https://doi.org/10.53656/str2024-3s-1-mod



# A MODEL FOR CALCULATING THE INDIRECT ADDED VALUE OF AI FOR BUSINESS

**Dr. Petya Biolcheva, Assoc. Prof.,**
**Prof. Nikolay Sterev, DSc.**
*University of National and World Economy*

**Abstract.** The new world, where artificial intelligence is applied in every industry and aspect of life, is already becoming second nature to us. Strengthen the penetration of all the company's business operations to withstand competitive pressures. Its impact is also apparent. The increasing importance of the added value of your application is being widely discussed, yet there is little discussion on how to measure it. This essay seeks to address this disparity. It raises the question of how to determine the indirect added value of artificial intelligence in the businesses that utilize it. In order to achieve this, we propose a model based on three main factor groups: cognitive elements, which influence how AI is perceived; behavioral elements, which affect behavior when using AI; and environmental variables, which impact laws governing the adoption or regulation of AI. The indirect value added by the application of AI is calculated by the organization's management using numerical expressions for each set of elements.

*Keywords:* Artificial Intelligence; value added; factors

## 1. Introduction

Artificial intelligence has been permeating every aspect of the economy at an ever-increasing rate in recent years. Its significance is increasing and bringing forth important changes that will usher in the next industrial revolution. It is already known to be the primary differentiator driving the company and the future major source of wealth (Mikalef & Gupta 2021). To shed light on its characteristics, the European Commission defines artificial intelligence as hardware and software systems that, when presented with a complex task, operate in a physical or digital realm. They observe their surroundings through collected data, process information, reason, extract knowledge, and make optimal choices to achieve the assigned objective (Christenko et al. 2022).

AI, according to Kunnathur (2020), guarantees a computer's ability to perform tasks that are characteristic of intelligent individuals. It works well for creating artificial intelligence systems that replicate cognitive functions such as meaning-

finding, extrapolation, and experience-based learning. Generally speaking, artificial intelligence (AI) can be defined as a collection of various intelligent technologies that have the potential to advance society, technology, and the economy by improving prediction accuracy, streamlining operations, optimizing resource allocation, and customizing digital solutions that are available to individuals and organizations. Artificial intelligence has the potential to significantly enhance economic competitiveness while advancing social and environmental goals. Numerous industries, such as agriculture, energy, transportation, and logistics, are interested in utilizing it (Regulation 2021/0106(COD) 3).

The way businesses interact with their partners and consumers is another area where AI is clearly influential (Lauterbach, 2019). Numerous AI tools are also necessary for productivity and efficiency (Wamba-Taguimdje et al. 2020). It is becoming increasingly evident that AI capabilities enhance corporate innovation and efficiency (Mikalef & Gupta 2021). Nonetheless, past experience demonstrates that every succeeding industrial revolution affects society and business financially in all spheres (Yoav Shoham et al. 2018).

The AI revolution is about to begin. What can we anticipate from it, and how will it specifically affect business agility? We aim to provide solutions to these questions in this content. The report provides a framework for quantifying the value that companies derive from integrating AI into their operations. We utilize behavioral, contextual, and cognitive aspects to identify high-value areas for each firm. We also quantify the additional value of artificial intelligence (AI) for companies using their ratings. In order to elucidate the methodology, a review of the literature is provided in the following chapters. These chapters encompass the historical context and contemporary perspectives on the added value derived from the utilization of artificial intelligence.

## 2. Literature preview

### *2.1. Background of added value*

Regardless of the kind and structure of an organization's management, added value is one of the most important metrics for assessing its effectiveness. Value-added theory, which is used in marketing, people management, and general management theory, aims to define a certain quantity of "outcome" that is contrasted between the "before" and "after" experiences of each particular firm. Appearing in the start of the twentieth century, the idea of added or surplus value was actively employed and reached its peak of popularity in the 1980s thanks to theories of firm competitiveness. One of the primary issues that every management encounters is the production of added value and how to use it in the development of a new strategy (Kulińska 2014).

After examining the various macro- and micro-economic theories related to the definition, calculation, and determination of "added value," it should be concluded that an organization's management must constantly ask themselves: What is added

value? Where does it come from? What defines it? What can we do to maximize the value of the entire chain of its creation?

