JLECON

Volume / Cilt: 10, Issue / Sayı: 3, 2023, pp. 141-156
E - ISSN: 2148-4139
URL: https://www.journals.gen.tr/jlecon
DOI: https://doi.org/10.15637/jlecon.2078

Received / Geliş: 23.05.2023
Acccepted / Kabul: 03.07.2023

RESEARCH ARTICLE / ARAŞTIRMA MAKALESİ

Creating complexity matrix for classifying artificial intelligence applications in e-commerce: New perspectives on value creation

Najaf Babayev[1] **Khalil Israfilzade**[2]

[1] PhD Candidate,Vytautas Magnus University, Lithuania, e-mail: najaf.babayev@vdu.lt
[2] PhD, Vytautas Magnus University, Lithuania, e-mail: khalil.israfilzade@vdu.lt

Abstract

This research paper provides a comprehensive exploration of the role of Artificial Intelligence (AI) in value creation within the e-commerce sector, focusing on how task and information complexity affect AI deployment. It first outlines the historical development of value theory and value creation, highlighting the shift from traditional modes to modern interactive and co-creation models. Following this, the paper delves into AI's potential in various e-commerce dimensions including personalization, product recommendation, supply chain efficiency, and more. The centrepiece of the study is a detailed matrix classifying AI into Automated Intelligence, Assisted Intelligence, and Augmented Intelligence, based on the complexity of tasks they execute and the information they analyse. This research study engaged a panel of fifteen industry and academic experts to critically examine and assign complexity scores to various Artificial Intelligence applications within the e-commerce and similar sectors. The experts evaluated task and information complexity, thereby enabling a classification of the applications into a comprehensible matrix. This classification not only provides a guide for AI system design and evaluation but also enhances understanding of their functional dynamics. The paper contributes theoretically by advancing our understanding of AI as a value creator in e-commerce and practically by offering a roadmap for businesses to adopt and leverage AI technologies. As AI continues to revolutionize the e-commerce sector, the findings of this study provide invaluable insights for businesses seeking to gain a competitive advantage in the digital marketplace.

Keywords: Artificial Intelligence, E-Commerce, Value Creation, Ai In Marketing, Digital Marketing

JEL codes: M31, M37, D46

Citation/Atıf: BABAYEV, N. & ISRAFILZADE, K. (2023). Creating complexity matrix for classifying artificial ıntelligence applications in e-commerce: New perspectives on value creation. *Journal of Life Economics*. 10(3): 141-156, DOI: 10.15637/jlecon.2078

Corresponding Author/ Sorumlu Yazar:
Najaf Babayev
E-mail: najaf.babayev@vdu.lt

1. INTRODUCTION

Artificial intelligence (AI) has become an integral part of the e-commerce value creation process, transforming the way businesses operate and interact with their customers. As a result, understanding how AI interacts with task and information complexity is critical. In light of this, the research paper attempts to explore the intricacies of the value creation process and the evolution of value theory within the context of e-commerce and AI technologies.

Firstly, the research explores the historical development and conceptualization of value creation and value theory, laying the groundwork for our subsequent exploration of AI in e-commerce. The paper highlights the paradigm shift from the traditional linear and localized modes of value creation to the modern interactive and value co-creation models, fuelled by advancements in technology and shifts in socio-economic factors. Additionally, it explores the evolution of the concept of value from its ancient philosophical origins to its contemporary significance in marketing, business, and economy, elucidating the intricate relationship between value creation and successful business endeavours.

Next, the paper transitions into an in-depth exploration of AI in e-commerce. The research describes the potential of AI to create value across various dimensions of e-commerce, including personalization, intelligent product recommendations, supply chain efficiency, advertising and sales, enhanced customer service, product content management, visual and voice search, and dynamic pricing optimization. It also touches upon the role of AI in augmenting human intelligence, presenting the concept of augmented intelligence.

The core of this research paper lies in understanding how task and information complexity influence the deployment and functionality of different types of AI in e-commerce. It also presents a comprehensive matrix that categorizes AI into Automated Intelligence, Assisted Intelligence, and Augmented Intelligence, based on the complexity of tasks they carry out and the information they analyse. This matrix will not only serve as a guiding framework for designing and implementing AI systems but will also aid in evaluating their performance and identifying areas of potential improvement.

The paper engages a panel of fifteen experts from various domains, including Marketing Managers, Market Intelligence Analysts, Senior Managers, and Digital Marketing Specialists, all providing their perspectives on the complexities of various AI applications in e-commerce. By employing a 10-point ordinal scale, these experts evaluated AI applications' task and information complexity, producing a comprehensive complexity matrix that offers an innovative method for understanding and strategizing the deployment of AI in e-commerce.

Overall, this research paper provides a holistic view of the value creation process, the evolution of value theory, and the role of AI in e-commerce. It is designed to enlighten readers on the transformative potential of AI in redefining the e-commerce landscape and fostering sustainable business growth through value creation.

2. LITERATURE REVIEW

2.1. The Value Creation Process and the Evolution of Value Theory

The primary objective of every business is to maximize profit, but achieving this without offering value is not a sustainable approach. Value creation is essential for the success and longevity of any firm, regardless of size. It involves developing and delivering products and services that consistently cater to customer needs, fostering brand loyalty. Value creation transforms work and assets into something that fulfils the needs of others, such as tangible goods or intangible offerings like software and innovative ideas (Garcia-Castro & Aguilera, 2015; Windsor, 2017; Chesbrough, Lettl & Ritter, 2018; Sjödin et al., 2020). Successful companies understand that the purpose of any commercial endeavour is to create value for customers, shareholders, and employees. Value creation does not involve selling or persuading; rather, it involves producing a product in its optimal form that caters to customer demands, making them want to purchase it.

The concept of value has been an essential element of marketing (Eggert et al., 2018; Kotler & Armstrong, 2020), business, and especially philosophy since ancient times (Halim, 2012). The value construct came to the forefront in marketing during the 1990s, although it had been discussed by philosophers for centuries prior. Aristotle was one of the first to explore the concept of value, distinguishing between value-in-use (a thing's functional purpose) and value-in-exchange (a thing's worth in trade) (Southerton, 2011; Halim, 2012; Eggert et al., 2018). This differentiation laid the groundwork for future thinkers, such as Adam Smith (Smith, 1776), who further explored the value paradox and introduced the law of supply and demand. However, the connection between the two value perspectives wasn't fully understood until the advent of Hermann Gossen's law of declining marginal utility (Gossen, 1854; Eggert et al., 2018).

