Proliferations in Algorithmic Control: Review of the Phenomenon and Its Implications

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Abstract. This research explores algorithmic controls, observing the phenomenon through micro, meso and macro perspectives of contextual analysis. Discovered themes across reviewed papers are classified at the three levels and overlaps. Study across 31 high relevance research papers helps develop an initial nomological network of the primary emerging themes. The proposed network consists of evolution and implication factors for algorithmic control. Factors like individual adoptions, institutional focus areas, technology, mediators, capabilities, regulatory and other guidance were observed of primary relevance and form the 'evolution' side of the network. Significant structural impacts, socio-economic impacts as well as sentiments and concerns were explored form the 'implication' side. The research reveals alignment to chosen industry formats which led to a set of propositions aiding the network development. The intent of this encapsulation is to integrate the emerging knowledge on the phenomenon of algorithmic control through exploratory qualitative research and propose a nomological network indicating evolution and its implications. Understanding these themes is of significance for future academic research and as organizational leaders embrace the power of algorithmic controls for meaningful deployments.

Keywords: Algorithmic Control · Nomological Network · Thematic Analysis · Exploratory Qualitative Research

1 Introduction

Proliferations in artificial intelligence alongside accelerated embrace of digital ways and transactions across organizations, governments unleash new experiences, engagements and outcome paradigms between employees, consumers, citizens, and large institutions. These are increasingly mediated via machine interfaces, intelligences, and algorithms. Emerging focus on future of work, employment, new organizational designs including labor platforms, algorithmic dominance represents an evolving phenomenon. Considered a derivative of the scientific management, algorithms represent the most recent trend in the rationalization or bureaucratization of workplaces. Simultaneously availability of big data enables organizations to predict and control their key processes,

© IFIP International Federation for Information Processing 2024
Published by Springer Nature Switzerland AG 2024
S. K. Sharma et al. (Eds.): TDIT 2023, IFIP AICT 697, pp. 44–54, 2024.
https://doi.org/10.1007/978-3-031-50188-3_5

including material flow optimization, marketing, and work organizations more reliably. Algorithmic management of work is emerging inside and between organizations [1]. Simultaneously, adoption of robotic assistance and collaboration in work processes is likely to increase across industries globally. With such a trend towards applications of algorithm run products, services, and work processes, the need to manage its nuances become critical and triggers the need for structured explorations and establishing associations in this emerging knowledge area. This requires multidimensional explorations to make sense of the transformations and the consequences.

1.1 Research Methodology

The research deploys structured approaches from Saunders methodology [2] and pragmatism in research [3]. The exploration is qualitative and applies inductive research approaches [4]. Themes are assimilated and evaluated across the reviewed literature to categorize into micro-meso-macro and overlapping contexts. Theme based clustering and qualitative analysis is conducted to propose associations indicated through a nomological network. To operationalize multiple keywords like 'Algorithmic Management', 'Algorithm Control', 'Worker Autonomy', 'Gig work', 'Future of work', 'Policy' and others were used to search relevant papers across multiple databases including Scopus, Google Scholar, Web of Science and ScienceDirect. Through the search newer relevant keywords were discovered and used iteratively. With the help of the keywords and the phrases at first 123 peer-reviewed journals, books and book chapters were identified. This initial set was evaluated independently by the researchers to arrive at a subset of 31 research publications in the domain of algorithmic control. This subset bears strong relevance to exploration with minimum variance in choice across the researchers applying purposive sampling methods [5]. Considerations for choice included factors like relevance, keywords, recency of publication, citation of research and importance of the publication platform. The data analysis and extraction, across the 31 articles helps discover key themes and associations to understand the evolution and consequences of algorithmic control. Nomological network [6] is deployed to visualize the thematic associations.

2 Findings

A study across the 31 papers revealed multiple themes emerging in micro-meso-macro and overlapping contexts. Figure 1 indicates a mapping of the themes and the associated context. Further qualitative analysis is conducted to cluster related and associated themes. This helps in reduction of multiple observed variables into meaningful constructs and is instrumental in proposing the nomological network. The following discussion helps understand these constructs and the underlying themes that relate to it.

Based on the key literature reviews, several institutional focus areas have found to be important particularly in the meso-context. Focus on techno-deterministic approach, E-Leadership and data driven management, are some of the major highlights [7, 8], driving 'Algorithmic' training, instructions, evaluations, discipline [9], matching [10], allocation of work and direction, evaluation, rating and reward of workers, planning and strategy [11], outcomes [12], and power [13, 14]. These give rise to concepts such as lifecycle of algorithmic management systems [15], gatekeeping and guiding control, classification of algorithm [9], degrees of automation [10].