As per Chetty et al. (2016), one of the primary issues that managers need to address is the generation of added value and its application. Various value-added models evaluate an agent's performance based on the outcomes they generate. The degree of selection bias in value-added estimations determines the efficiency of these models when applied (Chetty et al. 2016).

According to Kulińska (2014), customers have a significant influence on what constitutes added value. Important requirements are related to the financial value that clients offer. It may be acquired through continuous development and by fully meeting the individual demands throughout the supply chain.

In conclusion, added value should be viewed as an enhancement or addition to something. Typically, this involves the labor process and the skills required for managing human resources, the production process for management, the quality of the products for marketing and customer management, etc., through which value is added for the recipient.

The foundation of the concept of value distribution in competitiveness management is based on the notion that the individual who generates the added value does so "more naturally" and at a lower cost than the one who receives the "added value" (Formula 1) (Sterev and Penchev, 2023).

$$AV_{i+1} = AV_i + \partial \quad \rightarrow \quad \sum R_{i+1} - \sum C_{i+1} + \alpha = \sum R_i - \sum C_i + \beta \quad \rightarrow$$
$$\sum C_i - \sum C_{i-1} + \alpha = \sum R_{i+1} - \sum R_i + \beta \qquad \textbf{Formula 1}$$

That lead to the next Formula 2

$$-\sum \Delta C_i > \sum \Delta R_{i,\ as}\ \beta > |\alpha| \qquad \textbf{Formula 2}$$

In keeping with the foregoing, the theory of businesses proposes three methods for adding value:

– A modification to business procedures that reduces the cost of producing (1) a product while maintaining or increasing its value to customers (2).

– A modification to business procedures that increases the production costs of the product beyond the increase in its perceived value to customers (3).

Based on the formula, it follows that the two primary indicators of benefit and usefulness determine the calculation of the added value. Utility refers to the subjective assessment of the enterprise's ability to modify the cost/quality ratio (R – C) of the process change, while benefit relates to an evaluation of the actual change in benefits (R) before and after the process change. Moreover, since utility in this sense is a reflection of an ordered preference system, utility can only be assigned to the average value. (Kulińska 2014).

*2.2. Added value of AI in business*

Although artificial intelligence (AI) applications and their benefits are often discussed, it is important to examine how their added value is truly quantified. In fact, a survey of the scientific literature suggests that this area of study still requires more effort. This is mostly because there are a lot of unknowns when it comes to calculating the added value of AI. Yana (2020), for instance, observes that one of the biggest obstacles is the lack of an established international approach for monitoring the digital economy. The primary challenges identified here are disparities in national statistics and the lack of data related to digital information. The introduction of new value-creation sources is another obstacle (Yana 2020).

According to research by Ransbotham et al. (2017), one of the main obstacles to reaping the benefits of artificial intelligence is a lack of technological expertise. The primary cause is the ignorance and incapacity of a still significant portion of the organizations. Wamba-Taguimdje et al. (2020) suggest analyzing the impacts of AI capabilities on productivity improvement at the organizational level, as well as their intermediary effects on productivity improvement at the individual process level, in order to overcome this kind of impediment. According to Wamba-Taguimdje (2020), this approach may be used to evaluate the added value of AI transformation programs within enterprises.

**3. Methodology**

An extensive analysis of the primary elements that typically contribute value to companies forms the foundation of the current paradigm for evaluating the added value of AI for enterprises. Based on these findings, a second research was conducted with the goal of determining the relevance of each factor's AI value. As a result, only the elements with the highest added value and the greatest impact on the competitiveness of business organizations were included in the analysis. Subsequently, the elements were categorized and ordered according to their primary importance. To utilize the approach, these elements can be categorized into three primary groups: cognitive elements related to the perception of AI; behavioral elements that alter behavior when using AI; and environmental aspects, which refer to the impact of regulations that limit or introduce AI usage. Well, it seems like it.

Both the changes in benefits and the rearrangement of business preferences should be considered when evaluating the added value of artificial intelligence to a company. The assessment of added value should consider three primary aspects because the generation of added value is a process involving several firms that create the overall value chain.