Over time, the marketing discipline has also evolved, with the definition of marketing shifting from exchange-based to value-creation-focused. This change emphasizes the importance of customer relationships and the provision of value through these interactions. The American Marketing Association's definition of marketing, last updated in 2017, highlights the importance of creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large (AMA, 2017). As the field of marketing continues to change and adapt, the ability to analyse broad trends will be crucial to understanding and predicting how customer value will evolve in the future.

The evolution of value creation has been driven by technical developments and socioeconomic changes throughout history. Beginning with traditional methods focused on linear organization and localized production, value creation has evolved into interconnected networks, where businesses cooperate and interact with one another (Provan, Fish & Sydow, 2007). Further development led to interactive value creation (Prentice, Wang & Loureiro, 2019), where customers began to engage with companies, sharing knowledge and information. Specifically, the world wide web not only shaped customer views but also provided customers more control over marketing, resulting in a noticeable shift in customer behaviour over time. To conclude, the era of value co-creation emerged, in which consumers, known as "prosumers," actively participate in the production process (Ramaswamy & Ozcan, 2020). This shift necessitates innovative concepts, such as open innovation and crowdsourcing, as well as a bottom-up economics framework that emphasizes decentralization, interconnectedness, and collaboration between participants (Redlich & Moritz, 2016, Redlich, Moritz & Wulfsberg, 2019).

To put into perspective what has been addressed, the concept of value has been a fundamental element in philosophy, economics for centuries and marketing for decades. The evolution of marketing has led to a focus on value creation, emphasizing the importance of customer relationships and providing value through interactions. As the field continues to adapt, analysing trends will be crucial in understanding and predicting customer value's future development. Technical advancements and socioeconomic changes have driven the progression of value creation, leading to an era of value co-creation where consumers actively participate in the production process. Ultimately, successful businesses must prioritize value creation for customers, shareholders, and employees to ensure long-term growth and sustainability in an ever-changing landscape.

2.2. Artificial Intelligence as Value Creation in E-commerce

When most people think of AI, they automatically think of science fiction. Many might believe AI is something that belongs in the future, but in truth, most individuals come into contact with it multiple times each day. Research on artificial intelligence was indeed put on hold for several decades, a phenomenon known as "AI winter." In 1956, Artificial intelligence was coined by John McCarthy, father of AI (Andresen, 2002; McCarthy et al, 2006), has evolved over time and found its way into various business processes.

AI encompasses data mining, natural language processing (NLP), and machine learning (ML), including deep learning (Davenport, 2020; Nichifor, Trifan & Nechifor, 2021). Investment in AI startups has increased significantly, with AI expected to generate up to $15.7 trillion in the global economy by 2030 (Holmes, 2019; PwC, 2021). Therefore, artificial intelligence in e-commerce is a game-changing technology that is altering the face of online buying.

The adoption of AI technologies can lead to competitive advantages by enhancing customer experiences and engagement (Israfilzade, 2021). However, there are concerns about AI causing massive unemployment, though it is more likely that AI will augment human labour rather than entirely replace it.

Although some markets, industries, and businesses are further along in their development than others, AI as a whole is still in an extremely early stage of development at this point (Israfilzade, 2020; 2021). Emerging markets have the ability to overcome their more established competitors from a macroeconomic standpoint, which is an opportunity for these countries.

The combination of human and artificial intelligence is referred to as augmented intelligence (Webb, 2019). While AI applications, such as virtual assistants, bots, and machine learning, have disrupted various industries, the potential for collaboration between humans and machines is tremendous (Israfilzade, 2020; 2021). Technologies can create new tasks, expand existing sectors, and rearrange occupational tasks, rather than merely automating existing systems. As AI technologies continue to develop and integrate into society, the focus should be on leveraging the unique strengths of both humans and machines to create a more efficient and innovative future.

Therefore, it is evident that AI has emerged as a powerful tool for boosting sales and optimizing operations (Samek, Wiegand & Müller, 2017, Borges et al., 2021; Israfilzade, 2021). Even smaller online retailers have begun adopting technology with AI capabilities. According to PwC (2021), the most substantial economic benefits from AI in the coming years will likely arise from increased productivity in e-commerce, achieved by automating routine tasks and enhancing employee skills. Industries like manufacturing and transportation, which involve numerous operational processes amenable to automation, are expected to experience the most significant productivity gains from AI.

In light of the theoretical foundation that pertains to the co-creation of customer value in e-commerce, it is now understood that AI can act as a value-creation source within this setting (Samek et al., 2017; Melović et al., 2020; Soni, 2020; Huang & Rust, 2021a; 2021b; Panigrahi & Karuna, 2021; Nimbalkar & Berad, 2021; Moura, Reis & Rodrigues, 2021; Borges et al., 2021; Nichifor et al., 2021; Bawack et al., 2022). However, given the dynamic nature of this industry, it constantly evolves through the introduction of new e-commerce applications. Stated differently, two decades ago, AI-powered e-commerce apps were scarce and contributed minimally to value creation. Reflecting on the theoretical exposition, modern AI has started to diversify significantly. This paper reviews the literature thoroughly to discuss various modes of value creation attributed to the application of AI. These categories include AI Personalization, Intelligent Product Recommendations, Improved Products & Services, Supply Chain Efficiency, Advertising & Sales, Enhanced Customer Service, Product Content Management, Visual & Voice Search, and Dynamic Pricing Optimization (Table 1). Therefore, the table below shows the classification of these categories and the relevant studies supporting each category.

From the given table 1, it's evident that AI has a significant impact on various aspects of e-commerce, ranging from personalization to supply chain management. Here are a few key observations:

1. AI Personalization: In the era of customer-centric services, AI offers sophisticated personalization capabilities, enabling businesses to tailor their offerings to individual customer needs. This enhances the customer experience and boosts customer loyalty.

