

# Digital Technologies for Food Loss and Waste Prevention and Reduction in Agri-Food Supply Chains: A Systematic Literature Review and Research Agenda

Caterina Trevisan  and Marco Formentini 

**Abstract**—Despite the benefits resulting from the use of Industry 4.0 technologies in the agri-food sector, the adoption of digital technologies for preventing and/or reducing food loss and waste (FLW) across the agri-food supply chain is still under investigation. In fact, enhancing and optimizing agri-food supply chain operations through digital technologies would just represent a partial effort if FLW prevention and reduction are not effectively addressed. Although companies are starting to adopt digital technologies for eliminating FLW from their operations, the implementation process and the achieved results are generally presented at a superficial level and practical guidance is still missing. This systematic literature review contributes to theory by developing a framework analyzing the state-of-the-art of adoption of each Industry 4.0 technology across the agri-food supply chain, and providing a research agenda structured around the main themes of research design, digital technologies, contextual differences, governance, and sustainability. Eventually, the study also informs managers in the agri-food industry about the potential implementation of digital technologies for preventing and reducing FLW in across the agri-food supply chain.

**Index Terms**—Agri-food supply chain (AFSC), digital technologies, digitalization, food loss and waste (FLW), industry 4.0.

## NOMENCLATURE

### List of Abbreviations

|      |                                   |
|------|-----------------------------------|
| AFSC | Agri-food supply chain.           |
| AI   | Artificial intelligence.          |
| BDA  | Big data analytics.               |
| CRM  | Customer relationship management. |
| DT   | Digital technologies.             |
| EIS  | Enterprise information system.    |
| ERP  | Enterprise resource planning.     |
| FLW  | Food loss and waste.              |

|      |   |
|------|---|
| FW   | Food waste.                               |
| GPS  | Global positioning system.                |
| ICT  | Information and communication technology. |
| IoT  | Internet of Things.                       |
| ML   | Machine learning.                         |
| PLM  | Product lifecycle management.             |
| RFID | Radio-frequency identification.           |
| RPA  | Robotic process automation.               |
| SLR  | Systematic literature review.             |
| WMS  | Warehouse management system.              |

## I. INTRODUCTION

As a growing number of people is facing food insecurity and the global food systems have been severely tested by a combination of health crisis, climate-related issues, and conflicts, still too much food is lost or wasted throughout the AFSC. Between 25% and 50% of food produced does not reach the consumers, with the majority of losses occurring from the producers to the retailers point in the supply chain [1]. Wasting food has significant negative consequences on social, economic, and environmental sustainability: wasted food in landfills generates about 8%–10% of global greenhouse gas emissions [2], not to mention blue water footprint, land footprint, and biodiversity reduction [3]. Moreover, it leads to an economic cost of around 143 billion euros per year in the 28 European countries alone [4]. Halving per capita global food waste by 2030 is the objective of target 12.3 of UN sustainable development goal [5]; thus, reducing FLW represents a relevant and timely issue.

Several strategies of reducing FLW have been identified, depending also on the supply chain stages considered [6]. Despondi [1] individuates the adoption of technology as one key aspect for food loss reduction, especially in the upstream part of the supply chain. For instance, Industry 4.0 (I4.0) solutions, such as blockchain or IoT, allow the monitoring of the ambient conditions of food products from the harvest until the selling stage, thus detecting their deterioration stage and improving the operations along the entire AFSC [7], [8], [9]. Even in the downstream supply chain stages (i.e., consumption, food service, and food sharing), digital technologies are frequently adopted to avoid or reduce food waste, such as digital platforms

Manuscript received 5 May 2022; revised 31 January 2023; accepted 21 April 2023. This work was supported by the Project “Consumere a Coordinare a Condividere, Bando interno 2020, Covid-19, Università di Trento.” Review of this manuscript was arranged by Department Editor M. Shukla. (Corresponding author: Marco Formentini.)

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Digital Object Identifier 10.1109/TEM.2023.3273110

# Reduction In The Abstract Sciences

**Wang Wei**



## **Reduction In The Abstract Sciences:**

Reduction in the Abstract Sciences Daniel A. Bonevac,1982      The Philosophy of Science Richard Boyd,Philip Gasper,J. D. Trout,1991 The more than forty readings in this anthology cover the most important developments of the past six decades charting the rise and decline of logical positivism and the gradual emergence of a new consensus concerning the major issues and theoretical options in the field As an introduction to the philosophy of science it stands out for its scope its coverage of both historical and contemporary developments and its detailed introductions to each area discussed