– Environmental variables or factors affecting policies that introduce or restrict the use of AI;

– Behavioral or behavioral change factors when utilizing AI;

– Cognitive or perceptual aspects of AI. Fig. 1 depicts their connection.

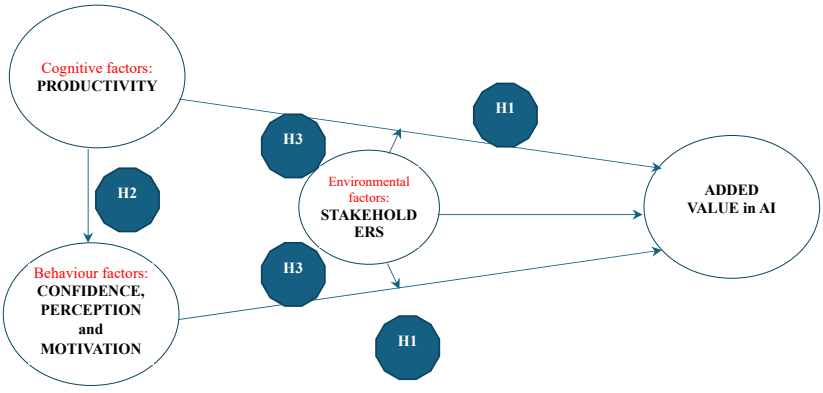


**Figure 1.** Key factors for assessing the added value of AI in business
*Source*: based on Sterev et al. (2020) and Park, Sung and Im (2017)

Cognitive elements that have been examined using a variety of productivity and process efficiency metrics can be categorized in several ways:

– Degree of manufacturing automation and/or decreasing production time, including.

– Technically optimizing the work process by fine-tuning the procedure in accordance with the type and quality of the materials;

– Keeping an eye on the machines' technical state requires very precise work and rigorous adherence to standards.

– Performing economic optimization involves reducing labor, material, and raw material costs, and enhancing efficiency.

– Assessment of the increasing quality of the sold products, including the extent to which:

– To enhance the speed and convenience of shopping, features such as high-quality search engines and 24/7 customer service are provided.

– On-site and electronic payment security, and speed;

– Enhancing the degree of personalization of the customer experience.

To foster innovation in design, including through electronic virtual reality systems

– Evaluating the degree to which

– Manufactured goods meet quality standards.

– Strictly adhering to quality standards;

– Automating quality management tasks and conducting automated defect root cause analysis.

– Optimizing production processes involves considering user and production

characteristics, such as reliability, accuracy, efficiency, and the duration of quality control processes (Panayotova et al. 2023).

– Evaluation of the impact of reducing human labor in the production process, including adjustments to production metrics such as:

– Production accuracy;

– Production process automation;

– Processing power and capacity in the production process;

– Production experience in real-time;

– The degree of product customization in the manufacturing process.

Three aspects are assessed in relation to behavioral factors:

– Motivation evaluation: based on the main reasons for utilizing AI. Such non-working motives include a reaction to market or competitive pressures, as well as simple curiosity and personal reasons. A compelling case linking the introduction of AI to the achievement of specific business objectives and the role AI plays in advancing those objectives is necessary for effective motivation as the corporate culture is very important for personal motivation (Minkov & Ivanov 2023).

– Evaluating the extent of AI adoption. It involves applying artificial intelligence to various levels. AI adoption levels can be estimated at five to nine levels using the same parameters that were used to establish Industry x.0 and Internet x.0.

– Evaluation of Trust in Artificial Intelligence. While there could be a relationship between perception and trust, reputation, openness, honesty, and a sense of community are often associated with trust.

Environmental influences can affect behavioral and cognitive aspects, in addition to directly impacting the extent of AI utilization. As an illustration, public trust in AI has the potential to influence individual perceptions of AI based on behavioral characteristics or cognitive elements, such as assessments of the level and quality of automation. Thus, the evaluation of environmental factors related to the use of AI is based on the following:

– Real-time measurement of the impact of production value on stakeholders;

– Automatic identification and assessment of stakeholder profiles;

– Personalized content delivery to individual stakeholders based on their profiles;

– Enhancement of interaction among stakeholders through improved communication and feedback in automated communication systems with stakeholders, etc.