2. Intelligent Product Recommendations: AI can analyze user behaviour, preferences, and history to recommend products, leading to increased engagement and potentially higher sales.

3. Improved Products & Services: AI tools can analyze vast amounts of data to provide insights and make predictions, enabling businesses to optimize their offerings and improve conversion rates. This includes predicting customer churn, enhancing the user experience, and optimizing conversion rates.

4. Supply Chain Management: AI can streamline and automate various aspects of the supply chain, including demand prediction, route optimization, and task automation. This increases efficiency, reduces costs, and can lead to a more responsive and flexible supply chain.

5. Advertising & Sales: AI can help businesses to optimize their advertising efforts, including lead generation and campaign tracking. It also aids in customer segmentation and targeting, ensuring marketing efforts reach the right audience.

6. **Improved Customer Service**: With AI, businesses can provide timely and efficient customer service, such as through chatbots. This can help to improve customer satisfaction and loyalty.

7. Product Content Management & Visual and Voice Search: AI can help in improving content creation and optimizing search algorithms, including image search and recognition, which could potentially increase the visibility of products and improve customer experience.

8. Dynamic Pricing Optimization: AI can dynamically adjust prices based on a variety of factors, including demand, inventory, and competitors' prices, potentially increasing sales and profits.

The literature review has yielded an initial list of 32 items (refer to Table 2). These items have been categorized into nine areas of application for Artificial Intelligence: AI Personalization, Intelligent Product Recommendations, Enhanced Products & Services, Supply Chain Management,

Table 1. Classification of AI applications in forms of value creation

Forms of Value Creation	Relevant Studies
AI Personalization	Panigrahi & Karuna, 2021; Kumar & Kumar, 2021; Moura, Reis & Rodrigues, 2021; Israfilzade, 2021; Bawack et al., 2022
Intelligent Product Recommendations	Kumar & Trakru, 2020; Pallathadka et al., 2021; Nimbalkar & Berad, 2021
Improved Products & Services	Soni, 2020; Panigrahi & Karuna, 2021; Kumar & Kumar, 2021; Bawack et al., 2022
Supply Chain Efficiency	Pindyck & Rubinfeld, 2017; Kumar & Trakru, 2020; Nimbalkar & Berad, 2021; Yang, Feng & Whinston, 2022
Advertising & Sales	Pindyck & Rubinfeld, 2017; Shukla, 2019; Panigrahi & Karuna, 2021; Micu et al., 2021; Yang, Feng & Whinston, 2022
Enhanced Customer Service	Kumar & Trakru, 2020; Soni, 2020; Nimbalkar & Berad, 2021; Panigrahi & Karuna, 2021
Product Content Management	Soni, 2020; Kumar & Kumar, 2021; Micu et al., 2021; Barla, Cuneo & Nunzi, 2022
Visual & Voice Search	Kumar & Trakru, 2020; Pallathadka et al., 2021; Nimbalkar & Berad, 2021; Kumar & Kumar, 2021; Israfilzade, 2021
Dynamic Pricing Optimization	Shukla, 2019; Panigrahi & Karuna, 2021; Yang, Feng & Whinston, 2022

Advertising & Sales, Superior Customer Service, Product Content Management, Visual & Voice Search, and Dynamic Pricing Optimization.

This table 2 structure groups all applications under each AI dimension together. It provides a quick overview of the range of applications within each AI dimension.

3. METHODOLOGY

This research study primarily comprises two sections - the creation of a matrix for different types of Artificial Intelligence based on complexity, and the formation and consultation of an expert panel. Both sections hold pivotal roles in the research design and its execution.

The methodology for this research is designed to classify various AI applications in e-commerce based on complexity. An expert panel was constituted for the task. The experts were drawn from both academia and industry, and their selection was based on their specialized knowledge in the field of AI technologies. The process was designed to ensure a thorough and objective assessment of all value-creation measurement items within the domain of AI applications for e-commerce.

3.1. Creating Complexity Matrix of the Various AI Types

Task complexity and information complexity are essential dimensions for understanding the deployment and functionality of Artificial Intelligence in fields such as e-commerce. These complexities not only characterize the nature of tasks and information that AI processes but also help differentiate between various AI applications, elucidating their capabilities. Furthermore, understanding these complexities aids in the design and implementation of AI systems, and assists in estimating the necessary computational resources, level of algorithm sophistication, and human oversight required. Lastly, these complexities serve as key metrics in evaluating the performance of AI systems, helping to identify areas of potential improvement, thereby contributing to the continuous development and refinement of AI applications.

The three distinct types of Artificial Intelligence that are utilized in e-commerce, namely Automated Intelligence, Assisted Intelligence, and Augmented Intelligence, are largely determined by the complexity of the tasks they

Table 2. AI applications contributing to value creation in e-commerce.

Item No.	AI Application Dimensions	E-commerce AI Applications
1-3	**AI Personalization**	Personalized product and services through AI, Real-time content personalization, AI-personalized ads
4-6	**Intelligent Product Recommendations**	Recommendation Systems, New content suggestion, AI-powered email recommendations
7-12	**Enhanced Products & Services**	Conversion Rate Optimization, Retail Analysis, Product Description Analysis, Improved user experience, Customer churn prediction, User journey analysis
13-19	**Supply Chain Management**	Demand prediction, Optimizing future performance, Route optimization, Task Automation, Automated Order Placing System, Self-Checkout Systems, Automated Warehouses
20-23	**Advertising & Sales**	Lead Generation, Campaign Tracking & Analysis, Customer Segmenting and Targeting, AI-powered Display Retargeting
24-25	**Superior Customer Service**	Chatbots, Customer Feedback System
26-27	**Product Content Management**	Improved content creation, AI-generated keyword (SEO)
28-30	**Visual & Voice Search**	Improved search algorithm, Image search on e-commerce, Image Recognition
31-32	**Dynamic Pricing Optimization**	Price Optimization, Inventory Pricing

carry out and the information they analyse. Figure 1 provides a matrix illustrating this concept.

Information complexity refers to the organization and volume of the data. Some data might be well-organized, stable, and limited in volumes, such as budgeting or sales data. Conversely, other data may be unstructured, volatile, and high-volume, like social media, visual information, and sensor data.