The institutional focus areas were plotted in close semblance with individual adoption indicators which were largely observed to be behavioral and contextual. These are particularly relevant in micro-context. The evaluations pointed out to the prevalence of fairness perception [16], trust and emotion [17] bringing it closer to social psychology readings which attempts to decipher the experience of humans with algorithms. The focus on autonomy and experience, lean towards studies which employ socio-technical perspectives [18] to understand organization design. Multiple investigations discuss on value, self-determination, norms, beliefs, power, personal integrity, and ethics delving into dimensions of autonomy, privacy and fairness issues while achieving a fine balance between integrity and compliance [19–23]. This is relevant to establishing algorithmic governance protocols from a meso and wider macro context. Furthering the existing discussions in philosophy, psychology, and human rights on self-determination [22], an extended terminology 'digital self-determination' has gained interest. Digital Self-Determination incorporates the ideas of respecting, embedding, and enforcing peoples' agency [24], rights, interests, preferences, and expectations throughout the digital data life cycle in a mutually beneficial manner for all parties involved [25]. This becomes particularly relevant in design of algorithm mediated work processes and exchanges.

The labour process analysis [26] is relied upon to balance the control, resistance and exploitation discussions in the labour-capital debate, which eventually leads to concerns on de-humanization as evident in multiple instances of algorithmic processes. Gill [27] deciphers a gamut of commitment, control, fulfillment, identity, resistance, regulation issues while understanding the non-optimal positions including sufferings in organizational settings. Gill [27] earmarks to compatibility and coherence as key individual prerogatives in the narratives on algorithms. Meijerink & Bondarouk [28] brings forth the need for personal growth, identity, work satisfaction, sense of accomplishment and sense-making as they study HRM algorithms, which can simultaneously enable/offer and restrain/ limit autonomy and value to workers. There is also a recursive inter-relationship between algorithmic management and worker autonomy/value which they unearth as an outcome. To enhance workers' marketplace bargaining power, Wood, et al. [19] discusses the key individual resources required as skill and reputation. Schafheitle, et al. [29] brings forth a framework to study how datafication technologies, alter or expand traditional organizational control configurations and considers normative concerns as well as employee perceptions to be drivers of re-configuration efforts. Multiple theoretical lenses used in the studies is indicative of the possibilities that lay vested in understanding the ever-evolving individual adoption criteria in relation to working alongside algorithms.

Fig. 1. Algorithm Control Themes relevant in Micro-Meso-Macro and overlapping context.

Several mediator constructs emerge particularly in the works of Rahman [30] which discuss how opaque third-party evaluations in Labor platforms influence workers' reactivity, and what mechanisms contribute to this form of reactivity. Research identifies success on the platform, platform dependence and evaluation setbacks as factors which influence experimental/ constrained reactivity. Bai, et al. [16] considers sensitivity to task difficulty and education levels, as the factors which are impacted by productivity. Wood, et al. [19] explains Marketplace bargaining power to be a key job quality determinant [31] in discussions on particularly remote work. These are relevant in micro-meso context. Continued pursuit around the focus areas manifests through development of varied institutional and individual capabilities attributable to algorithmic control. More and more organizations are building capabilities on people analytics, surveillance [8], feedback calibrations [13], automated work nudges, algorithms to be deployed in regular workplaces [13], which enhances the ability to learn [13]. Hence, we see models with focus on supervised learning, unsupervised learning, reinforcement learning, deep learning [32], technology mediated controls [8], Integrated Assessment Modeling (IAM) [33] etc., further facilitating response speed [13], systems integration, interdependence for decisions [32].

Research indicates that development of capability is mediated via technology proliferation paths. This relates to macro developments in wider technology and innovations. Increased availability of technologies is enabling rise of human-computer interactions, use of digital sensors to collect Big Data alongside proliferations in Artificial Intelligence. Evidence of dominant use cases in large language models and organizational applications [8], with Natural Language Processing (NLP) capabilities leads to multiple insight generations, all feeding into making algorithmic control and governance more robust. Deployment of such capabilities lead to impacts in working models, society, and economy, and in generation of varied sentiments on algorithmic control.

Observed multiple implications from studies, relate to three broad areas including - working with algorithms, socio-economic impacts, amidst emerging sentiments and concerns. Working with algorithms, trends show sub-ordinated agency over platforms [9], work standardization, interface anthropomorphism [13], digital labour platforms, centralization of knowledge, data and control, redefining of tasks and roles [11], job price determination [7] influencing the decisions of organizations and employees with AI recommendations [13]. These decisions typically remain focused towards cost optimization [13], efficiency [10], accuracy, agility, profit maximization [8]. Some other areas observed through research in scenarios of algorithmic control relate to blackbox, sociomateriality, role ambiguity [10], lack of two-way communication [7], and collective productivity [8]. Emerging from a human-machine configuration perspective, possibilities of auditing and augmenting algorithm as well as its acquisition architecture is discussed to enhance organizational reflexivity [34]. This is primarily relevant across meso-macro context.