The additional value needs to provide a numerical evaluation of Formula 1's two primary parameters.

– Benefits for the business, consumers, and stakeholders were evaluated during the assessment, including estimated benefits for the business before and after the adoption of AI initiatives and activities within the business.

– A subjective assessment of usefulness for stakeholders and consumers at the time of review, including projected benefits for the business before and after implementing AI initiatives and activities.

A higher degree of AI implementation (Figure 1), based on more complex changes (H2) in business processes and increased trust and motivation resulting from AI integration, leads to a greater economic impact of utilizing AI in business. This is the thesis (H1) that is sought to be confirmed in the model verification process. The decline or growth of the desired connection might be indirectly influenced by environmental variables (H3).

Furthermore, once the research thesis has been confirmed, it is possible to evaluate the quantitative representation of the added value. For example, for businesses that have incorporated AI technologies into their operations, use the following variables to obtain:

– One product's manufacturing expenses;

– Sales revenue;

– One product's added value, accounting for changes in the aforementioned figures both before and after the introduction of AI.

The 7-point Likert scale is used to examine the primary components and determine the strength of the assertion or indices' rank ($C_{ik}$) according to the evaluated indices ($c_{ik}$). A basic arithmetic mean value represents the overall score for each respondent in the factor groupings (Formula 3).

$$C_{ik} = 6 * \frac{c_{ik} - c_{imin}}{c_{imax} - c_{imin}} + 1 \quad , \qquad \textbf{Formula 3}$$

where $C_{ik} - relative\ score\ of\ c_{ik}$

$c_{ik} - observed\ score\ of\ index\ i\ for\ observation\ k$

Correlation and regression analysis can be used to verify the three hypotheses regarding their direct or indirect impact on each other once the estimations have been collected and adjusted.

**4. Discussion and Conclusion**

Intentional company managers may more readily integrate AI features into their business operations with the help of new research domains enabled by the creation and provision of a model for evaluating the added value of AI for business. The actual added value is reflected in both material and non-material terms by the presence of such a technique.

AI's contributions extend beyond direct returns and encompass a broader scope. This is typically quantified by comparing the value of goods produced post-investment with the initial investment in AI. It involves factors such as the opinions of all parties involved, the level of reputation, and a variety of other aspects that are challenging to summarize in a few sentences.

Employing intelligent technologies ensures objectivity and accurate evaluation of

the added value at both the corporate and employee levels (Biolcheva and Valchev 2023). As a result, it may boost employee enthusiasm and faith in AI at work and assist corporate management in converting corporate indices to individual ones. This, in turn, enables them to create special, targeted stress-reduction strategies. This will compel further growth in added value and ensure an increase in both individual and corporate productivity and efficiency.

**Acknowledgments**

This article was financially supported by the UNWE Science Fund (contract No. 5/2023).

**REFERENCES**

BIOLCHEVA, P., VALCHEV, E., 2023. Safety Through Artificial Intelligence in The Maritime Industry. *Strategies for Policy in Science & Education/Strategii na Obrazovatelnata i Nauchnata Politika*, vol. 31, no. 3, pp. 270 – 280. https://doi.org/10.53656/str2023-3-3-saf.

CHETTY, R.; FRIEDMAN, J. N. & ROCKOFF, J., 2016. Using lagged outcomes to evaluate bias in value-added models. *American Economic Review*, vol. 106, no. 5, pp. 393 – 399.

CHRISTENKO, A.; JANKAUSKAITĖ, V.; PALIOKAITĖ, A.; BROEK, E.; REINHOLD, K.; JÄRVIS, M., 2022. *Artificial intelligence for worker management: an overview*, European Agency for Safety and Health at Work. DOI: 10.2802/76354

EUROPEAN COMMISSION, Regulation of the European Parliament and of the Council laying down harmonized rules on artificial intelligence (artificial intelligence legislation) and amending certain Union legislation, 2021/0106(COD) (3).

KULIŃSKA, E., 2014. The significance of costs calculation in evaluation of the value added. *China-USA Business Review*, no. 13, pp. 1537 – 1514.