Task complexity, on the other hand, could range from repetitive, predictable, and rule-based tasks such as credit decisions or recommendation engines to more complex, unpredictable tasks that require human judgment, such as tasks involving the judgment and creativity of research scientists, designers, and financial experts.

Consequently, table 3 provides a concise summary of the categorization of AI types based on their task complexity and information complexity. Automated Intelligence is characterized by low task complexity and low information complexity, as it focuses on automating routine and non-routine tasks without requiring new techniques. Assisted Intelligence, on the other hand, can handle tasks with either high information complexity or high task complexity, but not both simultaneously. It can manage tasks that involve either complex information or complex tasks, but not both together. Finally, Augmented Intelligence is associated with high task complexity and high information complexity, making it capable of handling complex tasks and analysing complex information. The following table presents a summary of the characteristics associated with each AI type:

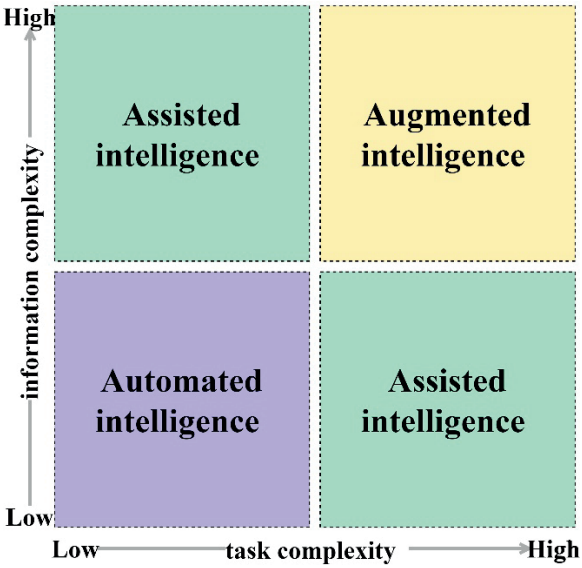
This classification offers valuable insights into the appropriate application of each type of AI in various e-commerce scenarios. It allows businesses to identify the most suitable AI type based on the complexity of tasks and information they need to handle, aiding in the design and implementation of AI systems.

3.2. Classifying the various AI Applications by the Expert Panel

A specially organized panel of experts was assembled for the task at hand. These experts, drawn from both academia and industry, were invited to serve as panellists in the content validation process through email invitations or dedicated meeting sessions. The selection was premised on their specialized knowledge in the field of AI technologies.

In establishing the size of the panel, there was a variety of perspectives to consider. Suggestions for the ideal number of experts to evaluate an instrument ranged between 2 and 20 (Zamanzadeh et al., 2015; Boateng, 2018).

Figure 1. Matrix of the various AI types in e-commerce based on complexity levels.



However, it is generally recommended that a minimum of 5 individuals be involved to ensure adequate control over unanticipated agreements.

Of the twenty-three experts invited, only fifteen responded. Thus, the content validity was evaluated by a team of fifteen experts, which included Marketing Managers, Data Analysts, Senior Data Scientists, and Digital Marketing Specialists, among others (See Appendix 1). In this study, all panel members provided informed consent to participate and independently assessed the validity of all value-creation measurement items.

Experts were prompted to examine the defined dimensions and their corresponding items with an objective lens before assigning a score to each. Panel members were also encouraged to provide feedback, either verbally or in written form, to enhance the relevance and significance of items within the domain of AI applications for value creation.

In academic discourse, the methodology for evaluating certain factors or variables is often as important as the results themselves. In this context, these factors--task complexity and information complexity of AI applications--are evaluated on a 10-point ordinal scale.

An ordinal scale is a scale that allows for rank order by assigning a value to a variable. In this case, the variable is the complexity of tasks and information associated with different AI applications. The use of a 10-point scale as opposed to a smaller scale, such as a 5-point scale, prevents a limited matrix of AI applications. This means that a larger scale allows for a more nuanced evaluation of the variables at hand.

The range of responses on this scale, from 1 to 5, signifies low complexity, while a range from 6 to 10 indicates high complexity. This dichotomy allows for a clear distinction between applications of lower and higher complexity, respectively.

Justification of the research. This bifurcated research methodology provides a comprehensive assessment system for understanding the complexity of AI applications in e-commerce. The complexity matrix allows for a systematic and detailed analysis, while the expert panel offers a range of perspectives to ensure reliability and validity. Consequently, this methodology facilitates consistent, reproducible, and interpretive findings crucial for academic research in this complex and fast-evolving field.

3.2.1. The Result of Classifying Various AI Applications

The complexity values assigned to each AI application help to plot them within a complexity matrix. Figure 2, as referenced in the text, is an illustrative representation of this matrix, where the horizontal axis represents task complexity, and the vertical axis represents information complexity. This visualization provides an accessible and comprehensive overview of how different AI applications are distributed based

Table 3. Categorization of AI Types based on complexity levels.

AI Type	Task Complexity	Information Complexity	*Example*
Automated Intelligence	Low	Low	Automates routine and non-routine tasks without the need for new techniques
Assisted Intelligence	Low (with high information complexity) or High (with low information complexity)	High (with low task complexity) or Low (with high task complexity)	Manages tasks with either high information complexity or high task complexity but not both simultaneously
Augmented Intelligence	High	High	Handles complex tasks and analyses complex information

on their relative complexities.

Table 4 provides a comprehensive evaluation of various AI applications in the e-commerce domain based on their information complexity and task complexity. Each application is assessed and categorized according to its suitability for different AI types: Augmented Intelligence, Assisted Intelligence, or Automated Intelligence.

The evaluations highlight the specific characteristics associated with each AI application. *For example*, AI Personalization involves tailoring e-commerce products and services to individual customer preferences, indicating a high information complexity (score: 8) and moderate task complexity (score: 5). This suggests that Augmented Intelligence, with its capability to handle complex tasks and analyze complex information, is the suggested AI type for this application.

The table 4 further evaluates a range of AI applications across different dimensions, including Improved Products & Services, Supply Chain, Advertising & Sales, Improved Customer Service, Product Content Management, Visual & Voice Search, and Dynamic Pricing Optimization. Each application is assessed based on its complexity levels, aiding in determining the most suitable AI type for its implementation.

