

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

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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

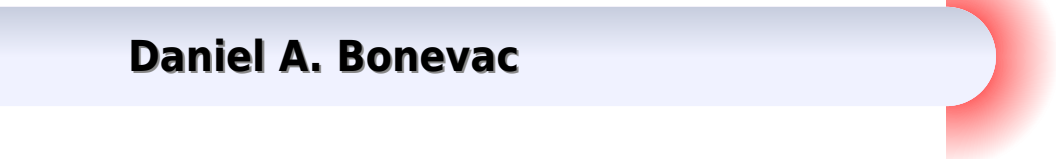
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Reduction In The Abstract Sciences

Daniel A. Bonevac



Reduction In The Abstract Sciences:

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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 **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 *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
 Nuclear Science Abstracts ,1976 **Philosophical Logic and Logical Philosophy** P.I. Bystrov,V. Sadovsky,2012-12-06
Vladimir Aleksandrovich Smirnov was born on March 2 1931 He graduated from Moscow State University in 1954 From 1957 till 1961 he was a lecturer in philosophy and logic at the Tomsk University Since 1961 his scientific activity continued in Moscow at the Institute of Philosophy of Academy of Sciences of the USSR From 1970 and till the last days of his life V A Smirnov was lecturer and then Professor at the Chair of Logic at Moscow State University V A Smirnov played an important role at the Institute of Philosophy of Russian Academy of Sciences being the Head of Department of Epistemology Logic and Philosophy of Science and Technology and the Head of Section of Logic Last years he was the leader of the Centre of Logical Investigations of Russian Academy of Sciences In 1990 91 he founded a new non government Institute of Logic Cognitive Sciences and Development of Personality for performing research teaching editorial and organization activity in the field of humanities At the Department of Philosophy of Moscow State University and at the Institute of Philosophy V A Smirnov and his close colleagues have founded a Russian logical school which brought up many talented researchers who work at several scientific centres in various countries **Science Abstracts. Physics and Electrical Engineering** ,1906

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