**Religion and Reductionism** Idinopulos,Yonan,2018-08-14 This volume on Religion and Reductionism grew out of a conference convened in November 1990 where the participants were asked to respond to the conceptual and methodological problem of reductionism in the academic study of religion The conference focused on the writings of Robert A Segal and his defence of reductionism and criticism of Mircea Eliade s non reductive interpretation of religion At the Miami conference some of the most important and enduring questions were raised 1 What is religion 2 What is religion and or religious meaning 3 How should religion be studied and taught 4 What are the possibilities and limits of social scientific analyses of religious phenomena 5 What is reductionism 6 What is anti reductionism These and other questions on religion and reductionism are widespread and invite serious consideration they help to illuminate the basic issues that are at the core of any study of the world s major religions      **Science Abstracts** ,1900      **Thomas Seebohm on the Foundations of the Sciences** Thomas Nenon,2020-02-03 This book explores the work of Thomas Seebohm 1934 2014 a leading phenomenologist and hermeneuticist It features papers that offer a critical and constructive dialogue about Seebohm s analyses and their implications for the sciences The net result is an in depth study and a helpful overview of Seebohm s general approach and his specific views on various areas of modern science The contributors focus especially upon his final text History as a Science and the System of the Sciences They view this as the culmination and summary of his historical and phenomenological investigations into the foundations nature and limits of modern sciences This includes not just history but the Geisteswissenschaften more generally along with the social and natural sciences as well The essays in this volume reflect that range This volume presents insightful discussions about the nature and legitimacy of the human sciences as sciences and the unique character of the social sciences It will be of interest not just as a matter of historical scholarship but also and above all as an important contribution to phenomenology and to the philosophy of science and the sciences as such It deserves attention by scholars from any philosophical tradition interested in thinking about the foundations of their disciplines and a philosophy of science that includes but is not limited to the natural sciences      *Science Abstracts* ,1922

The Philosophy of Science: N-Z, Index Sahotra Sarkar,Jessica Pfeifer,2006 The first in depth reference to the field that combines scientific knowledge with philosophical inquiry this encyclopedia brings together a team of leading scholars to provide nearly 150 entries on the essential concepts in the philosophy of science The areas covered include biology chemistry

epistemology and metaphysics physics psychology and mind the social sciences and key figures in the combined studies of science and philosophy Midwest      **Reductionism** Richard H. Jones, 2000 Reductionism's approach brings together many of the most interesting questions today in philosophy consciousness and computers and in science issues of complexity and self organization It also presents a brief history of how reductionism has developed in Western philosophy and religion with reference to Indian philosophy on certain issues      *Nuclear Science Abstracts*, 1975      **Ontology** Dale

Jacquette, 2014-12-18 The philosophical study of what exists and what it means for something to exist is one of the core concerns of metaphysics This introduction to ontology provides readers with a comprehensive account of the central ideas of the subject of being This book is divided into two parts The first part explores questions of pure philosophical ontology what is meant by the concept of being why there exists something rather than nothing and why there is only one logically contingent actual world Dale Jacquette shows how logic provides the only possible answers to these fundamental problems The second part of the book examines issues of applied scientific ontology Jacquette offers a critical survey of some of the most influential traditional ontologies such as the distinction between appearance and reality and the categories of substance and transcendence The ontology of physical entities space time matter and causation is examined as well as the ontology of abstract entities such as sets numbers properties relations and propositions The special problems posed by the subjectivity of mind and of postulating a god are also explored in detail The final chapter examines the ontology of culture language and art

Foundations of Software Science and Computational Structures Martin Hofmann, 2011-03-18 This book constitutes the refereed proceedings of the 14th International Conference on Foundations of Software Science and computational Structures FOSSACS 2011 held in Saarbrücken Germany March 26 April 3 2011 as part of ETAPS 2011 the European Joint Conferences on Theory and Practice of Software The 30 revised full papers presented together with one full paper length invited talk were carefully reviewed and selected from 100 submissions The papers are organized in topical sections on coalgebra and computability type theory process calculi automata theory semantics binding security and program analysis      *Reductionism in the Philosophy of Science* Christian Sachse, 2013-05-02 In contemporary philosophy of science ontological reductionism or the claim that everything that exists in the world is something physical is the consensus mainstream position Contrary to a widespread belief this book establishes that ontological and epistemological reductionism stand or fall together The author proposes a new strategy of conservative theory reduction that operates by means of the construction of functional sub concepts that are coextensional with physical concepts Thus a complete conservative reductionism is established that vindicates both the indispensable scientific character of the special sciences and their reducibility to physics The second part of the book works this strategy out using the example of classical and molecular genetics      Reduction - Abstraction - Analysis Alexander Hieke, Hannes Leitgeb, 2013-05-02 Philosophers often have tried to either reduce disagreeable objects or concepts to more acceptable objects or concepts Reduction is regarded attractive by those who subscribe to an ideal of

ontological parsimony But the topic is not just restricted to traditional metaphysics or ontology In the philosophy of mathematics abstraction principles such as Hume's principle have been suggested to support a reconstruction of mathematics by logical means only In the philosophy of language and the philosophy of science the logical analysis of language has long been regarded to be the dominating paradigm and liberalized projects of logical reconstruction remain to be driving forces of modern philosophy This volume collects contributions comprising all those topics including articles by Alexander Bird Jaakko Hintikka James Ladyman Rohit Parikh Gerhard Schurz Peter Simons Crispin Wright and Edward N Zalta

*Computer Science Handbook* Allen B. Tucker, 2004-06-28 When you think about how far and fast computer science has progressed in recent years it's not hard to conclude that a seven year old handbook may fall a little short of the kind of reference today's computer scientists software engineers and IT professionals need With a broadened scope more emphasis on applied computing and more than 70 chap