By systematically evaluating and categorizing AI applications in e-commerce based on their complexity, businesses can make informed decisions regarding the deployment of AI technologies. This assessment provides valuable guidance in selecting the appropriate AI type for each application, ensuring optimal performance and value creation in the e-commerce sector.

Based on table 4, it is evident that Assisted, Augmented, and Automated Intelligence have distinct roles within the e-commerce industry.

a. Augmented Intelligence:

Augmented Intelligence involves AI systems working in collaboration with human intelligence to enhance cognitive performance, including learning, decision-making, and new experiences. In the table 4, it is noticeable that Augmented Intelligence is predominantly suggested for tasks with high complexity, both in terms of information and the tasks themselves. These

Figure 2. Visually classifying the various AI applications in e-commerce on complexity

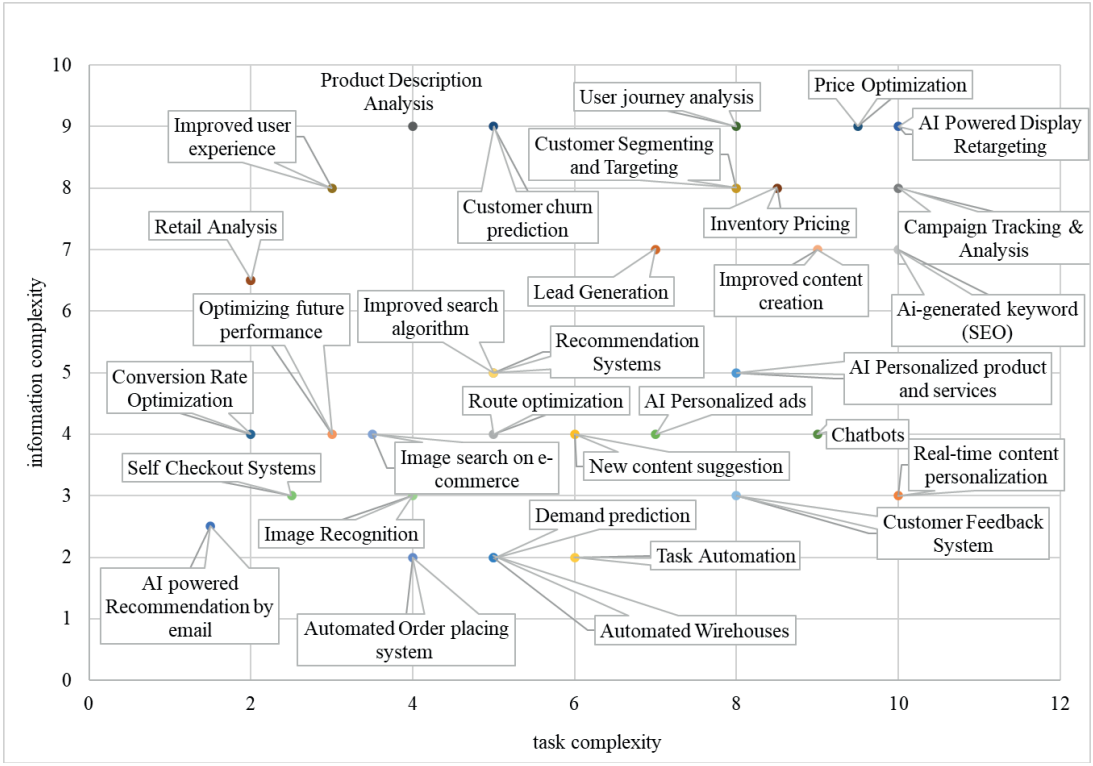


Table 4. The evaluations AI Applications in E-commerce provided by the experts

Dimensions	Items	Information Complexity	Task Complexity	Scope and AI Interpretation	Suggested AI Type
AI Personalization	AI Personalized product and services	8	5	AI tailoring e-commerce products/services to individual customer's preferences	*Augmented Intelligence*
	Real-time content personalization	10	3	Personalizing e-commerce content in real-time based on customer interactions	*Assisted Intelligence*
	AI Personalized ads	7	4	AI serving customized ads to users based on their behaviour and preferences	*Assisted Intelligence*
Intelligent Product Recommendations	Recommendation Systems	5	5	AI suggesting products based on user's past behaviour and preferences	*Augmented Intelligence*
	New content suggestion	6	4	AI suggesting new content based on user's interest and interaction patterns	*Assisted Intelligence*
	AI-powered Recommendation by email	2	3	AI generating personalized product recommendations via email based on user data	*Automated Intelligence*
Improved Products & Services	Conversion Rate Optimization	2	4	AI improving the rate of user conversion through optimization of sales funnels	*Automated Intelligence*
	Retail Analysis	2	7	AI performing analysis on retail data for insights and improvements	*Assisted Intelligence*
	Product Description Analysis	4	9	AI analyzing product descriptions to improve product understanding and categorization	*Assisted Intelligence*
	Improved user experience	3	8	AI enhancing the user experience through personalized interfaces and interactions	*Assisted Intelligence*
	Customer churn prediction	5	9	AI predicting customer churn to help in retention strategies	*Augmented Intelligence*
	User journey analysis	8	9	AI analyzing user journeys to understand and enhance the user experience	*Augmented Intelligence*
Supply Chain	Demand prediction	5	2	AI predicting product demand for better inventory management	*Automated Intelligence*
	Optimizing future performance	3	4	AI optimizing future supply chain performance based on past data	*Automated Intelligence*
	Route optimization	5	4	AI optimizing delivery routes for efficiency and cost reduction	*Automated Intelligence*
	Task Automation	6	2	AI automating routine supply chain tasks for efficiency	*Automated Intelligence*
	Automated Order placing system	4	2	AI system for placing orders automatically based on inventory status	*Automated Intelligence*
	Self-Checkout Systems	3	3	AI powered self-checkout systems for improved customer experience	*Automated Intelligence*
	Automated Warehouses	5	2	AI managing warehouse operations for optimized inventory management	*Automated Intelligence*