KUNNATHUR, M., 2020. Applying Artificial Intelligence techniques in Project Management. *Masters in Engineering and Management*. DOI: 10.13140/RG.2.2.15113.39526.

LAUTERBACH, A., 2019. Artificial intelligence and policy: quo vadis?, Digital Policy. *Regulation and Governance*, vol. 21 no. 3, pp. 238 – 263. DOI: 10.1108/DPRG-09-2018-0054.

MIKALEF, P. & GUPTA, M., 2021. Artificial intelligence capability: Conceptualization, measurement calibration, and empirical study on its impact on organizational creativity and firm performance. *Information & Management*, vol. 58, no. 3, https://doi.org/10.1016/j.im.2021.103434.

MINKOV, I.; IVANOV, Y., 2023. Impact of The Publicization of Corporate Culture On the Internet On the Financial and Economic Indicators of Courier Companies in Bulgaria. *Strategies for Policy in Science & Education-Strategii na*

*Obrazovatelnata i Nauchnata Politika*, vol. 31, no. 6s, pp. 94 – 102. https://doi.org/10.53656/str2023-6s-8-imp.

PANAYOTOVA, T.; DIMITROVA, K. & VELEVA, N., 2023. Study of The Key Factors Influencing the Effective Planning and Utilization of Production Facilities in The Industrial Enterprise. *Strategies for Policy in Science & Education/ Strategii na Obrazovatelnata i Nauchnata Politika*, vol. 31, no. 6s, pp. 80 – 93. https://doi.org/10.53656/str2023-6s-7-stu.

PARK, J.Y.; SUNG, C.S.; IM, I., 2017. Does Social Media Use Influence Entrepreneurial Opportunity? A Review of its Moderating Role, Sustainability, no. 9, p. 1593; doi:10.3390/su9091593.

RANSBOTHAM, S.; KIRON, D.; GERBERT, P.; REEVES, M., 2017. Reshaping business with artificial intelligence: Closing the gap between ambition and action. *MIT Sloan Management Review*, vol. 59, no. 1.

STEREV, N. & PENCHEV, P., 2023. *Historical Development of Business Economics: Bulgarian Case*. In: ÇALIYURT, K.T. (eds) History of Accounting, Management, Business and Economics, Volume I. Accounting, Finance, Sustainability, Governance & Fraud: Theory and Application. Springer, Singapore. https://doi.org/10.1007/978-981-99-3346-4_10.

STEREV, N.; SABEVA, M.; ZLATEVA, R.; DIMITROVA, V., 2020. Business Social Network (BSN): Does the Business Escape from Reality Impossible?. In: BILGIN, M.H., DANIS, H., DEMIR, E. (eds) *Eurasian Business Perspectives. Eurasian Studies in Business and Economics*, vol 14, no. 2. Springer, Cham. https://doi.org/10.1007/978-3-030-52294-0_8.

WAMBA-TAGUIMDJE, S. L.; FOSSO WAMBA, S.; KALA KAMDJOUG, J. R. & TCHATCHOUANG WANKO, C. E., 2020. Influence of artificial intelligence (AI) on firm performance: the business value of AI-based transformation projects. *Business Process Management Journal*, vol. 26, no. 7, pp. 1893 – 1924.

YANA, M., 2020. Creation of added value in the context of measurement complexity of the digital economy. *E-Management*, vol. 69.

YOAV SHOHAM, R.P.; BRYNJOLFSSON, E.; CLARK, J.; MANYIKA, J.; NIEBLES, J.C.; LYONS, T.; ETCHEMENDY, J.; GROSZ, B. AND BAUER, Z., 2018, Artificial Intelligence Index 2018, available at: https://creativecommons.org/licenses/by-nd/4.0/legalcode.

✉ **Prof. Nikolay Sterev, DSc. (econ)**
ORCID iD: 0000-0001-8262-3241
✉ **Dr. Petya Biolcheva, Assoc. Prof.**
ORCID iD: 0000-0001-9430-773X
Department of Industrial Business
University of National and World Economy
E-mail: ind.business@unwe.bg
p.biolcheva@unwe.bg