In work settings with algorithms, research highlights varied outcomes including 'Algorithmic' fatigue, aversion [8], resistance [9, 14], appreciation, co-operation and collaboration, culture, accountability, and formalization. Concepts of autonomy paradox and leader-member exchange fragmentation [8] are seen to be influencing the human machine interactions while negotiating with algorithms [9] along with robotic decisions [7] processes. Embracing of algorithmic controls in work settings, bring out several sentiments and concerns including dominant hype and a looming fear, proliferation of unintended ways [15], 'technological unconscious' and hegemony [14], value-laden assumptions, reductionist approach [33], technostress, information asymmetry [8], undefined locus of control, opacity [30], complexity [13], anxiety [9], uncertainty [10], lack of trust, and confrontation [15]. Interesting academic debates attribute metaphors like Taylorism [7] on steroids to the phenomenon of algorithmic control. These are more relatable at a micro-meso context.

Evolution in algorithmic control and related ecosystems manifests across multiple socio-economic impacts in a macro-context. This is evidenced across research findings on new models of work frameworks, understanding and processes. Gig-economy [35], freelance [8], platform urbanism [10], platformization [11] have not only led to fuzzy organizational boundary [11], but have also led to erosion of democratic control [32], with impacts on equity and democracy [33]. As we move towards a logic-driven society, questions like whether humans might be left out of loop emerge [7]. Scenarios of unequal bargaining [7], biases (including racial) [14], social coalitions [10], trade union non-acceptance, workplace resistance [9], job insecurity and deskilling [11] are emerging considerations and needs necessary mitigations to derive true gains from algorithmic control paradigms and transformed future work processes.

Review of literature reveals multiple means and developments in such mitigations in the form of abiding regulations, compliances and expected guidance. Research indicates moderating influence of regulations and other guidance as algorithmic control gains focus and capabilities globally. These are relevant across meso-macro context. This is of significance in deriving meaningful, purposeful, and sustainable human-centric implications [36]. Literature Review reveals regulations across different geographies, industries and even functions. Narratives around algorithmic controls are observed across ILO code of practice, data rights and laws, AI regulations [7, 11] and new technology agreements [9]. These consider variables like input legitimacy, throughput legitimacy, output legitimacy [8, 32] particularly in relation to algorithmic outcomes, data protection impact assessment [32], national labour representation laws, national interpretation of law [11], protection of personal data [8] including GDPR compliances [9], worker's rights protections, and the lack of protection [7]. Research indicates evidence in algo-activisim [15], leading to increasing narratives around guidance and best practices in adoption of algorithmic control. When it comes to guidance, some dominant findings include FATE (fairness, accountability, transparency, ethics) principles [15]. Fairness-aware machine learning, sensitivity or gradient-based analysis, mimic models, statistical parity, hidden layers [12], procedural equity, logic [33], configurability [14], interpretability and calculated conformity [8] are evolving considerations for algorithm conceptualizations. Amidst such guidance, present deployments and studies of the same reveal concerns on transparency, trust, ethical considerations, policy, practices [8, 11, 15], balancing to establish synergetic relationship [7] between human-centricity and algorithms.

3 Conclusion

The research emphasizes the need for continuous probing and understanding the area of algorithmic control, with interdisciplinary collaborations, and critical engagements. While there are existent alignments among institutional focus areas and individual adoptions, technology mediation is evident, to help embrace the opportunities, moderated by guidance and controls. The evolved nomological network indicates that, deeper understanding of interrelated implications and promotion of inclusive and ethical practices are some of the obligatory needs for harnessing the power of algorithmic control. Overall, a holistic approach combining the socio-legal and ethical considerations would be required for leveraging the benefits of algorithmic control, to serve as a tool for empowerment and societal benefits. In a globalized world with digital proliferations, algorithms are slowly influencing the different actions, processes, and outcomes of the activities. This research is significant in terms of proposing the linkages among the constructs constituting the elements of algorithmic control, which further enables understanding of implications and impacts across wider society, organizations, and individuals. Table 1 constituting the cluster of variables associated with the evolved constructs are presented here followed by Fig. 2 a representation of the nomological network.