Table 4 (Continue). The evaluations AI Applications in E-commerce provided by the experts

Advertising & Sales	Lead Generation	7	7	AI identifying potential customers for targeted advertising	*Augmented Intelligence*
	Campaign Tracking & Analysis	10	8	AI tracking and analyzing advertising campaigns for optimization	*Augmented Intelligence*
	Customer Segmenting and Targeting	8	8	AI segmenting customers and targeting them with personalized ads	*Augmented Intelligence*
	AI Powered Display Retargeting	10	9	AI retargeting potential customers with personalized display ads	*Augmented Intelligence*
Improved Customer Service	Chatbots	9	4	AI powered chatbots for improved customer interaction and support	*Assisted Intelligence*
	Customer Feedback System	8	3	AI analyzing customer feedback for insights and improvements	*Assisted Intelligence*
Product Content Management	Improved content creation	9	7	AI aiding in the creation of enriched and optimized content for better user engagement	*Augmented Intelligence*
	AI-generated keyword (SEO)	10	7	AI generating effective keywords for SEO to enhance visibility and reach	*Augmented Intelligence*
Visual & Voice Search	Improved search algorithm	5	5	AI refining search algorithms for faster and more accurate results	*Assisted Intelligence*
	Image search on e-commerce	4	4	AI enabling image search functionality on e-commerce platforms	*Automated Intelligence*
	Image Recognition	4	3	AI recognizing and interpreting images for various applications such as product identification	*Automated Intelligence*
Dynamic Pricing Optimization	Price Optimization	10	9	AI dynamically adjusting prices based on demand, supply, and other factors	*Augmented Intelligence*
	Inventory Pricing	9	8	AI optimizing inventory pricing based on various influencing factors	*Augmented Intelligence*

tasks often require a nuanced understanding or advanced analytical capabilities, such as lead generation, campaign tracking, customer churn prediction, user journey analysis, AI-powered display retargeting, and dynamic pricing optimization. In conclusion, Augmented Intelligence is academically perceived as an effective way to tackle high-complexity tasks that benefit from human-AI collaboration.

b. Assisted Intelligence:

Assisted Intelligence is where AI systems help humans with tasks but without any self-learning or autonomous decision-making capabilities. Assisted Intelligence is commonly suggested for tasks with moderate information and task complexity. Examples from the table 4 include real-time content personalization, AI personalized ads, new content suggestions, and retail analysis. Assisted Intelligence also plays a crucial role in improving customer service through AI-powered chatbots and customer feedback analysis. Thus, academically, Assisted Intelligence is understood as a reliable AI application to enhance efficiency and effectiveness in moderately complex tasks without the necessity of autonomous decision-making.

c. Automated Intelligence:

This AI type appears primarily in supply chain applications such as demand prediction, performance optimization, route optimization, task automation, automated order placing, and in managing automated warehouses. It's also applied in generating product recommendations via email and conversion rate optimization. Automated Intelligence is typically engaged for tasks requiring high levels of automation, routine tasks, or those needing real-time responses based on predefined rules and parameters. This form of AI is designed to work autonomously, often without any human intervention, making it suitable for tasks that demand high efficiency and speed.

In assumption, the choice between Augmented, Assisted, and Automated Intelligence largely depends on the complexity and requirements of the task. While Augmented Intelligence tends to be employed for complex tasks requiring strategic decisions, Assisted Intelligence often aids in tasks that involve continuous learning from user behaviour and immediate decision-making based on these learnings. On the other hand, Automated Intelligence is primarily chosen for tasks that can be fully automated to increase efficiency and speed.

4. CONCLUSION

The expanding field of artificial intelligence has redefined the way we perceive and conduct business, with e-commerce being one of the industries where it has demonstrated transformative value. This study aimed to investigate AI as a source of value creation within the e-commerce sector. The paper began by providing a theoretical foundation, discussing the origins and evolution of AI, its importance in modern business processes, and the anticipated economic impact it holds for the future.

Through a detailed review of the extant literature, the paper identified various ways in which AI contributes to value creation in e-commerce, including personalization, intelligent product recommendations, product and service enhancement, supply chain efficiency, advertising and sales optimization, improved customer service, product content management, visual and voice search capabilities, and dynamic pricing optimization. These areas were supported by an extensive list of AI applications contributing to value creation in e-commerce, which was then classified according to the complexity of tasks and information they handle.

Consequently, the paper further identified three distinct types of AI - Automated Intelligence, Assisted Intelligence, and Augmented Intelligence - based on their capacity to process varying degrees of task and information complexity. This classification can help businesses in making informed decisions about the right AI applications to employ based on their specific requirements.

In the process of classifying the AI applications, research was leveraged by an expert panel drawn from academia and industry, who evaluated the complexity of tasks and information associated

with each AI application on a 10-point ordinal scale. This not only validated our proposed classification but also resulted in an insightful complexity matrix, providing a comprehensive understanding of how various AI applications are distributed based on their relative complexities.

The implications of this study are multifold. From a theoretical standpoint, it advances the current understanding of AI as a value creator in e-commerce, offering a comprehensive classification of AI applications based on their complexity. From a practical perspective, it offers a roadmap for businesses, particularly those in the e-commerce sector, to understand, adopt, and leverage AI technologies for enhancing their operational efficiency, customer experience, and ultimately, their bottom line.

Despite the significant strides made by AI in e-commerce, it's important to note that the field is still in its early stages. As such, businesses must be open to continuous learning, adaptation, and transformation as AI continues to evolve and revolutionize the business landscape. As we continue to explore the potential of AI in e-commerce, the focus should be on leveraging the unique strengths of both humans and machines to create a more efficient, innovative, and inclusive future.

In conclusion, the emergence of AI in e-commerce offers an exciting prospect for value creation. Businesses that are proactive in adopting AI technologies and aligning them with their business strategies stand to gain a competitive advantage in the ever-evolving digital marketplace. The findings of this study serve as a beacon, guiding businesses on their journey of AI integration and value creation.

4.1. Future Works and Limitations

The current paper presents numerous of opportunities for future research. Such studies will allow us to comprehend the complexity of AI applications in e-commerce and beyond in greater depth. These are the **future research directions**:

Cross-Sector analysis: Further studies could be conducted across different sectors to see if the complexity classification holds true beyond e-commerce.

