat loss, climate change, human-wildlife conflict, poaching, disease, and invasive species? How can systems thinking help you deal with the challenges and limitations of conservation strategies, some of which are controllable and some of which are not, such as ethical issues, social perceptions, legal frameworks, economic incentives, and political will? How can systems thinking help you foster conservation values and actions among the public and policymakers, using tools such as education, communication, advocacy, and stakeholder engagement?

Are you curious about how to understand and prevent the HIV/AIDS epidemic in China? Then Chap. 19 will engage you with several intriguing research questions that you can pursue using systems thinking, such as: How can a system dynamics model help you capture the main modes of transmission and the effects of medical interventions on reducing HIV infection and mortality? How can systems thinking help you create the dynamics of HIV/AIDS under different scenarios and compare the results using time graphs? How can systems thinking help you assess the testing and prevention programs that China has implemented to achieve the UNAIDS 90–90–90 targets and curb the epidemic? How can systems thinking help you propose policy recommendations to address the HIV/AIDS epidemic in China?

20.4 Concluding Remarks

In this book, we have explored systems thinking and its applications in various domains such as education, technology, agriculture, sustainability, and healthcare. We have presented some theoretical and methodological advancements in systems thinking and system dynamics, such as integrating behavioral economics, value networks, and systems engineering. We have shown how these advancements can help us manage the complexity and uncertainty of real-world problems and systems. We have also provided some examples of how systems thinking can help us address some of the most critical and complex challenges in these domains.

To what extent we are successful in achieving our goal of spreading virtues of the systems thinking approach, you, the reader of this book be the judge☺. I would be happy to hear from you at: hassanq@yorku.ca.