Table 1. Associated Variables across the evolved constructs in relation to Algorithmic Control

Concepts (Constructs)	Observations/Variables
Individual adoptions	Perception (Fairness), trust, emotion, autonomy, value, norms, beliefs, experience, privacy, resources (skill, reputation), personal integrity, ethics, self-determination (digital), sense-making, agency, motivation, compatibility, coherence, personal growth, identity, work satisfaction, sense of accomplishment, normative concerns, balance between integrity and compliance
Institutional focus areas	Techno-deterministic approach, E-Leadership, data driven management, **'Algorithmic'** training, instructions, evaluations, discipline, matching, allocation of work and direction, evaluation and rating of workers, and reward of workers, planning and strategy, outcomes, power, lifecycle of algorithmic management systems, gatekeeping and guiding control, classification of algorithm, degrees of automation
Mediators	Success on the platform, platform dependence, evaluation setbacks, sensitivity to task difficulty, education levels, marketplace bargaining power
Capabilities	People analytics, surveillance, feedback calibrations, automated work nudges, algorithms in regular workplaces, ability to learn, supervised learning, unsupervised learning, reinforcement learning, deep learning, technology mediated control, response speed, systems integration, interdependence for decision, Integrated Assessment Modeling (IAM)
Technology	Human-computer interactions, digital sensors, big data, AI, LLMs, NLP

(*continued*)

Table 1. (*continued*)

Concepts (Constructs)	Observations/Variables
Working with Algorithms/ structural impact	Sub-ordinated agency over platforms, Interface Anthropomorphism, digital labour platforms, work standardization, centralization of knowledge, data and control, redefining of tasks and roles, job price determination, cost, efficiency, accuracy, agility, profit maximization, AI recommendations, blackbox, sociomateriality, role ambiguity, lack of two-way communication, collective productivity, modification of power dynamics, **'Algorithmic'** fatigue, aversion, resistance, appreciation, co-operation and collaboration, culture, negotiating with algorithm, robotic decisions, accountability, formalization, autonomy paradox, leader-member exchange fragmentation, cognitive complacency, anticipatory quantification, hidden politics, reactivity (experimental/constrained)
Socio-Economic Impacts	Gig-economy, freelance, platform urbanism, platformization, erosion of democratic control, impacts on equity and democracy, fuzzy organizational boundary, logic-driven society, humans might be left out of loop or humans in loop, unequal bargaining, biases (including racial), social coalitions, trade union acceptance, workplace resistance, job insecurity, deskilling, lack of social security, low pay, social isolation, work fragmentation, causalisation, precarisation, privacy concerns
Sentiments and concerns	Dominant hype and a looming fear, proliferation of unintended ways, 'technological unconscious' and hegemony, value-laden assumptions, reductionist approach, technostress, information asymmetry, fear, locus of control, opacity, complexity, anxiety, uncertainty, lack of trust, confrontation, Taylorism on steroids

(*continued*)

Table 1. (*continued*)

Concepts (Constructs)	Observations/Variables
Regulations	ILO code of practice, data rights and laws, new technology agreements, AI regulations, input legitimacy, throughput legitimacy, output legitimacy, data protection impact assessment, national labour representation laws, National Interpretation of law, protection of personal data, GDPR compliances, worker's rights protection, and lack of protection, algoactivisim
Guidance	FATE principles, fairness-aware machine learning, sensitivity or gradient-based analysis, mimic models, statistical parity, hidden layers, procedural equity, configurability, interpretability, calculated conformity, logic, transparency, trust, ethical considerations, policy, practice, human-in-command, synergetic relationship between human beings and algorithms

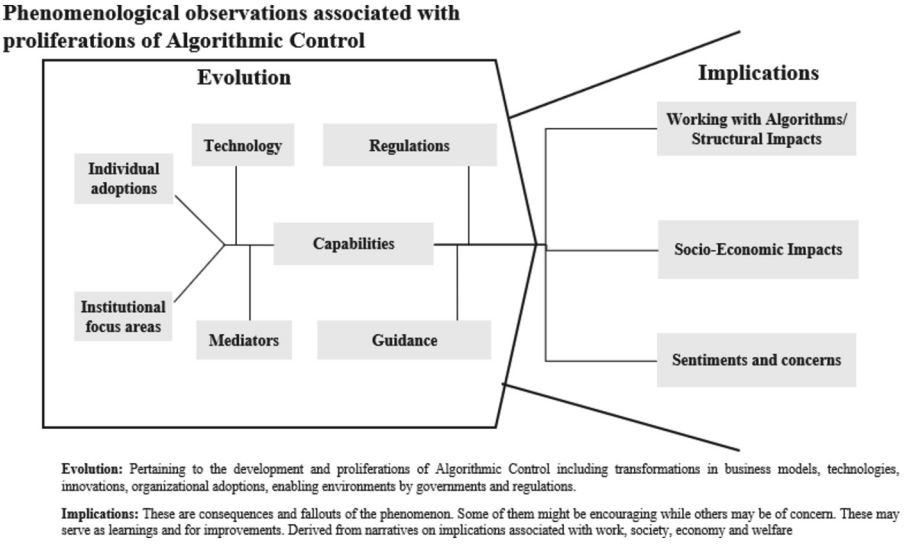

Fig. 2. A figure Nomological Network: Evolution and Implications from Micro-Meso-Macro Context.

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