Temporal assessment: Given the rapid advancements in AI technology, it would be beneficial to conduct this assessment over time to track the evolution of AI applications' complexity.

Comparative analysis: It would be insightful to conduct a comparative analysis using different complexity matrices, thereby potentially highlighting additional insights into the application of AI in e-commerce.

Inclusion of additional complexity factors: Future research could also aim to include other factors contributing to complexity, thereby providing a more comprehensive understanding of AI application complexity.

Similar to other academic endeavours, our research is not exempt from limitations. Acknowledgement of these factors is necessary in order to fully comprehend the extent and potential practicality of our findings. The study was subject to the following limitations:

Subjectivity in expert assessment: Despite efforts to reduce bias in expert evaluations, subjectivity could still play a role in the classification of AI applications' complexity. Each expert brings in their unique perspective and experience which might influence their ratings.

Expert panel size: Although the study included fifteen experts, which is within the acceptable range for such assessments, the conclusions drawn might still be limited due to the relatively small size of the expert panel.

Specificity of the domain: The panel was heavily drawn from individuals with specific expertise in AI and e-commerce. Therefore, the applicability of the findings may be limited in other sectors or disciplines.

REFERENCES

AMA (2017). *Definitions of Marketing by American Marketing Association*. Retrieved May 2022, from https://www.ama.org/the-definition-of-marketing-what-is-marketing/

ANDRESEN, S. L. (2002). John McCarthy: father of AI. *IEEE Intelligent Systems, 17(5),* 84-85.

BARLA, A., CUNEO, M., & NUNZI, S. R. (2022). AI-based component management system for structured content creation, annotation, and publication. In *AHFE international*. https://doi.org/10.54941/ahfe1001009

BAWACK, R. E., WAMBA, S. F., CARILLO, K. D. A., & Akter, S. (2022). Artificial intelligence in E-Commerce: a bibliometric study and literature review. *Electronic Markets*, 1-42.

BOATENG, G. O., NEILANDS, T. B., FRONGILLO, E. A., MELGAR-QUIÑONEZ, H. R., & YOUNG, S. L. (2018). Best practices for developing and validating scales for health, social, and behavioral research: a primer. *Frontiers in public health*, *6*, 149.

BORGES, A., LAURINDO, F. J. B., DE MESQUITA SPINOLA, M., GONÇALVES, R. F., & DE MATTOS, C. A. (2021). The strategic use of artificial intelligence in the digital era: Systematic literature review and future research directions. *International Journal of Information Management*, *57*, 102225. https://doi.org/10.1016/j.ijinfomgt.2020.102225

CHESBROUGH, H., LETTL, C., & RITTER, T. (2018). Value creation and value capture in open innovation. *Journal of Product Innovation Management*, *35*(6), 930-938.

DAVENPORT, T., GUHA, A., GREWAL, D., & BRESSGOTT, T. (2020). How artificial intelligence will change the future of marketing. *Journal of the Academy of Marketing Science*, *48*(1), 24-42.

EGGERT, A., ULAGA, W., FROW, P., & PAYNE, A. (2018). Conceptualizing and communicating value in business markets: From value in exchange to value in use. *Industrial Marketing Management*, *69*, 80-90.

GARCIA-CASTRO, R., & AGUILERA, R. V. (2015). Incremental value creation and appropriation in a world with multiple stakeholders. *Strategic management journal*, *36(1),* 137-147.

GOSSEN, H. H. (1854). *Entwickelung der Gesetze des menschlichen Verkehrs, und der daraus fließenden Regeln für menschliches Handeln*. Friedrich Vieweg und Sohn.

HALIM, I. (2012). *Aristotle's Explanation for the Value of the External Goods* (Doctoral dissertation, Columbia University).

HOLMES, F. (2019). *AI Will Add $15 Trillion To The World Economy By 2030*. Forbes. Retrieved August 8, 2022, from https://www.forbes.com/sites/greatspeculations/2019/02/25/ai-will-add-15-trillion-to-the-world-economy-by-2030/?sh=4adad5a11852

HUANG, M. H., & RUST, R. T. (2021a). A strategic framework for artificial intelligence in marketing. *Journal of the Academy of Marketing Science*, *49*(1), 30-50.

HUANG, M. H., & RUST, R. T. (2021b). Engaged to a robot? The role of AI in service. *Journal of Service Research*, *24*(1), 30-41.

ISRAFILZADE, K. (2020). WHAT S IN A NAME EXPERIMENT ON THE AESTHETIC JUDGMENTS OF ART PRODUCED BY ARTIFICIAL INTELLIGENCE. *Journal of Arts*, *3*(2), 143–158. https://doi.org/10.31566/arts.3.011

ISRAFILZADE, K. (2021). Conversational marketing as a framework for interaction with the customer: Development & validation of the conversational agent's usage scale. *Journal of Life Economics*, *8*(4), 533–546. https://doi.org/10.15637/jlecon.8.4.12

KOTLER, P., & ARMSTRONG, G. (2020). *Principles of Marketing, 18th Global Edition*. New York, NY: Pearson Education.

KUMAR, N., & KUMAR, R. (2021). The Application of Artificial Intelligence in Electronic Commerce. Turkish Journal of Computer and Mathematics Education, 12(12), 1679-1682.

KUMAR, T., & TRAKRU, M. (2020). The colossal impact of artificial intelligence. E-commerce: statistics and facts. *Int. Res. J. Eng. Technol.(IRJET)*, *6*, 570-572.

MCCARTHY, J., MINSKY, M. L., ROCHESTER, N., & SHANNON, C. E. (2006). A proposal for the dartmouth summer research project on artificial intelligence, august 31, 1955. *AI magazine*, *27*(4), 12-12.

MELOVIĆ, B., JOCOVIĆ, M., DABIĆ, M., VULIĆ, T. B., & DUDIC, B. (2020). The impact of digital transformation and digital marketing on the brand promotion, positioning and electronic business in Montenegro. *Technology in Society*, *63*, 101425.