**Systematicity** Paul Hoyningen-Huene, 2013-05-02 In *Systematicity* Paul Hoyningen-Huene answers the question What is science by proposing that scientific knowledge is primarily distinguished from other forms of knowledge especially everyday knowledge by being more systematic Science is here understood in the broadest possible sense encompassing not only the natural sciences but also mathematics the social sciences and the humanities The author develops his thesis in nine dimensions in which it is claimed that science is more systematic than other forms of knowledge regarding descriptions explanations predictions the defense of knowledge claims critical discourse epistemic connectedness an ideal of completeness knowledge generation and the representation of knowledge He compares his view with positions on the question held by philosophers from Aristotle to Nicholas Rescher The book concludes with an exploration of some consequences of Hoyningen-Huene's view concerning the genesis and dynamics of science the relationship of science and common sense normative implications of the thesis and the demarcation criterion between science and pseudo science

**The Space of Mathematics** Javier Echeverria, Andoni Ibarra, Thomas Mormann, 2012-10-25 No detailed description available for *The Space of Mathematics*

*Philosophy of Science* Wang Wei, 2020-12-29 The book is a translation of the second edition of a much used and research based Chinese textbook As a succinct and issue based introduction to the Western philosophy of science the book brings eight focal issues in the field to the fore and augments each topic by incorporating Chinese perspectives Followed by an overview of the historical framework and logical underpinnings of the philosophy of science the book thoroughly discusses eight issues in the discipline 1 the criteria of cognitive meaning 2 induction and confirmation 3 scientific explanation 4 theories of scientific growth 5 the demarcation between science and pseudoscience 6 scientific realism and empiricism 7 the philosophy of scientific experimentation 8 science and value Not confined to Western mainstream discourse in this field the book also introduces voices of Chinese philosophers of note and adopts a stance that productively combines logical empiricism and Kuhnianism both of which tend to be covered in less detail by many English language textbooks In the final chapter the author offers a prognosis regarding

the future of the discipline based on recent trends This book will be of value to students who study philosophy of science and hope to gain a better understanding of science and technology *Scientific and Technical Aerospace Reports* ,1995 Lists citations with abstracts for aerospace related reports obtained from world wide sources and announces documents that have recently been entered into the NASA Scientific and Technical Information Database **Advancing Culture of Living with Landslides** Kyoji Sassa,Matjaž Mikoš,Yueping Yin,2017-05-16 This book is open access under a CC BY 4 0 license This volume contains peer reviewed papers from the Fourth World Landslide Forum organized by the International Consortium on Landslides ICL the Global Promotion Committee of the International Programme on Landslides IPL University of Ljubljana UL and Geological Survey of Slovenia in Ljubljana Slovenia from May 29 to June 2 2017 The complete collection of papers from the Forum is published in five full color volumes Thisfirst volume contains the following Three forum lectures Background and Content of the Sendai Partnerships 2015 2025 Contribution from the signatory organizations of the Sendai Partnerships Landslide Dynamics ISDR ICL Landslide Interactive Teaching Tools LIT T Progress of the World Report on Landslides WRL International Programme on Landslides IPL Objects History and List of WCoE IPL projects UNESCO KU ICL UNITIWIN Network supporting IPL Landslides Journal of International Consortium on Landslides International Programme on Landslides IPL WCoEs and IPL Projects Landslides and Society Prof Kyoji Sassa is the Founding President of the International Consortium on Landslides ICL He is Executive Director of ICL and the Editor in Chief of International Journal Landslides since its foundation in 2004 Prof Matja Miko is the Forum Chair of the Fourth World Landslide Forum He is the Vice President of International Consortium on Landslides and President of the Slovenian National Platform for Disaster Risk Reduction Prof Yueping Yin is the President of the International Consortium on Landslides and the Chairman of the Committee of Geo Hazards Prevention of China and the Chief Geologist of Geo Hazard Emergency Technology Ministry of Land and Resources P R China IPL International Programme on Landslides is a programme of the ICL The programme is managed by the IPL Global Promotion Committee including ICL and ICL supporting organizations UNESCO WMO FAO UNISDR UNU ICSU WFEO IUGS and IUGG The IPL contributes to the United Nations International Strategy for Disaster Reduction and the ISDR ICL Sendai Partnerships 2015 2025 Encyclopedia of Philosophy and the Social Sciences Byron Kaldis,2013-03-07 This encyclopedia magnificently edited by Byron Kaldis will become a valuable source both of reference and inspiration for all those who are interested in the interrelation between philosophy and the many facets of the social sciences A must read for every student of the humanities Wulf Gaertner University of Osnabrueck Germany Byron Kaldis Encyclopedia of Philosophy and the Social Sciences is a triumph The entries are consistently good the coverage is amazing and he has managed to involve the whole scholarly community in this field It shows off the field very well and will be a magnificent resource for students and others Stephen Turner USF USA Like all good works of reference this Encyclopedia of Philosophy and the Social Sciences is not to be treated passively it provides clear and sometimes controversial material for

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