MICU, A., MICU, A. E., GERU, M., CĂPĂȚÎNĂ, A., & MUNTEAN, M. C. (2021). The impact of artificial intelligence use on the e-commerce in Romania. *Amfiteatru Economic*, *23*(56), 137-154.

MOURA, S., REIS, J. L., & RODRIGUES, L. S. (2021). The Artificial Intelligence in the Personalisation of the Customer Journey–a literature review. *CAPSI 2021 Proceedings*. 28.

NICHIFOR, E., TRIFAN, A., & NECHIFOR, E. M.

(2021). Artificial intelligence in electronic commerce: Basic chatbots and the consumer journey. *Amfiteatru Economic*, *23*(56), 87-101.

NIMBALKAR, A. A., & BERAD, A. T. (2021). The Increasing Importance Of Ai Applications In E-Commerce. *Vidyabharati International Interdisciplinary Research Journal*, *13*(1), 388-391.

PALLATHADKA, H., RAMIREZ-ASIS, E. H., LOLI-POMA, T. P., KALIYAPERUMAL, K., VENTAYEN, R. J. M., & NAVED, M. (2021). Applications of artificial intelligence in business management, e-commerce and finance. *Materials Today: Proceedings*.

PANIGRAHI, D., & KARUNA, M. (2021). A Review on Leveraging Artificial Intelligence to Enhance Business Engagement in Ecommerce. *ISSN*, *2582*(7421), 2.

PINDYCK, R. S., & RUBINFELD, D. L. (2017). *Microeconomics, Global Edition*. Pearson.

PRENTICE, C., WANG, X., & LOUREIRO, S. M. C. (2019). The influence of brand experience and service quality on customer engagement. *Journal of Retailing and Consumer Services*, *50*, 50-59.

PROVAN, K. G., FISH, A., & SYDOW, J. (2007). Interorganizational networks at the network level: A review of the empirical literature on whole networks. *Journal of management*, *33*(3), 479-516.

PWC (2021). *PwC's Global Artificial Intelligence Study: Sizing the prize*. PwC. Retrieved August 8, 2022, from https://www.pwc.com/gx/en/issues/data-and-analytics/publications/artificial-intelligence-study.html

RAMASWAMY, V., & OZCAN, K. (2020). The "Interacted" actor in platformed networks: theorizing practices of managerial experience value co-creation. *Journal of Business & Industrial Marketing*, *35*(7), 1165–1178. https://doi.org/10.1108/jbim-10-2018-0318

REDLICH, T., & MORITZ, M. (2016). Bottom-up Economics. Foundations of a Theory of Distributed and Open Value Creation. In *The decentralized and networked future of value creation* (pp. 27-57). Springer, Cham.

REDLICH, T., MORITZ, M., & WULFSBERG, J. P. (2019). Introduction: Co-creation in the Era of Bottom-Up Economics. In *Management for professionals* (pp. 1–6). Springer Nature. https://doi.org/10.1007/978-3-319-97788-1_1

SAMEK, W., WIEGAND, T., & MÜLLER, K. R. (2017). Explainable artificial intelligence: Understanding, visualizing and interpreting deep learning models. *arXiv preprint arXiv:1708.08296*.

SHUKLA, N., KOLBEINSSON, A., OTWELL, K., MARLA, L., & YELLEPEDDI, K. (2019). Dynamic pricing for airline ancillaries with customer context. In *Proceedings of the 25th ACM SIGKDD International Conference on knowledge discovery & data mining*, 2174-2182.

SJÖDIN, D., PARIDA, V., JOVANOVIC, M., & VISNJIC, I. (2020). Value creation and value capture alignment in business model innovation: A process view on outcome-based business models. *Journal of Product Innovation Management*, *37*(2), 158-183.

SMITH, A. (1776). An Inquiry into the Nature and Causes of the Wealth of Nations. *JM Dent and Sons, London*.

SONI, V. D. (2020). Emerging roles of artificial intelligence in ecommerce. *International Journal of trend in scientific research and development*, *4*(5), 223-225.

SOUTHERTON, D. (2011). *Encyclopedia of Consumer Culture* (1st ed.). SAGE Publications, Inc.

WEBB, M. E. (2019). The Impact of Artificial Intelligence on the Labor Market. *Social Science Research Network*. https://doi.org/10.2139/ssrn.3482150

WINDSOR, D. (2017). Value Creation Theory: Literature Review and Theory Assessment. In *Business & society 360* (pp. 75–100). Emerald Publishing Limited. https://doi.org/10.1108/s2514-175920170000004

YANG, C., FENG, Y., & WHINSTON, A. (2022). Dynamic pricing and information disclosure for fresh produce: An artificial intelligence approach. *Production and Operations Management*, *31*(1), 155-171.

ZAMANZADEH, V., GHAHRAMANIAN, A., RASSOULI, M., ABBASZADEH, A., MAJD, H. A., & NIKANFAR, A. (2015). Design and Implementation Content Validity Study: Development of an instrument for measuring Patient-Centered Communication. *Journal of Caring Sciences*, *4*(2), 165–178. https://doi.org/10.15171/jcs.2015.017

Appendix

Appendix 1. Background information on the expert panel's participants.

No.	Country	Sex	Occupation/ Position	Year of Experience	Sector
1	Azerbaijan	M	Marketing Manager	11	E-commerce
2	Ukraine	F	Marketing Manager	15	Retail
3	Georgia	M	Digital Marketing Specialists	10	E-commerce
4	Turkey	F	Marketing Researcher	12	Banking
5	Azerbaijan	M	Data Analyst	18	Logistics
6	Azerbaijan	F	Marketing Consultant	8	Banking
7	Ukraine	M	Senior Data Scientist	13	Banking
8	Georgia	F	Marketing Manager	14	Technology
9	Turkey	M	Ecommerce manager	12	E-commerce
10	Russia	F	Head of Innovation	14	Retail
11	Azerbaijan	M	Data Analyst	10	E-commerce
12	Ukraine	F	IT Project Manager	7	Banking
13	Azerbaijan	M	Senior AI Developer	9	Banking
14	Turkey	M	Ecommerce Strategist	11	E-commerce
15	Azerbaijan	M	Digital Marketing Specialists	8	Technology